THE SENSES

AND

THE INTELLECT.

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BY

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LONDON:
JOHN W. PARKER AND SON, WEST STRAND.
1855.

PREFACE.

THE object of this treatise is to give a full and systematic account of two principal divisions of the science of mind,—the Senses and the Intellect. The remaining two divisions, comprising the Emotions and the Will, will be the subject of a future treatise.

While endeavouring to present in a methodical form all the important facts and doctrines bearing upon mind, considered as a branch of science, I have seen reason to adopt some new views, and to depart in a few instances from the most usual arrangement of the topics.

Conceiving that the time has now come when many of the striking discoveries of Physiologists relative to the nervous system should find a recognised place in the Science of Mind, I have devoted a separate chapter to the Physiology of the Brain and Nerves.

In treating of the Senses, besides recognising the so-called muscular sense as distinct from the five senses, I have thought proper to assign to Movement and the feelings of Movement a position preceding the Sensations of the senses; and have endeavoured to prove that the exercise of active energy originating in purely internal impulses, independent of the stimulus produced by outward impressions, is a primary fact of our constitution.

Among the Senses, have been here enrolled and described with some degree of minuteness the feelings connected with the various processes of organic life, —Digestion, Respiration, &c.—which make up so large a part of individual happiness and misery.

A systematic plan has been introduced into the description of the conscious states in general, so as to enable them to be compared and classified with more precision than heretofore. However imperfect may be the first attempt to construct a Natural History of the Feelings, upon the basis of a uniform descriptive method, the subject of mind cannot attain a high scientific character until some progress has been made towards the accomplishment of this object.

In the department of the Senses, the Instincts, or primitive endowments of our mental constitution, are fully considered; and in endeavouring to arrive at the original foundation, or first rudiments, of Volition, a theory of this portion of the mind has been suggested.

In treating of the Intellect, the subdivision into faculties is abandoned. The exposition proceeds entirely on the Laws of Association, which are exemplified with minute detail and followed out into a variety of applications.

LONDON, *June*, 1855.

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INTRODUCTION.

CHAPTER I.

DEFINITION OF MIND.

1. THE operations and appearances that constitute Mind are indicated by such terms as Feeling, Thought, Memory, Reason, Conscience, Imagination, Will, Passions, Affections, Taste. But the Definition of Mind aspires to comprehend in few words, by some apt generalisation, the whole kindred of mental facts, and to exclude everything of a foreign character.

Mind, according to my conception of it, possesses three attributes, or capacities.

1. It has Feeling, in which term I include what is commonly called Sensation and Emotion.

2. It can Act according to Feeling.

3. It can Think.

Consciousness is inseparable from the first of these capacities, but not, as appears to me, from the second or the third. True, our actions and thoughts are usually conscious, that is, are known to us by an inward perception; but the consciousness of an act is manifestly not the act, and, although the assertion is less obvious, I believe that the consciousness of a thought is distinct from the thought. To flee on the appearance of danger is one thing, and to be conscious that we apprehend danger is another.

The three terms, Feeling, Emotion, and Consciousness, will, I think, be found in reality to express one and the same fact or attribute of mind, and will be used accordingly in the present exposition.

2. A Definition should itself be intelligible, and composed of terms not standing in need of further definition. Thus, for a notion of what feeling is, I must refer each person to their own experience. The warmth felt in sunshine, the fragrance of flowers, the sweetness of honey, the bleating of cattle, the beauty of a landscape, are so many known states of consciousness, feeling, or emotion. The aim of the definition is to propose a generalisation, or general expression including all such states; and this generalisation admits of being elucidated and discussed, proved or disproved. I shall now offer a few remarks in explanation of each of the heads of the Definition.

(1.) With regard to the quality variously called Feeling, Consciousness, or Emotion, I would remark that this is the foremost and most unmistakeable mark of mind. The members of the human race agree in manifesting the property of Feeling. The orders of the brute creation give like symptoms of the same endowment. The vegetable and mineral worlds are devoid of it. True, it is each in ourselves that we have the direct evidence of the conscious state, no one person's consciousness being open to another person. But finding all the outward appearances that accompany consciousness in ourselves to be present in other human beings, as well as, under some variety of degree, in the lower animals, we naturally conclude their internal state to be the same with our own. The gambols of a child, the shrinking from a blow, or a cry on account of pain, and the corresponding expressions for mental states common to all languages, prove that men in all times have been similarly affected. The terms for expressing pleasure and pain in all their various forms and degrees are names of conscious states. Joy, sorrow, misery, comfort, bliss, happiness are a few examples out of this wide vocabulary.

(2.) Although the signs and language of feeling are sufficient proofs of the existence of mind, yet mere feeling is not all that we look for in a mental nature. *Action* is a second requisite. The putting forth of power to execute some work or perform some operation is to us a mark of mind. Eating, drinking, running, flying, sowing, reaping, building, destroying, —are operations rising beyond the play of mere emotion. In speaking of Action, however, as a characteristic of mind, we must render explicit the distinction between mental actions and such as are not mental. This distinction I have endeavoured to set forth by describing mental actions as under the prompting and guidance of Feeling. When an animal tears, masticates, and swallows its food, or hunts its prey, the stimulus and support of the activity manifested is to be sought in a strong sensation or feeling. By this limitation, we exclude many kinds of action familiar to us in nature,—the powers of wind, water, gravity, steam, gunpowder, electricity, vegetation, &c. True, the impulse of personification, so spontaneous in man, has often personified those powers, ascribing their workings to some mental nature concealed behind them. But there is a very great difference between the two cases, as is shown by the habitual mode of dealing with each, especially in modern scientific discussions. With respect to the powers of nature, we ascertain the general laws of working solely by an examination of the phenomena themselves. As regards gravitation, for example, Newton and his followers went no deeper than the observed movements, describing as they best might the uniformities or general rules that these movements follow. There is still, it is true, a class of less scientific and more fanciful speculators, who are disposed to regard gravity as the direct emanation of a mind or will. Yet even they are still obliged to speak of the laws in the same way. But in regard to mental actions the practice is otherwise. There we descend for an explanation into the laws of feeling or emotion, —into the sensations and various affections that work within the animated creature. We cannot trace any uniformity in the operations of a human being by merely looking at the actions themselves, as we can in the fall of a stone or the course of a planet. It is the unseen feelings that furnish the key to the vast complication of man's works and ways.

We may also remark, that these powers of creation give no evidence of mind according to the only form known to us. They have no senses, no brain, no gesticulation or signs of passion, no articulate utterance or language of emotion. Poets may fancy a passionate expression in the tumult of wind and wave, cataract and thunder-storm, but the sources of these displays are so obviously the result of nature's forces, and so entirely unconnected with sensible impressions received from without or the stirrings of a mental nature within, that all such fancies are felt at once to be fictions. The same analogy that enables us to ascribe a true mental constitution to the brute creation, does not exist between humanity and the forces of external nature.

The definition also excludes such animal functions as breathing, the circulation of the blood, and the movements of the intestines. These are in one sense actions, and serve a purpose; but they are not mental actions. We can conceive ourselves so constituted that these processes would have had to be prompted by inward emotions or desires, and to be controlled or arrested by feeling. They would then have been mental actions; as it is they rank with the circulation of the sap in a plant. They are awake when we are asleep.

There are certain other actions that would seem at first sight to be excluded by the definition, which, nevertheless, are always looked upon as of the kindred of mental actions. For example, it will be an object with us to show that there are in the human system movements and tendencies to movement independent of, and anterior to the stimulus of the outward world upon the senses. The eyes may open of themselves, the voice may break forth into utterance, the limbs may gesticulate, unprompted by any painful or pleasurable state. Yet those movements belong to the sphere of mind, and come to form part of its characteristic indications. It will be found, however, that these actions are not excluded, and for the following reason :—

These exertions as soon as made are conscious : though not preceded by feeling, they are accompanied by feeling and come under the control of that feeling. An energy not originating in consciousness may open the eyes or throw out the limbs, but the movement is a conscious one and is liable to be prolonged or arrested according as the feeling is pleasurable or the reverse.

Another case in which our definition may appear to exclude true mental phenomena, is that of the actions called habitual. These in some cases approach to the unconscious and automatic, like the movements of the heart and lungs; and almost appear to become independent of feeling either to originate or to control them. Notwithstanding, such actions cannot be held as excluded, when we consider that they had their rise in feelings, and merely, in virtue of a plastic operation truly mental in its nature, grow less and less the objects of consciousness. Although a musical performer should play an air with an almost entire absence of mind, we should still consider the performance as an effort of mind in the sense of the definition; for the power was acquired step by step under the prompting and guidance of sensations and emotions. The mental force that gives cohesiveness to the successive touches is not included either in the first or second parts of the definition; this belongs to the part next to be adverted to.

The term *Volition*, applies, as I conceive, to the entire range of mental or feeling-prompted actions; and it is proposed therefore to make constant use of this word for expressing the second attribute of mind.

(3). The concluding attribute of the definition is Thought, or Intelligence. Even in the lowest forms of mind some portion of Intelligence is found. The first fact implied in it is *discrimination*, with sense of agreement or of difference, as when of two things taken into the mouth the animal prefers the one to the other. If a honey-bee were to alight on one flower, try its quality, go to a second and then return to the first as the better of the two, such an act of deliberate preference would imply intelligence along with volition. The fact that one impression can remain in the mind when the original is gone so as to be compared with a second impression, implies the very essence of intelligence however limited the degree. To go back upon a former experience as preferable to the present is to act upon an idea, a thought; whenever this is clearly manifested we see an intelligent being.

Another fact of intelligence, also exhibited by the lower order of creatures, is the power of associating ends with means or instruments, so as to dictate intermediate actions. An animal going to the water to quench its thirst performs an intelligent act; in order to this act the creature had to associate in its mind the feeling of thirst with the place and the appearance of water and the movements requisite to approach it. This is an acquisition, an effort of memory, of the very same nature as the stored-up experience of the wisest of men. For an animal to have a home, this kind of memory or intelligence is indispensable.

These two facts, discriminating with preference, and the performance of intermediate actions to attain an end, are the most universal aspects of intelligence, inasmuch as they pervade the whole of the animal creation. In the higher regions of mind, the attribute of thinking implies the storing up, reviving, and combining anew all the impressions constituting what we call knowledge, and principally derived from the outer world acting on the senses. It is this wider range of intellectual operations displayed by the human mind, that gives scope for exposition in a work like the present.

Although in the animal constitution, Thought is coupled and conjoined with Feeling and Volition, it does not follow that intelligence is a necessary part of either the one or the other. I have a difficulty in supposing volition to operate in the entire absence of an intellectual nature, nevertheless I cannot help looking upon the intellect as a distinct endowment, following laws of its own, being sometimes well developed and sometimes feeble, without regard to the force or degree of the two other attributes.

3. If we advert to the various classifications of the mental phenomena that have hitherto passed current, we shall find that the three attributes above specified have been more or less distinctly recognised.

In the division of mind into *Understanding* and *Will*, the element of Emotion would appear to be left out entirely. We shall find in fact, however, that the feelings are implied in, or placed under, the head of the Will. The same remark applies to Reid's classification, also twofold and substantially identical with the foregoing, namely into *Intellectual Powers* and *Active Powers*. The submerged department of Emotion will be found partly taken in among the Intellectual Powers, wherein are included the Senses and the Emotions of Taste, and partly treated of among the Active Powers, which comprise the discussion of the benevolent and malevolent Affections.

Dr. Thomas Brown, displeased with the mode of applying the term 'Active' in the above division, went into the other extreme, and brought forward a classification where Emotion seems entirely to overlie the region of Volition. He divides mental states into *external affections* and *internal affections*. By external affections he means the feelings we have by the Senses, in other words Sensation. The internal affections he subdivides into *intellectual states of mind* and *emotions*. His division therefore is tantamount to Sensation, Emotion, and Intellect. All the phenomena commonly recognised as of an active or volitional nature he classes as a part of Emotion.

Sir William Hamilton, in remarking on the arrangement followed in the writings of Professor Dugald Stewart, states his own view as follows:—'If we take the Mental to the exclusion of Material phœnomena, that is, the phœnomena manifested through the medium of Self-consciousness or Reflection, they naturally divide themselves into three categories or primary genera;—the phœnomena of Knowledge or Cognition,—the phœnomena of Feeling or of Pleasure and Pain,—and the phœnomena of Conation or of Will and Desire.'* Intelligence, Feeling, and Will are thus distinctively set forth.

Mr. Morell, in his *Elements of Psychology*, adopts the same triple division, and shows that it pervades the systems of many of the recent German expositors of Mind, for example, Beneke.

I may farther notice the mode of laying out the subject that has occurred to an able physiologist. I quote a passage intended as introductory to the Anatomy of the Nervous System.

* Collected Works of Dugald Stewart, Vol. II.: Advertisement by the Editor.

'Of the functions performed through the agency of the nervous system, some are entirely corporeal, whilst others involve phenomena of a mental or psychical nature. In the latter and higher class of such functions are first to be reckoned those purely *intellectual operations*, carried on through the instrumentality of the brain, which do not immediately arise from an external stimulus, and do not manifest themselves in outward acts. To the same class also belong *sensation* and *volition*. In the exercise of sensation the mind becomes conscious, through the medium of the brain, of impressions conducted or propagated to that organ along the nerves from distant parts; and in voluntary motion a stimulus to action arises in the brain, and is carried outwards by the nerves from the central organ to the voluntary muscles. Lastly, *emotion*, which gives rise to gestures and movements, varying with the different mental affections which they express, is an involuntary state of the mind, connected with some part of the brain, and influencing the muscles through the medium of the nerves.'*

In this passage a quadruple partition is indicated,—Sensation, Intellect, Emotion, and Volition. Seeing, however, that Emotion, in a comprehensive definition, such as that given in the foregoing section, takes in Sensation; these four divisions are reducible to the three defining attributes above laid down.

4. In the plan of the present work, Book First, entitled Sense and Instinct, will include the discussion of both Feeling and Volition in their lower forms, that is, apart from Intellect, or so as to involve Intellect in the least possible degree; the Sensations of the different Senses will form a leading portion of the contents. This book will comprise all that is primitive or instinctive in the susceptibilities and impulses of the mental organization. The Second Book will propose to itself the full exposition of the intellectual phenomena.

Thus, while regarding Emotion, Volition, and Intellect, as

* Dr. Sharpey, in QUAIN'S *Anatomy*, 4th edition, p. clxxxvi.

the ultimate properties and the fundamental classification of mind, we do not propose that the exposition should proceed strictly in the order in which those are stated.

Although Emotion and Volition, in their elementary aspect, can be explained before entering on the consideration of the Intellect, while one large important department of Emotion, namely, Sensation, is always considered as introductory to the Intellectual powers, yet the full exposition of the emotions and active impulses of our nature properly comes last in the systematic arrangement of the subject of mind. This exposition I do not enter upon in my present treatise.

CHAPTER II.

OF THE NERVOUS SYSTEM.

1. THE connexion of the mental processes with certain of the bodily organs is now understood to be of the most intimate kind. A knowledge of the structure of those organs may therefore be expected to aid us in the study of mind. The contribution at present obtained from this source is something considerable; which makes it not improper to introduce a small portion of the Anatomy and Physiology of the human body into the present work. The parts of the human frame that chiefly concern the student of mental science are the Nerves and Nerve Centres (principally collected in the Brain), the Organs of Sense, and the Muscular System. The organs of sense and movement will fall to be described in Book First; a brief description of the Nerves and Nerve Centres will occupy this preliminary chapter, in which we shall confine ourselves as far as possible to the facts bearing directly upon Mind, introducing only such further explanations as may be needed to make those facts clear and evident.

2. That the Brain is the principal organ of Mind is proved by such observations as the following:—

(1.) From the local feelings that we experience during mental excitement. In most cases of bodily irritation we can assign the place or seat of the disturbance. We localise indigestion in the stomach, irritation of the lungs in the chest, toothache in the gums or jaws, and when the mental workings give rise to pain we point to the head. In ordinary circumstances the action of the brain is unconscious, but in a time of great mental agitation, or after any unusual exertion of thought, the aching or oppression within the skull tells where the seat of action is, precisely as aching limbs prove what muscles have been exercised during a long day's march. The observation can occasionally be carried much farther; for it is found that a series of intense mental emotions, or an excessive action of the powers of thinking, will end in a diseased alteration of the substance of the brain.

(2.) Injury or disease of the brain impairs in some way or other the powers of the mind. A blow on the head will destroy consciousness for the time; a severe hurt will cause a loss of memory. The various disorders of the brain, as for example, softening, &c., are known to affect the mental energies. Insanity is often accompanied by palpable disease of the cerebral substance, as shown by outward symptoms during life and by dissection after death.

(3.) The products of nervous waste are increased when the mind is more than ordinarily exerted. It is ascertained that the kidneys are mainly concerned in removing from the blood the saline and other matters arising from the waste of nervous substance; and it is well known that the secretions from the kidneys are greatly increased in times of mental excitement. Chemical analysis proves that the products on such occasions are derived from the nervous tissue.

(4.) There is an indisputable connexion between size of brain and the mental energy displayed by the individual man or animal. It cannot be maintained that size is the only circumstance that determines the amount of mental force; *quality* is as important as quantity, whether in nerve, muscle, or any other portion of the animal structure. But just as largeness of muscle gives greater strength of body as a general rule, so largeness of brain gives greater vigour of mental impulse. The facts proving the large size and great weight of the heads of remarkable men have often been quoted. 'All other circumstances being alike,' says Dr. Sharpey, 'the size of the brain appears to bear a general relation to the mental power of the individual,—although instances occur in which this rule is not applicable. The brain of Cuvier weighed upwards of 64 oz., and that of the late Dr. Abercrombie about 63 oz. avoirdupois. On the other hand, the brain in idiots is remarkably small. In three idiots, whose ages were sixteen, forty, and fifty years, Tiedemann found the weight of their respective brains to be 19¾ oz., 25¼ oz., and 22½ oz.; and Dr. Sims records the case of a female idiot twelve years old, whose brain weighed 27 oz. The weight of the human brain is taken at about 3 lbs. (48 oz.).'—QUAIN's *Anatomy*, 5th edition, p. 671.

(5.) The specific experiments on the nerve cords and nerve centres, to be afterwards quoted, have proved the immediate dependence of sensation, intelligence, and volition on those parts.

No fact in our constitution can be considered more certain than this, that the brain is the chief organ of mind, and has mind for its principal function. As we descend in the animal scale, through Quadrupeds, Birds, Reptiles, Fishes, &c., the nervous system dwindles according to the decreasing measure of mental endowment.

3. 'The NERVOUS SYSTEM consists of a *central part*, or rather a series of connected *central organs* named the *cerebro-spinal axis*, or *cerebro-spinal centre*;* and of the *nerves*, which have the form of cords connected by one extremity with the cerebro-spinal centre, and extending from thence through the body to the muscles, sensible parts, and other organs placed under their control. The nerves form the medium of communication between these distant parts and the centre; one class of nervous fibres, termed *afferent* (in-bringing) or *centripetal*, conducting impressions towards the centre,—another, the *efferent* (out-carrying) or *centrifugal*, carrying material stimuli from the centre to the moving organs. The nerves are, therefore, said to be internuncial in their office, whilst the central organ receives the impressions conducted to it by the one class of nerves, and imparts stimuli to the other,—rendering certain of these impressions cognizable to the mind, and combining in due association, and towards a definite end, movements, whether voluntary or involuntary, of different and often of distant parts.

* Being contained partly within the head, and partly within the spine, or back-bone.

'Besides the cerebro-spinal centre and the nervous cords, the nervous system comprehends also certain bodies named *ganglia*, which are connected with the nerves in various situations. These bodies, though of much smaller size and less complex nature than the brain, agree, nevertheless, with that organ in their elementary structure, and to a certain extent also in their relation to the nervous fibres with which they are connected; and this correspondence becomes even more apparent in the nervous system of the lower members of the animal series. For these reasons, as well as from evidence derived from experiment, but which, as yet, it must be confessed, is of a less cogent character, the ganglia are regarded by many as nervous centres, to which impressions may be referred, and from which motorial stimuli may be reflected or emitted; but of local and limited influence as compared with the cerebro-spinal centre, and operating without our consciousness and without the intervention of the will.'—QUAIN, Introduction, p. clxxxvii.

The foregoing division of the nervous system into nerve-centres and nerve cords determines the order and method of description both as regards their Anatomy or structure, and their Physiology, or function.

OF THE NERVOUS SUBSTANCE.

4. For the full details of the structure of nerve, as regards both the ultimate elements of cell and fibre and the masses made up of these elements, reference must be had to the best works on Anatomy. In the present state of our knowledge the entire significance of these details cannot be assigned; Physiology on the one hand, and mental science on the other, must be in a more advanced condition in order to make out such significance. Nevertheless there are certain leading features of the nerve structure that are even now of interest in the study of mind. I quote again from Dr. Sharpey's contributions to the 5th edition of QUAIN'S *Anatomy*.

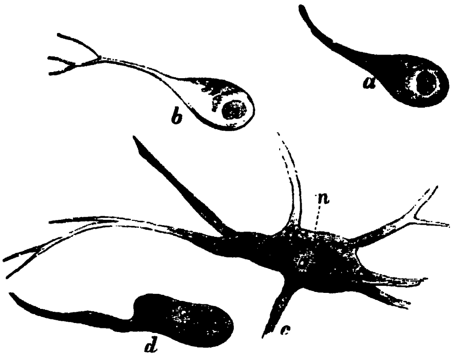
'The nervous system is made up of a substance proper and peculiar to it, with inclosing membranes, cellular tissue, and blood-vessels. The *nervous substance* has long been distinguished into two kinds, obviously differing from each other in colour, and therefore named the *white*, and the *grey*, or *cineritious* (ash-coloured).

'When subjected to the microscope, the nervous substance is seen to consist of two different structural elements, viz., *fibres*, and *cells* or *vesicles*. The fibres are found universally in the nervous cords, and they also constitute the greater part of the nervous centres; the cells or vesicles, on the other hand, are confined in a great measure to the latter, and do not exist in the nerves properly so called, unless it be at their peripheral expansions in some of the organs of special sense; they are contained in the grey portion of the brain, spinal cord, and ganglia, which grey substance is, in fact, made up of these vesicles intermixed in many parts with fibres, and with a variable quantity of granular or amorphous matter.'—Introduction, p. clxxxviii.

The author goes on to describe the nerve fibres as of two distinct kinds, and the nerve cells as consisting of several varieties, but to us it must suffice to know that the nerve cords or connexions are bundles of separate fibres, and that the nerve centres are aggregates of cells or vesicles mixed with fibres.

The mode of connexion of nerve threads with the central vesicles is not uniform. In one class of cases the vesicles are pear-shaped, and send out tails that are the commencement of fibres, so that the cells are, as it were, swellings or expansions of the fibres, having granular or solid nuclei enclosed in them. According to this plan, in any nerve cord coming from the extremities of the body to the brain, the separate fibres would end each in a swollen mass or vesicle, and the total of these vesicles would be the grey matter of the brain. To this grey matter, with its infinitude of cells, all the nerves tend, or from it they issue. These two elements of nerve cell and nerve fibre are the sole ingredients peculiar to the brain. The blood vessels are common to it with every other organ; whilst the membranes or sheaths that surround the cords and enclose the brain serve partly for protection and insulation, and partly for containing and distributing the blood-vessels.

FIG. 1.*



To form an estimate of the multitude of nerve fibres entering into the ramifying cords, it is necessary to be made aware of the size of the ultimate filaments. 'Their size differs considerably even in the same nerve, but much more in different parts of the nervous system; some being as small as the $\frac{1}{12000}$, and others upwards of $\frac{1}{1500}$ of an inch in diameter; and the same fibre may change its size in different parts of its course.' Thus it would appear that a nerve branch, like the main trunk supplying the arm, might contain hundreds of thousands of separate fibres. The optic nerve of one of the eyes might contain as many as a million of fibres.

The nerve vesicles also 'differ greatly from one another in size; some being scarcely larger than a human blood corpuscle,† others $\frac{1}{300}$ of an inch or upwards in diameter.' We may, therefore, speak in somewhat similar terms respecting the

* 'Nucleated nerve-cells magnified 170 diameters. *a* and *b* from the cortical grey matter of the cerebellum; *c* and *d* from the spongy grey matter of the medulla oblongata. *n* the nucleus of a cell,—(*a*, *c*, and *d*, after Hannover).' From QUAIN'S *Anatomy*, p. cxcvii.

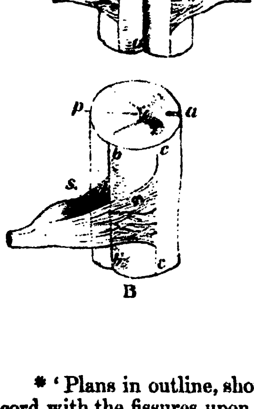
† The magnitude of the red corpuscles of the human blood 'differs somewhat even in the same drop of blood, and it has been variously assigned by authors; but the prevalent size may be stated at from $\frac{1}{3500}$ to $\frac{1}{3200}$ of an inch in diameter, and about one-fourth of that in thickness.'

countless millions of nerve cells existing in the grey substance of a single convolution of the brain. The minuteness of the fibres and vesicles of the nerve substance is not without importance, for we are to consider that each fibre carries forward its own distinct impression without affecting, or being affected by, the impressions passing along the other fibres that run side by side with it in the same bundle. In the act of perceiving the objects about us, this distinctness enables us to hold in our minds all the parts of a complicated scene, each in the proper place, without mingling or confusion; and in the command of our muscular movements it gives the means of singling out specific muscles to be acted on while all the others are left quiescent.

OF THE NERVOUS CENTRES.

In the collective mass made up of the brain and spinal cord, and denominated the cerebro-spinal axis or centre, the following parts stand distinct from each other, although mutually connected by bundles of nerve fibres.

FIG. 2.*



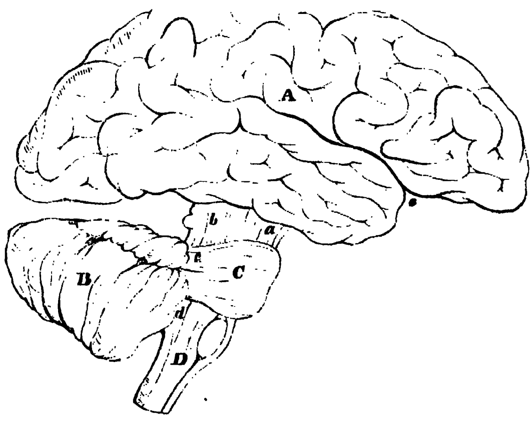
I. The SPINAL CORD, contained in the back bone, and sending out two pairs of nerves from between every two vertebræ, one pair to each side of the body. The Cord consists of a column of white fibrous matter with a grey portion enclosed. In a cross section, the grey matter is seen to form two crescents with the horns turned outwards, and connected in the middle of their convexities by a cross band.

* 'Plans in outline, showing the front, A, and the sides, B, of the spinal cord with the fissures upon it; also sections of the grey and white matter, and the roots of the spinal nerves. *a, a*, Anterior fissure. *p, p*, Posterior fissure. *b*, Posterior, and *c*, Anterior horn of grey matter. *e*, Grey commissure. *r*. Anterior, and *s*, Posterior roots of a spinal nerve.'—QUAIN, p. 676.

II. The ENCEPHALON or BRAIN. This includes the entire contents of the cavity of the skull, or cranium. The spinal cord is continued up into it. The brain is itself an aggregate of distinguishable masses of mixed grey and white matter. Each of these masses is looked upon either as a distinct centre or as communicating between the centres. In proportion as the grey vesicular matter prevails the mass has the character of a centre; according as the white fibrous substance prevails the part serves as a medium of conduction or communication solely. Of these various masses, some have a preponderance of grey, others of white matter. None are purely of one kind.

The mere mechanical arrangement of the brain is exceedingly complex, and there are different modes of classifying and grouping the various portions. The division adopted by human Anatomists is into four parts (a different arrangement has been proposed founded on Comparative Anatomy). Those four parts are the *Cerebrum*, the *Cerebellum*, the *Pons Varolii*,

FIG. 3.*



* 'A plan in outline, showing, in a lateral view, the parts of the encephalon separated somewhat from each other. A, Cerebrum. *e*, Fissure of Sylvius, which separates the anterior and middle lobes. B. Cerebellum. C. Pons Varolii. D. Medulla oblongata. *a*. Peduncles of cerebrum; *b*. Superior; *c*. Middle; and *d*. Inferior peduncles of cerebellum.'—QUAIN, p. 681.

and the *Medulla Oblongata.* 'The cerebrum, which is the highest and by far the largest part of the human encephalon, occupies the upper and larger portion of the cranial cavity.' 'The cerebellum is placed beneath the hinder part of the cerebrum, by which it is completely overlapped.' The pons Varolii is in the base of the brain near the entrance of the spinal cord, and connects together the three other parts,—the cerebrum, cerebellum, and medulla oblongata. The medulla oblongata connects the spinal cord with the brain.

6. In giving a more detailed description of those four parts, it will be convenient to take them in an inverse order, beginning from below, or where the brain joins the spinal cord.

(1.) The *Medulla Oblongata.*—This portion is continuous below with the spinal cord, of which it seems an expansion; lying wholly within the cranial cavity, its upper end passes into the pons Varolii. See Figs. 3 and 4, D.

'It is of a pyramidal form, having its broad extremity turned upwards, from which it tapers to its point of connexion with the spinal cord; it is expanded laterally at its upper part. Its length from the pons to the lower extremity of the pyramids is about an inch and a quarter; its greatest breadth is about three quarters of an inch; and its thickness from before backwards about half an inch.'—*Quain*, p. 683.

In form and general Anatomical characters the medulla oblongata very much resembles the cord, of which it is a prolongation upwards to the brain. It is not our purpose here to enter into the minute Anatomy of the part, or to set forth the points of difference between it and the cord; suffice it to observe that in it the white and grey constituents of the cord, are both increased in size and altered in arrangement. The grey matter especially becomes more abundant and additional deposits occur. The medulla oblongata has thus more of the character of an independent centre of nervous action than belongs to the cord. It gives origin to several nerves of a very special and important nature.

(2.) The *Pons Varolii,* or *annular protuberance* (tuber annulare). (See Figs. 3 and 4 c.) This 'is a comparatively small portion of the encephalon, which occupies a central position on its under surface, above and in front of the medulla oblongata, below and behind the crura cerebri *a*, and between the middle crura of the cerebellum *c*, with all which parts it is connected.' By the term 'crura cerebri,' introduced in this description, is meant the 'legs' or roots of the cerebrum, or the two bundles of nerve that unite it with the parts below. The crura of the cerebellum express in like manner the several connexions of that centre with the other centres. On account of the intermediate and connecting position of the pons, it has also been called the middle-brain (meso-cephalon). From its embracing as in a ring the medulla oblongata and stems of the cerebrum, it has derived the name of annular protuberance; the other name, 'pons,' or bridge, expresses the same circumstance.

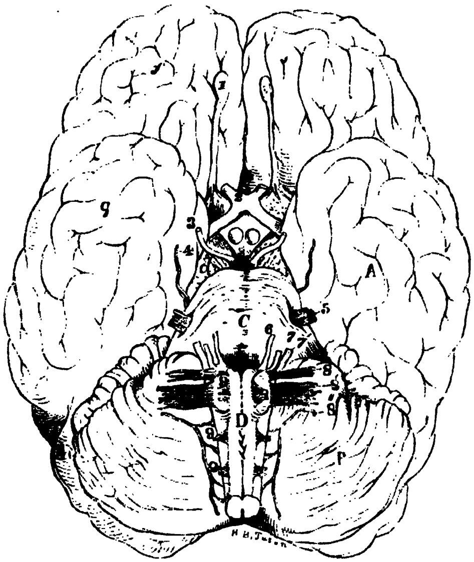
'The substance of the pons Varolii consists of transverse and longitudinal white fibres, interspersed with a quantity of diffused grey matter. The transverse fibres, with a few exceptions, enter the cerebellum under the name of the middle crura or peduncles, and form a commissural (or connecting) system for its two hemispheres. The longitudinal fibres are those which ascend from the medulla oblongata into the crura cerebri, augmented, it would seem, by others which arise within the pons from the grey matter scattered through it.'—*Quain*, p. 689. The pons is thus mainly a grand junction between the medulla oblongata and spinal cord below, the cerebrum above, and the cerebellum behind. The existence of a considerable amount of the grey or vesicular matter proves that conduction or communication is not the sole function of this part of the brain.

(3.) 'The *cerebrum* or brain proper (Figs. 3 and 4, A), as already mentioned, is the highest, and by far the largest portion of the encephalon. It is of an ovoid (or egg) shape, but is irregularly flattened on its under side. It is placed in the cranium with its small end forwards, its greatest width being opposite to the parietal eminences.

'The cerebrum consists of two lateral halves, or *hemi-*

spheres, as they are called, which, though connected by a median portion of nervous substance, are separated in a great

FIG. 4.*



part of their extent by a fissure, named the great longitudinal fissure, which is seen on the upper surface of the brain, and partly also on its base.

'The cerebral hemispheres are not plain or uniform upon the surface, but are moulded into numerous smooth and tortuous eminences, named *convolutions*, or gyri, which are marked off from each other by deep furrows, called sulci, or *anfractuosities*. These convolutions are coloured externally;

* Shows the under surface or base of the encephalon freed from its membranes. A. Cerebrum. *f*, *g*, *h*. Its anterior, middle, and posterior lobes. B. Cerebellum. C. Pons Varolii. D. Medulla Oblongata. *d*. Peduncle of cerebrum. 1 to 9, indicate the several pairs of cerebral nerves, numbered according to the usual notation, viz.—1. Olfactory nerve. 2. Optic. 3. Motor nerve of eye. 4. Pathetic. 5. Trifacial. 6. Abducent nerve of eye. 7. Auditory, and 7′, Facial. 8. Glosso-pharyngeal. 8′. Vagus. 8″. Spinal accessory nerve. 9. Lingual or hypoglossal nerve.

for the surface of the cerebral hemispheres, unlike the parts hitherto described, is composed of grey matter.'—QUAIN, 690.

The complete description of the cerebrum, includes an account of the external surface, with its convolutions and the various masses that make up the interior and in part appear at the base of the brain. Although in the highest degree interesting as a study, no important application to our present subject arises out of such minute knowledge. There are, however, a few particulars that it is of use for us to add, selected out of the elaborate detail of cerebral Anatomy.

A distinction exists between the convoluted mass of the hemispheres and certain enclosed smaller masses of the cerebrum. Of these there are two that are usually named together, partly on account of their proximity, and partly because it has not been practicable hitherto to distinguish their functions. They are the *optici thalami* and *corpora striata*, being double and symmetrical on the two sides. They both lie imbedded in the heart of the hemispheres. The peduncles or stems of the cerebrum pass into them before spreading-out into the mass of the hemispheres. The third important mass is termed the *corpora quadrigemina* (quadruple bodies),* from consisting of four rounded masses put together in a square. This portion is more detached than the two others, and finds a place between the cerebrum and cerebellum. In some of the inferior animals it is very large, and takes a prominent position in the general structure of the brain; whereas the two other masses above mentioned for the most part rise and fall according to the degree of development of the convoluted hemispheres. Hence the comparative Anatomist assigns to the quadruple bodies a character and function apart from the rest of the cerebrum. I quote a short description of each of the three centres.

The *corpora striata* 'are two large ovoid masses of grey matter, the greater part of which is imbedded in the middle of the white substance of the hemisphere of the brain.' 'The surface

* See in Fig. 3, the two rounded eminences behind *b*, the superior peduncle of the cerebellum. These represent the corpora quadrigemina in section.

of the corpus striatum is composed of grey matter. At some depth from the surface white fibres may be seen cutting into it, which are prolonged from the corresponding cerebral peduncle, and give it the streaked appearance from which it has received its name.'

'The *thalami optici* (posterior ganglia of the brain) are of an oval shape, and rest on the corresponding cerebral crura, which they in a manner embrace. On the outer side each thalamus is bounded by the corpus striatum, and is then continuous with the white substance of the hemisphere.' 'The inner sides of the two thalami are turned to each other.' 'The optic thalami are white on the surface, and consist of several layers of white fibres intermixed with grey matter.'

'In front of the cerebellum are certain eminences, which may be reached from the surface of the brain. These are the corpora quadrigemina, and above them is the pineal gland.'

('The pineal gland (conarium) so named from its shape (pinus, conus, the fruit of the fir), is a small reddish body, which rests upon the anterior pair of the corpora quadrigemina.' 'It is about three lines (a quarter of an inch) in length, and its broad part, or base, is turned forwards, and is connected with the rest of the cerebrum by white substance.')

'The *corpora* or *tubercula quadrigemina* are four rounded eminences, separated by a crucial depression, placed two on each side of the middle line, one before the other. They are connected with the back of the optici thalami, and with the cerebral peduncles at either side.'

'The upper or anterior tubercles, are somewhat larger and darker in colour than the posterior. In the adult, both pairs are solid, and are composed of white substance outside, containing grey matter within.

'They receive bands of white fibres from below.'—'A white cord also passes up on each side from the cerebellum to the corpora quadrigemina, and is continued onwards to the thalami: these two white cords are the superior peduncles of the cerebellum. At each side, the corpora quadrigemina send off two white tracts, which pass to the thalami and to the commencements of the optic nerves.'

'In the human brain these quadrigeminal bodies are small in comparison with their size in the series of animals. In ruminant, soliped, and rodent animals, the anterior tubercles are much larger than the posterior, as may be seen in the sheep, horse, and rabbit. In the brains of carnivora, the posterior tubercles are rather the larger.

'In the fœtus this part of the brain appears very early, and then forms a large proportion of the cerebral mass. The eminences are at first single on each side, and hollow. They are constant in the brains of all vertebrate animals, but in fishes, reptiles, and birds, they are only two in number, and hollow. In marsupialia and monotremata, they are also two in number, but solid.'

In this brief allusion to the different parts composing the cerebrum, we have had to exclude the mention of many smaller portions. We have also avoided all allusion to the *ventricles* of the brain. These are enclosed spaces extending in various directions, and serving as boundaries to the other parts.*

* The following passage may assist in giving a connected view of the cerebrum, and also of the nature of the ventricular cavities or space.

'The hemispheres are connected together in the middle by the corpus callosum, and it is obvious that the structures filling up the interpeduncular space, serve also as connecting media. Between the corpus callosum above and the peduncles below, the two hemispheres are partially separated from each other, so as to leave an interval, *the general ventricular space*, across which some slighter connecting portions of nervous substance pass from one hemisphere to another.

'Again, as seen in a transverse vertical section of the cerebrum, the peduncles diverge as they ascend towards the hemispheres, and pass on each side through two large masses of grey matter, sometimes called ganglia of the brain,—at first through the thalamus opticus, and afterwards through a much larger mass named corpus striatum. These two masses of grey matter project somewhat, as smooth convex eminences, on the upper and inner surface of the diverging fibres of the peduncles. Immediately above the thalami and corpora striata, the hemispheres are connected together across the median plane by the corpus callosum; and it is between the under surface of the latter, and the upper surfaces of the eminences mentioned and the interpeduncular structures, that the general ventricular space is situated in the interior of the cerebrum. The upper part of this space is again divided by a median vertical partition, so as to form the two *lateral* ventricles: below this, it forms a single cavity named the *third* or middle ventricle, which communicates with both the lateral ventricles above, and, below, with the ventricle of the cerebellum or *fourth* ventricle. The median vertical partition, which separates the lateral ventricles from each other, consists at one part (septum lucidum) of two layers, between which is contained the *fifth* and remaining ventricle of the brain.'

. pp. 701-2.

(4.) 'The *cerebellum*, *little brain*, or *after brain* (Figs. 3 and 4, B), consists of a *body* and three pairs of *crura* or *peduncles*, by which it is connected with the rest of the encephalon. They are named superior, middle, and inferior, peduncles.

'The superior peduncles (Fig. 3, *b*) connect the cerebellum with the cerebrum through the corpora quadrigemina, as already stated. The inferior peduncles *d*, pass downward to the back part of the medulla oblongata. The middle peduncles, *c*, pass from the middle of the cerebellum around the outer side of the crura of the cerebrum, and meet in front of the pons Varolii, constituting its transverse fibres. They connect the two halves of the cerebellum below. All these peduncles consist of white fibres only; and they pass into the interior of the cerebellum at its fore part.'

'The *body* of the cerebellum A, being covered with cortical substance, is of a grey colour externally, but is rather darker on the surface than the cerebrum. Its greatest diameter is transverse: it is about three and a half or four inches wide, about two or two and a half from before backwards, and about two inches deep in the thickest part, but is much thinner all round its outer border.

'It consists of two lateral *hemispheres*, joined together by a median portion called the *worm*, or vermiform process, which in birds, and in some animals still lower in the scale, is the only part existing.'

'The body of the cerebellum at the surface, and for some depth, consists of numerous nearly parallel laminæ or folia, which are composed of grey and white matter, and might be compared with the gyri or convolutions of the cerebrum, but are smaller and not convoluted. These are separated by sulci of different depths.'—QUAIN, 720-2.*

* The above is a brief outline of the parts of the brain, as given in the best works on human Anatomy. I shall here append a view of its divisions founded on the comparative Anatomy of the vertebrate series of animals, and with reference to the analysis of the cranium into vertebral sections. It is supposed that the bony parts of the head and face of any animal in this series is made up of four vertebræ, expanded and transformed for the accommodation of the brain, senses, and the other organs that distinguish

7. We must next attend to the internal structure of the brain, considered as made up of the two kinds of matter, the grey, vesicular, or central substance, and the white, fibrous, or communicating substance. The distribution and arrangement of those two kinds of matter throw light upon the mode of action, or the peculiar kind of activity that distinguishes the brain. The subject is still a very obscure one, but not so obscure as it has been, and we can even now learn from it a better mode of conceiving the workings of the nervous system than what has come down to us from the times when nothing whatever was known. I still quote from Dr. Sharpey.

the head from the rest of the spine. On a similar supposition, the brain would be looked upon as an expansion of as much of the spinal cord as would extend over the length of four vertebræ. When we descend in the scale, as low as fishes, we find a most apparent division of the encephalon into four segments, corresponding with the four vertebræ, whose expansion makes the head.

Proceeding upon this hint, Professor Owen makes a classification of the parts of the brain, which he considers applicable alike to the highest and lowest members of the vertebrate class. Beginning from behind, where the encephalon joins the spinal cord, he enumerates as follows, specifying at the same time what he considers the functions of the several segments.

I. *Encephalon* (Hind-brain). This includes the hinder parts of the mass, namely, the medulla oblongata, the pons Varolii, and the cerebellum. These parts together form an aggregate centre for sustaining the functions of Respiration and Digestion, and for performing combined and rhythmical movements. The two first functions, Respiration and Digestion, are commonly conceived as attaching to the medulla oblongata. The pons Varolii is far more of a connecting organ than a centre. To the cerebellum belongs, as is supposed, the function of harmonizing complex movements, of the instinctive kind, such as walking on all fours. Of the functions of the brain, we shall, however, speak particularly again.

II. *Mesencephalon* (Middle-brain). The parts here intended, are those next in order to the previous. They are the enclosed space, called the third ventricle, the corpora quadrigemina, with its connected organ, the pineal gland, and another small round mass in the same region named the Pituitary body or gland. This is considered the Centre of Vision, and of the movements prompted and regulated by vision.

III. *Prosencephalon* (Fore-brain). The hemispheres, including the corpora striata and thalami optici. This is reckoned the seat of the higher functions of mind, namely, Consciousness, Volition, and Intelligence. It is the portion whose enlargement distinguishes the human subject. In the fish and reptile it is surpassed in size by the members of the middle brain, the corpora quadrigemina being the chief of these.

IV. *Rhinencephalon* (Nose-brain). The olfactory lobe and crura. In man this is a very insignificant mass, lying over the nose and between the eyes. In the lowest vertebrate animals, it stands forward as the terminating segment of the brain. It is the Centre of Smell.

'*White Part of the Encephalon.*—The white matter of the encephalon consists of tubular fibres. The general direction which they follow is best seen in a brain that has been hardened by immersion in spirits, although it is true that we do not then trace the single fibres, but only the fine bundles and fibrous lamellæ which they form by their aggregation.

'It may suffice here to remark, that one large body of fibres can be traced upwards from the spinal cord to the grey matter situated in different regions of the encephalon; some of these fibres reaching as high as the cortical layer on the surface of the cerebrum and cerebellum, others apparently terminating in the corpus striatum, thalamus opticus, corpora quadrigemina, and other special deposits of grey substance. These fibres are generally believed to be continued by their lower ends into the spinal nerves, though it is also supposed that part of them may terminate below in the grey matter of the cord. Other fibres pass between different parts of the encephalon itself, serving most probably to connect its different masses of grey substance; among the most conspicuous examples of these may be adduced, the fibres connecting the cerebrum and cerebellum, forming what are called the superior cerebellar peduncles; fibres passing up from the grey matter in the medulla oblongata and pons Varolii, in company with those from the spinal cord, and having probably a similar connexion superiorly: fibres radiating from the corpus striatum to the cortical grey matter of the cerebrum; fibres between adjacent or distant convolutions; and, lastly, the vast body of fibres belonging to the commissures of the cerebrum and middle crura of the cerebellum which pass from one side of the encephalon to another.'—QUAIN, Introduction, p. ccii.

The following is an interesting classification of the different fibres of the cerebrum, and will serve to enhance the effect of the foregoing extract.

'The fibres of the cerebrum, though exceedingly complicated in their arrangement, and forming many different collections, may be referred to three principal systems, according to the general course which they take, viz.—I. *Ascending or* *peduncular fibres*, which pass up from the medulla oblongata to the hemispheres, and constitute the two crura or peduncles of the cerebrum. They increase in number as they ascend through the pons, and still further in passing through the optic thalami and striated bodies, beyond which they spread in all directions into the hemispheres. These were named by Gall the *diverging* fibres. 2. *Transverse* or *commissural fibres*, which connect the two hemispheres together. 3. *Longitudinal* or *collateral fibres*, which, keeping on the same side of the middle line, connect more or less distant parts of the same hemisphere together.'—QUAIN, p. 736.

This general classification is followed out by the author into minute details, full of interest in themselves, but too technical and too little instructive as regards the workings of mind, to be farther dwelt upon here. We shall now give an extract on the distribution of the grey matter, and then pass to the general view of the mechanism and mode of working of the brain, suggested by these descriptions of its component structure.

'*Grey Matter of the Encephalon.*—Considering the imputed physiological importance of the grey nervous substance, it may be well to mention connectedly the different positions in which it is found in the several parts of the encephalon.

'By far the larger amount is situated upon the convoluted surface of the cerebrum and the laminated surface of the cerebellum, forming, in each case, the external cortical layer of cineritious matter.'

I regret to have to omit a portion of the connected account of the spread of the grey matter in the parts in the interior and base of the brain, as including a number of terms that the reader has not been prepared for in the present sketch of the nervous system. We must rest satisfied with perusing in addition to the above, the account of the distribution of grey substance in the larger portions, and in the parts already in some degree known to us.

'In the crura cerebri, the grey matter is collected into a dark mass; below this it is continuous with that of the pons and medulla oblongata, and through them with the spinal cord.' Thus though the crura cerebri are, in the main, connexions of white matter between the hemispheres and the parts below, yet, like the medulla oblongata and spinal cord, they contain in the interior a portion of the grey matter, and are to that extent centres of nerve force, as well as being conductors.

'In the centre of each of the corpora quadrigemina, grey matter is also found, and it occurs in the pineal gland (and in the corpora geniculata). These last bodies appear to be appendages of the large masses of grey matter, situated in the interior of the cerebrum, named the optic thalami; which again, are succeeded by the still larger collections of this substance, and indeed the largest situated within the brain,—viz., the corpora striata.'—p. 744.

8. *Plan of Structure indicated by the above arrangement of white and grey substance.*—The object of the present chapter being to ascertain, as far as possible, the mode of working of the brain and the connexion of its mechanism with the mental functions, we may here take a summary view of the plan of structure indicated by the foregoing description. We shall thus prepare the way for discussing, at a later stage, the precise kind of action that seems to be maintained throughout the different parts of the nervous system.

It would appear, then, that the cerebro-spinal centre, or the brain and spinal cord taken together, is an aggregate of distinct nervous masses or parts, each made up of a mixture of white and grey matter. The grey matter is the vesicular substance, being made of cells or vesicles; the white matter is the fibrous substance, being made up of fibres bundled together. The grey matter is a terminus; to it the fibrous collections tend, or from it commence. The fibrous matter contained within any of the cerebral masses is placed there as a means of communicating with some portion or other of the layers, or other collections, of grey substance.

Beginning with the spinal cord,—which we have seen to be a rod or column of white matter or fibres, enclosing a slender core of grey substance;—if we trace the fibres of the cord upwards, we find them continuing into the medulla oblongata, the first and lowest portion of the brain. Of the whole mass of fibres entering the medulla oblongata, the larger portion pass up into the cerebellum and the pons Varolii; while a part terminates in the grey substance of the medulla itself; and from that grey substance other fibres take their rise and proceed onwards, in the company of the through-going fibres of the cord. Thus the emerging white matter of the medulla oblongata is partly the fibres that entered it, as a continuation of the cord, and partly the fibres originating in the grey central matter of the medulla, replacing as it would seem, those that terminated there. From the pons Varolii, where we come next, the white fibres advance in various directions; intersecting with transverse fibres connecting the two halves of the cerebellum, and passing upwards towards the cerebrum proper. The fibres thus going upwards constitute the crura, peduncles, or stems of the cerebrum, and seem destined to terminate in the grey matter of the convoluted surface of the hemispheres. But in passing through the ganglia of the brain—the thalami optici and corpora striata—the arrangement describe l above is repeated; that is to say, while a large part of the fibres pass clear through the ganglionic masses, the rest stop short in the grey substance of those masses, which grey substance gives origin to other fibres to pass out with those that had an uninterrupted course through the bodies alluded to. Both sets together—those passing through, and those originating in, the grey substance of the corpora striata, or thalami optici—constitute a portion of the white or fibrous substance of the hemispheres, spreading out and terminating in the grey matter, or cortical layer, of the convolutions. They are the first of three classes of fibres, described above, as constituting the white matter of the cerebrum; that is to say, the ascending or diverging class.

Whatever number of central masses we may calculate as interposed between the spinal cord beneath and the convoluted surface of the cerebrum, the manner of communication between them is found to be as now stated. The fibres passing between one intermediate mass and another are partly transmitted and partly arrested. Wherever grey matter exists, there is the commencement or termination of white matter. The fibres that enter the cerebellum from the medulla oblongata, terminate in whole, or in part, in its outer layer of grey substance, and in that substance a new set of fibres originate to pass to other parts of the brain, as the corpora quadrigemina, the hemispheres, &c., and from one half of the cerebellum to the other. The fibres spreading out, as already mentioned, in the hemispheres towards the convoluted grey surface will have had very various origins. Some have perhaps come all the way from the extremities of the body, passing by the spinal cord, medulla oblongata, cerebellum, pons Varolii, thalami optici, &c.; others have originated in the grey matter of the cord, passing without a break through all the intervening centres; a third class may have had their rise in the grey matter of the medulla oblongata; a fourth in the grey matter of the pons; a fifth in the cerebellum; a sixth in the corpora quadrigemina; others in the thalami optici or corpora striata; besides other more minute sources.

The arrangement may thus be seen to resemble the course of a railway train. The various central masses are like so many stations where the train drops a certain number of passengers and takes up others in their stead, whilst some are carried through to the final terminus. A system of telegraph wires might be formed to represent exactly what takes place in the brain. If from a general terminus in London a mass of wires were carried out to proceed towards Liverpool, and if one wire of the mass were to end at each station, while from the same station new wires arose, one for every station further on, a complete and perfectly independent connexion could be kept up between any two stations along the line. Calling the stations *a*, *b*, *c*, *d*, *e*; there would be from *a* the London terminus, the wires, *a b*, *a c*, *a d*, *a e*; from *b*, would arise, *b c*, *b d*, *b e*; from *c*, *c d*, *c e*; and from *d*, *d e*. The mass of wires found on the road at a point between *c* and *d*, would be *a e*, or the one through-going wire, *b e* and *b d*, *c e* and *c d*; five wires in all, which would be the number sustained throughout. This system of telegraph communication would be, so far as appears, the type of nervous communication among the various masses strung together in the cerebro-spinal axis or centre.

But it is only a very small number of the fibres ending in the convolutions of the hemisphere that have performed the entire course from the extremities of the body. Indeed, some Anatomists have doubted the existence of any such uninterrupted fibres, or at least consider that they have not been traced with unimpeachable certainty through the entire line of centres. Others, however, whom we are compelled to acknowledge as among the highest authorities in Anatomy maintain that such fibres have been undoubtedly traced.

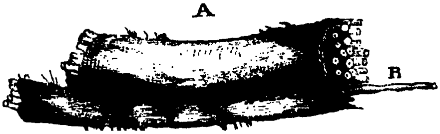
The application of this view of the plan of structure of the brain will appear in the sequel, after we have ascertained the distinctive functions or uses of the two kinds of nervous matter.

OF THE CEREBRO-SPINAL NERVES.

9. By the cerebro-spinal nerves are meant the connexions of the cerebro-spinal centre with the different parts of the body. These connexions consist of ramifications of nerve cords, threads, or bundles, arising in the central masses, and distributed like the blood vessels, by subdividing and spreading themselves over the various organs and tissues, thereby establishing a connection between the brain and the remotest extremities.

'These nerves are formed of the nerve fibres already described, collected together and bound up in membranous sheaths. A larger or smaller number of fibres inclosed in a tubular sheath form a small round cord, usually named a *funiculus;* if a nerve be very small, it may consist of but one such cord, but in larger nerves several funiculi are united together into one or more larger bundles, which, being wrapped up in a common membranous covering, constitute the nerve (Fig. 5.) Accordingly, in dissecting a nerve, we first come to an outward covering, formed of cellular tissue, but often so strong and dense, that it might well be called fibrous. From this common sheath we trace laminæ passing inwards, between the larger and smaller bundles of funiculi, and finally between

FIG. 5.*



the funiculi themselves, connecting them together as well as conducting and supporting the fine blood vessels which are distributed to the nerve.'

'The funiculi of a nerve are not all of one size, but all are sufficiently large to be readily seen with the naked eye, and easily dissected out from each other. In a nerve so dissected into its component fasciculi, it is seen that these do not run along the nerve as parallel insulated cords, but join together obliquely at short distances as they proceed in their course, the cords resulting from such union dividing in their further progress to form junctions again with collateral cords; so that, in fact, the funiculi composing a single nervous trunk have an arrangement with respect to each other similar to what we find to hold in a plexus formed by the branches of different nerves. It must be distinctly understood, however, that in these communications *the proper nerve fibres do not join together or coalesce.* They pass off from one nervous cord to enter another with whose fibres they become intermixed, and part of them thus intermixed may again pass off to a third funiculus, or go through a series of funiculi and undergo still further intermixture. But through all these successive associations, the nerve fibres remain, as far as known, individually distinct, like interlaced threads in a rope.'

'*Vessels.*—The blood vessels of a nerve supported by the nerve sheath divide into very fine capillaries, said by Henlé

* 'Represents a nerve consisting of many smaller cords or funiculi, wrapped up in a common cellular sheath. A, the nerve. B, a single funiculus drawn out from the rest (after Sir C. Bell).'—QUAIN, p. ccix.

to measure in the empty state not more than $\frac{1}{3000}$th of an inch in diameter. These, which are numerous, run parallel with the funiculi, but are connected at intervals by short transverse branches, so as in fact to form a network with very long narrow meshes.

'*Branching and Conjunction of Nerves.*—Nerves in their progress very commonly divide into branches, and the branches of different nerves not unfrequently join with each other. As regards the arrangement of the fibres in these cases, it is to be observed, that, in the branching of a nerve, portions of its fibres successively leave the trunk and form branches; and that when different nerves or their branches intercommunicate, fibres pass from one nerve and become associated with those of the other in their further progress; but in neither case (unless at their peripheral terminations) is there any such thing as a division or splitting of an elementary nerve into two, or an actual junction or coalescence of two such fibres together.'—SHARPEY; QUAIN, Introduction, ccix-xii.

'*Origins or Roots of the Nerves.*—The cerebro-spinal nerves, as already said, are connected by one extremity to the brain or to the spinal cord, and this central extremity of a nerve is, in the language of anatomy, named its origin or root. In some cases the root is single, that is, the funiculi or fibres by which the nerve arises are all attached at one spot, or along one line or tract; in other nerves, on the contrary, they form two or more separate collections, which arise apart from each other, and are connected with different parts of the nervous centre, and such nerves are accordingly said to have two origins or roots. In the latter case, moreover, the different roots of a nerve may differ not only in their anatomical characters and connexions, but also in function, as is well exemplified in the spinal nerves, each of which arises by two roots, —an anterior and a posterior; the former containing the motory nerves of the fibre, the latter the sensory.

'The fibres of a nerve, or at least a considerable share of them, may be traced to some depth in the substance of the brain or spinal cord, and hence the term 'apparent or superficial origin', has been employed to denote the place where the root of a nerve is attached to the surface, in order to distinguish it from the 'real or deep origin,' which is beneath the surface and concealed from view.

'To trace the different nerves back to their real origin, and to determine the points where, and the modes in which their fibres are connected with the nervous centre, is a matter of great difficulty and uncertainty: and, accordingly, the statements of anatomists respecting the origin of particular nerves are, in many cases, conflicting and unsatisfactory. Confining ourselves here to what applies to the nerves generally, it may be stated, that their roots, or part of their roots, can usually be followed for some way beneath the surface, in the form of white tracts or bands, distinguishable from the surrounding substance; and very generally these tracts of origin may be traced towards deposits of grey nervous matter situated in the neighbourhood, such, for instance, as the central grey matter of the spinal cord, the grey nuclei of the pneumogastric and glossopharyngeal nerves, the corpora geniculata (attached to the corpora quadrigemina), and other large grey masses connected with the origin of the optic nerve. It would further seem probable, that certain fibres of the nerve roots take their origin in these local deposits of grey matter, whilst others become continuous with the white fibres of the spinal cord or encephalon, which are themselves connected with the larger and more general collections of grey matter situated in the interior or on the surface of the cerebro-spinal axis. As has been already more fully stated, there is a difference of opinion as to the mode in which the nerve fibres, supposed to arise in the grey matter, are connected with its elements; some anatomists describing them as forming loops or arches in the grey matter, passing into it, as it were, and returning, whilst others maintain that the fibres are prolonged from the caudate nerve cells.'—Id. ccxiii-v.

'*Termination or Peripheral Extremity of Nerves.*—The results of modern microscopic discovery seemed for a time to lead to the conclusion that the fibres of nerves do not, strictly speaking, end in the tissues in which they were distributed, but merely dip into those tissues, as it were, and, after forming slings or loops of greater or less width, return sooner or later to the nervous trunks. The further progress of inquiry has, however, failed to establish the generality of this conclusion, and has even gone far to disprove the existence of the alleged mode of termination in various cases, in which it had been previously held to take place: and indeed it must be admitted that the arrangement of the nervous fibres at their peripheral extremities is still but imperfectly understood, as will appear from the following summary of what is at present known on the subject.'

Passing over the details of this very interesting inquiry, we must be content with the statement of the conclusions arrived at.

'From the account of the peripheral extremities of the nerves, it will be apparent,—*First*, that the disposition of their elementary fibres in terminal loops, or in terminal plexuses, through which they return again towards the parent trunks, is by no means general: that, as far as known, they more commonly end by simply truncated, or slightly swollen extremities, as in the instance of those entering the Pacinian bodies, or become gradually lost to the sight in the surrounding tissue, usually afte considerable reduction in size, and after laying aside their dark outline, probably from privation of their white substance. That even where, apparently, terminal loops are observed, it is difficult to say whether these may not in some cases, be caused by serpentine windings in the fibres previous to their actual termination, which may itself be hidden from view. *Secondly*, that elementary nerve fibres, although, as far as is known, they keep entire and distinct in their course along the nerves, do in various instances actually divide into branches, and in some cases unite or inosculate with each other, in approaching their termination. *Thirdly*, that in certain cases the fibres of nerves come into near relation at their peripheral extremities with cells resembling the nerve cells of the brain and ganglia.'—Id. ccxvi, ccxxiv.

Thus in comparing the termination of the blood vessels with the termination of the nerves, we find a dissimilarity or contrast, indicating some radical difference in the way that the two very different influences, blood and nervous force, are brought to bear upon the various tissues. In the case of the circulation of the blood, the arteries are seen to subdivide till they reach their smallest ramifications in the capillaries, which capillaries are in contact with the tissues, and supply nourishing material through their coats or walls, by an oozing or sweating process; the stream passes on through the capillaries without interruption into the veins, where it is accumulated by flowing from the smaller branches into the larger, and at length reaches the heart; being thus kept in close channels large or small through the entire circuit of the body. But although the nerves are arranged on the plan of carrying one influence outward, and bringing another back from the same spot, the distinct sets of nerves used for the two purposes, do not join or become continuous at their extremities like arteries and veins; they seem rather to terminate absolutely and apart in the tissues; instead of a self-contained circuit, the course is broken or interrupted by the muscular, mucous, or other tissue where they end. This break is an important fact in the nervous structure; for although as yet we may not be able to trace the full meaning of it, it furnishes several instructive suggestions; and we shall probably avail ourselves of some of these in some of the discussions that are afterwards to occupy our attention.

FUNCTIONS OF THE NERVOUS SYSTEM.

10. Hitherto we have restricted our attention to the structure and arrangement of parts in the nervous mechanism: including under that head the central masses and the ramifying threads or cords passing between the centres and the various regions of the body. The functions, uses, or mode of operation, of those centres and ramifying cords have now to be considered. The experimental enquiries of recent years have thrown much light upon this obscure and mysterious subject; and the microscopic investigation of the nervous substance, from which we have obtained our knowledge of the distinctive structure of the grey and white matter, has tended greatly to simplify the study of nervous action. Reversing the order observed

above in the description of structure, I shall take up the subject of function, first as regards the Nerves, and next as regards the Nerve Centres.

Functions of the Nerves.

11. The Nerves are divided into two classes according as they proceed from the Spinal Cord, or issue direct from the Brain. The first class, called the Spinal Nerves, is the most numerous. It is not implied that these nerves have no connexion with the brain, but merely that their place of emergence or 'superficial origin' is in the Spinal Cord. The arrangement is to be looked upon as a matter of local convenience. The nerves destined for the lower limbs do not leave the general trunk until they approach the neighbourhood that they are to supply: that is, they are prolonged within the spine to its lower extremity; whilst those branching towards the arms emerge in the neck and between the shoulders. On the other hand, the nerves that supply the face and head leave the brain at once by openings in the skull; these are the Cerebral Nerves. There is no substantial difference of nature between the two classes.

In the mode of junction of the Spinal Nerves with the Spinal Cord a peculiarity is observed of great importance in the present subject. I have already noticed the fact that they issue from the spine in pairs, one pair between every two vertebræ; there are in all thirty-one couples. Each couple contains a right and a left member, for distribution to the right and left sides of the body. This part of the arrangement is likewise a matter of local convenience. But, further, when one individual of these emerging couples is examined, say a right branch, we find that this branch does not arise from the cord single; it springs from two roots, and these after proceeding apart for a short way, unite in the one single nerve that is seen to issue from between the vertebræ on the right side. The same holds of any left branch that may be fixed upon; the connexion with the cord is not single, but double. The smaller of the two roots in each case proceeds from the fore part of the cord, and is called the *anterior* root; the other or larger, proceeds from the hinder portion of the cord, and is called the *posterior* root. This last root, the posterior, is distinguished in another point, besides its greater size. Just after leaving the cord there is a ganglion or little swelling formed upon it, this ganglion being composed in part of grey matter, and being to appearance of the nature of a nerve centre. Beyond the ganglion, the two roots mingle and constitute the one nerve seen to emerge from the spine.*

12. Having thus noticed two classifications of the Nerves, the one,—into Spinal and Cerebral—unimportant as respects function, the other,—into anterior and posterior roots—highly important, as will be seen; we now proceed to state what the function or use of nerve is. *The function of a nerve is to transmit impressions, influences, or stimuli, from one part of the system to another.* The nerves originate nothing; they are exclusively a medium of communication; they have the carrying function. It is not easy to describe the nature of the influence that passes along the various spinal and cerebral ramifications; but whatever that influence be, we do not find it to be generated in the fibrous bundles of the nerve substance, nor can it be absorbed there. Hence the term '*conductor*' applied to the lines of nerve passing to and fro throughout the body. These are in their essential function telegraph wires; for although the force conveyed by a nerve differs from the force conveyed by a telegraphic wire, there is an absolute sameness in this, that the influence is generated at one spot and transmitted to another through an intermediate substance, which substance acts the carrier part solely. When a nerve fibre is not employed in transmitting an influence from one part to another, it sleeps, or is wholly idle and inert. We know of no other mode of employing a nerve thread than in conduction; and whatever may be the operations that any branch or twig is concerned in maintaining, the part performed by it consists simply and solely in carrying an impulse, given to it at one extremity, onwards to the other extremity.

Neither feeling nor action will start up at any point on the line of a nervous bundle ; but through the instrumentality of transmission, every nerve may be the means of causing either the one or the other.

The experimental proofs of this position are numerous, and they are now reckoned conclusive. If a main trunk nerve supplying a limb be cut through, all sensation in the limb ceases, and also all power of movement. The nerve with its numerous branches still remains, but, dissevered from the centres, it has no influence ; the entire ramifications might as well be torn out of the limb. The blood circulates and the parts are nourished, but for the purposes of feeling or action the member is excommunicated, dead. The telegraph wire is cut.

If, instead of cutting the nerve through, we prick or irritate it, an influence is generated and is made to appear by causing both feeling and movement. Whether the irritation is applied high or low, near the nervous centres or near the extremities of the body, the effect is precisely the same. The pricking originates an impression or stimulus, which the nerve conveys through its whole length; wherever that nerve ramifies, in each place do we note feeling or movement, or both. The nerve neither begins nor swallows up the influence; but carries forward and discharges it. Vary the experiment as we may, the interpretation to be put upon the result is of one unvarying tenor.*

* It seems singular that such an action as pricking a nerve with the point of a needle, pinching it, electrifying it, dropping pungent liquids upon it, should set a-going the same kind of influence as comes from its own proper centres. But this is from the peculiarity of the nerve, and not from any identity between the influence of a nerve centre and the influence of a mechanical irritation, electrical action, or chemical corrosion. A nerve is so constituted that it will carry one set of influences and no other. If we are able to disturb it at all, so as to propagate any kind of influence, this will be the influence that the nerve is accustomed to propagate. It will be an influence either setting some part in motion, or producing sensation somewhere. Because we burn it with an acid at one point, it will not therefore convey to the extremities a corroding influence, as if acid were poured out at the end of every fibre; it will simply cause either a convulsive action of the muscles, or a strong sense of pain in the parts where its terminations lie. The fibres are formed to transmit a peculiar and distinct influence, and they will either take on the bent requisite for

13. This property of communication or conduction, the exclusive function of the nerve threads, belongs to all the fibrous masses, that is, to the *white matter* of the nervous system. The conveying structure is the fibrous; a different function is reserved for the grey matter, as we shall presently see,—that of originating influence. Every separate fibre is a wire, and carries its own independent stimulus, although bound up with thousands of other fibres in the same cord or tract. Wherever white matter exists, lines of communication are established. We recognise lines of conduction or transmission not only between the remote organs of the body and the cerebro-spinal centre, but also throughout the different parts of the encephalon and spinal cord; in other words, we must admit the existence of currents and counter currents in the interior of the brain itself. All those connecting bands of fibres, or white substance, known as peduncles of the cerebrum and cerebellum, the commissures of the cerebrum, and all the white matter in the interior of the hemispheres underneath the convolutions, must be looked upon as employed in receiving influences from one nervous centre or portion of the cerebral mass, to discharge them in another. A bundle of white fibres in the main serves no other purpose in the heart of the cerebrum than a similar bundle serves in passing along the arm or over the face.

14. We have remarked of the nerves that they convey influence for the two distinct ends of causing action and causing feeling. For action, the influence must proceed outwards from the centres to the active organs; a stimulus from the brain or spinal cord has to be transmitted to the limbs, trunk, head, eyes, mouth, voice, or other parts that are to be set in

transmitting that influence, or remain dormant. It so happens, however, that the substance of nerve is extremely susceptible, and very readily falls into the active propagating attitude; whence influences very unlike those coming from the proper sources of influence may disturb the quiescent condition and set on the very current belonging to the legitimate stimulus. This gives to the fibrous substance of nerve, not an originating but a *determining power*, it will take on only one kind of influence, only one sort of message will be carried by it.

motion. For feeling, the influence must pass inwards. In a sensation of hearing, for example, an impression made on the sensitive surface of the ear is conveyed by the nerve of hearing towards the cerebral centres. Now it is found that different sets of nerves are employed for those two purposes; one class being exclusively devoted to the outward transmission of stimulants to action or movement, while the other class is equally confined to the office of conveying influence centrewards, for the ends of sensation or feeling. The first of these two classes is that named *efferent* (out-carrying) nerves, the second comprises the *afferent* (in-carrying) nerves. In every individual fibre it would appear that the influence always follows one direction. No single nerve can combine both functions.

It is further known, since the discovery of Sir Charles Bell, that one of the two roots of the spinal nerves is entirely composed of nerves conveying the outward stimulus; these are, therefore, purely nerves of motion, '*motor* nerves.' The other root consists of fibres transmitting influence from the various parts of the body inwards to the centres; these are called the *sentient* nerves. (They are not all sentient in the full sense of word, as will be afterwards explained.) The anterior roots are the motor nerves; the posterior roots are the in-carrying or afferent nerves. On these last roots, the posterior, the ganglionic swellings occur; and both in the spinal nerves and in those emerging at once from the brain by openings in the cranium, the occurrence of a bead is a proof that the nerve is of the in-carrying or sentient class.

In the experiments above described as made upon trunk nerves of an arm or leg, effects both of movement and sensation were seen to follow; the limb was thrown into convulsive movements, and the animal showed all the symptoms of being in bodily pain. If, now, instead of a main trunk, the trial is made upon one of the roots of a spinal nerve, only one single effect will be produced,—motion without sensation, or sensation without motion of the part. If an anterior root is pricked or irritated, movements of some part of the body will follow, showing that an active stimulus has been discharged upon a certain number of muscles. If a posterior or ganglionic root is pricked, the animal will show symptoms of pain, and the pain will be mentally referred to the part where the filaments of the nerve are distributed. If the nerve is one proceeding to the leg, there will be a feeling of pain in the leg; but there will be no instantaneous convulsions and contractions of the limb, such as are produced by irritating an anterior root. All the movements that an animal makes under the stimulus of a sentient root, are consequent on the sensation of pain; they are not the direct result of the irritating application. In one of the trunk nerves of an arm or leg, both motor and sentient fibres are mixed up, which is the reason of the mixed effect in the first experiment above mentioned.

15. Experiments with pure nerves, that is, with motor fibres alone, or sentient fibres alone, are best made upon the nerves of the head,—the Cerebral Nerves. A certain number of these are exclusively motor, certain others are exclusively sentient, while a third kind are mixed, like the spinal nerves beyond the point of junction of the two roots.

The Cerebral Nerves are divided into nine pairs, some of these being considered as admitting of farther subdivision. *Four* are enumerated as nerves of pure sensation:—the nerve of smell (olfactory nerve, 1st pair); the nerve of sight (optic nerve, 2nd pair); the nerve of sensation of the tongue and face generally (5th pair); the nerve of hearing (auditory nerve, part of the 7th pair). These nerves, therefore, are exclusively engaged in transmitting influence from the surfaces of special sense, the nose, eyes, ears, tongue, and face, towards the cerebral mass. *Five* nerves are enumerated as purely motor or out-carrying:—the nerve supplying the four recti (or rectangularly arranged) muscles of the eye, and sustaining its ordinary movements (*motor communis oculorum*, 3rd pair); the nerve supplying the superior oblique muscle of the eye (*trochlearis*, 4th pair); the nerve distributed to the external rectus muscle of the eye, and serving to abduct the two eyes by an independent stimulus requisite in adjusting the eyes to different distances (*abducent*, 6th pair); the trunk nerve for setting on the movements of the face and features (2nd part of 7th pair); the nerve for moving the tongue (9th pair). The pair reckoned the 8th, consists of sensitive fibres distributed to the tongue, throat, lungs, and stomach, and also of motor fibres distributed to muscles.

If any one of the four sensitive nerves issuing from the cranium be cut through, sensation in the connected organ is lost; disease will produce the same effect. Injury in the optic nerve causes blindness, in the auditory nerve deafness. If any one of them is irritated by pricking, corrosion, or electricity, a sensation is produced of the kind proper to the nerve; if the olfactory nerve, a smell is felt; the optic, a flash of light; the auditory, a sound; but no movement is generated. If any one of the five motor pairs is cut, the corresponding muscles cease to act; they are said to be paralysed, an effect also produced by nervous disease. If the third pair were cut, the motion of the eyeballs would cease, there would no longer be any power of directing the gaze at pleasure, the most brilliant spectacle would fail to command the sweeping glances of the eye. If the moving portion of the seventh pair were cut on one side, all the muscles of the face on that side would lose their tension, and the equipoise of the two sides being thus destroyed, the face would be set awry, by the action of the unparalysed muscles.

By experiments of this nature the functions of the several cerebral nerves have been successively ascertained. In like manner, the discovery of Sir Charles Bell as to the compound nature of the spinal nerves has been fully confirmed. It has been shown beyond the possibility of doubt, that the nerve fibres are of two distinct classes, with different functions, and that the same fibre never serves both functions; that a current peculiar to each fibre sets in always in one direction; and that nothing beyond a conducting character ever belongs to the nerve bundles, or to the fibrous aggregates, the white substance, of the cerebro-spinal system.

Functions of the Spinal Cord and Medulla Oblongata.

16. We have now to speak of the Centres, or the masses

that make up the cerebro-spinal axis,—the brain and spinal cord. These central masses all contain grey substance, the cellular or vesicular matter, wherein the nerve fibres are known, in some cases if not all, to terminate. None of them is exclusively composed of grey matter, for within the boundaries of each mass a quantity of the communicating fibres occur. But their peculiar or distinctive character is imparted by the grey substance that they contain. By setting forth the ascertained functions of these masses in succession, we shall arrive at some notion of the powers and properties of the grey matter, just as in discussing the nerve fibres we have obtained a knowledge of the use of the white substance whether in the nerve ramifications, or in the interior of the centres.

17. With regard to the Spinal Cord, we find, in the first place, that it is necessary to sensation and to voluntary movement (movement from feeling) throughout the entire trunk and extremities of the body. If the cord is cut across at any part, all feeling is lost, and all power of movement by the will, everywhere below that place, or in every portion of the body where the nerves arising beyond the cut are distributed. If the division is made far down in the back, the lower limbs are the parts principally paralysed; from them feeling comes no more, nor is it possible to move them by any mental effort. If the cut is in the neck, the arms, trunk, and legs are alike paralysed. It becomes evident that the continuity of the cord with the brain is necessary in order to connect the mental system with the bodily members. The cord by itself will not give the power either of sensation or of voluntary movement. We must regard this portion of the cerebro-spinal axis as a main channel of nervous conveyance for sensation and voluntary action, between the brain, and the trunk, and extremities of the body. The nerve ramifications are here, as it were, gathered together into one rope or bundle for convenient transmission to and from the masses of the encephalon. To this extent, the cord is not a centre, but an assemblage of the general system of ramifying or com-

municating fibres; we may look upon it as the trunk of the tree, the final stream of the river system.

If now we make experiments upon the cord when dissevered from the brain, we discover that a power of producing movements, though not voluntary, still remains. On irritating any portion of the substance, movements of the limbs are observed. This effect might, no doubt, arise from the continuity of the part with some of the motor nerves; for we have seen that movements in a limb are caused by pinching one of the nerves that supply the limb. But there is a mode of trying the experiment so as to prove decidedly that the spinal cord is itself a source of movement; that is, to prick the skin of the toes; when this is done we find that a convulsive stimulus instantly returns upon the limb and throws it into action. Hence we infer that an impression arising on the surface of the body and conveyed to the spinal cord, but not to the brain, causes the cord to send forth a motor stimulus to the moveable organs, a phenomenon, moreover, that ceases on the destruction of the cord.

'In most instances where the spinal cord has been divided, whether by design or accident, it has been found that although the will cannot move the paralysed parts, movements do occur in them of which the individual is unconscious, and which he is wholly unable to prevent. These take place sometimes as if spontaneously, at other times as the effect of the application of a stimulus to some surface supplied by spinal nerves. The apparently spontaneous movements frequently resemble voluntary actions so closely, that it is almost impossible to distinguish them.'

'The following experiments serve to illustrate these actions:—

'If a frog be pithed by dividing the spinal cord between the occipital hole and the first vertebra, an universal convulsion takes place while the knife is passing through the nervous centre. This, however, quickly subsides; and, if the animal be placed on the table, he will assume his ordinary position of rest. In some exceptional cases, however, frequent combined movements of the lower extremities will take place for a longer or shorter time after the operation; when all such disturbance has ceased, the animal remains perfectly quiet, and as if in repose, nor does there appear to be the slightest expression of pain or suffering. He is quite unable to move by any voluntary effort. However one may try to frighten him, he remains in the same place and posture. If now a toe be pinched, instantly the limb is drawn up, or he seems to push away the irritating agent, and then draws up the leg again into its old position. Sometimes a stimulus of this kind causes both limbs to be moved violently backwards. A similar movement follows stimulation of the anus. If the skin be pinched at any part, some neighbouring muscle or muscles will be thrown into action. Irritation of the anterior extremities will occasion movements in them: but it is worthy of note, that these movements are seldom so energetic as those of the lower extremities.'—TODD and BOWMAN, I., 308-9.

These experiments prove beyond a doubt that a circle of nervous action is completed by the spinal cord in its isolation from the brain. It is manifest that the in-carrying nerves must be in communication with out-carrying or motor nerves, in the interior of the spinal substance, a communication that renders the cord, to all intents and purposes, a *nerve centre*, and not merely an aggregate or bundle of nerve conductors. This property of sending out motor power is believed to depend upon the grey matter that is enclosed in the cord; for no reflex force is ever shown without the intervention of a certain portion of grey substance; and such reflected power is more energetic as the grey or vesicular matter exists in larger quantity. The cord is therefore one of the power-originating portions of the nervous system; and investigation has determined pretty accurately what kind of power it yields, and for what purposes in the animal economy. I shall here present a brief summary of the principal active functions sustained or assisted by the central energy lodged in this part.

18. In describing the functions of the cord it is convenient to include the Medulla Oblongata, with which the cord is continuous in structure, and which is found to possess the same

essential characters. As a centre the medulla originates and sustains movements independent of the cerebrum; those movements need not the stimulus of feeling nor that exertion consequent upon feeling, that we term volition. By classing the spinal cord and medulla oblongata together, and comprehending along with these the corpora quadrigemina and pons Varolii, and studying this aggregate apart from the rest of the brain, we seem to draw a broad line—the broadest that can be drawn anywhere within the cerebro-spinal axis, between the seat of stimuli and actions without feeling, and the seat of stimuli and actions with feeling; between the involuntary and the voluntary—between body and mind. The actions maintained by the cord and medulla oblongata resemble many of the true mental actions; they actuate the same muscles, the same moveable parts, but inasmuch as they do not require feeling as an indispensable condition of their performance, they are excluded from the province, marked by our definition of mind. They are termed *automatic* or self-moved actions, and also *reflex* actions. The enumeration of the functions of the cord will be an enumeration of this class of actions which seem to be mental but are not.

(1.) Movements connected with the process of *Digestion*. This process requires a series of movements to be kept-up for passing the food along the different stages of the alimentary canal, to undergo its various changes there. The first operation upon the food in the mouth,—the chewing and masticating—is voluntary, and requires the stimulus of the brain. On passing to the back part of the tongue, the food enters the bag of the throat, or pharynx, and is thence projected down the gullet by contractions and movements that are involuntary; the mind has no control over them, and scarcely any feeling or consciousness of their taking place. These movements are due to the medulla oblongata. The contact of the food with the surface of the throat makes an impression on certain nerves distributed on that surface; these nerves transmit an influence to the medulla oblongata, and there returns a stimulus to the muscles of the pharynx, which muscles are in connexion with the same centre through motor nerves. In this manner, the food is propelled onwards by the muscular contractions of the tube, and enters the stomach. The mind is utterly excluded from participation in this effect, being unable either to assist or retard the progress of the mass, and except at the two extremities, being hardly aware of the stage that is reached at any moment. This function illustrates what is often said of the medulla oblongata and the cord, that they give birth to the movements necessary for keeping up the organic processes.

(2.) Connected with the *Respiration*, there are certain reflex, or automatic, movements. The action of breathing is performed by means of a number of muscles, but these, unlike the muscles of the alimentary region, are also the instruments of the will in voluntary operations. The muscles of the chest and abdomen are employed in the acts of breathing ; in taking in breath the lungs are expanded by the muscles of the chest, and in expiration the abdominal muscles contract the chest and force out the contained air. This action goes on whether we wake or sleep, being involuntary, and the seat of power in this case is found to be the medulla oblongata. There passes to and fro, between the muscles and the grey matter of the medulla, a nervous stimulus ; the two opposing sets of muscles are acted on by turns, and an alternating movement is thus kept up from the first moment of drawing breath to the last. There is more here than a simple reflex stimulus, such as described in the actions of a pithed frog. The case is not one where irritation or contact with a surface, excites a single group of muscles in one way, as when the frog's limb is drawn up on the pinching of the toe. We have a higher complication, a stage in advance towards *combined and regulated action*, the kind of action that attains its highest pitch under the mental organization, being developed to some small extent within the automatic, or spinal system. In the propulsion of food there is in reality a compound or double action, a contraction along the length of the gut with a contraction of the thickness, and this action follows a certain order or rhythm so as to move the food always in one way; but in breathing the compound action is of a more decided and palpable kind, inasmuch as the two acts are opposed to each other and must take place by turns. The commencing stimulus in this case requires to be a muscular stimulus, an effect arising out of the action of muscles, and not the irritation or compression of a surface. The completed action, the fully accomplished contraction, of one set of muscles must affect the centre so as to commence the action of the other set. There would require to be distributed to the same muscles two classes of nerves, one for conveying influence inward to the medulla oblongata, the other for receiving the motor stimulus arising there; and the circles would require to be so organized, that the nerves conveying influence inward from the muscles of inspiration should pass to those portions of the grey substance of the medulla that send out motor nerves to supply the muscles of expiration; and, conversely, the ingoing nerves from the last named set should be in relation with the motor nerves belonging to the other set, those of inspiration; while the stimulus proper to these incarrying nerves, the influence that they are adapted to convey, should be that arising from the full and complete contraction of their respective muscles. Such is the arrangement that we are obliged to assume or suppose, in order to account for the double action. It is important for us to recognise this mode of mechanism in this its simplest example, as we shall have reason for believing that the same mode prevails extensively throughout the bodily and mental constitution.*

There are certain special movements occasionally executed by the respiratory apparatus likewise belonging to the automatic or reflex class. *Coughing* is one of those. The stimulus in this case, however, is a true surface stimulus; the contact of foreign matter with the interior wall of the bronchial tubes is the cause of the spasmodic movement. The irritation of the bronchial surface originates a stimulus propagated to that

* When the sensory nerve distributed to the surface of the lungs is cut through, the breathing action is weakened, showing that a certain amount of stimulus is derived from the action going on throughout the surface. If, farther, the brain is paralyzed by any poison, the respiration is still more enfeebled, leading us to infer that the brain contributes to the breathing activity. What remains after deducting those two aids requires the supposition made in the text to account for it.

part of the medulla oblongata that sustains the action of the lungs. The consequence is a momentary increase of the expiratory force, the glottis being closed and opened suddenly, so as to amount to an explosion, or a shot, which propels the material out of the tube. The action of the lungs is peculiarly liable to be raised to this explosive pitch, owing, we may suppose, to the readiness of the medulla oblongata to give off sudden discharges of central energy. *Sneezing* differs from coughing in the circumstance that the seat of irritation is the nose. The course of the explosive current is on that account directed through the nostrils.

Among the reflex influences exerted upon the lungs through spinal intervention we are to include the stimulus of cold suddenly applied; which stimulus acting on the surface of the lungs in the shape of cold air, or on any part of the skin, as in the cold bath, reinforces the breathing energy. This influence is accompanied with a very keen sensation, but the instantaneous reaction that increases the movement of the lungs is believed to be entirely independent of sensation or will, and is attributed with appearance of reason to the medulla oblongata. The hysteric laugh, which is one of the effects of cold, points to the mediation of the medulla even in the effects arising from the sensation.

(3.) The *winking of the eyes* is essentially automatic. Although not entirely withdrawn from the control of the mental centres, this movement of the eyelids usually goes on independent of these centres. The stimulus to the movement is a surface stimulus, apparently due to the liquid that washes the eye, and in so doing comes in contact with the inner surface of the upper eye-lid. When an action takes place on this inner surface an influence is transmitted inwards to some centre,* and there is reflected a stimulus to the muscle that closes the lids. One may try the experiment by touching the edge or inner surface of the upper eye-lid with anything solid; instantly there is produced a spasmodic flutter of the eye-lid, or

* Probably the corpora quadrigemina.

a very rapid succession of winks. The reflex act goes to closing the eye, and the opening is effected by the muscles that keep the eye open during the ordinary waking state. In sleep, the winking muscle is unresisted and keeps the eyes shut. The activity of this muscle, (called the orbicularis) is shown by this fact to be purely reflex, for no voluntary movement is sustained when we are asleep.

(4.) It is to be considered how far the *muscular movements generally*, the locomotive and other actions of the body at large, are sustained by the spinal cord. We have already seen that convulsive movements of the limbs can be excited in a decapitated animal; and the question arises, does the cord keep up any of the regulated motions of the animal body, such as walking, running, flying, swimming, &c. The answer is that the cord does not seem capable of maintaining these motions. For, although there exists an innate power of performing them in many cases, other centres besides the cord are essential to their performance. In fact, the cerebellum is looked upon as the centre of the higher order of combined actions, notwithstanding that one pair of alternating movements, as in breathing, can be kept up by the cord alone. The locomotive movements of animals immediately after being decapitated are not a proof of the power of the cord acting by itself, inasmuch as these may be owing to the yet unexhausted stimulus of the brain, or they may be actions induced upon the cord, in consequence of habit.

There is one instance of muscular action by most physiologists ascribed to the spinal cord, and believed to have a peculiar interest in this point of view; that is, the *tension*, *tone*, or *tonicity* of the muscles. By this is meant the fact that a muscle is never wholly relaxed while the animal is alive. Even in the perfect repose of sleep there is yet a certain vigour of contraction inhering in all the muscles of the body. The force of contraction is increased at the moment of wakening, and still more when an effort is to be made, but at no time is the relaxation total; the limbs never dangle like a loosely constructed doll until after the animal is dead. Now there is a certain amount of this permanent contractile force fairly ascribable to the muscle's own vitality apart from any nerve stimulus whatever. For we are not to suppose that the contractility of muscle is wholly dependent on the conveyed influence of nerve centres; whence there is some difficulty in ascertaining how much of the effect is derived and how much inherent.

The experiments relied upon for showing that the permanent tension of the muscle is in part due to spinal influence are very striking and not easily explained away. I quote from Dr. Carpenter: 'It has been proved by Dr. Marshall Hall that the muscular Tension is not dependent on the influence of the Brain but upon that of the Spinal Cord, as the following experiments demonstrate: 'Two Rabbits were taken: from one the head was removed; from the other also the head was removed, and the spinal marrow was cautiously destroyed with a sharp instrument: the limbs of the former retained a certain degree of firmness and elasticity; those of the second were perfectly lax.' Again: 'The limbs and tail of a decapitated turtle possessed a certain degree of firmness and tone, recoiled on being drawn from their position, and moved with energy on the application of a stimulus. On withdrawing the spinal marrow gently out of its canal, all these phenomena ceased. The limbs were no longer obedient to stimuli, and became perfectly placid, having lost all their resilience. The sphincter lost its circular form and contracted state, becoming lax, flaccid, and shapeless. The tail was flaccid.'—(Carpenter, p. 700). Here we see that the disconnecting of the muscles from the brain still left them in a tense condition, while that tension gives way the instant the spinal cord is removed. A current of nervous stimulus is thus shown to be perpetually derived from the cord to the muscles in connexion with it; any impression made upon the surface or extremities of a limb suddenly increases this current in some one direction, but does not create it entirely. We are therefore led to infer that the nerve centres of the spine have in them a constant charge of nervous energy, which flows out at all times, a force originating there independently of the stimulus of outward impressions, and merely yielding itself in greater abundance under such outward stimulus. This is an extremely important fact whichever way we view it, and one that will again force itself upon our notice.

So much for Reflex actions and the Functions of the Spinal Cord.

Functions of the lesser grey centres of the Brain.

19. The principal bodies of the nature of centres situated between the medulla oblongata and the convoluted hemispheres of the brain, have been already enumerated. There are four masses of conspicuous size and position, the pons Varolii, the corpora quadrigemina, the thalami optici, the corpora striata. Experiments made upon these bodies similar to those made on the cord produce like results; any irritation applied to any one of them produces both sensation and movements. With the exception of the corpora quadrigemina, a centre intimately connected with vision, the functions are not determined in the case of any of them. The thalami optici and corpora striata, from their size, and the amount of grey matter they contain, are likely to be influential bodies, but what precise purpose they perform is a subject of uncertain speculation.

Functions of the Cerebral Hemispheres.

20. The convoluted hemispheres of the brain enclose within them the above-mentioned masses or centres, and both the convolutions and these centres are included in the cerebrum. Experiments have been made with a view of determining the characteristic functions of this cerebral mass, so large in the human brain, although dwindling to the most insignificant dimensions in the lowest vertebrate animals, namely, reptiles and fishes.

The convolutions are the portion most accessible to operations. The hemispheres have been seen above to consist of an outer layer of convoluted grey matter and an interior mass of white, fibrous, or connecting matter. When irritation is applied to the hemispheres, as by pricking or cutting, we find a remarkable absence of the effects manifested in the other centres. Neither feeling nor movement is produced. This marks a very great distinction between the hemispheres and the whole of the ganglia and centres lying beneath them.

The entire removal of the hemisphere including the corpus striatum and thalamus, lowers the power of the animal, but does not destroy any of the bodily or mental functions.

Pressure from above downwards produces stupor.

The removal of both hemispheres in an animal has the following results :—

First. Sight and hearing are entirely lost.

Second. Consciousness, or feeling, seems utterly abolished: so that whatever bodily activity may survive, the mental life is extinct.

Third. All power of moving for an end, all forethought, purpose, or volition, is entirely extinguished. This is an inevitable consequence of the loss of feeling; for with feeling, the actions stimulated or guided by feeling must disappear.

Fourth. The power of accomplishing many connected movements still remains. The actions of flying or walking may be sustained after the loss of the hemispheres, but in that case a stimulus from without is necessary in order to commence the action. As a matter of course the Automatic actions, those that we have seen to go on in the decapitated or acephalous animal may still proceed.

Thus it appears that the hemispheres of the brain are indispensable to the exercise of our two highest senses, and to consciousness and feeling-prompted action, or volition. In so far as Intelligence demands the exercise of those functions, it, too, must perish. The actions that remain are at best the actions of a somnambulist. Mind is thus pre-eminently associated with the cerebral hemispheres.

Functions of the Cerebellum.

21. The experiments made upon the cerebellum, and the inferences founded on its comparative size in different animals, have led physiologists to assign to it the function of harmo-

nizing and co-ordinating the locomotive movements. When an action becomes complex, that is, demands the exercise of several groups of muscles in a fixed order and alternation, the due performance of the act must be provided for by some organization of the nerve centres. We have already seen that the medulla oblongata can support the two-stroke movement of the lungs; but there are still higher complexities to be provided for. The act of walking of a biped, for example, is at the very least a four-stroke movement, since there must be an impulse to and fro for either limb; and if these four strokes did not succeed in due harmony, the animal would be at a stand-still. Walking on all fours is still more complicated, demanding at least eight motions to be harmonized. The operation of chewing is another case in point; there is a complicated concurrence of movements of the jaw, the tongue, and the cheeks; and if any one of these make a false step, some accident, such as the biting of the tongue will result. In man the actions of the hand and fingers are extremely complex. The movements connected with the maintenance of the erect posture are likewise very numerous, so much so that a long education is needed for their due performance. To as many of these actions as are primitive, or instinctive, the cerebellum would appear to be an indispensable support, and so doubtless it must be to the acquired actions based on them. The following quotation from Messrs. Todd and Bowman, will exhibit the experimental proofs of this function.

'Flourens removed the cerebellum from pigeons by successive slices. During the removal of the superficial layers there appeared only a slight feebleness and want of harmony in the movements, without any expression of pain. On reaching the middle layers, an almost universal agitation was manifested, without any sign of convulsion; the animal performed rapid and ill-regulated movements; it could hear and see. After the removal of the deepest layers, the animal lost completely the power of standing, walking, leaping, or flying. The power had been injured by the previous mutilations, but now it was completely gone. When placed upon his back, he was unable to rise. He did not, however, remain quiet and motionless, as pigeons deprived of the cerebral hemispheres do; but evinced an incessant restlessness, and an inability to accomplish any regular or definite movement. He could see the instrument raised to threaten him with a blow, and would make a thousand contortions to avoid it, but did not escape. Volition and sensation remained,—the power of executing movements remained; but that of co-ordinating these movements into regular and combined actions was lost.

'Animals deprived of the cerebellum are in a condition very similar to that of a drunken man, so far as relates to their power of locomotion. They are unable to produce that combination of action in different sets of muscles which is necessary to enable them to assume or maintain any attitudes. They cannot stand still for a moment, and in attempting to walk, their gait is unsteady, they totter from side to side, and their progress is interrupted by frequent falls. The fruitless attempts which they make to stand or walk are sufficient proof that a certain degree of intelligence remains, and that voluntary power continues to be enjoyed.' (T. and B., 359.)

When the cerebellum is cut away at the top, the animal moves backward. When one side is cut away, the animal rolls over to the injured side. Sometimes a vertiginous action ensues, as if the body were revolved on a spit.

We have reason to suppose that dexterity and precision of movements, manual or other, are connected with a well developed cerebellum.

The phrenologists have attributed to the cerebellum the sexual function, with the amatory feelings corresponding thereto; but the greater number of physiologists are decidedly opposed to this view.

The white matter of the brain, which performs those incessant and innumerable acts of communication between the central masses, is thus not less important than the grey matter where force originates. Accordingly, we find that in the higher animals, the white substance becomes developed in proportion to the energy of the mental functions. As we descend the scale, the white matter dwindles in a most notable way: in birds, the grand junction of the brain, the pons Varolii, disappears as a distinct mass; and down to reptiles and fishes, the same course of diminution is seen to proceed.

Of the Nerve Force and the course of Power in the Brain.

22. The structure of the nervous substance, and the experiments made upon the nerves and nerve centres, establish beyond doubt certain peculiarities as belonging to the force that is exercised by the brain. This force is of a *current* nature; that is to say, a power generated at one part of the structure is conveyed along an intervening substance, and discharged at some other part. The different forms of Electricity and Magnetism have made us familiar with this sort of action. In a voltaic cell, an energy is gendered and transmitted along a wire with inconceivable rapidity to any place where the conductor reaches. The telegraph wire, as already said, bears a strong resemblance to a nerve passing from the brain to any part of the body; and the grey substance of the nerve centres, which are highly supplied with blood, is paralleled by the voltaic battery where the electric power is generated by the corroding power of an acid.

This portable, or curren', character of the nerve force is what enables movements distant from one another in the body to be associated together under a common stimulus. An impression of sound, a musical note, for example, is carried to the brain; this impression is seen to produce a responsive action and excitement extending to the voice, mouth, eyes, head, &c. This multiplex and various manifestation implies a system of connexion among the centres of action, whereby many strings can be touched from one point; a connexion due to the conducting nerves that pass and repass from centre to centre, and from the centres to the muscular apparatus over the body. Supposing the corpora quadrigemina to be a centre for the sense of vision, an impression passing to this centre propagates a movement towards many other centres,—to the convoluted hemispheres upwards, to the cerebellum behind, and to the medulla oblongata and spinal cord beneath; and through these various connexions an extensive wave of effects may be produced, ending in a complicated chain of movements all over the framework of the body. Such a system of intercommunication and transmission of power is therefore an essential part of the bodily and mental structure.

23. The analogy that exists between nerve power and electricity does not amount to identity. The nerve force is not either electricity or magnetism. The differences between the two are broad and distinct. The following is a statement of some of those differences.

In the first place, in the development of voltaic electricity a closed circuit is indispensable. The influence generated in the cell cannot pass along the conducting wire until a complete circle of wire or other conducting material is made, bringing the influence round to the cell again. The moment the circuit is interrupted, the power ceases. But no such closed circuit can be traced in the nervous apparatus. An influence arising from a centre may pass out into a muscle and be discharged there, without any return influence that can at present be traced. It has been seen that in the experiments on the nerves, by mechanical or other irritation, there is no necessity for a completed circuit. Nervous power requires the connexion of a centre with fibrous communications to distant parts, but does not appear to demand a perfect circle of nerves. Grey matter alone can do nothing; a combination of grey with white, or of central with conducting power is always requisite, but a single outgoing thread terminating in a limb, would seem to suffice for the effect. We do not, however, include the kind of circle completed in reflex actions, which is quite different in its nature from the circle here discussed.

In the second place, the conducting power of nerve fibre is a wasting operation, one that draws upon the vitality of the fibre, and causes the necessity for times of rest and a copious supply of nourishment. The common experience of nervous fatigue and exhaustion is a proof of this. We have no good grounds for limiting the locality of nervous exhaustion to the grey matter alone. The nerve fibres are richly supplied with blood vessels through their whole length, although less so than the vesicular matter of the centres. Moreover, in experiments upon the irritability of nerves, it is shown that they lose this quality entirely after being separated from the means of nourishment for a certain length of time—a time not sufficient to produce a radical alteration in the structure of the nerve.

If now we compare this liability to waste and exhaustion with the undying endurance of an electric wire, we shall be struck with a very great contrast. The wire is doubtless a more compact, resisting, and sluggish mass; the conduction requires a certain energy of electric action to set it agoing, and in the course of a great distance becomes faint and dies away. The nerve, on the other hand, is stimulated by a slighter influence, and propagates that influence, it may be, with increase, by the consumption of its own material. The wire must be acted on at both ends, by the closure of the circuit, before acting as a conductor in any degree; the nerve takes fire from a slight stimulus like a train of gunpowder, and is wasted by the current that it propagates. If this view be correct the influence conveyed is much more beholden to the conducting fibres than electricity is to the copper wire. The fibres are made to sustain or increase the force at the cost of their own substance.

'The proofs,' say Messrs. Todd and Bowman, 'of the passage of an electric current through the nerve fibres during nervous action must be held to be altogether defective. Not only is experimental evidence wanting to support the electrical theory, but certain facts are admitted which greatly invalidate it.'—Vol. I. p. 233.

24. It is nevertheless manifest that the nervous power is generated from the action of the nutriment supplied to the body, and is therefore of the class of forces having a common origin, and capable of being mutually transmitted,—including mechanical momentum, heat, electricity, magnetism, and chemical decomposition. The power that animates the human frame and keeps alive the currents of the brain, has its origin in the grand primal source of reviving power, the Sun; his

influence exerted on vegetation builds up the structures whose destruction and decay within the animal system give forth all the energy concerned in maintaining the animal processes. What is called vitality is not so much a peculiar force as a collocation of the forces of inorganic matter for the purpose of keeping up a living structure. If our means of observation and measurement were more perfect, we might render account of all the nutriment consumed in any animal or human being; we might calculate the entire amount of energy evolved in the changes that constitute this consumption, and allow one portion for animal heat, another for the processes of secretion, a third for the action of the heart, lungs, and intestines, a fourth for the muscular exertion made within the period, a fifth for the activity of the brain, and so on till we had a strict balancing of receipt and expenditure. The nerve force that is derived from the waste of a given amount of food, is capable of being transmuted into any other force of animal life. Poured into the muscles during violent conscious effort, it increases their activity; passing to the alimentary canal, it aids in the force of digestion; in moments of excitement the power is converted into sensible heat; the same power is found capable of yielding true electrical currents. The evidence that establishes the common basis of mechanical and chemical force, heat, and electricity, namely, their mutual convertibility and common origin, establishes the nerve force as a member of the same group.

25. The current character of the nerve force leads to a considerable departure from the common mode of viewing the position of the brain as the organ of mind. We have seen that the cerebrum is a mixed mass of grey and white matter, —the matter of centres and the matter of conduction. Both are required in any act of the brain known to us. The smallest cerebral operation includes the transmission of an influence from one centre to another centre, from a centre to an extremity, or the reverse. Hence we cannot separate the centres from their communicating branches; and if so, we

that originate or receive nerve stimulus. The organ of mind is not the brain by itself; it is the brain, nerves, muscles, and organs of sense. When the brain is in action, there is some transmission of nerve power, and the organ that receives or that originated the power is an essential part of the mechanism. A brain bereft of the spinal cord and spinal nerves is dead though the blood continues to flow to it; and these nerves, if plucked out of the limbs and other parts where they terminate, would probably not suffice to sustain the currents associated with mental life.

It is, therefore, in the present state of our knowledge, an entire misconception to talk of a *sensorium* within the brain, a *sanctum sanctorum*, or inner chamber, where impressions are poured in and stored up to be reproduced in a future day. There is no such chamber, no such mode of reception of outward influence. A stimulus or sensation acting on the brain exhausts itself in the production of a number of transmitted currents or influences; while the stimulus is alive, these continue, and when these have ceased the impression is exhausted. The revival of the impression is the setting on of the currents anew; such currents show themselves in actuating the bodily members,—the voice, the eyes, the features,—in productive action, or in mere expression and gesture. The currents may have all degrees of intensity, from the fury of a death struggle to the languor of a half-sleeping reverie, or the fitful flashes of a dream, but their nature is still the same.

We must thus discard for ever the notion of the *sensorium commune*, the cerebral closet, as a central seat of mind, or receptacle of sensation and imagery. We may be very far from comprehending the full and exact character of nerve force, but the knowledge we have gained is sufficient to destroy the hypothesis that has until lately prevailed as to the material processes of perception. Though we have not attained a final understanding of this obscure and complicated machinery, we can at least substitute a more exact view for a less; and such is the substitution now demanded of current action for the crude conception of a central receptacle of stored up impressions. Our present insight enables us to say with great probability, no currents, no mind. The transmission of influence along the nerve fibres from place to place, seems the very essence of cerebral action. This transmission, moreover, must not be confined within the limits of the brain: not only could no action be kept up and no sensation received by the brain alone, but it is doubtful if even thought, reminiscence, or the emotions of the past and absent, could be sustained without the more distant communications between the brain and the rest of the body—the organs of sense and of movement. It is true that between the separate convolutions of the brain, between one hemisphere and another, between the convoluted hemispheres and the corpora striata, thalami optici, corpora quadrigemina, cerebellum, medulla oblongata, and spinal cord, influence might be imagined to pass and repass without flowing into the active extremities or to the five senses, and might thus constitute an isolated cerebral life; but it is in the highest degree improbable that such isolation does or can exist. Nervous influence, rising in great part in sensation, comes at last to action; short of this nothing is done, no end served. However feeble the currents may be, their natural course is towards the organs accustomed to their sway. Hence the reason for adopting language, as we have done throughout the present chapter, to imply that the brain is only a part of the machinery of mind; for although a large part of all the circles of mental action lie within the head, other parts equally indispensable extend throughout the body.

BOOK I.

MOVEMENT, SENSE, AND INSTINCT.

WE now commence the subject of Mind proper, or the enumeration and explanation of the States and Varieties of Feeling, the Modes of Action, and the Powers of Intelligence, comprised in the mental nature of man.

In the First Book, which is to comprehend the MOVEMENTS, SENSATIONS, APPETITES, and INSTINCTS, I propose to deal with what may be termed the inferior region of mind, the inferiority being marked by the absence, in a great degree, of Intellect and cultivation. This is the region wherein man may be most extensively compared with the brute creation, whose intelligence and education are comparatively small. When the powers of a superior intellect, and the example and acquirements of former generations are superadded to the primitive Sensations and Instincts, there results a higher class of combinations, more difficult to analyse and describe, and falling therefore more properly to a later stage of the exposition.

It will, however, be remarked as a novelty in the plan thus announced, that the Appetites and Instincts have been included in the same Book with the Sensations. In the works of former writers on Mental Science, as, for example, Reid, Stewart, Brown, and Mill, those portions of our nature have been included among the general group of Active Powers, including Desire, Habit, and the Will. My reasons for departing from the example of these eminent writers are the following. In the first place, the Appetites and Instincts are scarcely at all connected with the higher operations of intelligence, and therefore they do not require to be preceded by the exposition of the Intellect. Everything necessary to be said respecting them may be given as soon as the Sensations are discussed. In the second place, I hope to make it appear that the illustration of the Intellectual processes will gain by the circumstance that Appetite and Instinct have been previously gone into. Thirdly, the connexion of Appetite with Sensation is so close, that the one will be found to tread on the heels of the other. Fourthly, as regards Instinct, I conceive it to be proper to render an account of all that is Instinctive in our nature—all our untaught activities—before entering upon the process of acquisition as treated of under the Intellect. In addition to these reasons stated in advance, I trust to the impression produced by the effect of the arrangement itself for the complete justification of my departure from the plan of my predecessors.

The arrangement of the present Book will be into four chapters.

The subject of Chapter first is Action and Movement considered as spontaneous, together with the Feelings and Impressions resulting from muscular activity.

Chapter second treats of the Senses and Sensations.

Chapter third treats of the Appetites.

Chapter fourth includes the Instincts, or the untaught movements, and the primitive rudiments of Emotion and Volition. This subject is brought in at that stage in order to complete the plan of the present Book, which professes to exhaust all the primitive germs, whether of Action or Emotion, belonging to our nature, before proceeding to the consideration of intelligence and acquisition. In a complete system of mind the Intellect would in this view be placed midway between the instinctive, and the cultivated, emotions and activities, being itself the instrument for converting the one class into the other.

CHAPTER I.

OF SPONTANEOUS ACTIVITY AND THE FEELINGS OF MOVEMENT.

1. THE feelings connected with the movements of the body, or the action of the muscles, have come to be recognised as a distinct class, differing materially from the sensations of the five senses. They have been regarded by some metaphysicians as proceeding from a sense apart, a sixth, or muscular sense, and have accordingly been enrolled under the general head of sensations. That they are to be dealt with as a class by themselves, as much so as sounds or sights, the feelings of affection, or the emotion of the ludicrous, is now pretty well admitted on all hands.

With regard, however, to the position of this class of feelings in the plan or arrangement of our subject, there is still room for differences of opinion. In my judgment they ought not to be classed with the Sensations of the five Senses, and I believe further that the consideration of them should precede the exposition of the Senses. The grounds of this belief are such as the following:—namely, that movement precedes sensation, and is at the outset independent of any stimulus from without; and that action is a more intimate and inseparable property of our constitution than any of our sensations, and in fact enters as a component part into every one of the senses, giving them the character of compounds while itself is a simple and elementary property. These assertions require to be proved in detail, but before doing so, it is advisable to notice briefly the mechanism or anatomy of movement in the animal frame.

OF THE MUSCULAR SYSTEM.

2. *Muscular Tissue.*—'The muscular tissue is that by means of which the active movements of the body are produced. It consists of fine fibres, which are for the most part collected into distinct organs, called muscles, and in this form it is familiarly known as the flesh of animals; these fibres are also disposed round the sides of cavities and between the coats of hollow viscera, forming strata of greater or less thickness. The muscular fibres are endowed with *contractility*—a remarkable and characteristic property, by virtue of which they shrink or contract more or less rapidly under the influence of certain causes which are capable of exciting or calling into play the property in question, and which are therefore named *stimuli*. A large class of muscles, comprehending those of locomotion, respiration, expression, and some others, are excited by the stimulus of the will, or volition, acting on them through the nerves; these are therefore named 'voluntary muscles,' although some of them habitually, and all occasionally, act also in obedience to other stimuli. There are other muscles or muscular fibres which are entirely withdrawn from the control of the will, such as those of the heart and intestinal canal, and these are accordingly named 'involuntary.' These two classes of muscles differ not only in the mode in which they are excited to act, but also to a certain extent in their anatomical characters.'—SHARPEY; QUAIN'S *Anatomy*, p. clxiii.

Structure of Voluntary Muscles.—'The voluntary muscular fibres are for the most part gathered together into distinct masses, or muscles of various sizes and shapes, but most generally of an oblong form, and furnished with tendons at either extremity, by which they are fixed to the bones. The two attached extremities of a muscle are named, in anatomical descriptions, its origin and insertion,—the former term being usually applied to the attachment which is considered to be most fixed, although the rule cannot always be applied strictly. The fleshy part is named the belly.

'The muscular fibres are collected into packets or bundles of greater or less thickness, named fasciculi, or lacerti, and the fibres themselves consist of much finer threads visible by the aid of the microscope, which are termed muscular filaments, or fibrillæ.

'The fibres, although they differ somewhat in size individually, have the same average diameter in all the voluntary muscles, namely, about $\frac{1}{400}$ of an inch; and this holds good whether the muscles be coarse or fine in their obvious texture. According to Mr. Bowman their average size is somewhat greater in the male than in the female, being in the former $\frac{1}{352}$, and in the latter $\frac{1}{454}$, or more than a fourth smaller.'—*Ib.*

'As to the structure of fibres, it has been ascertained that each is made up of a larger number of extremely fine filaments or fibrils, inclosed in a tubular sheath.' 'When a fibril completely insulated is highly magnified, it is seen to consist of a single row of minute particles, connected together like a string of beads.' 'The length of the elementary particles is estimated by Mr. Bowman at $\frac{1}{9400}$ of an inch, while their transverse diameter is less, often by one-half,—at least, in specimens which have not been altered by contraction, he finds that their size is remarkably uniform in mammalia, birds, reptiles, fishes, and insects.'—*Ib.*

Nerves of Voluntary Muscles.—'The nerves of a voluntary muscle are of considerable size. Their branches pass between the fasciculi, and in their progress repeatedly unite with each other in form of a plexus, the finer branches of which may be seen running between the smallest order of fasciculi, often in company with blood vessels; at last the nervous plexus is reduced into minute bundles consisting of two or three primitive tubules each, some of them separating into single tubules. By means of the microscope these fine nervous bundles and single tubules may be observed to pass between the muscular fibres, and after a longer or shorter course, to return to the plexus. They cross the direction of the muscular fibres directly or obliquely, forming wide arches; and on their return they either rejoin the larger nervous bundles from which they set out, or enter other divisions of the plexus. The nervous filaments, therefore, do not come to an end in the muscle, but form loops or strings among its fibres.'—*Ib.* clxxii.

I refrain from transcribing the description given of the involuntary muscles,—those of the heart, intestines, bronchial tubes, iris, middle coat of the arteries, &c.—as being less important for the object of the present work. It will, however, be interesting to hear what the same authority has said on the Sensibility of muscle, as well as on the contractility, or source of its power as a mechanical prime mover.

3. *Sensibility.*—'This property is manifested by the pain which is felt when a muscle is cut, lacerated, or otherwise violently injured, or when it is seized with spasm. Here, as in other instances, the sensibility, properly speaking, belongs to the nerves which are distributed through the tissue, and accordingly, when the nerves going to a muscle are cut, it forthwith becomes insensible. It is by means of this property, which is sometimes called the 'muscular sense,' that we become conscious of the existing state of the muscles which are subject to the will, or rather of the condition of the limbs and other parts which are moved through means of the voluntary muscles, and we are thereby guided in directing our voluntary movements towards the end in view. Accordingly, when the muscular sense is lost, while the power of motion remains,—a case which, though rare, sometimes occurs,—the person cannot direct the movements of the affected limbs without the guidance of the eye.'—p. clxxvii.

On this passage I would remark that two very different modes of muscular sensibility are here indicated, while a third mode distinct from both is omitted. In my view the feelings arising from wounds, lacerations, injuries, and spasms make one class; the feelings of pleasure, and sometimes of pain, arising from movement, exercise, and resistance are a second class; and the conscious states that act as guides to the voluntary movements constitute a third class. Between the first and third, those given above, as almost the same, there is a very wide distinction, not to say a strong contrast; while the pleasures of exercise and activity which have their seat in the muscles, the class overlooked in the foregoing quotation, are considerably different from either. The detailed illustration of these various kinds of sensibility will be given before concluding the present chapter.

With regard to the other property of muscle, I shall likewise quote from the same source.

4. *Irritability or Contractility.*—'In order to cause contraction, the muscle must be excited by a stimulus. The stimulus may be applied immediately to the muscular tissue, as when the fibres are irritated by a sharp point; or it may be applied to the nerve or nerves which belong to the muscle; in the former case, the stimulus is said to be "immediate," in the latter "remote." The nerve does not contract, but it has the property when stimulated, of exciting contractions in the muscular fibres to which it is distributed, and this property, named the "vis nervosa" (true nervous force), is distinguished from contractility, which is confined to the muscle. Again, a stimulus may be either directly applied to the nerve of the muscle, as when that nerve is itself mechanically irritated or galvanized; or it may be first made to act on certain other nerves, by which its influence is, so to speak, conducted in the first instance to the brain or spinal cord (or perhaps even to some subordinate nervous centre) and thence transferred or reflected to the muscular nerve.

'The stimuli to which muscles are obedient are of various kinds; those best ascertained are the following, viz.—1. Mechanical irritation of almost any sort, under which head is to be included sudden extension of the muscular fibres. 2. Chemical stimuli, as by the application of salt or acrid substances. 3. Electrical; usually by means of a galvanic current made to pass through the muscular fibres, or along a certain length, however short, of the nerve; the effect taking place on closing or on breaking the circuit. 4. Sudden heat or cold. These four may be classed together, as *physical stimuli*. Next, *mental stimuli*, viz.—1. The operation of the will, or volition. 2. Emotions, and some other involuntary states of the mind. Lastly, there still remain exciting causes of muscular motions in the economy, which, although they may probably turn out to be physical, are as yet of doubtful of the nerve centres, consequent on the night's repose, is the cause of that burst of spontaneous exertion which marks the moment of awakening. The antecedent of the activity in this case is, therefore, more physical than mental; and this must be the case with spontaneous energy in general. When linked with sensation and other mental conditions, the character of the activity is modified so as to render the spontaneity much less discernible.

(5.) The next proof is derived from the early movements of infancy. These I look upon as in great part due to the spontaneous action of the centres. The mobility displayed in the first stage of infant existence is known to be very great; and it continues to be shown in an exuberant degree all through childhood and early youth. This mobility can be attributed only to three causes. It may arise from the stimulus of sensation, that is, from the sights, sounds, contacts, temperature, &c., of outward things; in which case we should have a reflected or stimulated activity. It may, in the second place, be owing to emotion generated within the body, or states of consciousness growing out of the brain and the bodily processes generally, as when internal pains give rise to paroxysms, or high health to the lively movements of mere animal spirits. The effect may, lastly, be due to the spontaneous discharge of central vigour over all the active organs of the body, limbs, trunk, features, voice, &c.

The two first named influences, external sensation and inward emotion, are undoubted causes of active gesticulation and movement. But the question is, Do they explain the whole activity of early infancy and childhood? I think not, and on evidence such as the following. We can easily observe when any one is under the influence of vivid sensation; we can tell whether a child is affected by sights or sounds, or tastes, by seeing whether the attention is actually engaged upon such objects. And if the observation is carefully made, I believe it will be found, that although the gesticulations of infants are frequently excited by surrounding objects, there are times when such influence is very little felt, and when nevertheless the mobility of the frame is strongly manifested.

With regard to inward feelings, or emotions, the proof is not so easy; but here, too, there is a certain character belonging to emotional movements that serves to discriminate them when they occur. The movements, gestures, and cries of internal pain are well marked, and cannot be ascribed to the spontaneous energy of the centres; and highly pleasurable feeling is distinguished by the equally characteristic flow of smiles and extatic utterance. If there be times of active gesticulation and exercise that show no connexion with the sights and sounds, or other influence of the outer world, and that have no peculiar emotional character of the pleasurable or painful kind, we can ascribe them to nothing but the mere abundance and exuberance of self-acting muscular and cerebral energy, which will rise and fall with the vigour and nourishment of the general system.

The activity of young animals in general, and of animals, remarkable for their active endowments (as the insect tribe), may be cited as strongly favouring the hypothesis of spontaneity. When the kitten plays with a worsted ball, we always attribute the overflowing fulness of moving energy to the creature's own inward stimulus, to which the ball merely serves for a pretext. So an active young hound refreshed by sleep or rested by confinement pants for being let loose, not because of anything that attracts his view or kindles up his ear, but because a rush of activity courses through his members, rendering him uneasy till the confined energy has found vent in a chase or a run. We are at no loss to distinguish this kind of activity from that awakened by sensation or emotion, and the distinction is accordingly recognised in the modes of interpreting the movements and feelings of animals. When a rider speaks of his horse as 'fresh,' he implies that the natural activity is undischarged, and pressing for vent; the excitement caused by mixing in a chase or in a battle, is a totally different thing from the spontaneous vehemence of a full-fed and underworked animal.

It is customary in like manner to attribute much of the activity of early human life, neither to sensation nor to emotion, but to 'freshness,' or the current of undischarged activity.

There are moments when high health, natural vigour, and spontaneous outpouring, are the only obvious antecedents of ebullient activity. The very necessity of bodily exercise felt by every one, and most of all by the young, is a proof of the existence of a fund of energy that comes round with the day and presses to be discharged. Doubtless it may be said that this necessity may proceed from a state of the muscles, and not from the centres, that an uneasy craving rises periodically in the muscular tissue and is transmitted as a stimulus to the centres, awakening a nervous current of activity in return. Even if this were true, it would not materially alter the case we are labouring to establish, namely a tendency in the moving system to go into action without any antecedent sensation from without or emotion from within, or without any stimulus extraneous to the moving apparatus itself. But we do not see any ground for excluding the agency of the centres in the commencing stimulus of periodical active exercise. The same central energy that keeps up the muscular tonicity must be allowed to share in the self-originating muscular activity. If so the demand for exercise that comes round upon every actively constituted nature is a strong confirmation of the view we are now engaged in maintaining.

Coupling together, therefore, the initial movements of infancy, the mobility of early years generally, the observations on young and active members of the brute creation, and the craving for exercise universally manifested, we have a strong body of evidence in favour of the doctrine of spontaneous action.

(6.) The mode of activity shown under states of excitement is in perfect consistency with the present doctrine. We find that excitement causes an unusual degree of activity, in fact an almost uncontrollable discharge of energy and power, as if the nervous centres were rendered incontinent and profuse by some temporary alteration in their nature. Whatever may be the way that the excited condition has been worked up—and there are very many ways—the character of it can be most accurately expressed by saying that there is an extraordinary discharge of active force from the brain towards the bodily members. Every sensible impression made during this state causes a more than average effect, and yet the current of energy does not wait for outward stimuli. Independently altogether of what a man sees, or hears, or thinks, he is disposed to be active to an uncommon degree; these influences of sense and thought seem merely to direct or point the course of the current, they do not create it. A stream of power is flowing from the centres to the extremities; the movements of the individual are vehement, and hurried. Outward circumstances may control or modify them; inward self-sustaining power alone seems to prompt them. Excitement in fact is but an exalted degree of spontaneity, making a weak man for the moment equal to a stronger, and simulating the effects of natural vigour and freshness by an exhausting effort of the nervous centres. We shall afterwards see that, in reality, the stimulants supplied through the senses may not improperly be looked upon as causing or preparing a state of excitement during which the spontaneity of the centres is momentarily heightened to a more copious discharge.

(7.) As a farther confirmation, it may be remarked that sensibility and activity do not as a general rule rise and fall together; on the contrary, they often stand in an inverse proportion to each other. In comparing different characters, or the different states of the same individual, we may test the truth of this observation. The strong, restless, active temperament is not always marked as the most sensitive and emotional, but is very frequently seen to be the least affected by these influences. The activity that seems to sustain itself, costing the individual almost no effort, being his delight rather than his drudgery, and very little altered by the presence or the absence of stimulus or ends, is manifestly a constitutional self-prompting force; and such activity may be seen in innumerable instances in the living world. This feature makes one of the fundamental distinctions of character, both in individuals and in races; being seen in the restless adventurer, the indefatigable traveller, the devotee of business, the incessant meddler in affairs; in the man that hates repose and despises passive enjoyments. It is the pushing energy of Philip of

Macedon and William the Conqueror. On the other hand, sensitive and emotional natures, which are to be found abundantly among men, and still more abundantly among women, are not active in a corresponding degree, while the kind of activity actually displayed is plainly seen to result more from some stimulus or object than from an innate exuberance of action. The activity prompted by ends, by something to be gained or avoided, is easily distinguished from the other by its being closely adapted to those ends, and by its ceasing when they have been accomplished. He that labours merely on the stimulus of reward, rests when he has acquired a competency, and is never confounded with the man whose life consists in giving vent to a naturally active temperament, or a superabundance of muscular and central energy.

Although a less conclusive, because more complicated, consideration than those advanced in the previously cited proofs, I do not hesitate to bring this last consideration under the notice of observant readers as accurately chiming in with the main stream of the general argument on this subject. If action were strictly dependent on sensation and emotion, it would be found to be always proportional to those stimuli; but such proportion palpably and notoriously fails to hold good.

(8.) My last argument is one that can only be indicated here, the full illustration belongs to a more advanced stage of the exposition. In the proper place, I hope to be able to show that without this spontaneity of our actions, the growth of volition, or of activity guided to ends, would be impracticable.

Regions of Spontaneous Activity.

7. The natural tendency to act of their own accord belongs to all the muscles that are reckoned voluntary, and originates an extensive variety of movements. The muscles for the most part act in groups, being associated together by the organization of the nervous centres for the performance of actions requiring the concurrence of several of them. It will be convenient to refer at the present stage to the principal

groupings thus formed, in order to pass in review the different kinds of actions that may arise independently of outward or foreign stimulation.

The locomotive apparatus is perhaps the most conspicuous of the voluntary groups. This involves, (taking vertebrate animals in general), the limbs or the anterior and posterior extremities with their numerous muscles, and the trunk of the body, which in all animals chimes in more or less with the movements of the extremities. In the outbursts of spontaneous action, locomotive effort, (walking, running, flying, swimming, &c.) is one of the foremost tendencies; having the advantage of occupying a large portion of the muscular system, and thus giving vent to a copious stream of accumulated power. No observant person can have missed noticing hundreds of instances where locomotion resulted from purely spontaneous effort. In the human subject, the locomotive members are long in being adapted to their proper use, and in the meantime they expend their activity in the dancing gestures and kicking movements manifested by the infant in the arms of the nurse.

The locomotive action agitates the whole length of the spine up to the articulations of the neck and head. The members concerned, however, have many movements besides, especially in man, and these are found to arise no less readily. Thus the movements of the arms are extremely various, and all of them may burst out in the spontaneous way. The grasp of the hand is the result of an extensive muscular endowment, and at an early stage manifests itself in the round of the innate and chance movements.

The erections and bendings of the body are outlets for spontaneous activity, more especially erection, which implies the greatest effort. When superfluous power cannot run into the more abundant opening of locomotive movement, it expends itself in stretching and erecting the body and limbs, to the extreme point of tension. This is accompanied by greater vigour of inspiration of the breath, and consequent increase of expiration. The erection extends to the carriage of the head and the distension of the eyes, mouth, and features.

The vocal organs are a distinct and notable group of the active members. The utterance of the voice is unequivocally owing on many occasions to mere profusion of central energy, although more liable than almost any other mode of action to be stimulated from without. In man the flow of words and song, in animals the outbursts of barking, braying, howling, are often manifestly owing to no other cause than the 'fresh' condition of the vocal organs.

Among the varied movements of the human face, including the internal movements of the tongue and jaw, we can single out two or three distinct groupings. The *eyes* have their independent centre of energy, whence results a spontaneously sustained gaze upon the outer world. When no object specially arrests the attention, the activity of the visual movements must be considered as mainly due to central power. In the blind this is necessarily the sole influence at work. In a person deprived of the sight of one eye, we find that eye still kept open, but not so wide as the other. The *mouth* is also subject to various movements which may often be the result of mere internal power, as is seen in the contortions indulged in after a period of immobility and restraint. The *jaws* find their use in masticating the food, but failing this, they may put forth their force in biting things put into the mouth, as we see in children not yet arrived at the age of chewing. The *tongue* is an organ of great natural activity, being endowed with many muscles, and having a wide scope of action. In the spontaneous action of the voice, which is at first an inarticulate howl, the play of the tongue, commencing of its own accord, gives the articulate character to utterance, and lays a foundation for the acquirement of speech.

Among the special aptitudes manifested among the lower animals we find very well-marked examples of the spontaneity of action. The destructive weapons belonging to so many tribes are frequently brought into play without any stimulus or provocation, and when no other reason can be rendered than the necessity for discharging an accumulation of inward energy. As the battery of the Torpedo becomes charged by the mere course of nutrition, and requires to be periodically relieved by being poured upon some object or other, so we may suppose that the jaws of the tiger, the fangs of the serpent, the spinning apparatus of the spider, require at intervals to have some objects to spend themselves upon. It is said that the constructiveness of the bee and the beaver incontinently manifests itself even when there is no end to be gained; a circumstance not at all singular if we admit the spontaneous nature of many of the active endowments of men and animals.

The spontaneous activity is always observed to rise and fall with the vigour and state of nutrition of the general system, being abundant in states of high health, and deficient during sickness, hunger, and fatigue. Energetic movements, moreover, arise under the influence of drugs and stimulants acting on the nerves and nerve centres; also from fever and other disease. Convulsions, spasms, and unnatural excitement, are diseased forms of the spontaneous discharge of the active energy of the nerve centres.

OF THE MUSCULAR FEELINGS.

8. We are now brought to the express consideration of the first class of phenomena proper and peculiar to mind, namely, States of Feeling, Consciousness, or Emotion; these we have from the outset recognised as one of the three distinct manifestations of our mental nature. To give a systematic and precise account of the states of human consciousness, a Natural History of the feelings, is one of the professed objects of the science of mind. The attempt is scarcely paralleled by any mode of procedure occurring in the sciences that embrace the outer world; the only instructive analogy that I know of, is found in some of the branches of Natural History proper, as for example, Mineralogy, where a great effort of scientific classification is needed to reduce to order the vast variety of mineral substances.

I reckon it inexpedient at this early stage to enter upon a justification of the method and order of description herein adopted for the systematic delineation of the conscious states. When the method has been fully exemplified, the character and sufficiency of it will be appreciated without much difficulty.* Moreover, I mean to defer the metaphysical consideration of Consciousness itself, with the problems suspended therein, to a future period. Most of the individual states and varieties of consciousness can be sufficiently well determined and described without raising controversies as to the definition of consciousness in the abstract; while the handling of an abstraction so intensely debated as this has been, demands some previous preparation.

9. Having seen fit to commence the present Book with Movements and Muscular States, the Feelings that come first to be enumerated, are those connected with Muscularity and Movement. We have already recognised three distinct classes of these, namely :—

(1.) Feelings connected with the *organic condition of the muscles*; as those arising from hurts, wounds, diseases, fatigue, rest, nutriment. These affections the muscles have in common with the other tissues of the body; and the feelings that they

* It may facilitate the comprehension of the method, if I offer a few explanatory remarks as to the scope of it. The reader is sufficiently acquainted with the threefold partition of mind into Emotion, Volition, and Intellect. If this partition be complete and exhaustive, every mental fact and phenomenon whatsoever falls under one or other of these heads; nothing mental can be stated that is not either a feeling, a volition, or a thought. It must, nevertheless, be observed, that mental states need not belong to one of these classes exclusively. A feeling may have a certain volitional aspect, at the same time that it possesses all the characters of a true emotion: thus the mental state caused by intense cold, is of the nature of a feeling in the proper acceptation of the term; we recognise it as a mode of consciousness of the painful kind, but inasmuch as it stimulates us to perform actions for abating or freeing ourselves from the pain, there attaches to it a volitional character as well. In like manner every state that can be reproduced afterwards as a recollection, or retained as an idea, has by that fact a certain intellectual character.

Now, in describing states that come properly under the general head of emotion or feeling, we are called upon to bring forward in the first instance the peculiarities, or descriptive marks, that characterize them as feelings. This done, we may carry on the delineation by adverting to their influence on action, or volition; and, lastly, we may specify anything that is distinctive in the hold that they take of the intellect. It is clear that if a Natural History of the human feelings is at all possible, we must endeavour to attain an orderly style of procedure, such as Naturalists in other departments have had recourse to. If the fundamental divisions of mind have any validity in them, they ought to serve as the basis of a proper descriptive method; in fact the description should accord with them.

give birth to, have nearly the same general character everywhere.

(2.) Feelings connected with *muscular action*, including all the pleasures and pains of *exercise*. These are the emotions most peculiar to the muscular system.

(3.) The Feelings that indicate the *various modes of tension of the moving organs*. According as a muscle is tense or relaxed, according as much or little energy is thrown into it, and according to the quickness or slowness of the contraction, we are differently affected, and this difference of sensibility enables us to judge of the positions of our active members and of many important relations of external things. These are the feelings of muscle that enter most directly into our intelligence; they have little of the character of mere emotion, and a very large reference to Thought.

All through the present chapter, and through the following chapter, on Sensations, we shall require to keep in view this distinction between feelings that yield a large measure of the distinctive character of feeling or emotion, and others whose emotional character is feeble, and whose function it is to supply the materials of the intelligence. In the eye, for example, the effect of a blaze of sunshine is of a very different nature from the sight of a watch. The one serves for the purpose of immediate enjoyment or emotion, the other is nothing in itself and derives its value from intellectual applications and the rational guidance of our life. The contrast between music and speech expresses the same distinction among effects on the ear.

I. *Of Organic Muscular Feelings.*

10. In a quotation already given from Dr. Sharpey, it is remarked that muscular sensibility 'is manifested by the pain which is felt when a muscle is cut, lacerated, or otherwise violently injured, or when it is seized with spasm.' These forms of pain are so many states of consciousness, having their seat or origin in the muscular tissue; the integrity of the nerves and nerve centres being likewise essential to this, as to every other kind of sensibility.

When we come to describe the states of feeling arising through the Senses, named Sensations, it will be proper to assign in each case the external agent that causes the Sensation (light, sound, &c.); to follow this up with an account of the action or change effected on the sensitive surface, (as the skin, the tongue, &c.); and then to proceed with a delineation of the feeling itself, according to the forms made use of for this purpose. In the case of the muscular sensibilities, however, neither the exciting cause, nor the changes produced on the tissue, constitute in the generality of cases a part of the delineation. There is no external agent to act on the muscular tissue, during bodily exercise, in the way that light acts on the eye, or hard surfaces on the skin.

But with reference to the first class in Dr. Sharpey's enumeration, 'cuts, lacerations, and violent injuries,' we discern both an external agent and an assignable change in the substance of the muscle. There is in those circumstances a sudden break in the continuity of the fibre, which is an effect productive of pains in almost any tissue of the body. This is manifestly one of the effects calculated to give an intense shock to the nerves, originating a most energetic and pungent stimulus, which is transmitted to the centres, and there wakens up both consciousness and activity in very violent forms.

The character of the feeling or conscious state thus produced is clear and unmistakeable.* Such feelings are described

* The peculiarities properly belonging to Emotion or Feeling are attempted to be exhibited as the first item of our systematic delineation. The first of these is the nature of the conscious state as pleasure or pain, and the degree and mode of the one or the other. Likewise, anything that can be laid hold of as marking agreement or disagreement with other feelings, looked at in their passive aspect, or as pure emotion, is seized upon to aid in the description. The more extensively we can compare any one state with others, the better able shall we be to give an exact and characteristic account of it.

The nature of the inward consciousness being thus described, the outward manifestations, or the *Expression,* are a proper subject of notice, in so far as they present any distinctive peculiarities. The expression I look upon as part and parcel of the feeling. I believe it to be a general law of mind, which I shall endeavour to prove on another occasion, that along with the fact of inward feeling or consciousness, there is a diffusive action, by such names as pain, suffering, agony, torture. To use a term that has something of precision attached to it, they are of a most *intense* character; they are acute in their nature. Their generic name is 'pain,' which expresses an ultimate fact of human consciousness, a primary experience of the human mind resolvable into nothing more general or more fundamental than itself. The specific designation is 'intense' or 'acute;' the phrase 'acute pain,' is thus a tolerable description of the species of feelings in question. The peculiar distinction of quality, between the pains of cut muscle and the pains determined by lacerations of the skin, broken bones, burns, blisters, &c., I do not here undertake to reduce to language. Nor is it absolutely necessary for the ends of mental science to enter nicely into the varieties of acute physical suffering; although for the purposes of the medical man the attempt might come within the scope of a treatise of Pathology.

Acute pain, then, may be characterised in language such as the following, if any expansion or commentary is requisite in addition to the name itself. Being of the class of feelings recognised by the general term, pain, (which with its contrast, pleasure, may be said almost to comprehend the entire sum of conscious states) the acuteness or intensity of it is manifested by overpowering the vast proportion of other pains and emotions, so that these although present are for the time being submerged and lost to the consciousness. This comparison alone determines the degrees of intensity of pains; and physical suffering such as the cases now under consideration stands very high in the scale, there being few pains that surpass it, and few pleasures that can neutralize it. It is their nature either to pass speedily away or else to require active measures

or excitement, over the bodily members. I may at present cite, as an illustration, the effect of a blow; it being well known that in proportion as this is felt as a pain, it causes a shock and agitation over the whole body, manifested in the convulsive start, the cry, the contortion of feature, so familiar to us in our experience of men and animals. According to this view, every variety of consciousness ought to have a special form of diffusive manifestation. It is not every state, however, that carries this diffusive action far enough to be ostensible as a characteristic outward display.

for allaying them, otherwise they soon wear out the strength and even the life of the sufferer.

The description of their character as Emotion is not complete, unless we advert to the Expression that they stimulate, or the effects of that diffusive influence which I look upon as a concomitant of feeling. These effects render the mental state apparent to others, while the purely conscious phase is known only to the individual's self. The expression of acute pain is strong and characteristic. There is not, however, much difference in this respect between one form and another. The *body* is driven into movements and attitudes of a violent, intense character; sometimes the ordinary movements are quickened and at other times contortions and unusual gestures are displayed. The suddenness, quickness, intensity, of the bodily action, rather than the peculiar direction or form of it, constitutes the distinctive character of the situation. Artists, in giving the bodily expression of pain, as in the Laocoon, or the Crucifixion, differ according to the stage they fix upon, that is, according as they take the first moments when the energies are still fresh, or the subsequent state of drooping and exhaustion, which last gives more room for characteristic expression. In the early stage violent convulsive movement and intensity of attitude, such as any strong passion might bring out, are the points to be noted. If next, we turn to the *features*, whose chief use is expression, we find a much more distinctive manifestation. There is a well-known form of the countenance that marks the condition of pain,—being produced by certain movements of the eyebrows and the mouth to be afterwards analyzed; and in the case of acute pains these movements have the same appearance of violence and intensity that belongs to the bodily gestures at large. The *voice*, also a medium of expression, sends out acute cries sufficient to suggest suffering to every listener.

Besides instigating these various moving organs with an intensity that measures the acuteness of the feeling, the state we are describing awakens other manifestations of our emotional nature. The outburst of grief and tenderness,—tears and sobs—is brought on by pain. The irascible condition, or the various forms of rage, anger, fury, is often a part of the wave. So the convulsions of terror are wakened up by the same wide-spreading influence. It depends on the character of the individual at the moment, whether any, or which of these forms and displays of emotion are brought out, and to what degree; but all of them are extremely accessible to the stimulus of pain; anger and terror being more so than grief.

The foregoing description is meant to comprehend the strictly emotional characteristics of pain. Let us pass next to the *volitional* peculiarity, which is likewise very strongly marked.* By this I mean, as expressed in the Definition of Mind, the stimulus to a definite action for getting free from the state. The greater number of feelings have in them more or less of the property of spurring to action; some urge us to act for abating the feeling, others for the continuance or increase of it; the one class we term pains, the other pleasures, and although there is a broad distinction between these two great divisions of our states of consciousness in the region of emotion as above stated, yet the best marked and most unequivocal difference is that manifested under volition, or in the nature of the action that they respectively give birth to. Pain is what we avoid, repel, flee from; pleasure is what we cling to, and labour to increase. Intense pains are those that incite us vehemently to work for their abatement.

Thus, therefore, it is a part of the character of physical suffering to stimulate strongly every action that is felt to work an alleviation or tend to a relief, and to repel strongly all actions that heighten the irritation. The struggles of an animal to escape from a particular situation, prove to us that the creature is in pain. Any movement causing a felt relaxa-

* I have already observed (see note, p. 86), that after exhausting the description of each feeling, as feeling or emotion, we derive additional and instructive marks by proceeding to consider the effect of the state in stimulating to action. Volition, although a distinct fact of mind, implies a feeling as a part of its nature. Every feeling, therefore, has a certain character as respects volition; either it does not stimulate to action at all, in which case it is an example of emotion pure and simple, or it does stimulate to action, which fact is a property of the feeling, and deservedly enters into the description of it.

tion of the feeling is strenuously kept up, any movement of an aggravating kind is as strenuously resisted. If a means of alleviation is known, the sufferer employs it; if no such means is recognised, mere tentative struggling is maintained for the chance of relief. If lying down brings ease, that is chosen; if the erect posture gives relief, that posture would be sought and retained by the youngest infant or the most inexperienced of the brutes.

Volitionally, one feeling is stronger than another according as the one engrosses our activity in preference to the other. If a person suffering from the sickening air of a crowded room is also liable to pains from exposure to the cold night air, we judge that feeling to be strongest which is acted on. This measure is solely as regards the spur to action, and not as regards the expression, or any of the characters of pure emotion.

Our delineation of acute pains is not yet complete. We have viewed them as emotion and as volition; we may now derive marks of discrimination from the relation they bear to Intellect or thought. I shall advert to only one such mark, but this points to the very foundation and essence of our Intelligence; I mean the more or less facility of reviving the state or feeling in the absence of the physical cause, the ease of stirring up the experience as a recollection or idea. Conscious states differ remarkably in this particular; some that are most intense while they last, are very difficult to realize as a matter of recollection; their intellectual or ideal existence is of a low order. Others again are remarkable for their conceivability by an intellectual effort, and are therefore more prone to enter into the ideal life of the individual: such are the emotions of spectacle, the feelings of the beautiful and the sublime. We recognise a superior dignity in the emotions that have an ideal or intellectual persistence, as compared with such as can exist only in the actual, or while their physical stimulus is present. Applying this to the case in hand, we are fortunately able to say that acute pains, such as those cuts or lacerations whose consideration we have begun with, do not persist in the intellect as ideal emotions, and are not easily revived in any effort of recollection. Of all intense feelings, they may be reckoned to stand lowest in these peculiarities: whereby their influence and malignancy become confined to the evil hour of their real presence.

11. So much for the systematic delineation of acute pains as exemplified by one particular group, localized in the muscular tissue. A shorter description will suffice for the others. With regard to the class 'spasms' and 'cramps,' the mode of origin is different. What that origin is I cannot pretend to say, farther than, as every one knows, that there is some form of disease in the first instance. I am equally unable to assign the peculiar action that seizes the muscular tissue under spasm. This is generally understood to be a forcible and unnatural contraction of the whole or part of a muscle. But the *feeling* is well known and recognised as one of the most horrible inflictions that human nature is liable to; even surpassing in agony the acute suffering typified by lacerations and bruises. It would seem to be a form of pain peculiar and specific to the muscular tissue; for although occurring in the alimentary canal in a most distressing form, we may presume with reason that the muscular fibres of the stomach and intestines are in that case the seat of the disturbance. While the feeling is one of pain and acuteness in the highest degree, it has a peculiar quality of its own, that I can only express by remarking how forcibly it sometimes suggests the idea of being drawn two ways at once; as if we were on the rack of conflicting forces. Perhaps, however, after all, the difference between it and the former class lies more in the degree of acuteness than in any other well-marked quality. The acute agony of such feelings rises to the pitch of the utterly unendurable. The expression, the efforts for relief marking the volitional power, the impression left behind, are in proportion vehement and intense.

12. Another class of feelings connected with the muscles may be specified under the same general head of Organic Feelings, those arising from *over-fatigue*. This cause is known to produce acute pains of various degrees of intensity, from the easily endurable up to severe suffering. It is not

necessary to advert to these more specifically, they being sufficiently comprehended by referring them to the genus of acute pains of the muscles.

Very different is the state of feeling produced by mere *ordinary fatigue*, which we may introduce here rather than under the second division. This is a state not at all painful, but the opposite. It is one of the pleasurable experiences allied with the muscular system, and merits a full delineation.

The antecedent cause of this state is exertion, or the repeated contraction of the muscle up to exhaustion. Of the peculiar condition of the tissue in this state we are unable to speak with any precision; and no mere hypothesis of it would serve any end. The particulars we can speak to are the Conscious state with the expression, the Volitional aspect, and the relation to Intellect, following the order already exemplified in speaking of acute pains.

The Feeling, or conscious state, is, we have said, of the pleasurable class. The peculiarity of it as a pleasure is not intensity or acuteness, but *quantity*, massiveness, or volume. This distinction we shall often have to introduce in our descriptions of the varieties of human consciousness; believing it to be a real and apt distinction. When, instead of one narrow acute pain or pleasure, we have a feebler kind of excitement that seems to pervade large masses of the system, this we express by saying that the quantity is great and the intensity feeble; the difference between the half-scorching rays of a fire and a warm bath would be strictly defined by a similar description. Such is the view we take of the state of the healthy fatigue of the muscles. The feeling is of course pervasive according to the extent of the exercised parts; and within those parts it is a massive or voluminous feeling of comparatively little acuteness or intensity. The state is one of the pleasures of a life of hard exercise or bodily toil, and taken along with the sleep and general sensation of health following in its train, counts for a considerable portion of the sum of human pleasure. As a more specific mark, I may mention what it has in common with the state of exercise itself, namely, a feeling of vigour, strength, or intense vitality in the organs of activity. The blood still coursing rapidly through the muscular fibres developes a large amount of sensibility within them, and the state of repose is favourable to the enjoyment of this sensibility. The state is therefore very much contrasted with other states of voluminous enjoyment, such as warmth and repletion; these contain in them nothing of the sense of active vigour now described.

With regard to the Expression that manifests this emotional state to the onlooker, I would recal to the reader's observation the general fact, that expression is most marked in the intense feelings, whether of pleasure or of pain. Even very massive and abundant sensations will often yield a very languid expression, perhaps no distinguishable expression at all. Such is the case with the sensibility of muscles exhausted within limits. In so far as this shows itself at all, it is by the serene placid expression of a moderate and satisfying enjoyment. Inaction being part and parcel of the state itself, there is no scope for display or the demonstration of the feelings. The real expression is the reposing attitude, although this belongs more properly to what we have to speak of next, the activity for an end, suggested by the state in question.

The relations of this feeling to Action or Volition, demand some preliminary remarks. In the first place, the peculiarity of the state being exhaustion consequent on exercise, it naturally follows that a cessation of activity should be one of the accompanying circumstances of the feeling. As a mere physical fact, fatigue would lead to inaction. Thus there would be a discouragement to new effort arising out of the very conditions of the case, even supposing that the state of feeling had in itself a strong volitional spur like the acute pains formerly described.

In the second place, there is an aspect of this state and of many other pleasures that brings them under the head of pains; and since pain is almost always a source of volitional impulse, we derive thence a descriptive feature to enter into our delineation. When repose is forbidden to exhausted limbs there is a galling pain, and a consequent powerful stimulus to do something for relief. We find that though this pained condition may not be acute like a hurt or wound, there is in it a strong massive influence upon the system, leading to considerable efforts for the alleviation that rest could bring. The measure of volitional force is the exertion and sacrifice made to obtain repose. The weary traveller lying down in a swamp, or in the neighbourhood of beasts of prey, shows how intense is the craving after rest that urges his mind. There are other cases of the same nature, where the pains of privation are a characteristic part of the feeling no less than the pleasures of fruition.

A third observation of no less importance has to be made respecting the state of consciousness growing out of the repose of wearied members. The feeling is one of a soothing kind, that is to say, instead of irritating the centres of activity towards discharging themselves, the opposite effect is caused by it. Consequently, volition of every kind is less strongly put forth under the influence of such a state. I believe this to be a consequence of the feeling itself, co-operating with the purely physical tendency to rest that was the subject of my first remark. There are many feelings that have this anti-volitional or soothing character without being at all connected with fatigue, as, for example, the sensation of genial warmth.

Apart from all these circumstances,—namely, the physical inclination to rest, the powerful stimulus of the pained condition of prolonged fatigue, the soothing character of the mental state,—I should say that the pleasurable feeling now under discussion is not one that manifests itself in the way of volition. I say this because we do not observe any efforts made to secure it in greater quantity, or to prevent it from dying away as a pleasure. A volitional pleasure is one that fires our active endeavours to prolong and increase it; such is the pleasure of eating and drinking while appetite is yet fresh. The pleasure of repose belongs therefore to the class of *serene* emotions: this is the popular description of what is here termed unvolitional pleasures. The state of serenity and contentment of mind is their distinguishing feature as regards volition, or the active part of our mental system.

The last feature in our systematic delineation respects the Intellect, or the degree of continuance or recoverability of the feeling in the absence of the fact. Is this one of those states out of mind, when out of reality? or may it be often and vividly present as a mere possession of the intellect? Allowing, as we must always do, for differences of individual character as regards the intellectual recovery of emotional states, I should say that this particular feeling is low in the order of ideal recoverability, although often present owing to the frequency of the corresponding bodily condition. In respect to an assertion of this nature, each person must judge for themselves, according to the actual experience of each. My own opinion is grounded chiefly on what I think a true and important observation, namely, that the pleasure of mere repose after fatigue is not much put forward as an end, or a thing expressly aimed at in the pursuits of everyday life. To many people it can hardly ever be present at all, if we may judge from the utter neglect of physical exercise as a habitual element of life. Now it will be seen again and again, as our exposition advances, that the intellectual existence of an emotional state is what renders it an end of standing pursuit, by furnishing a stimulus that may be present when the reality is absent. Considering the degree that the feelings of repose occupy and engross the mind when they are really present, the hold that they take of the intellect in reminiscence is remarkably feeble.

The only other organic feeling of the muscles that I shall allude to, is the feeling generated by their nutrition. But of this feeling no clear account can be given, unless we are content with the probability that it is a portion of the total sensibility of united rest and nourishment, and is in part absorbed by sleep, enhancing, it may be, the agreeable consciousness of sinking into slumber.

II. *Of the Feelings of Muscular Exercise.*

13. These are the feelings proper and peculiar to the muscular system. Many of those noticed above have a com-

mon nature with other organic feelings; but the mode of consciousness produced by movement and exercise cannot be made to spring from any other part of the system.

I do not here take into account the circumstances that stimulate or set on the movement. I desire to keep as close as possible to the states of mind generated by the act of muscular exertion, howsoever commenced. The stimulus may be spontaneous influence, emotion, or volition. Taking the entire situation into account, there will be great differences according to the mode of origin; but under all these differences there is one thing common, namely, the influence spread over the conscious centres when muscular contraction takes place. The nature of that consciousness we have now to define.

14. The first and simplest case of muscular exertion, is when the exertion is unaccompanied by movement, as in supporting a weight, or encountering a dead resistance. Here we have the feeling probably in the purest and least complicated form of it.

The physical state of the muscle in this state cannot be described otherwise than through the medium of the physiological details already quoted on the subject of muscular action. The particles making up the muscular threads are approximated by an energetic attraction developed in the muscle under the stimulus supplied by the nerves. An intense physical force is produced by a peculiar expenditure of the substance of the muscular mass; and in the production of this force the tissue is affected, as it were, with a strong internal agitation, which can hardly fail to make itself felt in the great centre of consciousness. By what nerves the state of muscular tension communicates with the brain it would be difficult to say: the nerves principally supplied to the muscles are the nerves for stimulating its movements, the motor filaments of the nerve ramifications. Sensitive nerves may be supplied along with these, and may be the medium for transmitting the stimulus both of organic states, such as those above described, and of the states of tension now under consideration.

Such being the physical condition, we must now endeavour to delineate the nature of the Consciousness that accompanies and grows out of muscular exertion. We may safely affirm in the first place, that this is a pleasurable state; indeed when the muscles are in a fresh condition, the feeling is pleasurable to a degree, although from the exhaustion that follows exercise the enjoyment is temporary, and changes into pain if the effort is too long continued. With regard to the character of the pleasure viewed as an emotion, we may put it down as massive or large in quantity; it is as if a great body of stimulus were at work; a dense and voluminous influence creeps through the system. The large total amount of feeling makes itself known not only by surpassing many other pleasures when brought to a comparison, but also by the extent of pain and irritation capable of being subdued by it. This last circumstance has great importance in many ways; there is hardly anything so much resorted to as muscular exertion for quenching states of pain. But probably this power of dissolving irritation will, in the present instance, be better treated of among the volitional properties.

The precise degree of quantity or massiveness belonging to muscular pleasures can be given only by comparison with the various kinds of pleasure, or with some standard, if any standard could be set up. But it is better to defer an attempt of this kind till we are farther advanced in our detail of states of feeling, and to compare each case only with those previously surveyed. At the present early stage we have no scope for such a comparison.

I have remarked already when speaking of the state of repose after fatigue, that there is a peculiarity in the feelings connected with muscular exertion, that distinguishes them from all others; a difference not in degree but in kind, and this we characterise by such phrases as the sense of power, the feeling of energy, and others to that effect. This is an ultimate phase of human consciousness that we can call attention to and compare with other states, but cannot resolve into anything else. As a root of some of our higher forms of emotion, for example; the feelings connected with the possession and exercise of power, there is an additional importance attached to it. But taken by itself we must look upon it as an interesting element of muscular feeling, being, in fact, one of the relishes of that pleasure, and by some constitutions very keenly enjoyed.

By the very nature of the case, Active pleasures are apt to be wanting in Expression, properly so called. The organs are so completely employed in the exercise itself, that they are not disposable as instruments of expression. Nevertheless we may note the gleesome and joyous excitement of the young in the midst of their active sports. The pleasurable stimulus of exertion diffuses itself over the whole system, lighting up the features with gaiety and mirth, and prompting the vocal organs to cries of delight. The various modes of expressing the feeling are so many new pleasures; they are an addition to the exercise that is the source of the emotion.

Turning next to the Volitional peculiarities of the feeling of muscular exertion, there is a complication similar to what I have already remarked upon under the feeling of repose. Indeed we fall at once into a difficulty, or an apparent contradiction. For the state itself arises from some action already set on, and therefore there is no room for a new bent at the instance of the resulting emotion. If a porter is carrying two hundred weight on his back, his activity is already occupied, and it is irrelevant to speak of the influence of his feelings upon his further action. Now all this may be true, and yet there may be a specific tendency in the feelings of exertion to incite us to act for giving them further scope, or for restraining them. For, although in most instances, our action is directed entirely to some outward end, as when the manual labourer is engaged in his toil, at other times the outward end is a mere pretext for muscular enjoyment, and in that case the feeling disposes of our activity. When we descend into the gymnastic arena to convert surplus energy into pleasure, the conscious state is then the spur and guide of our action. We continue our exercise while the pleasure lasts, and cease when it ceases. The inward feeling is, in such a case, an end and a prompter of voluntary action.

In these circumstances, we notice that the volitional spur to keep up exertion is very high in the first moments of fresh and unexpended vigour. At the outset of the exercise it is difficult to check or restrain the pursuit. This, however, is not wholly the result of the pleasurable feeling prompting us to go on; we must allow something to that spontaneous discharge of activity, that I have insisted on as a fact of our constitution. The feeling of pleasure doubtless works along with the spontaneous tendency, and so far there is a volitional power in the conscious state induced by exertion. This power is not inconsiderable on the whole, although many pleasures surpass the present in this particular. If we take the cases where the feeling of exertion is at its highest—namely, the concurrence of youth with high muscular energy, or the athletic constitution at its prime, the pleasure will be very great indeed, and the volitional promptings to keep it up equally great. With the generality of men, however, the same strong terms cannot be applied to describe this species of emotion, which in them sinks down to a second or third-rate pleasure.

It is also to be noted, that exertion is a means of soothing morbid activity of the nervous system, and is to that extent anti-volitional, like the state of healthy repose after muscular fatigue. There is here an effect partly physical and partly mental: physical, because exercise gives a new direction to the organic processes of circulation, respiration, &c.; and mental, because the emotion itself is capable of displacing and dissolving a considerable amount of the other emotions possessing the mind at the time.

With regard, finally, to the Intellectual aspect of this state of mind—namely, its existence as a recollection and an idea, we must still pronounce it of a low order. Generally speaking, the feeling does not frequently or readily occupy the thoughts in the entire cessation of the reality, and is not an object of longing, of prospective or retrospective interest.

This statement, which appears true in the main, is liable to a number of exceptions and qualifications, which I do not here enter upon.

15. Having thus endeavoured to present a delineation of the first and simplest variety of muscular consciousness under exertion, it remains only to cite a few examples of this form of the feeling.

The supporting of a weight on the back, head, or chest, or by the arms, is a common example of dead tension. No other feeling besides the pure sensibility of muscular contraction can enter into this case. The most interesting form of it is the support of the body's own weight, which yields a perpetual feeling of the muscular kind, varying with the attitudes. The feeling is least when we lie at full length in bed, and greatest in the erect posture. Sometimes the weight is oppressive to us, and gives the sensation of fatigue; in a more fresh condition of the muscles it makes one item of our pleasurable consciousness. The fatigue of standing erect for a length of time is, perhaps, one of the commonest cases of muscular exhaustion. The pleasure of standing up after a lengthened repose gives an opposite feeling. When the bodily strength is great, the laying on of a burden is a new pleasure.

This case of great muscular tension, without movement, presents itself in an infinite variety of forms, in the course of mechanical operations, and in many other ways. In holding on as a drag, in offering or encountering resistance of any sort, in compressing, squeezing, clenching, wrestling,—we have various forms of the situation, and the foregoing description of the emotional state ought, if correct, to be applicable to all of them.

A certain amount of movement may be permitted without essentially altering the case of dead tension, as in dragging a vehicle, or a boat, and in efforts of slow traction generally. In such cases a considerable number of muscles are kept tense at nearly one position, while those more especially concerned in locomotion are alternately relaxed and passed through the successive stages of contraction. This last element

I have expressly reserved, intending to make it a class by itself, the one next entered on.

16. When muscular tension brings about movements, there must be a gradually increasing contraction, and not a mere expenditure of power at one fixed attitude. Each muscle has to pass through a course of shortening, beginning, it may be, at the extreme state of relaxation, and passing on, sometimes slowly, and at other times rapidly, to the most shortened and contracted condition. The sensibility developed during this process, is greater in degree, and even somewhat different in kind, from that now discussed. As a general rule, the feeling is more intense and keen under movement, than under exertion without movement. The successive contraction of the muscle would seem capable of originating a more vivid stimulus than the fixed contraction. We even find, that in different degrees of rapidity, the sensibility changes considerably, which requires us to make a division of movements into several kinds.

17. Let us first advert to what we may term, by comparison, *slow* movements. By these I understand such as a loitering, sauntering walk, an indolent style of doing things, a solemn gesture, a drawling speech, whatever is set down as leisurely, deliberate, dawdling. The emotion arising from this kind of movement is far greater than an equal effort of dead tension would produce. Indeed we may say, that this is an extremely voluminous and copious state of feeling: being both abundant and strong, although deficient in the element that we recognise as the sense of energy, or of expended force; in fact, approaching more to the class of passive emotions. We may derive the greatest amount of pleasurable sensibility, at the least cost of exertion, through the means of well-concerted slow movements. The emotional state is not overwhelmed by the expenditure of active power, and hence the enjoyment is keen. We are thoroughly alive to the effect that is produced, and thus a feeble stimulus yields a great pleasure. The peculiar quality of the state may be still farther described by specifying the emotions in close relation to it. We find among these the emotions of

awe, solemnity, veneration, and others of the class of mingled tenderness and fear, indicating still further the deficiency of active tone already adverted to. The funeral pace, the solemn, slow enunciation of devotional exercises, the drawling tones of organ music, are chosen on account of this relationship. The whole expression of the feeling is in accordance with the nature of the action itself. The other members, chiming in with the principal, affect movements of the like slowness. The action suits the word, and the word the action.

There is a striking and instructive similarity of character between this feeling and the state of approaching sleep. In both cases we have a luxurious passive emotion, arising out of the peculiar condition of the muscles; and such is the accordance or sympathy of the two, that the one is well known to bring on the other with its accompanying reality.

Slow movements are entirely out of keeping with a fresh and active bodily tone; they are repugnant and intolerable in such a situation. They are nevertheless of great use in soothing down a morbid excitement, or an excessive and mistimed activity, and in preparing the way for absolute repose. After a bustling day, tranquillity is restored by the sympathy of languid movements, or stately music. Hence one of the influences ascribed to acts of devotion and the forms of worship.

There is every reason to believe that movements, gradually increasing or gradually diminishing, are more productive of pleasurable emotion than such as are of a uniform character. Indeed a uniform movement is altogether of artificial acquirement. The natural swing of the limbs tends to get quicker and quicker, up to the full stretch, and to die away again gradually. Through that deep-seated bond which connects feeling with action, and generates in our emotions the tendency to perpetuate themselves, if of the pleasurable kind, each emotional state feeds itself, and, in many cases, is satisfied only with an increase. A vast number of our feelings are of this thirsting character, and a bare and even continuance is felt as a privation. But, altogether apart from this view of the great law of volition, there would appear to be a special emotion connected with the acceleration or steady diminution of movement. The gradual dying away of a motion is pleasurable and graceful in every sort of activity, in gesture, in the dance, in speech, in vision. The 'dying fall' in sound is not so obviously a case of muscular effect, but I am satisfied that it is really so. If a common character pervades all such cases, the sensibility can belong only to the muscles, and if so this is the sweetest and most thrilling of all the muscular emotions. It is one of the ends of artistic education to acquire movements to bring out this effect.

18. We pass next to the consideration of *quick* movements. They differ considerably in feeling both from dead exertion and from a slow rate of action. Although there is still a common muscular sensibility at the bottom, the specific nature of it is very widely varied. The first and obvious effect of quickness is to increase the stimulus or excitement passing to the nerve centres. The feeling must for this reason become more intense, or vehement. But it would be a mistake to suppose that it always possesses the mind more thoroughly than the emotions of slow movement. The activity of the frame prevents the emotion from developing itself fully, and hence with an increased stimulus there may be less of actual feeling. What there is of emotion is more vehement, and more bound up with the sense of action and energy, which is the characteristic ingredient of muscular sensibility. A further peculiarity of quick movements, as distinguished from the mere putting forth of force, is the tendency to excite and inflame the system into a still more intense condition, such as we term elation, animal spirits, with boisterous manifestations: what may be called mechanical intoxication. The effect thus arising from rapid movements furnishes a salient proof of the influence belonging to movement, over and beyond dead tension. It is not the mere pouring in of nervous stimuli, and the development of great contractile force in a muscle, but the actual course of contraction gone through that yields the greatest amount of excitement in the brain, an excitement not satisfied till it impress a similar activity on all the organs of the frame. The power

of propagation and increase is strikingly seen in the influence of quick movements. In a rapid walk, still more in a run, the consciousness is excited, the gesticulations and speech are rapid, the features betray a high tension. The increase of emotional fervour must be attributed to an exalted condition of the nervous system, of the kind produced by intoxicating stimulants in general. It requires a special education, easier in some temperaments than in others, to perform rapid movements with coolness.

Examples of this class of motions and feelings are sufficiently abundant. They are expressly sought to give hilarity and excitement to human life. The chace, the dance, the vehemence of oratory and gesture, are prized for their stimulating character as well as from their proper sensations. In the ecstatic worship of antiquity, in the rites of Bacchus and Demeter, a peculiar phrenzy overtook the worshippers, yielding an enjoyment of the most intense and violent character, and in its expression mad and furious. This state is often brought on among the Orientals of the present day, and always in a similar manner, that is, by intense and rapid dancing and music under the infection of a multitude.

Movements, when too quick, frequently excite the nerves to the state of dizziness and fainting, showing the extreme effect of the peculiarity we are describing.

19. We may advert next to some of the minor incidents connected with movement, and exerting notable influences on the consciousness. The sudden interruption of any movement causes a feeling of a very painful and unsettling kind. When one has drawn a blow and meets a sudden arrest half way, there is a revulsion of feeling that is very hard to bear. Doubtless there has been some adaptation of the impetus to the distant end, which is perverted when some nearer thing is put in the way. A shock or encounter that we are prepared for is not unpleasant, but one coming by surprise gives a most painful and confusing jerk to mind and body. Hardly anything rouses a burst of anger more readily than a sudden and unexpected check : being of the nature of an interruption to the whole bent and current of the system, the occurrence of it

in any form is the occasion of a painful outburst most difficult to be appeased. The tripping of the foot, a sudden obstacle in our way, an arresting hand on the shoulder, cause a shock to the whole frame, often attended with a cold sweat, and taking some time to recover from. The sudden stoppage of any of our movements is the most usual cause of this general and distressing interruption,—an interruption that probably typifies a large class of feelings of the painful kind.

20. An equally remarkable and still more distressing circumstance connected with movements, is that arising from the sudden loss of support, as when the footing, or any prop that we lean upon, suddenly gives way. The contraction of a muscle demands two fixed points of resistance at its extremities; if one of those breaks loose, the force of the contraction has nothing to spend itself upon, and a false position is incurred. The contraction suddenly freed from its resistance does not make a vehement convulsive collapse like a spring; it would appear rather that the contractive force ceases almost immediately; and the sensation resulting is one of a most disagreeable kind. As in the previous case, this sensation seems to result rather from the jar given to the nervous system than from any influence flowing out of the muscle. The whole frame is agitated with a most revulsive shock, the cold perspiration is felt all over, and a sickening feeling seizes the brain. The breaking down of any prop that we are resting on, the snapping of a rope, or the sinking of a foundation, exemplify the most intense form of the effect. But we may probably look upon the peculiar influence whose repetition induces sea-sickness, to be of the same nature. The sinking of the ship has exactly the same unhinging action in a milder degree, although when continued for a length of time, this produces a far worse disturbance than any single break-down, however sudden. The precise physiological action in this situation does not seem agreed upon; the feeling is known to be one of the most distressing that human nature is subject to, being an intense and exaggerated form of stomachic sickness, with sensations in the head more aggravated than those occurring under any ordinary emetic.

Vertigo and swimming of the head are states that may be induced by movements of various kinds. Whirling is a common cause. Too great rapidity of any movement may have the same effect.

The state of feeling arising when a prop or support gives way may be experienced through mental causes, as when some great loss or disappointment overtakes a person. There is the same breach of confidence and the same nervous shock in both instances, although in the one the pure physical action is necessarily stronger.

21. We must advert next to the *passive* movements. Under these we include the case of being driven, or carried along, by some power without us. Riding in a vehicle is the commonest instance. One of the pleasures of human life is to be driven along at a moderate speed, in an easy carriage. Now it may be supposed at first sight, that there ought to be no feeling of muscular exertion whatsoever in this case, seeing that the individual is moved by other force than his or her own: and under certain circumstances this would be strictly true. We have no feeling of our being moved round with the earth's rotation, or through space by the movement about the sun. So in a ship we often lose all sense of being driven or carried along, and feel pretty much as if there were no forward movement at all. The sensibility arising in a carriage movement, is in part imbibed through the eye, which is regaled by the shifting scene, and partly through the irregularities of the movement, which demand a very gentle action of the muscles of the body in order to adapt it to those irregularities. By springs and cushions all violence of shock is done away, while the easy exercise caused by the commencement and stoppages of the motion, by the slight risings and fallings of the road, is somewhat of the nature of that influence already described as arising from slow and languid movements. It must not be forgotten, however, that the stimulus of the fresh air, procured at little expense of exertion, and with the eye amused by a shifting scene, is no small part of the agreeableness, as well as wholesomeness of the situation.

In horse exercise there is a larger amount of the ingredient of activity. The rider is saved a part of the exhaustion caused in walking, and has yet exercise enough for the stimulus of the bodily functions, and for exciting muscular pleasure.

With children, the relish for passive movements seems remarkably keen. In them, however, such movements are rarely passive. When swung, or jumped, or driven, the child generally puts forth vigorous exertions of its own, and converts the passive into an active exercise, while children are particularly apt in their relish for the pleasure given to the eye by the shifting scene.

The rocking chair, introduced by the Americans, who seem specially attentive to the luxuries of muscular sensibility, is calculated for passive movements. Anciently furniture was adapted for the pleasures of repose solely, but now the boy's rocking horse has its representative among the appurtenances of grown men.

On the whole, it is apparent that a large fraction of physical enjoyment flows out of the moving apparatus and muscular tissue of the body. By ingeniously varying the modes of it, this enjoyment may be increased almost without limit. The pleasure comes incidentally to manual labour, when moderate in amount and alternated with due sustenance and repose, and is a great element of field sports and active diversions of every kind; it is a great part of the pleasures of locomotion; and in gymnastic exercises and athletic displays forms the principal ingredient.

III. *Of the Discriminative or Intellectual Sensibility of Muscle.*

22. In the two foregoing heads I have aimed at exhausting the emotional sensibility of muscle, or the feelings that have reference to pleasure or pain. Although these feelings may have more or less of an intellectual existence, that is, may remain in the memory and influence the pursuits, they are not on that account intellectual feelings. This designation indicates a quite different class of sensibilities, a class having very little of emotional character, so little that they

are not counted in the sum of human happiness or misery, but having, nevertheless, a very high value as instruments or media in attaining to the one and avoiding the other. They are comprised in the power that we have of discriminating the different degrees of *force* and *range* of muscular action. Our inward impressions are different for a small exertion and for a greater, and also for two different situations of a limb caused by a smaller and a larger degree of contraction. The emotional sensibility may not be very much altered by a great additional contraction in a muscle, indicated by a greater flexion of the part moved, but there is, notwithstanding, a discriminative sense that recognises the distinctness of the two positions. Discrimination is a very different thing from vivid emotion, and is often greatest when emotion is faintest. There is a contrast pervading the whole region of mind between discriminative and emotional sensibility. Now discrimination is the basis of intelligence. Even the discovery of agreement presupposes difference.

There are three distinct varieties of difference in muscular action. The first is the degree of exertion, or of expenditure of force, which necessarily measures the *resistance* to be encountered. The second respects the amount of contraction of the muscle, or the stage of shortening which it has reached; this connects itself with the *situation or range* of the organ moved. The third head is the greater or less rapidity of contraction, corresponding with the swiftness or *velocity* of the movement. In distinguishing the qualities of external things, and in forming permanent notions of the world, all these discriminations are brought into play.

23. First, with respect to degrees of exertion or of expended force.

Along with every kind of feeling whatsoever we have a sense of degree or intensity. We can discriminate between a more and a less vehement emotion. When experiencing the pain of fatigue, or the pleasure of healthy exercise, we recognise differences in the different stages of the feeling. To be affected more or less in different circumstances is almost a consequence of being affected at all. Accordingly, as an emotion rises or falls, our difference of sensibility leads to a comparison, and the comparison gives birth to what we call the sense of difference. There is implied in it a certain amount of permanence of a past impression along with the full reality of the present; without some such endurance of impressions comparison would be impossible; we should live in the present moment and in that alone. This sentiment of difference determines our voluntary activity; that is to say, it prompts a continuance of the action that heightens a pleasure or soothes a pain. It goes still further, and is the foundation of all those discriminative impressions of outward things entering into our intellectual comprehension of the world. Sights and sounds, and touches and tastes, have a variety corresponding in some degree to the variety of natural objects, and thereby constitute what we call our 'knowledge' of those objects.

To apply this to the case now before us, we have a certain feeling or emotion when called to exert our muscular energy in setting on movement, or in encountering resistance. We have a certain degree of consciousness for some one degree of exertion; when the exertion increases, so does the consciousness. If a porter has a load on his back of one hundred weight, he has a peculiar and distinct muscular feeling associated with it; if other thirty pounds were added, he would have a sense of the addition in the increased expenditure of force; if thirty pounds were removed, he would have a feeling of diminished expenditure. In short, there is a perfect discrimination of degrees and difference of muscular energy, which serves us as a means of discriminating the resistances that we encounter. By this means we say that one body resists more than another, possesses in greater degree the quality that, according to circumstances, we call momentum, inertia, weight, or power. When we encounter two forces in succession, as in a wrestling match or a dead push, we estimate them according to this sensibility, the one greater, the other less, as it may happen.

24. Among the various cases where the sense of graduated resistance comes into play, we may mention first, the momen-

tum or force of moving bodies. Where we have to check or resist something in motion, as in bringing a vehicle to rest, our sensibility to expended exertion leaves with us an impression corresponding to the momentum of the vehicle. If we were immediately after to repeat the act with another vehicle heavier or swifter than the first, we should have a sense of increased effort, which would mark our estimate of the difference of the two forces. If the impressions thus made were gifted with a certain kind of permanence, so that they could be revived at an after time, to be compared with some new case of checking a moving body, we should be able to say which of the three was greatest and which least, and we could thus have a scale of sensibilities corresponding to the three different degrees of moving force.

The effort of traction presents another example of measured estimate of expended force. Every carriage horse knows the difference of draught between one carriage and another, between rough and smooth ground, and between up hill and down hill. This difference the animal comes to associate with the carriage, or with the sight of the road, and in consequence manifests preferences whenever there is an opportunity; choosing a level instead of a rising road, or the smooth side in preference to the rough.

The appreciation of *weight* comes under the same description of sensibility. This applies to burdens in general, and also to the discrimination of quantity of material through weight. We remark a difference between half an ounce and an ounce, or between five pounds and six pounds, when we try first the one weight and then the other. The generality of people can appreciate far nicer differences than these. A sensitive hand would feel the effect of a very small fraction of an ounce added to a pound. In this respect, there would appear to be wide constitutional differences, and also differences resulting from practice, among different individuals. We are all sensitive to some extent, but there is for each person a degree of minuteness of addition or subtraction that ceases to be felt; this is the limit of sensibility, or the measure of delicacy in the individual case.

There are two modes of appreciating weight, the relative, and the absolute. By relative weights we understand the comparison of two or more weights together, or by taking them in turn, they being all actually present; as when among a heap of stones we pick out what we deem the heaviest. Absolute weight implies a permanent standard, and a permanent impression of that standard. When taking up a lump of lead, and feeling the weight of it, I pronounce it to be seven pounds, I make a comparison between the sense of the lead and the impression acquired by handling the standard weight of seven pounds, or things known to be equivalent thereto. This absolute comparison, therefore, implies that enduring and revivable sensibility to impressions of resistance above alluded to as a possible fact of the human constitution. The fact is not only possible but real, as every one knows. We can acquire a permanent sense of any one given weight or degree of resistance so as to be able at all times to compare it with whatever weight may be presented. A receiver of posted letters acquires an engrained sensibility to half an ounce, and can say of any letter put into his hand whether it produces a sensibility equal to or under the standard. This is a result pre-eminently intellectual in its nature; the process of acquisition that brings it about ranks as a foundation of our intelligence. The sensibilities that can assume this permanent character, so as to be used in comparison, without reference to their original cause, are truly intellectual sensibilities. In speaking of the pains and pleasures arising out of the muscular system, I ventured to give as one of their attributes that they were not liable to be revived as mere impressions in the absence of the reality, that therefore they stood low in the intellectual scale. This description points to some other feelings that have a more abiding place in the life of intellect or ideas; and the feelings now specified are of that nature. In other words, I mean to affirm, that the sense of difference or degree in resistance is more endurable, more recoverable, more independent of the actual pressure, the real presence of the objects, than the emotional excitement, the pleasure or pain of intense muscular action. Of two burdens that stimulated an intense emotion of active expenditure, we can more easily retain the fact of one being greater than the other,—or the sensibility that would enable us to compare some new and present burden with them,—than we can realize over again all the vehement sense of exertion, the keen massive emotion, the perspiration, and the heat that constituted the pleasure or the pain of the moment. The mere sense of the difference is evidently a small and limited portion of the entire conscious state; and for that reason alone it would be more revivable. To re-agitate the whole frame with the entire current of that emotion, perhaps at a time when the state of the body and mind is unfavourable to it, cannot be so easy as to revive a portion of the sensibility that is not connected with much excitement. It is not necessary to revive the whole in order to revive the measure or estimate of the whole, and that portion sufficing for the comparative estimate is the portion available for the purpose now under consideration.

The sensitiveness to relative weight, or to things compared together, may not be the same as the sensitiveness to absolute weight, which implies the engrained impression of the standard. Both may be cultivated, but the one is a cultivation of mere sensibility, the other is an intellectual acquisition, and may depend on a distinct quality or region of mind.

Although the use of the balance supersedes to a very great extent the sensibility to weight residing in the muscular system, there are occasions where this sensibility can display its acuteness. In many manual operations, weight is often estimated without the aid of the balance. In throwing weapons, or any description of missile to reach a mark, an estimate of weight must enter into the computation of force expended; and they that have a distinguishing delicacy of the sense of resistance will come much sooner to perfection in the exercise.

In appreciating the cohesiveness of tenacious bodies,—the thickness of a dough, or the toughness of a clay, the same sense of resistance comes into operation. In like manner the elasticity of elastic substances—the strength of a spring, the rebound of a cushion—comes to be discriminated with more or less nicety.

25. The second attribute of muscular discrimination relates to the amount of contraction of the muscle, or the degree of shortening, irrespective of the energy put forth. This sensibility qualifies the mind for the perception of a new class of external attributes.

Under this head it may be asserted that when a muscle begins to contract, or a limb to bend, we have a distinct sense of how far the contraction and the bending are carried; that there is something in the special sensibility that makes one mode of feeling for half contraction, another mode for three-fourths, and another for total contraction. Our feeling of moving organs, or of contracting muscles, has been already affirmed to be different from our feeling of dead tension,—something more intense, keen, and exciting; and I am now led to assert, from my best observations and by inference from acknowledged facts, that the extent of range of a movement, the degree of shortening of a muscle, is a matter of discriminative sensibility. I believe it to be much less pronounced, less exact, than the sense of resistance above described, but to be not the less real and demonstrable.

If we suppose a weight raised, by the flexing of the arm, first four inches, and then eight inches; it is obvious that the mere amount of exertion, or expended power, will be greater and the sensibility increased in proportion. In this view, the sense of range would simply be the sense of a greater or less continuance of the same effort, that effort being expended in movement. We can have no difficulty in believing that there should be a discriminating sensibility in this case; it seems very natural that we should be differently affected by an action continued four or five times longer than another. If this be admitted, as true to observation, and as inevitably arising from the existence of any discrimination whatsoever of degrees of expended power, everything is granted that is contended for at present. It is not meant to affirm that at each degree of shortening of a muscle, or each intermediate attitude of a limb, there is an impression made on the centres that can be distinguished from the impression of every other position or degree of shortening; it is enough to require that the range or amount of movement gone over should be a matter of distinct perception through the sensibility to the amount of force expended *in time*, the degree of effort being the same. The sensibility now in question differs from the former chiefly in making the degree turn upon *duration*, and not upon the amount expended each instant; and it seems to me impossible to deny that force increased or diminished simply as regards continuance, is as much a subject of discriminative sensibility as force increased or diminished in the intensity of the sustained effort.

It is in the special senses of touch and sight, or rather in the muscular sensibility united with those senses, that the feeling of range is most conspicuously manifested. When instead of swinging the arm in empty space, we draw the hand over the surface of a table, the sense of range is made more distinct by the prolongation of the rubbing contact. So with sight, as we shall show in the proper place. But in the meantime, it is necessary to recognise an independent sensibility of muscle to this attribute of range, for without such inherent sensibility the addition of a sensation of special sense would not suffice to give birth to the discrimination we are now contending for.

26. If the sense of degrees of range be thus admitted as a genuine muscular discrimination, its functions in outward perception are very important. The attributes of extension and space fall under its scope. In the first place, it gives the feeling of *linear extension*, inasmuch as this is measured by the sweep of a limb, or other organ moved by muscles. The difference between six inches and eighteen inches is expressed to us by the different degrees of contraction of some one group of muscles; those, for example, that flex the arm, or in walking, those that flex or extend the lower limb. The inward impression corresponding to the outward fact of six inches in length, is an impression arising from the continued shortening of a muscle, a true muscular sensibility. It is the impression of a muscular effort having a certain continuance; a greater length produces a greater continuance (or a more

rapid movement), and in consequence an increased feeling of expended power.

The discrimination of length in any one direction includes *extension* in every direction. Whether it be length, breadth, or height, the perception has precisely the same character. Hence superficial and solid dimensions, the size or magnitude of a solid object, come to be felt in a similar manner. But we shall defer the consideration of this attribute till we come to speak of the senses, more especially Touch and Sight.

It will be obvious that what is called *situation* or Locality must come under the same head, as these are measured by distance taken along with direction; direction being itself estimated by distance, both in common observation and in mathematical theory. In like manner, *form* or *shape* is ascertained through the same primitive sensibility to extension or range.

By the muscular sensibility thus associated with prolonged contraction we can therefore compare different degrees of the attribute of space, in other words, difference of length, surface, situation, and form. When comparing two different lengths we can feel which is the greater, just as in comparing two different weights or resistances. We can also, as in the case of weight, acquire some absolute standard of comparison, through the permanency of impressions sufficiently often repeated. We can engrain the feeling of contraction of the muscles of the lower limb due to a pace of thirty inches, and can say that some one given pace is less or more than this amount. According to the delicacy of the muscular tissue we can, by shorter or longer practice, acquire distinct impressions for every standard dimension, and can decide at once as to whether a given length is four inches or four and a half, nine or ten, twenty or twenty-one. This sensibility to size, enabling us to dispense with the use of measures of length, is an acquirement suited to many mechanical operations. In drawing, painting, and engraving, and in the plastic arts, the engrained discrimination of the most delicate differences is an indispensable qualification.

27. The third attribute of muscular discrimination is the *velocity* or speed of the movement. It is difficult to separate this from the foregoing. In the feeling of range, velocity answers the same purpose as continuance; both imply an enhancement of effort, or of expended power, different in its nature from the increase of dead effort in one fixed situation. We must learn to feel that a slow motion for a long time is the same as a quicker movement with less duration; which we can easily do by seeing that they both produce the same effect in exhausting the full range of a limb. If we experiment upon the different ways of accomplishing a total sweep of the arm, we shall find that slow movements long continued are equal to quick motions of short continuance, and we are thus able by either course to acquire to ourselves a measure of range and lineal extension.

We have already seen that there is a characteristic difference between effort expended in movement and effort expended in dead resistance: the one is more keen, fiery, and exciting than the other. This peculiar exciting character seems to us as the means of discriminating the two kinds of effort, and also helps to discriminate the degrees or pace of movement; a more rapid action produces a different mode of excitement from one less rapid. This is to us a measure of speed, which, as well as continuance, is a measure of extension, or space moved over. Whether we fasten upon the slow movement with long continuance, or the quick movement with short continuance, we get a characteristic and peculiar sensibility different for every amount of length, and serving as our estimate and impression of such amount. But besides using velocity as a means of measuring length, we require it as a measure of itself, that is to say, we are often called upon to judge of the different velocities of moving bodies; our own speed in walking, for example, or the rate of any object moving past us. We can not only compare two different velocities tried in succession, but we can also acquire, as with weight and size, the engrained impression of some standard velocity, wherewith to compare any case that occurs.

28. We would thus trace the perception of the mathe-

matical and mechanical properties of matter to the muscular sensibility alone. We admit that this perception is by no means very accurate if we exclude the special senses, but we are bound to show at the outset that these senses are not essential to the perception, as we shall afterwards show that it is to the muscular apparatus associated with the senses that their more exalted sensibility must be also ascribed. The space moved through by the foot in pacing may be appreciated solely through the muscles of the limb, as well as by the movements of the touching hand or the seeing eye. Whence we may accede to the assertion sometimes made, that the properties of space might be conceived, or felt, in the absence of an external world, or of any other matter than that composing the body of the percipient being; for the body's own movements in empty space would suffice to make the very same impressions on the mind as the movements excited by outward objects. A perception of length, or height, or speed, is the mental impression, or state of consciousness, accompanying some mode of muscular movement, and this movement may be generated from within as well as from without; in both cases the state of consciousness is exactly the same.

We have thus gone over the three great classes of muscular feelings enumerated at the outset of the chapter. Other forms of muscular sensibility will arise in the course of our exposition, through the combinations with other kinds of consciousness. We have not exhausted all that requires to be said on the sense of *effort** accompanying muscular exercise, which

* Sir William Hamilton, in his Dissertations on Reid, p. 864, has drawn a distinction between what he calls 'the locomotive faculty,' and the muscular sense, maintaining that the feeling of resistance, energy, power, is due to the first and not to the second. By this locomotive faculty he means the feeling of volitional effort, or of the amount of force given forth in a voluntary action; while he reduces the application of the term muscular sense, to the passive feeling that he supposes us to have of the state of tension of the muscle.

His words are: 'It is impossible that the state of muscular feeling can enable us to be immediately cognizant of the existence and degree of a resisting force. On the contrary, supposing all muscular feeling abolished, the power of moving the muscles at will remaining, I hold that the consciousness of the mental motive energy, and of the greater or less intensity distinguishes the voluntary from the involuntary actions. I must likewise postpone the discussion of the feelings of self-confidence and self-satisfaction, and of self generally, which manifest themselves in the course of active exertion. Moreover, much yet remains to be said on the connexion of muscular sensibility with the processes of intelligence.

of such energy requisite, in different circumstances, to accomplish our intention, would of itself enable us always to perceive the fact, and in some degree to measure the amount, of any resistance to our voluntary movements; howbeit the concomitance of certain feelings with the different states of muscular tension, renders this cognition not only easier, but, in fact, obtrudes it on our attention.'

The difficulty that I feel, with reference to this distinction, is to recognise any muscular sense remaining after the feeling of expended energy is subtracted. I know of no fact that would suffice to substantiate Sir W. Hamilton's assumption, that we have a feeling of the state of tension of a muscle, independently of our feeling of motive power put forth. It may be quite true that sensitive nerve filaments are supplied to the muscles as well as motor filaments, and that through these we are affected by the organic condition of the tissue, as in the first class of feelings above described; but it does not follow that we obtain by the same filaments a distinctive feeling of the degree of the muscle's contraction.

The sense of expended energy I take to be the great characteristic of the muscular consciousness, distinguishing it from every mode of passive sensation. By the discriminative feeling that we possess of the degree and continuance of this energy, we recognise the difference between a greater and a less stretch of muscular tension, and no other sensibility seems to me to be called for in the case.

I may here express the obligations we are under to Sir William Hamilton for his historical sketch of the doctrine of the Muscular Sense contained in the same note; which is not the least valuable and interesting of his many contributions to the history of mental and metaphysical science.

CHAPTER II.

OF SENSATION.

BY Sensations we understand the mental impressions, feelings, or states of consciousness resulting from the action of external things on some part of the body, called on that account sensitive. Such are the feelings caused by tastes, or smells, sounds, or sights. These are the influences external to the mental organization; they are distinguished from influences originating within, as, for example, spontaneous activity, the remembrance of the past, or the anticipation of the future.

The Sensations are classified according to the bodily organs concerned in their production; hence the division into five senses. But along with distinctness of organ we have distinctness in the outward objects, and also in the inward consciousness. Thus objects of sight are different from objects of smell; or rather we should say, that the properties and the agency causing vision are different from the properties causing smell, taste, or hearing.

The difference of the mental feeling or consciousness in the various senses is strongly marked, being a more characteristic and generic difference than obtains among the sensations of any one sense. We never confound a feeling of sight with a feeling of sound, a touch with a smell. These effects have the highest degree of distinctness that human feelings can possess. The discrimination of them is sure and perfect.

We are commonly said to have five Senses, these being apparent to every observer: Sight by the eye, Hearing by the ear, Touch by the skin, Smell by the nose, Taste by the mouth. In addition to these, physiologists distinguish a sixth sense, of a more vague description, by the title of *common* or *general sensibility*, as will be seen in the following extract from Messrs. Todd and Bowman. 'Under the name of *common* or general sensibility may be included a variety of internal sensations, ministering for the most part to the organic functions and to the conservation of the body. Most parts of the frame have their several feelings of comfort and pleasure, of discomfort and pain. In many of the more deeply seated organs no strong sensation is ever excited, except in the form of pain, as a warning of an unnatural condition. The internal sensations of warmth and chillness, of hunger, thirst, and their opposites, of nausea, of repletion of the alimentary and genito-urinary organs, and of the relief succeeding their evacuation, of the privation of air, &c., with the bodily feelings attending strongly excited passions and emotions, may be mentioned among the principal varieties of common sensation.'

In this enumeration we can see several distinct groups of feelings, and can refer them to distinct bodily organs. Hunger, thirst, their opposites, nausea, repletion, and evacuation of the alimentary tube, are all associated with the *digestive* system. They might therefore be termed the digestive sensations. The privation of air causes a feeling whose seat is the lungs, and is only one of many kinds of sensibility associated with *respiration*. The sensations of warmth and chillness connect themselves partly with the lungs and partly with the organic processes in general, more especially, perhaps, the circulation and the various secretions. The genito-urinary organs have a class of feelings so very special and peculiar, that they had better not be included under common sensibility.

Looking at the very important classes of feelings here indicated, important at least as regards human happiness and misery, considering also that they are but a few examples chosen from a very wide field, it appears to me to be expedient to take them up in systematic detail, and for that purpose to provide a place for them among the Sensations. It is the business of a work like the present to review the entire range of human sensibility, in so far as this can be reduced to general or comprehensive heads; and the only question is, where ought these organic feelings to be brought in? I know of no better arrangement for them than to include them among the Sensations. The only apparent objection is the want of outward objects corresponding to them in all cases. The feelings of comfort or discomfort arising from a circulation healthy or otherwise, are not sensations in the full meaning of the term; they have no distinct external causes like the pleasures of music, or the revulsion of a bitter taste. But the reply to this objection is, first, that in many cases, if not in all, an external object can be assigned as the stimulus of the feeling: for example, in all the digestive feelings, the contact of the food with the surface of the alimentary canal is the true cause or object of the feeling. In like manner, the respiratory feelings may be viewed as sensations having the air for their outward object or antecedent. And with reference to the cases where feeling cannot be associated with any external contact, as in the acute pains of diseased parts, what we may plead is the strong analogy in other respects between such feelings and proper sensations. In all else, except the existence of an outward stimulus, the identity is complete. The seat of the feeling is a sensitive mass, which can be affected by irritants external to it, and which yields nearly the same effects in the case of a purely internal stimulus. So much is this the fact, that we are constantly comparing our inward feelings to sensations; we talk of being oppressed, as with a heavy burden, of being cut, or torn, or crushed, or burned, under acute internal sensibility. Taking all these considerations together, I feel satisfied of the propriety of the common view which classes these feelings with sensations. In carrying out this conviction, I shall place them first in the order of the Senses, under the title of Organic feelings, or Sensations of Organic Life.

In the Senses as thus made up, it is useful to remark a division into two classes, according to their importance in the operations of the Intellect. If we examine the Sensations of Organic Life, Taste, and Smell, we shall find that as regards pleasure and pain, or in the Emotional point of view, they are of great consequence, but that they contribute very little of the permanent forms and imagery employed in our intellectual processes. This last function is mainly served by Touch, Hearing, and Sight, which may therefore be called the Intellectual Senses by pre-eminence. They are not, however, thereby prevented from serving the other function also, or from entering into the pleasures and pains of our emotional life.

SENSATIONS OF ORGANIC LIFE.

1. The classification of these is best made to proceed according to the parts where they have their seat We have already alluded to the organic feelings connected with one tissue, the muscular ; we ought now to notice the other tissues entering into the moving apparatus, namely, the *Bones* and *Ligaments.* The *nerves* and *nerve centres* are subject to feelings dependent on their growth and waste, and on the changes that they go through in health and disease. The *Circulation of the Blood,* with the accompanying processes of secretion, assimilation, and absorption, may be presumed to have a distinct range of sensibility. The feelings connected with *Respiration* are of a less ambiguous character than the foregoing. The sensations of *Digestion* are numerous and prominent.

2. I will pass over with very few remarks the *Bones* and *Ligaments,* whose sensibility would appear to be almost exclusively connected with injury or disease, appearing in that case under the form of acute pain, a form of sensibility that it will suffice to have dwelt upon once for all. The minute discrimination of forms of pain is highly serviceable to the physician, and, if susceptible of being accomplished with precision, would enter with propriety into a systematic delineation of the Human Mind; at present it will be sufficient to remark, that sensibility everywhere demands a distribution of nerve fibres, and that the bones and ligaments are supplied with these, and although not in great number, yet sufficient to agitate the nerve centres with overpowering intensity on particular occasions. The diseases and lacerations of the periosteum give birth to excessive pains. The ligaments are said to be insensible to the cut of a knife, while the feeling of their being wrenched is most acute and painful. In extreme fatigue, the ligaments and the tendons of the muscles would

appear to act along with the muscular tissue in giving rise to the disagreeable feeling of the situation. The joints are noted on various occasions as the seat of pain. The diminution of atmospheric pressure consequent on ascending a great elevation causes an intense sensation of weariness in the hip joints. Fracture of the bones and laceration of the ligaments are among the most agonizing misfortunes of our precarious existence.

Organic Sensations of Nerve.

3. The nerves and nerve centres, apart from their action as the organs or medium of all human sensibility, have a class of feelings arising from the organic condition of their own tissue. Wounds and diseases of the nerves are productive of intense pains, witness tic douleureux and the neuralgic affections of the brain and spinal cord. Nervous exhaustion and fatigue produces a well known sensibility, very distressing in its extreme forms; and repose, refreshment, and stimulants engender an opposite condition through a change wrought on the substance of the nerve tissue.

The nervous pains arising from cuts, injuries, and disease of the substance are characterised by a most vehement intensity. It would appear that a conducting nerve fibre is never so powerfully agitated as when the irritation is directly applied to itself. When a muscle is spasmodically contracted, the influence passes from the muscular fibre to the nerve, and the affection of the nervous fibres is then only secondary; but in neuralgic affections the influence comes at first hand, and not by propagation from some other tissue. The pains of the nerves are of all degrees according to the irritating cause, but it is their nature to be more strongly felt than most other pains.

4. *Nervous fatigue* and exhaustion when carried beyond a certain pitch is an extremely trying condition. It is produced by excessive expenditure in one or other of the forms of nervous exercise; by emotions, by over-much thought, or by too long continued activity of either body or mind. The effect is doubtless to modify the nerve substance and its circulation,

but in what precise way we cannot undertake to point out, The resulting sensation can be more readily described. The most painful aggravation of the state occurs when a morbid activity is generated beyond the control of the individual, hurrying him for a time into still greater depths of painful exhaustion.

This state of mind merits a full and orderly delineation. Commencing as usual with the great characteristic distinction of pleasure and pain, we must attribute to it an exaggerated form of the latter. This pain is marked not by acuteness or intensity, but by massiveness or quantity. It is a wide spread and oppressive sensation, seeming to involve the entire nervous system. We are very strongly alive to it, a character probably belonging to all affections of the nerve substance. Its peculiar quality or tone cannot be seized by any descriptive phrase. I must appeal to each person's own experience for the perception of it. The re-action of an intense excitement, the exhaustion of a severe loss or grievous mortification, will bring up an instance of it to most minds. It will also be illustrated by contrast with the opposite state to be next treated of. The expression of the feeling is one of pain, not acute but deep seated and engrossing; collapsed features, restlessness, fretting, and melancholy. The action suggested is usually something quite extravagant and misplaced: the getting rid of life itself is one of the most natural desires when the condition assumes its most virulent forms. This is a proof of the total loss of freshness and tone through the entire substance of the nervous system, the final triumph of ennui.

I am aweary, aweary, O God that I were dead.

As regards intellectual marks and peculiarities, the condition is by no means one that has an intellectual persistence; when it recurs in idea, there is apt to be something of the reality at bottom. The most obvious comparison that the state suggests is to excessive burden or toil in the moving organs.

To fix by a precise delineation this condition of organic nervous exhaustion is an extremely important attempt, notwithstanding the difficulties arising both from the imperfection of our language and from the fluctuation and various nature of the condition itself. The importance lies in this great fact, that the state is the termination or final issue of a great many other forms of pain. The struggle that we maintain against painful inflictions of all kinds, whether bodily or mental, preys at last on the substance of the nervous system, and produces as its result this new form of evil. Hence the common source of complaint with all classes of sufferers,—the weariness, the ennui, the heavy tread of time, the impatience, the impossibility of being effectually soothed or comforted.

5. The consciousness arising out of the *healthy and fresh condition of the nerve tissue*, or out of the operations of the various artificial stimulants, is the exact contrast of the state now described. I do not enquire into the use and abuse of those stimulating materials, but merely advert to the effect common to them all, and for which they are had recourse to; an effect also to be reaped from the natural condition of the nervous organs when in their unexhausted vigour, as may be seen more particularly in early life. Emotions may likewise contribute to the same exaltation of the cerebral activity; but we must endeavour to distinguish between the purely nervous condition and the influence exercised upon the nerves by the various sensations and emotions. I am here considering causes unquestionably physical or material, such as can have no other action but on the organic condition of the nerve fibres and centres.

Following a parallel course of description, therefore, we may say of the state in question that the outward causes or antecedents are either healthy agents, or stimulants and drugs; and that the change in the tissue is of a physical nature, but not capable of being otherwise specified. The consciousness itself, is pleasurable, massive, and strongly felt. The expression, as might be expected from an exalted nervous activity, is lively and animated, and of the cheerful and pleasurable cast. The action and desire that it prompts are for continuance unlimited, and the cast of thought is hopeful for the future. The intellectual persistence is, as in the other case, extremely low; that is to say, the state is one difficult to be remembered or imagined when once entirely gone, and when either the opposite condition or some intermediate neutral one has taken the place of it.

Organic Feelings of the Circulation and Nutrition.

6. The circulation of the blood through the arteries and veins by the force of the heart, the secretion of nutritive material and of excrementitious matter in the several tissues and glands, and the various acts of absorption corresponding to those processes,—cannot be unattended with feeling. But the sensation arising out of the different degrees of vigour attending this course of operations is both vague and difficult to isolate. We may surmise with some probability that the depression of a low pulse and languid circulation has its seat in the capillaries situated all over the body, or is a sensation of the circulating machinery. To the same connexion we may assign the feelings of starvation when not reducible to the alimentary sensation of hunger. Thirst, also, is a feeling whose seat passes beyond the region of the stomach, and oppresses the entire system wherever the blood takes its course. The nerves distributed to the various tissues, muscular, glandular, mucous, &c., give note of the condition of those tissues as regards nutrition and the absorption of waste, in other words as regards the vigour of the blood's action in those parts. We may centralize all such indications, when they are general to the whole body, in the sufficiency of the composition and current of the blood.

The feelings of inanition and thirst are the most specific of all those that we can refer to this great function ; feelings not so much of the acute character, as of pervading, massive, deep, and intolerable wretchedness. They are far more intense than mere nervous depression, and therefore stimulate a more vehement expression and a more energetic activity. Even when not rousing up the terror of death, they excite lively and furious passions. The unsophisticated brute is the best instance of their power. Like other organic states, they are not very easily realized after they are gone, but the fear, and stir, and energy that they produce at the time leaves a much more lasting impression than mere low spirits; we take far greater precautions against them than against nervous depression, which last is perhaps the least provided for of all human pains.

The consciousness growing out of a vigorous circulation, with all that this implies, may be looked upon as the most characteristic sensation of pure animal existence. It is more continuous and persistent than good innervation, sound digestion, or than most of the other organic states. There is a thrill of corporeal gratification, not very acute, but of considerable volume, a gentle glow felt everywhere, rendering existence enjoyable, and disposing to serene and passive contentment.

> Let me have men about me that are fat;
> Sleek-headed men, and such as sleep o' nights.

It seems to be through the circulation that we are sensitive to atmospheric changes, more particularly as regards moisture and dryness. It is found that in a dry atmosphere the capillary circulation is quickened, and in a moist atmosphere retarded. The influence of heat and cold tells more through the lungs, whose sensations are next to be considered.

Feelings of Respiration.

7. 'Respiration is that function by which an interchange of gases takes place between the interior of an organized being and the external medium; and in the animal kingdom oxygen is the gas received, and carbonic acid the gas given out.' The aeration of the animal fluids or juices is an essential of their vitality; if this is put an end to, death ensues instantaneously, if insufficiently performed, the vigour of the animal is lowered; and a peculiar painful sensation experienced. In man and in air-breathing animals, there is a wind apparatus, the lungs, inflated and contracted by muscles so as to suck in and force out the air by turns.

In this action we have all the particulars necessary to constitute a Sense: *an external object,*—the air of the atmosphere,—which operates by physical contact upon the lining membrane of the tubes and cells of the lungs; *an organ of sense*, and a resulting *state of feeling*, or consciousness. The peculiarity of the case lies in its being almost entirely an emotional sense; generating feeling rather than yielding knowledge, or providing forms for the intellect; ranking therefore among the lower, and not the higher, senses.

As respects the *object* of this sense, the external air, it need only be remarked, that this differs considerably in its quality for breathing purposes, the chief point of difference being expressed by the term 'purity.' The purity is affected first by the loss of oxygen, which happens when the same air is repeatedly breathed, or otherwise consumed; secondly, by the accumulation of carbonic acid, from the same circumstance; and, thirdly, by the presence of foreign gases and effluvia arising from animal life, vegetation, or other causes. Closeness or confinement is the chief aggravation of all those impurities. Of the three evils,—the loss of oxygen, the accumulation of carbonic acid, and the generation of effluvia of animal and other substances,—the second is the least injurious; for although the production of a carbonic acid atmosphere, by burning charcoal in a close room, is fatal to life, yet the quantity ordinarily occurring in rooms is not found to do any harm if mixed with air otherwise pure. The loss of oxygen, and the diffusion of the gases of decay, are the main influences that deteriorate the atmosphere.

Of the *organ* acted upon, the lungs, a minute description is not necessary for our present purpose. The structure is so arranged by ramifications and doublings as to present a very extensive surface to the air; the surface consisting of a thin membrane, with capillary blood-vessels, thickly distributed on its inner surface. The exchange of gases takes place through the double medium of membrane and capillary tube. The muscular apparatus for sustaining the bellows-action, is the diaphragm and abdominal muscles, and the muscles of the chest or ribs. The integrity and vigour of these muscles, and of the centres that sustain and time their action, must be reckoned as a condition of healthy respiration.

The *feelings* of Respiration, both pleasurable and painful, are well marked. They include the gratification of pure air enhanced by the increased action due to muscular exercise; the various shades of oppression from over-crowded rooms and unwholesome gases, and the distressing experience of suffocation; besides the pains attendant on the many diseases of the lungs.

8. The influence of pure and stimulating air abundantly inhaled, spreads far and wide over the system, elevating all the other functions by the improved quality imparted to the blood. The indirect consequences do not altogether hide the grateful sensibility arising from the lungs themselves, and referred by us to the region of the chest; a sensation not very acute or prominent, but possessing that choice and well known quality, expressed by the term 'freshness,' or 'refreshing.' This quality manifestly implies a contrast; for it is most strongly felt when we pass from a lower to a higher degree of aeration. No technical nomenclature can increase the conception possessed by every one of this remarkable sensibility; but for the sake of comparison with the other parts of our mental constitution, an attempt at verbal description is necessary. The main feature of the description turns upon the contrast of the greater activity of the lungs with an immediately preceding activity of an inferior degree; and we derive here an example of a class of feelings not as yet dwelt upon in our exposition—the feelings of *relief*,—where the entire force of the sensibility rises out of the change from a state of pain or oppression to its opposite, or from a feeble to a powerful stimulus. It may be doubted whether much feeling resides in the lungs, after a given pace has been established for a length of time, but any acceleration of the rate of exchange of the two gases (by no means depending altogether on the rate of breathing) does for a time yield that delightful freshening sensation, which tells so immediately on the mental system as a contribution to our enjoyment, and a

stimulus to our activity and desire for rural recreation and bodily exercise.

9. The feelings of insufficient and impure air are manifested in the forms of faintness, sense of exhaustion and weariness, and are doubtless due not to the lung-sense alone, but to the lowered condition of the body at large. The characteristic sensibility of the lungs is manifested in the state termed *suffocation*, which will sometimes manifest itself clearly in the midst of a complex mass of other painful sensations. It is this state, therefore, that we must now particularly allude to, as perhaps the true foundation of the forenamed sensibility of freshness, seeing that this last is a feeling of relief. Suffocation is felt in the absence of air, as in drowning, in an atmosphere deteriorated by poisonous gases, such as chlorine or sulphurous acid, in attacks of asthma, and in voluntarily holding in the breath. 'After holding the breath for fifteen or twenty seconds during ordinary respiration; or forty seconds after a deep respiration, there arises an insupportable sensation over the whole chest, concentrated under the sternum, and no effort can maintain the interruption of the respiratory acts. This urgent sensation of want of breath when carried to its full extent by any mechanical impediment to the aeration of the blood is one of the most painful and oppressive kind, and is referable to the pulmonary plexuses (of nerves) distributed to the bronchia, and perhaps on the walls of the lobular passages and cells. The impression made on these peripheral nerves by the absence of oxygen, and the undue presence of carbonic acid in the air in contact with them, is propagated to the spinal cord and medulla oblongata by the sympathetic and vagus, and there excites those combined actions of the muscles of inspiration which lead to the renewal of the air.'* This sensation, so painful, intense, and keen, is aggravated, in the extreme cases, by the circumstance of growing worse every moment until relief or rupture ensue. It may rank as the most unendurable of all

* Todd and Bowman, ii. 403.

human sensations; while the fact that causes it, is the most dangerous to human life of any that can occur. The painfulness of the sensation would suffice to set on a train of voluntary actions, and to prompt the most urgent desires for relief; but this is not entirely left to the will, for the reflex nervous system is powerfully called into play on the occasion. This reflex action consists, as above stated, in an increased stimulus of the respiratory muscles; which however is not in all cases the thing demanded. When the suffocation arises from some pungent odour, the reflex stimulus is a mistake, and we must overpower it by the voluntary effort of holding the breath for a time, till we have got out of reach of the mischief. In the suffocation of a crowded room, the increased action is appropriate: like the accelerated breathing of consumptive patients, this compensates for the small quantity of oxygen gained by a single breath.

10. The present appears to me not an inappropriate place for bringing in the important feelings of Cold and Heat, whose description is not to be omitted among our Sensations. Under the sense of Touch, these feelings have to be adverted to as a certain class of sensations of contact with the skin; here we propose to deal with them as affecting the body throughout.

To commence with *Cold*. The outward cause of this feeling is some influence tending to lower the temperature of the body. The natural heat of the blood is about 98°, and any contact below this point feels cold: any contact above it feels warm. There is a certain surplus heat generated in the human system, which enables us to live in a medium below 98°, without feeling cold, and if this heat be husbanded by clothing, a very great depression of external temperature may be endured. A room is warm at 60°. The outer air can be endured at freezing and far below, either by means of exercise, which evolves heat, or of clothing, which retains it.

An acute cold acts like a cut or a bruise, injuring the part affected, and producing intensely painful sensations of the same class as arise from violent local injuries. The temperature of freezing mercury would destroy the skin, like boiling water, or a sharp cut. This case needs not any special discussion at the present stage.

The proper sensation of Cold arises from a general cooling of the body, or any considerable part of it, below the point suitable to healthy action. The term 'chillness,' expresses the fact precisely. How this cooling operates upon the various tissues, upon the circulation, and the different nutritive functions, I am not distinctly informed. We may safely infer, that the vital activities are impaired by it in some way or other—that it makes the blood to stagnate, suspends or vitiates the secretions, lowers the tone of the nerves—in short, deranges the organic processes, like disease or insufficient nutriment. No doubt the mode of derangement is something distinct, for I scarcely know any other action that can imitate the sensation of chillness, although such there may be, just as there are derangements that appear to imitate the effects of too great heat.

The feeling or sensation of chillness has a well-marked character, and a generical distinctness. It is as a general rule of the painful class, being not acute but massive and powerful, and strongly felt. Our body appears as if very raw and sensitive in the matter of temperature. The feeling of cold engrosses the sensibility of the frame; we find a difficulty in keeping the attention upon anything else. It has not the unendurable character of acute pains, nor the terrible influence of suffocation; nor can it rank with nervous depression unless intense enough to produce that special effect. But it can neutralise many pleasures; neither rest in fatigue, nor food in hunger, can satisfy a frame very much chilled with cold. The imagination can scarcely picture any satisfying scenes of enjoyment; the entire world seems comfortless. The expression of cold is chiefly the physical action of shivering, arising from its influence on the nerves; occasionally, too, there is hysteric laugh; beyond these there is nothing specific or different from the other forms of depression. The activity suggested is of course to get warm by some means or other; but the influence of the state is often paralysing to exertion.

In regard to the permanence of the impression, or the power of reviving in idea a state of depressing chill, although like all the other organic sensations, it is difficult to realize when not felt, yet the abiding impression is quite sufficient to induce constant and extensive precautions against this disagreeable condition. I have said above, that there are pains that are very much neglected when once gone, and I gave the case of nervous exhaustion as an example; but this is by no means true of cold. Of all the disagreeables hitherto treated of, this one seems to me to rank very high in the estimate of precautionary prudence, which is the strongest proof either of its endurance as an idea, or of its reality being always so close upon us as never to be long out of mind.

There is a secondary action of chillness, which alters considerably the character of its sensation. Cold is a stimulant of nervous action, and provokes an increased activity of the lungs and the circulation; also inducing bodily and mental exertion. When not too great, the stimulus is a wholesome and invigorating one, and heightens the powers of life, and all the sensations of energy and vitality. Hence the influence of cold air, cold climates, and cold water in sustaining the tone of the human constitution. The sensation of cold is not altered, but other states are induced which cause it to be no longer an object of revulsion and dread.

11. The consequences of *Heat* are in nearly every particular exactly the opposite of those now stated. Acute or intense heats agree with intense colds in being simply destructive and painful. Within the point of injury to the tissues, heat is a pleasurable sensation. The pleasure of heat, like the pain of cold, is both massive and keen. There is, however, a noticeable distinction of cases, some distinguished by intensity, and others by quantity; indeed, this distinction of quantity and intensity, used all through this work as a part of the description of conscious states, has its perfect type in the case of temperature, there being a physical reality corresponding to the mental fact. Sometimes we have great intensity and small quantity, as in the scorching rays of a fire, or a cup of hot tea: at other times we have large quantity with low

intensity, as in a hot bath, a warm room, a warm bed. The hot bath is the extreme instance. By no other contrivance can such a mass of heat be brought to bear upon the human system; consequently this presents the sensation of warmth in its most luxuriant form; a sensation cherished with intense avidity while it lasts, and surrendered with great reluctance. It is the intoxication of animal heat. We are unavoidably led to assume that this warmth must act in a very direct way upon the nerves; for it is not to be supposed that the organic processes are so very much furthered by the sustained temperature as to exalt the pleasurable consciousness to so remarkable a degree. I prefer rather to assume that both the cold shiver and the warm glow are due in a great measure to a direct influence of temperature on the substance of the nerves; although, as above remarked, there can be no doubt of the deranging influence of cold upon organic life. Nevertheless, we may derange the system by excessive heat, without producing the painful feeling arising from cold; the instances of scorching fires, hot liquors, and a burning sun will satisfy most people on this head.

As cold increases the action of the lungs and the circulation, so warmth enfeebles both; and hence, with all its pleasurableness, makes the body less disposed to action, as is seen in summer heat and in tropical climates. This effect, however, is not without a good side; for in the case of morbid activity of the nervous system, warmth is a soothing influence, either by its physical effects, or by the nature of the sensation, which, like repose, is eminently satisfying and anti-volitional, or from the physical and mental effects combined.

Sensations of the Alimentary Canal.

12. Digestion offers all the conditions of a sense. There is an external object,—the Food; a distinct organ of sense,—the Alimentary Canal and its appendages; and a set of Feelings arising from the contact, also distinct and specific. To treat these feelings under Taste is to confound together two senses totally different in their character, although happening to have one common object or stimulant.

13. The objects of this sense are the materials taken into the body as food and drink. These materials are extremely various, but there is no corresponding variety in their action on the stomach. They can be reduced to a few general heads, according to their composition, it being found possible to assign a few leading substances which comprehend all the different sorts of material serviceable in nourishing the body. The following is an abstract of this classification :—

1st. *Water* and the watery liquids, including the substances conveyed in solution, or suspension, in water.

2nd. *Saccharine* substances, derived from the vegetable kingdom. This comprehends sugars, starch, gums, vinegar.

3rd. *Oily* substances. These include the various fats and oils, as well as alcohol. Like the former group, they are composed of carbon and the elements of water, but in them the carbon is in a much higher proportion.

4th. *Albuminous* substances, containing nitrogen : fibrine, gelatine, albumen, caseine (matter of cheese), vegetable gluten, 'all the materials which make up this group are derived generally from the animal kingdom, with the exception of the last, which is contained in great abundance in wheat; similar if not identical, principles exist in other vegetables. Wheat, indeed, consists of two substances—one referable to the saccharine group, the other to the albuminous, the former consisting of starch, the latter of gluten.'

Milk is found to contain matter of all the four classes: water, sugar, oily matters (butter), caseine.

The three first classes are incapable of nourishing the principal animal tissues, such as nerve, muscle, &c. They are fitted rather for supplying fat, bile, and matters used in the production of the carbonic acid that escapes from the lungs. They are chiefly destined for the creation of animal heat, which in the main seems to arise from the conversion of carbon into carbonic acid. The fourth class, or the albuminous substances, are the proper elements of nourishment, having a composition fitting them for that purpose.—TODD and BOWMAN, II. 152, 3.

The differences that exist among the infinity of articles used as food are not at bottom so great as they seem. If we take the different species of grain,—wheat, barley, rye, oats, rice, maize, millet, we shall find they are all composed of the same ultimate materials, gluten and starch, though not in the same proportions. In like manner the potato is a starchy vegetable, with a very small share of gluten, hence the defective character of it as an article of nourishment. Another difference among vegetables relates to their texture, as fitting them for being acted on during mastication and digestion,—a circumstance, however, which cooking can modify. Thus the potato is a much looser texture than grain. A third point of distinction among alimentary substances is the extraneous essences that may enter into them and affect the sense of taste and the general relish, as in the difference between mutton and beef, chicken and venison, brandy and rum. Such elements belong more to Taste than to Digestion, although this last function may be influenced by extraneous additions, as mustard and spices.

14. I extract from Quain's *Anatomy* the following general view of the *Organs of Digestion.*

'The *digestive apparatus* includes that portion of the organs of assimilation, within which the food is received and partially converted into chyle, and from which, after the chyle has been absorbed, the residue, or excrement, is expelled. It consists of a main or primary part named the *alimentary canal*, and of certain accessory organs.

'The alimentary canal is a long membranous tube, commencing at the mouth and terminating at the anus, composed of certain tunics or coats, and lined by a continuous mucous membrane from one end to the other. Its average length is about thirty feet, being about five or six times the length of the body. The upper part of it is placed beneath the base of the skull, the succeeding portion is situated within the thorax, and the remainder is contained within the cavity of the abdomen. In these several situations, its form, dimensions, and connexions, its structure and functions, are so modified, that certain natural divisions of it, bearing different names, have been recognised by anatomists.

'It may he considered as composed of two parts; one situated above the diaphragm, and the other below that muscular partition, and therefore within the abdomen. The first division consists of the organs of mastication, insalivation, and deglutition; and comprises the *mouth*, the pharynx, and the *œsophagus*, or gullet. The second division consists of the organs of digestion, properly so called, and of those of defæcation; viz., the *stomach*, the *small intestine*, and the *great intestine*.

'The accessory parts are chiefly glandular organs, which pour their secretions into it at different points. They consist of the *salivary glands* (named the *parotid*, *submaxillary*, and *sublingual*), the *liver*, and the *pancreas*. Besides these large glandular organs, a multitude of small glands, compound, follicular, or tubular, are collected together at certain points, or scattered over large portions of the inner surface of the alimentary canal: these are described along with the mucous membrane of each part. The remaining accessory organs are the *teeth*, the *jaws*, the *tongue*, and the *spleen*.'—p. 965.

15. The physiology of digestion must be very briefly stated here. The first stage is mastication, which serves the double purpose of breaking down the food and mixing it with saliva; the function of the saliva is now known to be to convert the starch into grape sugar by a process of the nature of fermentation. The effort of mastication is purely voluntary, but when the food gets upon the back part of the tongue it is passed into the bag of the pharynx, and propelled down the gullet into the stomach by involuntary muscular contractions. In the stomach it is exposed to the action of the gastric juice. This peculiar action is not as yet fully understood, but so far as the researches of physiologists have yet gone, the most reasonable conclusion is, that 'in man and the carnivora the fluid secreted by the stomach during digestion simply dissolves animal and vegetable substances of the azotized kind, so as to render them capable of absorption, without materially altering their chemical constitution, leaving starchy, oily, saccharine, and the allied substances but little or not at all acted on.' The matter that leaves the stomach to pass into the intestines, is known by the

name of *chyme.* This is very soon mixed up with two other secretions, the pancreatic juice and the bile from the liver. In the stomach and along the intestine there is an absorption going on, by two different ways. The one is by the lacteal vessels: these have the exclusive power of taking up the fatty matters, which constitutes the chief part of the *chyle,* as their contents are named. The other is by the capillary blood vessels, by whose means the nutritive matter is taken at once into the circulation, but before reaching the heart it passes through the liver. The use of the pancreatic juice, which is poured into the intestine near its commencement, is to co-operate with the salivary glands in dealing with the starchy constituents of the food, and to contribute probably along with other fluids to the digestion of the fat. The functions of the liver are more complex and obscure. The bile appears to aid in the digestion of the alimentary matters; its abundant hydro-carbonous ingredients are in great part absorbed in its passage along the intestine, while other constituents are finally discharged as excrementitial. The liver is further believed to form sugar and fat out of other elements passing into it by the circulation. In coursing through the intestine by the successive contractions of the tube, the material is lessened by absorption into the lacteals and blood vessels; at the same time it gathers new matter by secretion from the coats of the intestines, which matter is of the impure kind, and is destined to pass out of the system along with the husk and undigested remainder of the food. The extremity of the great intestine is called the rectum, and on it are brought to bear the muscles of final expulsion.

It is important to be remarked before passing to the consideration of the states of consciousness allied with digestion, that only the upper and lower ends of the alimentary canal are supplied with cerebro-spinal nerves. The vagus nerve is largely distributed to the stomach, and nerves from the same system to the rectum, but the intestine receives its supply from the sympathetic system. This corresponds with our experience of alimentary sensations, which are concentrated chiefly in the two extremities of the canal, while the intervening thirty feet of intestine is almost entirely without sensation in ordinary circumstances. The movements of the intestine are kept up by means of the sympathetic system of nerves.

16. And now with regard to the Feelings of Alimentary action. These are of the pleasurable kind when the action is healthy; disease and disorder bring on a countless multitude of pains.

Discussing first the sensation of taking food, we shall find a pretty general agreement as to its character. I do not speak of the feeling of Taste, but of the sensibility connected more particularly with the stomach, and which extends even to the mouth in connexion with salivation, and is spoken of as the *relish*. If we include the entire mass of sensation arising from a healthy meal, and lasting a certain time after the meal is finished, at which stage the operation of digestion in the stomach is the sole cause of what we feel, we may safely pronounce it to be an agreeable state of a high order. It has in a high degree the characteristic of massiveness, or amount, being a rich, luxuriant, satisfying sensation. If we were to assign the precise and specific quality assumed by it after the first edge of appetite is over, we should compare it to the sensation of genial warmth, which it appears very closely to resemble, a feeling still more enhanced by the addition of alcoholic stimulants to the food. There is manifestly a great similarity of effect on the nervous system by the three very different actions—of warmth, the digestion of food, and alcohol. Such is the character common to all kinds of healthy nourishment; but there is the greatest possible difference in the qualities of food as regards stomach relish; from turtle to stale oat-cakes, or a piece of black bread, what a mighty interval! We cannot pretend to assign the difference of digestive action that corresponds to such unequal degrees of sensation. To the richer kinds of food belong a feeling intense and keen as well as voluminous, warm, and engrossing. The magnitude of the sensation is attested by its power to submerge a great many irritations, and make itself for the time the ruling element of the consciousness. This power belongs only to the more massive kinds of sensation, such as healthy exercise and repose, nervous elation, or the intoxication of warmth.

The Expression of this state is one of complacent satisfaction without much vehemence. In taking food, the movements are absorbed in the act, and in sympathy with the parts concerned; afterwards there supervenes a passive tone and disposition.

The energy of Volition generated corresponds to the relish and to the stage of the operation. At first the stimulus to action is intense and even furious. Appetite is only inflamed by partial gratification; and until such time as the stage of fulness draws near, the pleasure only shows itself in supplying impulse to continue it. Eating is among the most characteristic examples of the general law of Feeling-prompted Action that we can produce, being not only for the avóidance of pain, but also for the glutting of a pleasurable sensation. There is thus in a single round of digestive feeling a volitional commencement and a serene termination, the one graduating into the other.

To complete the delineation of this mode of consciousness, we may notice the peculiarity of it as related to the Intellect. In doing this, however, we have only to repeat what has been said on most of the feelings hitherto discussed, that there is comparatively little permanence in idea when the state of the organs is such as to forbid the reality. But this statement we must also qualify with the remark made above on heat, that the reality is one that can never be long absent. As a general rule, it is true of digestive and all other organic sensations, that they are exceedingly powerful when present, and exceedingly little realized when absent. They are very unlike sights and sounds, loves and hatreds, and other states that the intellect can retain in the ideal form; to imagine with effect the relish of a feast when under nausea passes the power of the most vigorous mind.

The sensation connected with the lower extremity of the canal is chiefly of the nature of a feeling of relief.

Another important healthy sensation of the alimentary canal is *Hunger*, the state preceding in order the one just described. The cause and seat of hunger are doubtless in the stomach, but on what particular condition of the stomach is yet uncertain. The feeling itself is of the uneasy painful class, with a degree of massiveness and engrossment corresponding to stomachic feelings in general. It may have all degrees of intensity, but assuming some average condition to start from, we may fairly speak of it as a sensation both powerful and keen. We can distinguish it from the sense of lassitude and faintness arising from want of nourishment to the tissues, a sense that may often be mixed up with it. Hunger, like other painful feelings, provokes to action for its appeasement, the strength of the impulse being the measure of its absolute force in the region of volition. Not being so acute or intense as a cut, a cramp, or a burn, it does not stimulate an instant and violent proceeding; but the influence on the entire consciousness of the individual is great and commanding, and the voluntary effort thence arising is of the most resolute kind. To satisfy hunger and impart stomachic relish, is one of the constant aims of human activity.

17. These are the chief alimentary feelings of the healthy kind. Among those caused by derangement, we can only select some of the most conspicuous and characteristic instances. The feeling of *Nausea* and *Disgust* is an effect indicating some great disturbance in the usual course of digestive operations. This state is associated with the act of vomiting, an act that may take place, '1. from the introduction of certain substances into the stomach, some of which, as bile, mustard, common salt, not becoming absorbed, must act simply by the impression they make on the mucous membrane; 2. By the introduction of emetics, as Tartar emetic, into the blood, or by the presence of certain morbid poisons in that fluid; 3. By mental emotion, as that excited by the sight of a disgusting object; 4. By irritation at the base of the brain.'—TODD and BOWMAN, ii. p. 214. To these must be added sea-sickness. The act of vomiting is the result of a reflex stimulus directed towards the muscles that compress the abdomen in the act of expiration of the breath. These

muscles violently contracting while the exit of the air from the lungs is shut up, squeeze the contents of the stomach upwards towards the mouth. The sensation of vomiting is in most cases horrible in the extreme. It proves by a strong instance the power of stomachic influences on the nervous system. The sensation is one *sui generis*—no other feeling can at all compare with it. There are many forms of unendurable pain, but this has a virulence of its own, being both great in amount and intense in degree. Its connexion with the stomach gives it the peculiarity of destroying the appetite and relish for food, and of subverting nutrition at the fountain head. It manifestly extends its influence to the nervous system, and makes the nervous tissue itself the seat of intense depressing sensation. The activity of the body is for the time destroyed, the muscular system being utterly relaxed. There is a strong revulsive stimulus operating within an exhausted frame; a fact that, whenever it occurs, must needs exaggerate the misery of the sufferer.

The feelings of nausea and disgust, and the objects causing them, are expressed in our language by a variety of strong terms. The 'disagreeable' is originally what revolts the stomach, extended in its application to other forms of the unpleasing. 'Disgust' is the extreme opposite of relish. The fact that these words are among the strongest that the language affords to express dislike or aversion, proves how deep and intense is the feeling that they primarily refer to.

Besides the objects that produce disgust by actual contact with the alimentary canal, there are substances whose appearance to the eye is disgusting. Certain gases also affect the smell in the same way. Disgusting sights are mostly the result of association; but some nauseous smells act from the very beginning. The arrangements of human life, particularly address themselves to our protection against disgusts; and singularly enough, the chief things to be avoided are the products of living bodies themselves. This is the foremost aim of the operations of cleansing and the removal of refuse. The influences that stimulate a healthy digestion and relish are contrasted with the opposite by the term 'fresh,' which we spoke of already as a quality of respiration, but which has still more emphasis as opposed to the causes of disgust. The power of resisting nauseating influences is an indication of great stomachic vigour in the right direction.

There are many things entering into the *ugly* or opposed to the beautiful; but nothing contrasts with beauty so entirely, or annihilates it so effectually, as a disgust.

18. The foregoing cases are intended to include the most prominent of our habitual and ordinary experiences in relation to the alimentary processes. With regard to the feelings arising from disease in the various organs of digestion, these are so many forms and varieties of pain. If we were to go systematically through the entire series of organs enumerated above, we should have to commence with mastication, and describe the pains and agonies which the *teeth* render familiar to us. The pain of toothache, its peculiar intensity and virulence, would appear to have some relation to the proximity of the parts to the nerve centres; any irritation about the face or head seems, so far as I can judge, to carry a greater amount of excitement to the brain than a similar irritation in more distant parts would give birth to. Distemper of the salivary glands yields a sensibility, not of the acute kind, but annoying, and difficult to bear, like disordered secretions in general. The pains and disorders of the early stages of digestion, that is in the stomach where the sensitiveness is greatest, are very numerous, and are sometimes acute and oftener not so. In proportion to the genial influence of a healthy digestion upon the general mass of sensibility, is the malign influence of an unhealthy digestive action. It is in extreme cases altogether overpowering, and renders futile almost every attempt to establish a pleasurable tone by other causes. The nervous connexion between the brain and the stomach is extremely intimate and powerful; and shows itself in many aspects. Not only is there a keen sensibility to stomachic states, but also a strong returning influence from the brain upon the digestive secretions in the way of supplementing their force,

or giving them a stimulus from without.* This partial dependence of stomachic vigour upon a derived power from the cerebral mass is well attested by the tendency of an overworked brain to bring on disordered digestion—an effect that does not seem to arise so readily in other parts, as the muscles or the lungs. On this point, however, we must make allowance for differences of temperament. The stomachic sensibility will be found very unequal in different individuals, just as we find inequalities in the feeling of music, or any other sense. Some persons count the feelings of digestion a very small item among the sources of pleasurable excitement; but I am led to suppose from the prevailing attention to the choice and preparation of food, that for the great majority of people I have not overstated their importance.

On acute stomachic pains it is not necessary to spend much discussion. They have their character chiefly from the great sensibility of the alimentary surface, which often makes a slight cause of irritation peculiarly keen and intolerable. They are not so violent as lacerations, burns, and broken bones, nor so intense as cramps, nor so fearfully oppressive as suffocation, but for the moment they are sharp and agonizing. On the subject of pains and distempers not acute, but connected with want of tone and vigour in the digestive system, or with deranged mucous surface, the pathologist and physician have much to describe. The stomach, intestines, liver, &c., have each their various modes of distemper. But what chiefly interests us is to mark, as a specific mental experience arising out of many forms of alimentary derangement, the depression and ennui spread over the consciousness at the times when any of these organs are failing to perform their part. This effect is one that, if not intense or acute, is powerful in its amount, and extremely difficult to combat either by other stimulants or by the action of the mind recalling or imagining situations of a less gloomy cast. It either resembles or else produces, that

* Wagner states (*Elements of Physiology*, § 362), that 'Increased movements of the intestines have been observed when the corpora quadrigemina have been irritated.'

physical depression of the nervous substance already considered; the likeness holds remarkably in the leading features, as in the distaste for existence while the state lasts, and the extreme facility of forgetting it when it is gone. In the rational point of view hardly any sacrifice is too much to prevent the frequent recurrence of this state, but so little hold does it take as a permanent impression, that the reason has very little power in the matter. Any feeling of general depression is easily forgotten when the animal spirits have returned; the evil then seems to have neither a local habitation nor a name.

We have now gone through the principal states of feeling that enter into the general fact of physical Comfort or Discomfort. The most powerful constituent elements of these two opposite modes of existence are the feelings of the muscular system as regards health, exercise, and repose, and the various classes of organic sensations above enumerated.

Feelings of Electrical States.

19. We shall touch upon only one other class of feelings before passing from this subject, the feelings of Electric and Magnetic agencies. It is very difficult to say anything precise on this class of sensations, but their interest is such that we ought not to pass them unnoticed.

The *electric* shock from a Leyden jar is perhaps the simplest of all the electric effects; yet we are not able to describe the change that it produces on the tissues affected by it. When very severe it destroys life. The stroke of lightning is proved to be of the same nature. The peculiar feeling of this kind of electricity has its main character from the suddenness of the action; the painful effect is described as a shock or a blow. When pretty smart it leaves an unpleasant impression behind, such as to render us averse to a repetition of the experiment. There can be no doubt of the disorganising tendency of the influence when at all severe, and the impression is one that remains with us as a thing of dread, like a scald or the blow of a weapon. The *Voltaic* shock is very different, in consequence of the altered character of the discharge; an incessant current is substituted for an instantaneous shock. Still the painful character remains. The first contact causes a slight blow like the other, then succeeds a feeling of heat, and a creeping sensation of the flesh as if it were unnaturally wrenched or torn, which after a time becomes intolerable.* The peculiar distorting sensation is carried to the utmost in Faraday's *Magneto-Electric Machine*, where the current instead of continuing of one character is changed from negative to positive and from positive to negative a great many times every second. The sense of contortion from this machine may be described as agonising. Feebler discharges of this kind are employed as an electric stimulus in certain diseases. There seems to be a power in electricity to revive the action of torpid nerves, and after trying both common and voltaic electricity, for the purpose, Faraday's invention has been adopted in preference to either.

20. The electricity of the Atmosphere is believed the cause of quite other sensations than the shock of the thunderbolt. In some states, this influence is supposed to kindle a general glow in the human frame, while in other states the effect is painful and depressing. Many persons complain of a disturbed, irritated condition of body on the eve of a thunder-storm. The highly electrified state of the atmosphere in dry cold is generally considered as bracing; while part of the depression of moist sultry weather is attributed to the absence of electricity.* Much, however, remains to be proved in regard to these popular beliefs. The time of greatest influence on the human sensibility from this class of influences is the eve of an earthquake or volcanic eruption; in which case it is known that the earth's magnetism suffers violent disturbances. On these occasions feelings of depression amounting to nausea and sickness overtake both men and animals, as if some great stimulus of a supporting kind were suddenly withdrawn.

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* I am informed as the result of the observations at Kew Observatory, (adopted at the instance of the British Association for observing atmospheric electrical states), that the electricity of the air is always in proportion to the

21. The influence of magnetism has been applied to produce new and artificial sensations in such experiments as those of Baron Reichenbach; but as the same sensations have been caused by crystals, heat, light, chemical activity, and the living hand, they can hardly be assigned specifically to the magnetic action. Reichenbach records two different classes of feelings arising in his patients, according to the polar direction of the agent, the one cool, refreshing, delightful; the other in all respects the opposite.*

The action of the human hand and the stare of the eye are employed in the process of mesmerism, which has now come to be used as a source of sensation and a cure of disease. Being a soporific influence there is in the action also the included quality of soothing the nervous system under pain and irritation, and thus of inducing again the more healthy texture of the nervous substance.

SENSE OF TASTE.

This is a peculiar sense attached to the entrance of the alimentary canal, as an additional help in discriminating what is proper to be taken as food, and an additional source of enjoyment in connexion with the first reception of the nutritive material.

1. The substances used as food are more completely distinguished by the taste than by the digestion. The tastes of bodies are almost as widely different as is their chemical composition; but in order to have a taste, a substance must be either liquid or soluble in the mouth.

The bodies acting on the sense of Taste are innumerable. They are found in the mineral, vegetable, and animal kingdoms, and are distinguished from one another by means of this property.

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* I may remark, however, that although Reichenbach's experiments have been performed with an amount of care unknown before in this class of subjects, and rivalling the most approved scientific researches, yet it is still a doubt with many whether these effects be not due to imagination. Mr. Braid's admirable observations on the influence of ideas in producing bodily states show to what great lengths the power of imagination may go in a peculiar class of temperaments.—See his criticism on Reichenbach, and

'The upper surface of the tongue is covered all over with numerous projections, or eminences, named *papillæ.* They are found also upon the tip and free borders, where however they gradually become smaller, and disappear towards its under surface.' These papillæ are distinguished into three orders, varying both in size and form.

'The *large* papillæ, eight to fifteen in number, are found on the back part of the tongue, arranged in two rows, which run obliquely backwards and inwards, and meet towards the foramen cæcum, like the arms of the letter V.' 'The *middle-sized* papillæ, more numerous than the last, are little rounded eminences scattered over the middle and fore part of the dorsum of the tongue; but they are found in greater numbers and closer together, near and upon the apex.' 'The *smallest* papillæ are the most numerous of all. They are minute, conical, tapering, or cylindrical processes, which are densely packed over the greater part of the dorsum of the tongue, towards the base of which they gradually disappear. They are arranged in lines, which correspond at first with the oblique direction of the two ridges of the large papillæ, but gradually become transverse towards the tip of the tongue.'

'These different kinds of papillæ are highly vascular and sensitive prolongations of the. mucous membrane of the tongue. When injected, they seem to consist almost entirely of capillary vessels; the large papillæ, containing many vascular loops, whilst the smallest papillæ are penetrated by only a single loop. Nerves proceed in abundance to those parts of the tongue which are covered with papillæ, into which the nerve-tubes penetrate.' 'The papillæ are undoubtedly the parts chiefly concerned in the special sense of taste; but they also possess, in a very acute degree, common tactile sensibility.'—QUAIN, p. 999—1001.

3. With regard to the precise localities of the tongue where the sensibility resides, there has been some difference of opinion. 'We conclude generally,' say Messrs. Todd and Bowman, 'with regard to the tongue, that the whole dorsal, or upper, surface possesses taste, but especially the circumferential parts—viz., the base, sides, and apex. These latter

regions are most favourably situated for testing the sapid qualities of the food; while they are much less exposed than the central part to the pressure and friction occasioned by the muscles of the tongue during mastication. The central region, as a whole, is more strongly protected by its dense epithelium, and is rougher, to aid in the comminution and dispersion of the food.' But in addition to the tongue, 'the soft palate and its arches, with the surface of the tonsils, appear to be endowed with taste in various degrees in different individuals.'—I., 443.

The increasing sensibility of the tongue, from tip to back, serves as an inducement to move the food gradually onward in the direction of the pharynx, in order to be finely swallowed. The same sensibility, acting according to the general law of feeling-guided action, or volition, keeps up the mastication, whereby the sapid action of the food is increased by solution and comminution of parts. Thus it is that mastication is purely a voluntary act, while deglutition or swallowing is purely reflex and involuntary.

Among the conditions of taste, in addition to solubility, it is noticed that 'taste, like touch, is much influenced by the extent of surface acted on; and is also heightened by the motion and moderate pressure of the substance on the gustatory membrane.' In order to taste, also, the tongue must not be in a dry or a parched condition. 'The impression of cold air deadens the sense of taste.'

4. The precise mode of action, whereby the nerves of the tongue are stimulated, has not been as yet explained. Taste may be produced by mechanical irritation of the surface, as by a smart tap with the fingers on the tip of the tongue, and by galvanism. Looking at the substances that cause tastes, it appears probable, that their chemical constitution is the determining circumstance, whence it would seem that the action is a chemical one. A certain secretion from the blood vessels that line the papillæ of the tongue combines with the dissolved food, and the act of combination constitutes the stimulus of the nerve fibres. We know that a chemical action on any surface or tissue will suffice to stimulate a

nerve and produce sensation; and it is difficult to assign any other mode of stimulus either in taste or in smell.

5. Having thus considered the external objects of the sense, and the structure of the organ, it remains for us to proceed to the mental phenomena, that is the Sensations themselves. At the outset we are met with a complexity, which hardly belongs to any other sense. From what has been already said, the reader will gather if he has not otherwise remarked it, that the tongue is the seat of a twofold sensibility, taste and touch. I am disposed to go still further, and to ascribe to it a threefold sensibility, viz.—touch, taste properly and strictly so called, and *relish*, or a participation in the alimentary sensations; my reasons are such as the following. First, there is an obvious continuity of structure in the tongue and alimentary canal, a common character of surface, as regards mucous membrane, glands, and papillæ, which would imply some community of action and feeling, in the midst of diversity. 'We may here allude to a certain gradation that is apparent from the papillæ of touch, through those of taste, to the absorbing villi of the small intestines. Touch shades into taste, and at a lower point sensibility is lost.'—(Todd and Bowman, I. 441.) Second, the tongue, besides its power of discriminating niceties of taste that have very little reference to digestibility, has the power of telling at once whether a substance will agree or disagree with the stomach, and this it can do only by being as it were a part of the stomach, affected like it by wholesome or unwholesome contacts. Third, the peculiarity we call relish is not the same as a mere taste. For the type of taste, I may take such substances as common salt, quinine, soot, Epsom salts; for relishes, I would select butter, animal flesh; the savoury in cookery being made up much more of relishes than of tastes. The condition of the stomach governs the one but not the other. After an attack of sea-sickness, a person is still in a condition to discriminate sour, bitter, alkaline, or acrid, when the choicest food has no feeling in the mouth. Fresh, disgusting, nauseous, are terms applying to the stomachic sensibility and to that portion of the tongue in sympathy

with the stomach, and not to tastes as I understand them. With this explanation I shall now proceed to examine in detail the sensations of the tongue.

6. Deferring for the present the consideration of the tactile sensibility, shared by the tongue in common with the skin and the inner surface of the mouth, we shall have to classify and describe the several kinds of sensations coming under both taste and relish. Following out our general plan of taking the least intellectual sensations first, we should commence with the relishes and disgusts of taste, which constitute its relation with the alimentary sensations already treated of. But these feelings need not be again gone into in the detail; all that appears necessary is to quote a few instances with the view of illustrating still farther the distinctions we have drawn between the alimentary sensations of the stomach and those of the mouth, and between both and the proper sensations of taste.

7. The classification will therefore commence with *relishes.* These are the agreeable feelings arising from the stimulus of food on the organs of mastication and deglutition; they are of an intense and massive kind. The substances that produce them in greatest degree are reckoned savoury by pre-eminence. Animal food has the greatest power of exciting a vigorous relish, or that keen sensation so powerful as a stimulus to mastication and the taking of food, rendering the individual for the time being voracious. A healthy digestion and the state of hunger are the necessary conditions of a strong relish, whether in the stomach or in the mouth, from which fact, as already said, we can discern the difference there is between a mere taste and a relish. Butter and oils and fatty substances are relishes, used for that purpose along with the more tasteless kinds of food, such as bread. Sugar I take to be both a taste and a relish. Being one of the necessaries of animal life, as is proved by the function of the saliva in producing it from starchy substances, there is a direct craving for it throughout the system, and everything craved for in this way is likely to produce a far deeper impression than a mere sensation of taste.

The relish in the mouth is much more intense or acute than the feeling of the stomach, although this last may be more influential upon the general tone of the system by its amount. That the two interests are not altogether identical is shown by the circumstance that many tongue relishes are hard of digestion. But I am not aware of any case where what passes in the mouth is found nauseous to the digestion; on this point the two parts would seem to be in accord.

8. Relishes imply their opposite, *disgusts*. This sensation is constantly inspired by certain substances in consequence of their own nature; at particular times it may arise from any contact whatever, the alimentary surface being in a state of distemper. Oily substances seem to have a facility in causing disgust, from what cause I cannot say, seeing that they class also among relishes. Their mechanical form, when in the liquid or half liquid state, would appear to have an unfavourable action: we are more ready to revolt at melted butter than at solid. Repletion renders any kind of food distasteful, and some kinds absolutely nauseous. In every point of view this feeling is much more dependent on the condition of the alimentary canal than on the material tasted.

The different degrees of relish and nausea exhaust all that part of taste in sympathy with digestion; what remains belongs to the distinctive sensibility of the tongue, a sensibility that it shares with no other part of the body. The sensation of bitter, or sweet, or acrid, is a separate fact of the consciousness, and can be resolved into no other conscious condition whatsoever. It has influences on the emotional condition of the system very similar to the sensations of other senses; yielding pain or pleasure, and stimulating action and intelligence; but remaining nevertheless as a distinct and characteristic form of human feeling. An exhaustive enumeration of the pure tastes is impossible, but we may mention a few comprehensive classes.

9. *Sweet* tastes are a well recognised variety. At the head of these we must class the sugary taste as being the most prevalent of all forms of sweetness. The sweetness of

every kind of fruit, of bread, and of milk, of alcoholic liquors, and of confectionary in general, is known to arise from sugar. Besides the relish that I attribute to this article of food, it undoubtedly acts upon the sense of taste in a remarkable way. We derive from it a highly pleasurable sensation in this limited sense; but no pleasure of mere taste can be compared in amount and influence to an agreeable alimentary feeling. We can lay it down as a rule that the pleasures of taste have as a whole a less influential action than the other class, and this must serve as a defining circumstance of every individual of them. The feeling of a sweet taste is keen and is dwelt upon with much satisfaction, but does not inspire the energy of the feeding action that follows up a savoury morsel. When digestion is satisfied there remains the enjoyment of sweets, and when the taste for these becomes cloyed by repetition it is by an independent effect on the gustatory nerves.*

But the great distinction of this feeling, and of all other feelings of taste proper, relates to the intelligence, or to the power of discrimination belonging to this organ, whereby a boundless number of substances can produce impressions recognised by us as totally different in character, which impressions of difference can remain or be recalled, after the original is gone, to compare with new cases that may arise, and to give that sense of agreement or disagreement whereon all our knowledge of the world is based. In the case of sweetness, for example, not only can we be affected with the pleasurable feeling or emotion belonging to it, but we can be distinctively affected by a great many substances possessing the quality; we can identify some and feel a want of identity in others; and we can so far retain the impression of a taste of yesterday as to compare it with a taste of to-day. This feature distinguishes the feelings of the mouth from organic feelings; it distinguishes in some degree tastes from relishes, although these last also possess considerable range of discrimination; and it is the point of superiority which sight, hearing, and touch, have to a still greater degree over organic sensations.

* I shall remark upon sweetness again, under Smell.

10. Next to sweet tastes I may class *bitter;* the taste of quinine, gentian, or bitter aloes. This, and not sourness, is the proper contrast of sweet. Sweetness is the pleasure proper to taste, bitterness the peculiar or distinctive form of pain derived through this sense. Without having the bulk and influence of the massive forms of pain, this sensation is highly intense in its own limited region and sets on a wryness and contortion of the features, showing how repulsive and distasteful it is. A man may, however, have a great deal that is sound and pleasant about him notwithstanding a bitter taste in his mouth, and he may therefore be induced, for good reasons, to tolerate it. This does not mar the happiness in the manner of many of the feelings above discussed. Still it is sufficient to create acts of avoidance, and sentiments of aversion, leaving an impression behind it sufficient to keep up a self-protecting impulse in the future. The sweet and the bitter express the two extremes of taste as regards pleasure and pain; the other varieties of the feeling involve qualities more important as means of discrimination than as sources of emotion, although not wholly devoid of this influence in either of its two opposite forms.

11. Perhaps we may be allowed to consider the *saline* as a class of tastes having something to distinguish it from the other great classes. The taste of a salt I hold to be more purely a taste than the sensation of an acid or an alkali for a reason that will presently be stated. Common salt may be taken as a good specimen of a saline taste, although very distinguishable from other salts, it being the glory of this sense to note a difference between almost any two substances that are capable of acting on it. Mineral waters, which contain salts of soda, magnesia, and lime, have a saline taste. This taste is rarely an agreeable one, in many cases it is very disagreeable, but we should be disposed to describe the feeling in most instances as singular and characteristic rather than as either pleasing or the reverse.

The repulsive taste of Epsom salts would be termed a compound of the saline and the bitter.

12. The *alkaline* taste is usually more energetic than the saline, as might be expected, seeing that a salt is a neutralized alkali. But if the remark above made be correct, namely, that salts owe their taste principally to their base, the alkali ought to have a considerable share of the saline in taste. Most alkalies and some earths and oxides of metals have characteristic tastes, rarely agreeable, and often not markedly the reverse.

13. The *sour* or *acid* taste is much more uniform in its nature than either the saline or the alkaline; which we may fairly ascribe to the influence of the acid quality itself, irrespective of the constituent elements. This is a sharp, penetrating, pungent action, having when very powerful more the pain of a burn, than of a repulsive taste; in diluted forms it is an agreeable pungent stimulus to the mouth; hence the liking for vinegar (the sour of cookery, as sugar is the sweet), and for acid fruits and vegetables.

14. The *astringent* is a distinct form of the sensation of taste; for an example we may refer to the effect of alum in the mouth. It is evident, however, that in the acid action, and still more in this of astringency, we depart farther and farther from the proper feeling of taste towards some grosser results of chemical and mechanical action. Astringent substances act on the skin and on the mucous membranes generally, and the influence lies in a kind of contraction or forcible shrinking of the part, to which we are sensitive whenever it occurs as a touch. The 'rough taste of tannin' may be put down under astringency.

15. The *fiery* taste of alcoholic liquors, camphors, and volatile oils, given in Gmelin's classification, seems to me to be happily designated. I am disposed to think that this too is more of a mechanical action than a gustative, although in some of the other substances entering with alcohol into wines, spirits, and malt liquors, there is a genuine stimulus of the taste. Gmelin's *acrid* taste may be looked on as a form of the fiery or astringent combined with some ingredient of the bitter. The pungency that marks all this class of sensations is a remarkable state of feeling deserving to be once for all

discussed at length. This discussion, however, I prefer to take up under the sense of smell, the next in order in our arrangement.

16. With regard to the intellectual aspect of Tastes in general, Longet observes that these sensations are deficient as regards the power of being remembered; and he gives as a proof the fact that when we dream of being present at a repast we see the viands but do not taste them. This is an extreme comparison; it contrasts the most intellectual of all the senses, the most abiding of all sensations, with those that are least so. It is so far true that we do not recover sensations of taste so as to live habitually on the ideas of them, but they are slightly recoverable even as ideas, and for the purposes of identification and contrast, they may be recovered to a very great extent. A wine tasted to-day can be pronounced the same or not the same as a wine tasted a week ago, while well marked tastes may be remembered for years in this way.

The intellectual character of the sense is also illustrated by its improveability. A wine-taster, a cook, or a chemist can acquire a delicate sensibility to differences of taste, which is not possible without some degree of permanence or retentiveness in the impressions made on the mind.

SENSE OF SMELL.

This sense is in close proximity to the organ of Taste, with which smell frequently co-operates; but we may consider the sense of Smell as placed at the entrance of the lungs to test the purity of the air we breathe.

1. The *external objects* of Smell, the material substances whose contact produces the sensations, are very numerous. They require to be in the gaseous state, in the same way that the objects of taste require to be liquified. Solids and liquids, therefore, have no smell except by being evaporated or volatilized.

The greater number of gases and vapours are odorous. Of inodorous gases, the principal are the elements of the atmosphere, that is to say, nitrogen, oxygen, vapour of water or steam, and carbonic acid.* In the long list of gaseous bodies recognised by the chemist, we find very generally some action on the nostrils,—carbonic oxide, sulphurous acid, chlorine, iodine, the nitrous gases, ammonia, sulphuretted and phosphoretted hydrogen, &c., the vapour of muriatic, nitric, and other acids. The singular substance *ozone*, produced occasionally in the atmosphere, is named from its smell, which is the smell of sulphur, and the odour given forth by electricity. Some of the metals and solid minerals give out an odour, as, for example, the garlic smell of arsenic, and the odour of a piece of quartz when broken. The effluvia of the vegetable kingdom are countless; besides such widely spread products as alcohol and the ethers, a vast number of plants have characteristic odours, usually attaching to their flowers. The animal kingdom also furnishes a variety of odours; some general, as the 'scent of blood,' and others special, as musk, the flavour of the cow, the sheep, the pig. 'All volatile organic compounds,' says Gmelin, 'are odoriferous, and most of them are distinguished by very strong odours; *e.g.* volatile acids, volatile oils, camphors or stearoptenes, and alcoholic liquids; marsh gas (carburetted hydrogen), and olefiant gas, have but very little odour.'

The pleasant odours, chemically considered, are hydrocarbons; that is, they are composed chiefly of hydrogen and carbon. Such is alcohol and the ethers, eau de Cologne, attar of roses, and the perfumes. Many smells, however, elude investigation from the minuteness of the substance causing them. Thus the vinous flavour is due to a substance which the chemist has been able to separate, being termed the œnanthic ether, but the bouquet of individual wines has not been laid hold of.

The repulsive and disagreeable odours very frequently con-

* With regard to carbonic acid, the assertion as to the absence of smell is true of the amount present in the atmosphere; but, collected in mass, this gas has a slightly pungent, somewhat acid odour. This is an important distinction observable in the case of both tastes and smells; some substances yield intense effects in quantities inconceivably minute, while other substances require to act in considerable masses before being sensible in any degree.

tain sulphur. Sulphuretted hydrogen is one of the most common of the disgusting class.

The worst smelling substances as yet discovered have arsenic for their base, as will be seen from the following extract. (GREGORY'S *Chemistry*, p. 382.)

'When acetate of potash is heated along with arsenious acid, a very remarkable liquid is obtained, which is the oxide of a new radical. This liquid, which is spontaneously inflammable, and has a most offensive alliaceous smell, has long been known in an impure state, under the names of liquor of Cadet, and *alcarsine*. Bunsen, by a long series of the most profound and persevering researches, established its true character as the oxide of the radical *kakodyle*.' This radical, when obtained, 'is a clear liquid, refracting light strongly. When cooled, it crystallizes in large square prisms, and acquires, when pure, the appearance of ice. Its smell is insupportably offensive, and its vapour is highly poisonous. The two latter characters belong to all the compounds of kakodyle, with hardly an exception.' Protoxide of kakodyle, the chief ingredient in the liquor of Cadet, is most offensive to the smell, and very nauseous to the taste. 'Chloride of kakodyle is a volatile, horribly fetid liquid, the vapour of which attacks strongly the lining membrane of the nose, and provokes a flow of tears.'

The pungent odours have ammonia for their type. The volatile alkali, nicotine, the element of the snuffs, is an instance. In smelling salts, ammonia is the substance given forth.

Liebig has been able to lay hold of and isolate the substance that gives the odour of roast meat. Burning fat gives forth odours which exemplify the volatile oils specified by Gmelin.

2. The *development* or production of odours is favoured by a variety of circumstances. Heat, by its volatilizing power, and by promoting decomposition, is the most powerful agent. Light, also, which carries forward the development of the plant, is an odoriferous influence. Hence the abundance and variety of odours in warm and sunny climates, and in the

summer season. The presence of moisture is often favourable; but the manner of acting of this agency is not always obvious. It may perhaps dissolve solid matters, and thus put them in the way of being volatilized; this may be the cause of the evolution of perfumes after a shower. On the other hand, some flowers are most odorous when dried. Friction is a source of odours; by rubbing two pieces of flint or siliceous rock a smell is given forth; sulphur treated in the same way has a smell. Many of the metals have the same property. Doubtless some ingredient is volatilized by the rubbing action.

3. The *diffusion* of odours is an interesting point, and has been cleared up by the researches of Professor Graham. Some odours are light, and therefore diffuse rapidly and rise high; as, for example, sulphuretted hydrogen. Such is evidently the character of the aromatic and spice odours; they, by their intensity and diffusibility combined, make themselves felt at great distances. The Spice Islands of the Indian Archipelago are recognised far out at sea. It happens, however, that the sweet odours are remarkably persistent, while the sulphuretted compounds, which are among the most nauseous, are very rapidly destroyed in the atmosphere.

The animal effluvia (excepting sulphuretted hydrogen) are dense gases, and are diffused slowly. They do not rise high in the air. In scenting, a pointer keeps his nose close along the ground, with the view also no doubt of bringing his nose close to the objects touched by the hare. The unwholesome effluvia of the decaying matter laid on the soil is avoided by getting to a moderate height: smells will be felt by a person lying that would not be felt standing, such is the difference between a stratum of eighteen inches and the height of five feet. The danger of lying on the ground in tropical swamps is a matter of fatal experience; swung in a tree fifty feet high, one may pass the night safely. Here diffusibility is one, although not the only circumstance; during the night, the ventilation or upward current from the ground is arrested, and the malaria, being little diffusible or buoyant, settles on the surface.

4. We have next to consider the *organ* of smell, that is,

the nose. 'This organ consists of, first, the anterior prominent part, composed of bone and cartilage, with muscles which slightly move the latter, and two orifices opening downwards; and secondly, of the two nasal fossæ, in which the olfactory nerves are expanded. The narrow cavities last mentioned are separated one from the other by a partition (the septum of the nose) formed of bone and cartilage; they communicate at the outer side with hollows in the neighbouring bones, and they open backwards into the pharynx through the posterior nares,' or openings. The sensitive surface is a membrane lining the whole of the interior complicated cavities, called the *pituitary* or *Schneiderian* membrane. The tortuosity of the passages of the nose gives extent of surface to this membrane, and thereby increases the sensibility of the nose as a whole. I shall quote part of the anatomical description of this sensitive tissue. 'The cavities of the nose are lined by a mucous membrane of peculiar structure, which, like the membrane that lines the cavity of the tympanum, is almost inseparably united with the periosteum and perichondrium, over which it lies. It belongs, therefore, to the class of fibro-mucous membranes, and it is highly vascular. Named the pituitary membrane, it is continuous with the skin, through the anterior openings of the nose; with the mucous membrane of the pharynx, through the posterior apertures of the nasal fossæ; with the conjunctiva (of the eye), through the nasal duct and lachrymal canals; and with the lining membrane of the several sinuses (hollows) which communicate with the nasal fossæ. The pituitary membrane, however, varies much in thickness, vascularity, and general appearance in these different parts.' With regard also to the distribution of the olfactory nerve on the membrane, there are great differences in the parts, the general fact being that the distribution is most copious in the interior parts of the cavity or those farthest removed from the outer openings. Hence the sensibility must belong mainly to those deeply lodged parts; where there are no nerves there can be no feeling.

The olfactory nerve is the most conspicuous of the nerves of sense; it passes inward to a special ganglion, called the olfactory ganglion, which is a prominent object of the brain in all the vertebrate animals, and in the lower orders stands forth as a distinct lobe, or division, of the encephalon.

5. The *action of odours* on the membrane of the nose has next to be considered. On this subject, as on the action of sapid substances on the tongue, much remains to be known. Nevertheless there are some interesting facts which show that the action is of a chemical nature, or at least depends upon chemical conditions. For the following statements I am indebted to Professor Graham.

Odorous substances in general are such as can be readily acted on by oxygen. For example, sulphuretted hydrogen, one of the most intense of odours, is rapidly decomposed in the air by the action of the oxygen of the atmosphere. In like manner, the hydro-carbons above alluded to as odorous, are all oxidizable,—the ethers, alcohol, and the essential oils that make the aromatic perfumes. The gases that have no smell are not acted on by oxygen at common temperatures. The marsh gas, carburetted hydrogen, is a remarkable case in point. This gas has no smell. As a proof of the absence of the oxidizable property, Professor Graham has obtained a quantity of the gas from the deep mines where it had lain for Geological ages, and has found it actually mixed up with free oxygen, which would not have been possible if there had been the smallest tendency for the two to combine. Again, hydrogen has no smell, if obtained in the proper circumstances; now this gas, although combining with oxygen at a sufficiently high temperature, does not combine at any temperature endurable by the human tissues.

It is farther determined, that unless a stream of air containing oxygen, pass into the cavities of the nostrils, along with the odoriferous effluvium, no smell is produced. Also, if a current of carbonic acid accompanies an odour the effect is arrested.

In the third place, certain of the combinations of hydrogen have been actually shown to be decomposed in the act of producing smell. Thus when a small quantity of seleniuretted hydrogen passes through the nose, the metallic selenium is found reduced upon the lining membrane of the cavities. The action on the sense is very strong, notwithstanding the minuteness of the dose; there is an intensely bad smell, as of decaying cabbage, and the irritation of the membrane causes catarrh.

These facts so far as they go, prove that there is a chemical action at work in smell, and that this action consists in the combination of the oxygen of the air with the odorous substance.

6. We pass now from the physical to the mental phenomena of smell; the *sensations*, or peculiar states of consciousness, that all those physical antecedents end in giving birth to. Unavoidable allusion has already been made to these mental effects in the description of the smelling substances.

'Linnæus has divided odours into seven principal classes: 1st. *aromatic*, as the carnation, the laurel, &c.; 2nd. *fragrant*, as the lily, the crocus, the jasmine, &c.; 3rd. *ambrosiac*, among which are musk and amber; 4th. *alliaceous*, which are agreeable to some persons and disagreeable to others, and more or less of the character of garlic, assafœtida, for example, and several other gum-resinous juices; 5th. *fetid*, as those of the goat, of the rag-wort (*orchis hircina*), valerian, &c.; 6th. *virulent*, as those of Indian pink (*l'œillet d'Inde*), and many plants of the family of the solaneæ (from solanum, the night-shade); 7th. *nauseous*, as the gourd, the cucumber, and those of its class.'—LONGET, p. 151.

Of several classifications quoted by the same author, the above seems to me the best, but even that one is by no means free from objections. The three first classes, the aromatic, fragrant, and ambrosiac, do not appear to have very strongly marked differences; nor is the distinction between fetid and nauseous a generic one.

I shall attempt a classification, on the principle of selecting such tastes as seem to have a well-marked character, and to prevail widely among natural objects. In this attempt, it will be convenient to commence, as in Taste, with those smells that owe their peculiarity to the sympathies of other organs, as the stomach, and the lungs.

7. *Fresh* odours, those that have an action akin to pure air, or coolness in the midst of excessive heat; an action mainly respiratory, or tending to increase the activity of the lungs, and with that the physical energy of the system. Many of the balmy odours of the field and garden have this effect; eau-de-Cologne and other, but not all, perfumes are included in the same class. We may recognise them by their effect in stimulating and reviving the system, under the oppression and suffocation of a crowded assembly. Such odours are not always fragrant in their character, for we might cite cases of unpleasant effluvia that seem to refresh and stimulate the system. The odour of a tan-yard is perhaps a case in point. The close connexion of the nostrils and the lungs enables this reaction of the one upon the other to take place; a connexion that doubtless extends to the nervous system, although not traceable there. Or the influence of the gases may be on the surface of the lungs rather than in the nose, a thing not at all unlikely in many cases coming under both freshness and the opposite. On this supposition these would be smells falsely so called, and would correspond to the relishes and disgusts described under taste.

8. The opposite of freshness is shown in the *close* or suffocating odours. The effluvia of crowds, by acting on the lungs, have pre-eminently this damping and discouraging action on the powers of life, whence it is that we seek the open air, and the solitudes of nature, to shake off the depression of rooms and cities. The effluvia of warehouses, stores, and mills, where cotton, wool, cloths, &c., are piled up, and ventilation is defective, are of a like unwholesome description. The smell of a pastrycook's kitchen is peculiarly sickening. The action of highly-heated iron stoves seems of the same nature; also the smell of a woollen screen when held too close to the fire. In these last instances, there is believed to be an evolution of the unwholesome and suffocating gas, cyanogen, from the destructive decomposition of the woolly particles floating in the air, or making part of the screen.

9. Although we may not be able to affirm that any class of odours stimulates the stomach by a direct influence, as fresh

odours do the lungs, there can be no doubt about the existence of a class of the opposite kind, the disgusting or *nauseous* odours. That is to say, there are certain gases, of which sulphuretted hydrogen is an example and a type, that pervert the action of the alimentary canal, as some tastes do. It is doubtful, at least so far as my information goes, on what surface these effluvia operate, whether on the membrane of the nose exclusively, or partly on it and partly on the mucous surface of the tongue, throat, and stomach. But whatever be the seat of action, the fact in question is one sufficiently well marked to make the specific difference of a class.

10. It may be a question whether the foregoing classes are true and proper effects on the organ of smell; no such ambiguity adheres to the odours that we term *sweet* or *fragrant*; these therefore I recognise as a general group with many varieties included under it. They represent the pure or proper pleasures of smell; the enjoyment we are able to derive through the olfactory nerves and ganglion. They include the substances that convey along this channel to the mind a perfectly pleasurable stimulus. The sweetness may accompany freshness or it may not. The odour of the violet I take as a pure instance, there being many such among the flowering and fruit-bearing plants. The cases of sweetness enjoyed with some other quality are also extremely numerous.

The feeling that we term sweetness, is one of the most remarkable experiences of the human mind. It is an effect that recurs upon us in many ways and from very different causes. We have seen it already under taste, and we shall find in the other senses, and in the emotions that pass beyond the scope of Sensation, an effect that is considered as falling under the same general term. This is one of our pleasurable feelings, not of the voluminous or massive kind, like exercise, warmth, or digestion, but intense or keen in the first degree. It stimulates a vivid expression and gesture of the kind marking acute pleasure: and the pleasure is one that is closely allied with tender emotion.

In the region of Volition, we remark an absence of the spur of appetite. We class the state among the serene emotions,—like repose, warmth, the refreshment and satisfaction of a wholesome meal. In other words the pleasure of smell proper, and of taste proper, has a tendency to satisfy the mind, yielding contentment rather than craving. This is to be a pure emotion. In the case of excess, the state is characterised by the terminating sensation of satiety, which as regards sweetness is a state of peculiar and well-marked unpleasantness,—the ennui of sense. The feeling is also one that must be craved for as an agreeable recollection and not as a want; and hence to be an object of pursuit, would need to have a considerable persistence in the memory: but this persistence is not alike for all the forms of it, that is for tastes, smells, sounds, sights, beauty, &c. Of smell in general, as of taste, we cannot affirm any very high persistence or endurance in the absence of the original; it being a matter of some difficulty to imagine the odour of a violet or an orange, while there is far less difficulty in imagining a sweet sound. The conclusion of the whole is that a sweet smell and a sweet taste are serenely pleasurable while they last, characteristically painful if carried to satiety, but not much desired in their absence.

11. The opposite of sweet in odours can only be described by the general name *stinks*; the expressive word bitter is not usually applied to smell. The term 'mal-odour' has been proposed, and would be a convenient word. If we leave out both the nauseous odours, and certain other forms of the disagreeable to be afterwards described, this class will be limited considerably. Assafœtida may be given as an example of an odour intensely repulsive by its action on the olfactory nerves alone. The cadaverous odour is of the repulsive kind, but it is only one of many forms of disagreeable effluvia arising from animal decay. The aroma of some plants, as those quoted by Linnæus, has an intensely unpleasant action. The disagreeable marsh smell may be experienced in its strongest form by squeezing in the fingers the brown scum of a stagnant pond, and applying them to the nose. The varieties of bad odours are endless.

As sweetness is the proper pleasure of smell, the effect of a stink is the proper pain of the organ, the influence that breeds the peculiar forms of misery that we are adapted to receive by means of this sense. The emotion may be specified as the nose-pain. Of an intense, rather than a massive character, we are stunned and discomposed, but not necessarily depressed or prostrated by it. We may compare it to a bitter taste, in this respect, and may contrast both with the massive pains of chillness, indigestion, or disgust. The expression also testifies to the acuteness of the sensation, being an intense contortion of the features, chiefly about the nose. A sort of hysteric smile may likewise be provoked, which, like all emotional outbursts, renders the state less unendurable, that is less volitional.

The Volitional stimulus to get rid of the feeling is simply proportioned to the degree of badness, and is no specific criterion of character. As regards Intellect, the action of a bad odour is sometimes such as to leave a very strong impression behind, which, however, would be an exception to the usual nature of smells. The peculiar feeling of an ill smell is often appealed to metaphorically to express the feelings caused by human conduct.

12. The name *pungent* is applicable to a large class of odours, and enters as an ingredient into many more. Ammonia is the type of substances producing this sensation. Nicotine, the snuff odour, is the best known example, a substance having a chemical analogy to ammonia. Many of the acid effluvia have a pungent action. This effect, however, is not an olfactory effect in the proper sense of the word; like astringency and acidity in taste, it would probably act on the sensibility of the nose independently of the power of smell. Snuff-takers are often devoid of smell; they lose the sense of sweet or repulsive in odours properly so called, but are still susceptible of the nicotine pungency. The influence flows through the same channel to the brain, and is of the same nature, as pricking the nose, or pulling out hairs, being conveyed by the nerves of common sensation.

Nevertheless, the excitement of pungency is a characteristic variety of the human consciousness, a species of agreeable sensation interesting to study. It shows the effect of a sharp mechanical irritation of the nerves that does not amount to acute pain. A scratch, or a blow on the skin, an electric spark, a loud crash, a brilliant flame, a scorching heat, are all pungent effects, and seem to owe the pleasure they cause to the general excitement they diffuse over the system, and the lively expression that they give birth to. They rouse the system from ennui to enjoyment; they are a species of intoxication. They exalt for the time being the emotional condition of the human system. They come therefore to be one of the cravings associated with ennui, or depression of mind; they are likewise a stimulus for bringing out the exuberance of the animal spirits among the young and vigorous, and those that lead a 'fast' life.

13. The *ethereal* is a distinct variety of the sensations of smell, and is probably a mixture of pungency with odour strictly so called. Alcohol and the ethers, including chloroform and the substance first employed as an anæsthetic, will recal this effect. There can be no question but that alcohol and the vinous aromas have true odours; most probably, however, they have an influence upon other nerves than the olfactory; just as the fiery taste attributed to them is something beyond the gustatory feeling. At all events the odour is a distinct one, and is very different from the odours of vegetation and the common perfumes. It is not destitute of sweetness, but something besides sweet is wanting to express it.

The sulphurous and electrical odour is not radically different from the above class, so far as I am able to discriminate it. This odour has been traced to a particular substance discovered by Professor Schönbein and named by him *ozone*, from the Greek word signifying smell.

If we were to recognise a class of acrid odours, they would only be a mixture of pungency and bad smell; like many of the so-called *empyreumatic* odours resulting from the action of heat on vegetable bodies, as in the manufacture of coal gas.

14. The *appetising* smells might be treated as a class apart from the rest. The smell of flesh excites the carnivorous

appetite, and rouses the animal to pursuit. We may probably consider this influence as similar in its working to the first taste of savoury food; by the law of feeling-prompted movement, it sets on the activity for an increase of the gratification. A savoury smell may partly give a commencing pleasure of digestion, and partly bring out into keenness and relief the sense of hunger; in either case it would fire the energy of pursuit towards the full fruition. The sexual excitement in some animals is induced by smell. Sympathy and antipathy are alike generated by odours. The influence of odours upon the voluptuous tender emotions has not escaped the notice of the poets. Cabanis observes that the odours of young animals are of a kind to attract, and he considers even to invigorate, the older.

15. It is remarked that bodies believed to have a strong taste, have often in reality only an odour; of which cinnamon is the common instance. Perhaps too in wine a large part of the effect in the mouth is in the smell. Hence the ambiguous term 'flavour' which is applied to solid and liquid substances, means most frequently the odour, or the mixed effect of taste and odour.

16. Smell, like taste, is an important instrument in the discrimination of material bodies, and therefore serves a high function in guiding our actions and in extending our knowledge of the world. Man does not exemplify the highest development of this organ. The order of ruminants, certain of the pachydermatous animals, and above all the carnivorous quadrupeds, excel the human subject in the expansion given to the membrane of the nose, and in a corresponding sensibility to odours. The scent of the dog is to us almost miraculous; it directs his pursuit, and tells him his whereabouts. It may act the part of sight in enabling him to retrace his steps or to find out his master.

[illegible] in describing the senses not unusually commence with Touch. 'This,' say Messrs. Todd and Bowman, 'is the simplest and most rudimentary of all the special senses, and may be considered as an exalted form of common sensation, from which it rises, by imperceptible gradations, to its state of highest development in some particular parts. It has its seat in the whole of the skin, and in certain mucous membranes, as that of the mouth, and is therefore the sense most generally diffused over the body. It is also that which exists most extensively in the animal kingdom; being, probably, never absent in any species. It is, besides, the earliest called into operation, and the least complicated in its impressions and mechanism.'

It may be well admitted that Touch is less complicated than Taste, where four different kinds of sensations may be said to meet, the tactile being one of them. It may be further said of touch, that the mode of action (mechanical contact or pressure), is the most simple and intelligible of any that we find giving rise to sensation. Nevertheless, there is one consideration that has prevailed with me in giving it a place subsequent to organic sensibility, taste, and smell. Touch is an intellectual sense of a far higher order than these. It is not merely a knowledge-giving sense, as they all are, but a source of ideas and conceptions of the kind that remain in the intellect and embrace the outer world. The notions of the size, shape, direction, distances, and situation of external bodies may be acquired by touch, but not by either taste or smell.

But this last assertion must be accompanied by an important explanation. Touch, considered as a source of ideas such as those, is really not a simple sense, but a compound of sense and motion; and it is to the muscular part of the sense, or to the movements of the touching organs that these conceptions owe their origin and their embodiment, as we have endeavoured to show in the previous chapter. The superiority of touch to taste and smell, in this view, therefore, consists in its union with movement and muscular sensibility; and the same advantage pertains to sight. The contact of solid bodies with the surface of the body gives occasion to the pleas[illegible] movement, force, and resistance, and to the feelings and [illegible]ceptions consequent on these: which cannot be said of smell, nor of taste properly so called.

A second feature marking the superiority of the sense of Touch, and qualifying it to furnish intellectual forms and imagery, is the distinctness or separateness of the sensations felt over the different parts of the skin. The sensations of the different parts of the surface of smell, would seem to fuse all into one stream of sensibility; it is not possible ever to refer a smell to any one portion of the membrane more than another. But the sensations of the skin are conveyed by distinct nervous filaments; each little area of skin has a separate nerve, and an independent communication with the nerve centres, whereby we can, after a little education, refer each sensation to the spot where the contact is made. The stimulus on one finger is not, at any part of the course of the nerve, confused with the stimulus on another finger; the back can always be distinguished from the breast, the right side from the left, and so on. I shall afterwards endeavour to show that this localization of touches has to be learned by practice; but the very possibility of it rests upon the distinctness and independence of the nerve filaments. This is an extremely important fact, and makes the great difference between touch and what is called common sensation, or the sensibility diffused over all the internal organs and tissues. There is no such distinguishing sensibility in the stomach, or the lungs, or the liver; at all events, the distinctness of the nerves in those parts is very low in degree, just sufficient to enable us to refer a pain to the lungs, the liver, or the stomach, without indicating the particular region or subdivision. The skin is therefore marked by a great exaltation of the common sensibility of the body, not as regards intensity of feeling, but as regards distinctiveness of locality.

2. Having made these preliminary remarks, we commence

as usual, with the *objects*, or external agents concerned in the sense of Touch. These are principally the *solid* substances of the outer world. Gases do not act on the touch unless they are blown with great violence. The pressure of the atmosphere gives rise to no feeling, excepting from its temperature. Liquids also give very little feeling, if they are of the same warmth as the body. The sensations of a bath are confined to heat or cold, which are feelings that the skin has in common with other tissues. It is manifest that an even, equal pressure, such as fluids give, is not sufficient to impress the tactile nerves. The asperities and inequalities of solid surfaces, by pressing intensely on some points and not at all on others, are requisite for this purpose.

The hard unyielding nature of the mineral constituents of the earth's crust, metals, rocks, &c., are particularly well fitted to excite the touch. The woody fibre of the vegetable world has a compactness next in degree to the solid minerals. The soft and yielding class of solids impress the surface in a totally different manner: and these differ among themselves according as they recover their form after pressure, or not; whence the distinction of elastic and non-elastic. When the substance is moved over the skin, the asperities come to be felt more acutely, and hence the further distinction into rough and smooth surfaces. In treating of the sensations themselves we shall attend to these qualities more minutely.

3. The *sensitive organ* or surface is the skin, or common integument of the body, the interior of the mouth, and the tongue. The parts of the skin are its two layers, its papillæ, the hairs and nails, its two species of glands,—the one yielding sweat, the other a fatty secretion,—with blood vessels and nerves. I shall quote a few extracts from the anatomical description of those parts. Of the two layers, the outermost is the *cuticle*, *epidermis*, or *scarf skin*. 'It forms a protective covering over every part of the true skin, and is itself quite insensible and non-vascular. The thickness of the cuticle varies in different parts of the surface, measuring in some not more than $\frac{1}{240}$, and in others from $\frac{1}{24}$ to $\frac{1}{12}$ of an inch. It is thickest in the palms of the hands and soles of the feet, where

the skin is much exposed to pressure, and it is not improbal that this may serve to stimulate the subjacent true skin t(more active formation of epidermis; but the difference d(not depend solely on external causes, for it is well marked the fœtus.

'Many of the cells of the cuticle contain pigment, a often give the membrane more or less of a tawny colour, ev in the white races of mankind; the blackness of the skin the negro depends entirely on the cuticle. The pigmen contained principally in the cells of the deep layer, and appe to fade as they approach the surface, but even the superfi(part possesses a certain degree of colour.

'The *true skin, cutis vera, derma,* or *corium,* is a senti and vascular texture. It is covered and defended by insensible and non-vascular cuticle, and is attached to parts beneath by a layer of cellular tissue, named "s cutaneous," which, excepting in a few parts, contains fat, has therefore been called also the "panniculus adiposus."] connexion is in many parts loose and moveable, in others c] and firm, as in the palmar surface of the hand and the sol(the foot, where the skin is fixed to the subjacent faciæ* numerous stout fibrous bands, the space between being fi] with a firm padding of fat. In some regions of the body skin is moved by muscular fibres, which, as in the case of orbicular muscle of the mouth, may be unconnected to fi parts, or may be attached beneath to bones or fasciæ, like other cutaneous muscles of the face and neck, and the sl palmar muscle of the hand.'

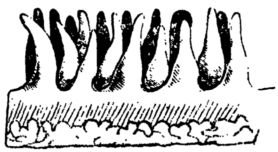
The upper or free surface of the true skin 'is marke(various places with larger or smaller furrows, which also a the superjacent cuticle. The larger of them are seen oppc the flexures of the joints, as those so well known in the p

* 'Fibrous membranes, named 'aponeuroses,' or '*fasciæ*,' are ployed to envelope and bind down the muscles of different regions, of w the great fascia enclosing the thigh and leg is a well known example. tendons of muscles, too, may assume the expanded form of aponeuros(those of the broad muscles of the abdomen, which form strong fibrous l in the walls of that cavity, and add to their strength.'—QUAIN, p. cxi

of the hand and at the joints of the fingers. The finer furrows intersect each other at various angles, and may be seen almost all over the surface; they are very conspicuous on the back of the hands. These furrows are not merely the consequence of the frequent folding of the skin by the action of muscles or the bending of joints, for they exist in the fœtus. The wrinkles of old persons are of a different nature, and are caused by the wasting of the soft parts which the skin covers. Fine curvilinear ridges, with intervening furrows, mark the skin of the palm and sole; these are caused by ranges of the papillæ, to be immediately described.

'*Papillæ.*—The free surface of the corium is beset with small eminences thus named, which seem chiefly intended to contribute to the perfection of the skin as an organ of touch, seeing that they are highly developed where the sense of touch is exquisite, and *vice versâ.* They serve also to extend the surface for the production of the cuticular tissue, and hence are large-sized and numerous under the nail. The papillæ are large, and in close array on the palm and palmar surface of the fingers, and on the corresponding parts of the foot. There they are ranged in lines forming the curvilinear ridges seen when the skin is still covered with its thick epidermis. They are of a conical figure, round or blunted at the top, and are received into corresponding pits on the under surface of the cuticle. They measure on the hand from $\frac{1}{200}$ to $\frac{1}{100}$ of an inch in height. In the ridges, the large papillæ are placed sometimes in single but more commonly in double rows, with smaller ones between them, that is, also on the ridges, for there are none in the intervening grooves. These ridges are marked at short and tolerably equal intervals with notches, or short transverse furrows, in each of which, about its middle, is

FIG. 6.*



* 'Papillæ of the palm, the cuticle being detached.—Magnified 35 diameters.'—(TODD and BOWMAN.)

the skin is much exposed to pressure, and it is not improbable that this may serve to stimulate the subjacent true skin to a more active formation of epidermis; but the difference does not depend solely on external causes, for it is well marked in the fœtus.

'Many of the cells of the cuticle contain pigment, and often give the membrane more or less of a tawny colour, even in the white races of mankind; the blackness of the skin in the negro depends entirely on the cuticle. The pigment is contained principally in the cells of the deep layer, and appears to fade as they approach the surface, but even the superficial part possesses a certain degree of colour.

'The *true skin, cutis vera, derma,* or *corium,* is a sentient and vascular texture. It is covered and defended by the insensible and non-vascular cuticle, and is attached to the parts beneath by a layer of cellular tissue, named "subcutaneous," which, excepting in a few parts, contains fat, and has therefore been called also the "panniculus adiposus." The connexion is in many parts loose and moveable, in others close and firm, as in the palmar surface of the hand and the sole of the foot, where the skin is fixed to the subjacent faciæ* by numerous stout fibrous bands, the space between being filled with a firm padding of fat. In some regions of the body the skin is moved by muscular fibres, which, as in the case of the orbicular muscle of the mouth, may be unconnected to fixed parts, or may be attached beneath to bones or fasciæ, like the other cutaneous muscles of the face and neck, and the short palmar muscle of the hand.'

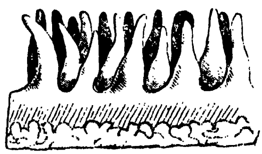
The upper or free surface of the true skin 'is marked in various places with larger or smaller furrows, which also affect the superjacent cuticle. The larger of them are seen opposite the flexures of the joints, as those so well known in the palm

* 'Fibrous membranes, named 'aponeuroses,' or '*fasciæ,*' are employed to envelope and bind down the muscles of different regions, of which the great fascia enclosing the thigh and leg is a well known example. The tendons of muscles, too, may assume the expanded form of aponeuroses, as those of the broad muscles of the abdomen, which form strong fibrous layers in the walls of that cavity, and add to their strength.'—QUAIN, p. cxix.

of the hand and at the joints of the fingers. The finer furrows intersect each other at various angles, and may be seen almost all over the surface; they are very conspicuous on the back of the hands. These furrows are not merely the consequence of the frequent folding of the skin by the action of muscles or the bending of joints, for they exist in the fœtus. The wrinkles of old persons are of a different nature, and are caused by the wasting of the soft parts which the skin covers. Fine curvilinear ridges, with intervening furrows, mark the skin of the palm and sole; these are caused by ranges of the papillæ, to be immediately described.

'*Papillæ.*—The free surface of the corium is beset with small eminences thus named, which seem chiefly intended to contribute to the perfection of the skin as an organ of touch, seeing that they are highly developed where the sense of touch is exquisite, and *vice versâ.* They serve also to extend the surface for the production of the cuticular tissue, and hence are large-sized and numerous under the nail. The papillæ are large, and in close array on the palm and palmar surface of the fingers, and on the corresponding parts of the foot. There they are ranged in lines forming the curvilinear ridges seen when the skin is still covered with its thick epidermis. They are of a conical figure, round or blunted at the top, and are received into corresponding pits on the under surface of the cuticle. They measure on the hand from $\frac{1}{200}$ to $\frac{1}{100}$ of an inch in height. In the ridges, the large papillæ are placed sometimes in single but more commonly in double rows, with smaller ones between them, that is, also on the ridges, for there are none in the intervening grooves. These ridges are marked at short and tolerably equal intervals with notches, or short transverse furrows, in each of which, about its middle, is

FIG. 6.*



* 'Papillæ of the palm, the cuticle being detached.—Magnified 35 diameters.'—(TODD and BOWMAN.)

the minute funnel-shaped orifice of the duct of a sweat gland. Fine blood vessels enter the papillæ, forming either simple capillary loops in each, or dividing, according to the size of the papillæ, into two or more capillary branches, which turn round in form of loops, and return to the veins. Filaments of nerves are also to be discovered ascending into the papillæ, but their mode of termination is doubtful. In other parts of the skin, endowed with less sensibility, the papillæ are smaller, shorter, fewer in number, and irregularly scattered. In parts where they are naturally small, they often become enlarged by chronic inflammation round the margin of sores and ulcers of long standing, and are then much more conspicuous.'—QUAIN, pp. cclxxxiii. to cclxxxvii.

I have quoted the description of the papillæ at length because of their evident connexion with the sensibility of the skin. As in the tongue, the nerves of touch terminate in the papillæ, and are acted on through them. I shall refrain from quoting the minute account of the nails and hairs, however interesting their structure in other points of view. Respecting the glands, it is only necessary to advert to the totally different nature of the two sorts, as respects the material secreted. The sweat glands are enormously numerous, and exist in all regions of the skin; they are reckoned to vary from 400 to 2800 in a square inch. 'The *sebaceous* or oil glands pour out their secretions at the roots of the hairs, for, with very few isolated exceptions, they open into the hair follicules, and are found wherever there are hairs.'

4. With respect to the functions and vital properties of the skin in general, I quote part of Dr. Sharpey's summary.

'The skin forms a general external tegument to the body, defining the surface, and coming into relation with foreign matters externally, as the mucous membrane, with which it is continuous and in many respects analogous, does internally. It is also a vast emunctory, by which a large amount of fluid is eliminated from the system, in this also resembling certain parts of the mucous membrane. Under certain conditions, moreover, it performs the office of an absorbing surface; but this function is greatly restricted by the epidermis. Throughout its whole extent the skin is endowed with *tactile sensibility,* but in very different degrees in different parts. On the skin of the palm and fingers, which is largely supplied with nerves and furnished with numerous prominent papillæ, the sense attains a high degree of acuteness; and this endowment, together with other conformable arrangements and adaptations, invests the human hand with the character of a special organ of touch. A certain, though low degree of vital contractility, seems also to belong to the skin.'—QUAIN, p. ccxcvi.

Of the other parts sensible to Touch, besides the skin, namely, the tongue and mouth, the needful description has been already furnished under the sense of Taste.

The nerves of touch are the sensory or posterior roots of the spinal nerves for the limbs and trunk, and certain of the cerebral nerves for the head, face, mouth, and tongue.

5. The *action* in touch is known to be simple pressure. The contact of an object compresses the skin, and through it the embedded nerve filaments. That the squeezing or pinching of a nerve can produce sensibility is proved in many experiments: in touch, the squeezing is of a more gentle nature, owing to the protection that the covering of skin gives to the nerves. The only point of interest connected with the mode of action is the singular fact, that very light contacts often produce a great sensibility, as the touch of a feather, or of a loose hanging piece of dress, which sensibility is diminished by making the contact more intense. Great pressures seem to yield little sensation in the skin; they are felt mainly in the muscles as a feeling of force and resistance.

This fact of the disproportion of the feeling to the pressure I can account for in no other way than by supposing that compression has an effect in deadening the conducting property of the nerve. In none of the other senses does a greater intensity of action produce a less amount of feeling. In sight and in hearing the sensation rises and falls with the energy of the light or the sound. But we know from various observations that the compression of a nerve does tend to arrest its conductibility; the deadening of the sensibility of the hand by leaning the elbow on a table, so as to squeeze the nerve that passes near the surface on the elbow joint, is a familiar instance.

6. We come now to the Sensations or feelings of touch, which are various in kind, and have many of them a considerable degree of interest, from their bearing on the higher operations of mind. In the order of enumeration, I shall commence with the emotional feelings, and end with the intellectual.

Sensations of soft Touch.—In this class of feelings, we suppose the contact of some extended surface with the skin, with no reference to the special character of the surface, and no more pressure than is sufficient for closeness of contact. I keep out of view the feeling of temperature. A good example is furnished by the contact of the under clothing with the general surface of the body, which is most perfect under the bedclothes at night. The glove not too tight on the hand is an instance. The extended hand, resting on a cushion, or other soft body, is a sufficiently good type of the situation.

The resulting emotion may be described as of the pleasurable kind, not highly acute or intense, but of some considerable massiveness or volume. The peculiar quality of the pleasure may be illustrated by a comparison with gentle warmth, to which there is a close resemblance. The sensation is far inferior in power to the muscular and digestive feelings, while superior perhaps to mere sweetness of taste and odour, and is of itself insufficient to give a prevailing tone to the consciousness, even when most fully experienced; we obtain from it, nevertheless, a felt contribution to the sum of sensuous enjoyment. Custom and inattention blunt our sensibility to it, but the contrasted state of nakedness reminds us again of its power. The blank sensation of the naked body is owing principally to the deprivation of touch. We cannot appreciate the full force of an extended contact without expressly attending to it, and this we rarely do. When our consciousness is fully alive to the state, we discern a close connexion between it and the whole class of serene, soft, and tender emotions, whence we find it suggesting these to the mind as objects of desire.

We do not derive any important marks of discrimination either from the volitional or from the intellectual aspect of this sensation. Its character is fully exhausted as an emotion; in other words, we regard it as a pure example of an emotional sensation.

7. *Pungent and painful Sensations of Touch.*—When instead of a diffusive soft contact we have an intense action on limited spots, mere points, as in the stroke of a whip, a sensation of smartness is produced very different from the above. In moderate degree, this gives a pleasurable pungency, beyond which it is acutely painful. The nerves are shocked as by the prick of an instrument, and the over-intensity and suddenness of the stimulus is a cause of pain. The nature of the sensation is not radically different from a cut in the skin, its peculiar smartness diffuses an excitement over the system of unparalleled rapidity. The retractation of the part would seem partly reflex, and partly the result of the general movement of the body that constitutes the expression of the feeling. It prompts the most decisive actions for avoiding the pain, and an intense mental aversion to all that relates to it. The intensity gives to it a hold in the memory not possessed by the luxurious feeling of diffused softness. Hence the efficacy of skin tortures in the discipline of all orders of sensitive beings.

The sensibility of the skin to these two classes of feelings is pretty evenly diffused, having no connexion with the discriminative or tactile sensibility, and being, in fact, smaller than ordinary where that is greatest, as in the palm of the hand, a fact explained by the thickness of the cuticle. This last circumstance is the only one that I am able to specify as ruling the susceptibility to blows. It is well known that the cheek and the ear smart acutely when struck or pinched. It would seem that the amount of feeling, pleasurable or painful, that may be excited in the skin, has nothing to do with the abundance of the nerves distributed to it, there being in this respect an analogy with the organic sensations of the internal organs, which are often very intense in parts supplied with few nerves, as in the ligaments, bones, liver, &c. So far as mere feeling or emotion is concerned, a very few fibres, intensely excited, can kindle up the most vehement mental effects.

8. *Sensations of Temperature.*—Excepting in surfaces of the same degree of temperature as the skin, these feelings must enter into every instance of touch. As sensations, we have already described them among the organic feelings; we need only to remark here, that the skin is extremely liable to this influence, and is very susceptible to it; probably as much so as to the effects above described. There is no reason for supposing that any other nerves than those of touch are needed to rouse a sensation of warmth or of coolness, although the action is doubtless in some degree peculiar. This action, however, if we look at it closely, may still be viewed as of a mechanical kind; for the chief influence of slight alterations of temperature is to expand or contract the material affected. In the human body, great heats and great colds derange the structure of the tissues, and are extremely painful; but the smaller changes may have no more than the mechanical effect now supposed.*

The sensation of wetness seems to be nothing else than a form of cold.

The mutual contact of living animal bodies yields a complex sensation of softness and warmth, and excites the corresponding emotions. There may be in addition magnetic or electric influences of a genial kind, but the reality of such currents is by no means established.

9. *Other painful Sensations of the Skin.*—Among these I would first advert to the sensation of tickling, of which however,

* Sir William Hamilton thinks it probable that the sensation of heat depends on a peculiar set of nerves, for two reasons: '1st, Because certain sentient parts of the body are insensible to this feeling; and 2nd, because I have met with cases recorded, in which, while sensibility in general was abolished, the sensibility to heat remained apparently undiminished.'—Reid, p. 875.

On the other hand, the experiments of Weber, while leading to the conclusion that the integrity of the skin is necessary to the discrimination of degrees of temperature by touch, give no ground for supposing that any other nerve fibres than those of common tactile sensation are necessary.—Carpenter's *Human Physiology*, 4th edition, § 866.

I can render no explanation. It is a very remarkable case of nervous susceptibility. The liability of the sole of the foot to this intense and unbearable excitement, is probably of a piece with the tendency of wounds in the same part to cause lock-jaw. Itchiness is a peculiar form of painful sensation, strongly exciting us to mechanical irritation, as a means of relief, which, however, while only temporarily alleviating the evil, in the end increases it. The conflict of volitions thus arising is the worst part of the infliction.

All the parts of the skin are liable to yield painful sensations, especially under injury or distemper. The epidermis is itself insensible, but the true skin is excessively alive to feeling. When lacerated, chafed, or burnt, it causes acute pains. Its capillary vessels and numerous sweat glands and oil glands are, in all probability, the source of organic sensations of cheerfulness or oppression, according as they are working well or ill. The hairs are themselves insensible, but the plucking of them causes acute pains. The place of attachment of the nails is the seat of a violent form of acute pain, which has a fatal facility of seizing on the imagination, and exciting revulsion even in idea.

We pass now to the more intellectual sensations of Touch.

10. *Impressions of distinguishable Points.*—I have already called attention to the discriminative or articulate character of the sense of touch, whereby it receives distinguishable impressions from the variously situated parts of an extended surface. Very interesting differences in the degree of this discrimination are observable on different parts of the surface of the body, which have been especially illustrated by the experiments of Weber.

'These consisted in placing the two points of a pair of compasses, blunted with sealing-wax, at different distances asunder, and in various directions, upon different parts of the skin of an individual. It was then found, that the smallest distance at which the contact can be distinguished to be double, varies in different parts between the thirty-sixth of an inch and three inches; and this seems a happy criterion of the acuteness of the sense. We recognise a double impression on very sensible parts of the skin, though the points are very near each other; while, in parts of less acute sensibility, the impression is of a single point, although they may be, in reality, far asunder.

'In many parts we perceive the distance and situation of two points more distinctly when placed transversely, than when placed longitudinally, and *vice versâ.* For example, in the middle of the arm or fore-arm, points are separately felt at a distance of two inches, if placed crosswise; but scarcely so at a distance of three, if directed lengthwise to the limb.

'Two points, at a fixed distance apart, feel as if more widely separated when placed on a very sensitive part, than when touching a surface of blunter sensibility. This may be easily shown by drawing them over regions differently endowed; they will seem to open as they approach the parts acutely sensible, and *vice versâ.*

'If contact be more forcibly made by one of the points than by the other, the feebler ceases to be distinguished; the stronger impression having a tendency to obscure the weaker, in proportion to its excess of intensity.

'Two points, at a fixed distance, are distinguished more clearly when brought into contact with surfaces varying in structure and use, than when applied to the same surface, as, for example, on the internal and external surface of the lips, or the front and back of the finger.

'Of the extremities, the least sensitive parts are the middle regions of the chief segments, as in the middle of the arm, fore-arm, thigh, and leg. The convexities of the joints are more sensible than the concavities.

'The hand and foot greatly excel the arm and leg, and the hand the foot. The palms and soles respectively excel the opposite surfaces, which last are even surpassed by the lower parts of the fore-arm and leg. On the palmar aspect of the hand, the acuteness of the sense corresponds very accurately with the development of the rows of papillæ; and where these papillæ are almost wanting, as opposite the flexions of the joints, it is feeble.

'The scalp has a blunter sensibility than any other part of the head, and the neck does not even equal the scalp. The skin of the face is more and more sensible as we approach the middle line; and the tip of the nose and red parts of the lips are acutely so, and only inferior to the tip of the tongue. This last, in a space of a few square lines,* exceeds the most sensitive parts of the fingers; and points of contact with it may be generally perceived distinctly from one another, when only one-third of a line intervenes between them. [The superior sensibility of the tip of the tongue to the finger, is illustrated by the familiar observation, that a hole in a tooth seems very much exaggerated when felt by the tip of the tongue.] As we recede from the tip along the back or sides of the tongue, we find the sense of touch much duller.

'The sensibility of the surface of the trunk is inferior to that of the extremities or head. The flanks and nipples, which are so sensitive to tickling, are comparatively blunt in regard to the appreciation of the distance between points of contact. Points placed on opposite sides of the middle line, either before or behind, are better distinguished than when both are on the same side.

'The above are the results obtained by making the several parts mere passive and motionless recipients of impressions. They evince the precision of the sense in so far only as it depends on the organization of the tactile surface. The augmented power derived from change of position of the object with regard to the surface, is well illustrated by keeping the hand passive, while the object is made to move rapidly over it. In this case the contact of the two points is separately perceived, when so close that they would, if stationary, seem as one. If, still further, the fingers be made to freely traverse the surface of an object, under the guidance of the mind, the appreciation of contact will be far more exquisite, in proportion to the variety of the movements, and the attention given to them. We are then said to *feel*, or to examine by the sense of touch.'—TODD and BOWMAN, I., 429-30.

* A line is $\frac{1}{12}$th of an inch.

These observations of Weber have been deservedly celebrated by physiologists, as the foundation of an accurate mode of estimating the tactile sensibility of the skin. They have been extended by other observers, as may be seen in Dr. Carpenter's article on Touch in the *Cyclopædia of Anatomy*. It is necessary, however, for us to discuss more closely the points involved in them, and especially to discriminate the tactile, from the muscular element of the sensations.

Whenever two points produce a double sensation, it is to be presumed that one point lies on the area supplied by one distinct nerve, while the other point lies on the area of a second nerve. There is a certain stage of subdivision or branching of the nerves of touch, beyond which the impressions are fused into one on reaching the cerebrum. How many ultimate nerve fibres are contained in each unit nerve, we cannot pretend to guess; but on the skin of the back, the middle of the thigh, and the middle of the fore-arm, an area of three inches diameter, or between six and seven square inches, is supplied by the filaments of a single unit. On the point of the finger the units are so multiplied, that each supplies no more than a space whose diameter is the tenth of an inch. Such units correspond to the entire body of the olfactory or gustatory nerve, for these nerves give but one undivided impression for the whole area affected. If we had two different regions of smell, and two distinct olfactory nerves, we should then probably have a feeling of doubleness or repetition of smells, like the sense of two points on the skin.

The primitive or original impression of a plurality of points, sufficiently far asunder, can be nothing but a feeling of repetition, a sense that the same impression reaches us through different unknown channels. What the real distance of the points is, we have no means of judging, any more than we can tell previous to experience whereabouts on the body the impression is made. Hence in those of the experiments that relate to our sense of the relative interval of the points, as when they pass from a duller to a more sensitive region, there are involved perceptions that we have got at in some other way than through the sense of contact. This other means is the feeling of movement or the muscular sensibility, without which it is impossible to explain the vast majority of the sensations of Touch. We have already dwelt upon the perceptions growing out of the moving apparatus of the body, and we must here, and under the two following senses, Hearing and Sight, point out the combinations that are formed by sense and movement.

11. *Sensations of Touch involving muscular perceptions.* —In discussing these we shall begin with examples that are almost purely muscular, the tactile sensibility being a mere incident of the situation. The feeling of *weight* is of this description; depending on the sense of muscular exertion, aided perhaps in some cases by the feeling of compression of the skin. On this last point I quote from Todd and Bowman. 'Weber performed experiments to ascertain how far we are capable of judging of weight by the mere sense of contact [without muscularity.] He found that when two equal weights, every way similar, are placed on corresponding parts of the skin, we may add to or subtract from one of them a certain quantity without the person being able to appreciate the change; and that when the parts bearing the weights, as the hands, are inactively resting upon a table, a much greater alteration may be made in the relative amount of the weights without his perceiving it, than when the same parts are allowed free motion. For example, 32 ounces may thus be altered by from 8 to 12, when the hand is motionless and supported; but only by from 1½ to 4, when the muscles are in action; and this difference is in spite of the greater surface affected (by the counter pressure against the support) in the former than in the latter case. Weber infers that the measure of weight by the mere touch of the skin is more than doubled by the play of the muscles. We believe this estimate to be rather under than over the mark.'—p. 431.

That the discriminative sensibility of the skin to degrees of compression may operate in appreciating weight is further confirmed by the following statement. 'The relative power of different parts to estimate weight corresponds very nearly with their relative capacities of touch. Weber discovered that the lips are better estimators of weight than any other part, as we might have anticipated by their delicate sense of touch and *their extreme mobility.* The fingers and toes are also very delicate instruments of this description. The palms and soles possess this power in a very remarkable degree, especially over the heads of the metacarpal and metatarsal bones; while the back, occiput, thorax, abdomen, shoulders, arms, and legs, have very little capacity of estimating weight.'—*ib.* p. 432.

What is said of weight applies to any other form of pressure, force, or resistance. The impetus of a push or a squeeze received on the hand is measured by the muscular exertion induced to meet it, and in some small degree, as above described, by the compression of the skin at the place of contact.

The qualities of *hardness* and *softness* are appreciated by this combined sensibility; the one means a greater resistance to compression, and the other a less. From the unyielding stone or metal to the mobility of the liquid state, we have all degrees of this property; the entire class of soft, viscid, and fibrous substances lying between. It belongs to many of the manual arts to appreciate minute differences of consistence in the class of soft bodies; the pastrycook, the builder, the sculptor, &c. In this they are assisted by practice, which improves all sensibilities; but there are great varieties of natural endowment in the case, which varieties must have their seat principally in the muscular tissue, and secondarily, in the skin and nerves of the hand.

The feeling of *elasticity* is only a case of simple resistance to force, exerted in the particular circumstance of a rebound or reaction from pressure. The elasticity implies a perfect return to the original position; air is elastic, and so is steel and ivory, meaning that when in any way compressed or distorted, they recover themselves. The softness that is agreeable to rest upon must be an elastic softness; we can note the difference by comparing a hair cushion with a lump of clay.

We may next consider the sensations rising out of the qualities of *roughness* and *smoothness.* Simple contact, we have seen, gives the sense of a multiplicity of points. The finger resting on the end of a brush would make us aware of its character; that is we should have the feeling of a plurality of pricks. In this way we are sensitive to rough and pointed surfaces. We can distinguish between bluntly-pointed asperities, like a file, and sharp points like a horse-comb: the sensibility of a blunt point being distinct from a needle-prick. We can also distinguish between thick-set points and such as are more scattered, provided they are not too close for the limits of sensibility of the part, that is one-tenth of an inch for the finger, and one-thirtieth for the tip of the tongue. On the back, the calf of the leg, and the middle of the fore-arm, where points are confounded up to the distance of three inches, roughness would be altogether imperceptible.

In these instances, the thing touched is supposed to lie at rest on the finger, or on the part touched. But this does not do full justice to the tactile sensibility; it is requisite that we should move the finger to and fro over the surface in order to give full range to the power of discrimination. By this means we may discriminate far nicer shades of roughness; we may in fact appreciate minuter intervals than in the resting position. Supposing the sensibility of the tip of the finger to be one line at rest, by motion we can extend this sensibility to an unknown limit. The case may be illustrated by the micrometer screw on an astronomical instrument. The divisions on the limb of the instrument extend we may suppose to one minute of a degree, and if the index lie between two divisions, its place can be measured by the number of turns of the screw required to bring it up to one of the divisions. So, if a point is undistinguished on the finger in consequence of not being a line removed from the neighbouring point, we may estimate its distance nevertheless by the amount of motion of the finger needed to bring it into the limit of sensibility. I will take as an example a row of points, one-fortieth of an inch apart, the extremes being one-tenth, which is the sensibility of the tip of the finger. This row would be felt as two points if the finger were stationary. But by the motion of the finger one point would pass away and another would come up, and there would be a feeling of the interval moved over between the perception of the successive points, which would be a measure of the intervals. The sense of movement would thus be brought in to aid the tactile feeling, and to reveal a degree of closeness in asperities beyond the reach of touch unassisted by motion. It is agreeable to all experience that the roughness of a surface becomes far more apparent by drawing the hand over it; whether the sense of movement explains all that there is in this increased sensibility, I will not undertake to say. For we must consider that friction creates a new variety of pressure on the skin and nerves, and the kind of friction is so different for a smooth and for a rough body, that by it alone we might learn to distinguish between the rough and the smooth contact.

If any one will make the experiment of drawing over the finger two points, so close that to the touch they seem one when at rest, it will be found that the motion gives the feeling of doubleness. What is the limit of this, for a limit there is, it would take a considerable amount of observation to decide. I venture to affirm that at least half the interval will become sensible by the motion of the points, the motion being by bringing them in train, and not abreast of one another.

Whatever may be the explanation of the increase of sensibility due to movement, the fact is an important one. A vast amount of discrimination turns upon it. From the variety of trace made by different kinds of surface, we can distinguish them or identify them at pleasure, up to a considerable limit of delicacy. Hence the power of telling substances by the feel, and of deciding on the qualities and merits of texture and workmanship. Degrees of polish in stone, metal, or wood, the fineness of cloths, wool, &c., the beat of a pulse, the quality of powdered substances, and many things besides, are matters of judgment and comparison to the touch, and put to the proof its natural or acquired delicacy.

The feeling of temperature is an element in many discriminations, as in the distinction between stone and wood. *Clamminess* is a distinct sensation arising from the adhesion of a substance to the skin, and is an uneasy feeling, caused in consequence of some interruption of the natural functions of the part.

These tactile sensations whereby surfaces are discriminated, have a great degree of persistence in the recollection; something intermediate between tastes or smells, and sights. We do not revel in them as imagery it is true, but this would be accounted for by the superior hold that we have of the very same objects by means of sight. With the blind the case must be different; to them the outer world must be represented as outspread matters of contact; their visions of the surfaces of all things are visions of touch.

Our permanent impressions of touch serve us for comparing present surfaces with remembered ones, and for identifying or distinguishing the successive objects that come before the view. The cloth-dealer sees whether a given specimen corresponds with another piece that passed through his hands a year ago, or with a permanent standard impressed upon his finger sensibility.

12. *Qualities of Extension, Size, Form,* &c.—I have endeavoured to show in the previous chapter that these qualities are impressed upon us by the movement they cause, and that the feelings they produce are feelings of movement or muscularity. As the origin of our permanent notions of these qualities makes one of the contested and doubtful questions of metaphysics, I shall take an opportunity at some later stage of the exposition, of examining the views opposed to those I advocate; and for the present I shall merely present some farther illustrations by way of making these more intelligible. Although I conceive that the movements of the limbs and body, without any contact with external matter, would impress upon the mind the feeling of extension, this being nothing else than a feeling of the sweep of a moving organ, yet in the actual experience there is usually combined some sensation with the muscular impressions; and this additional sensation mixes itself up, but not inseparably, with the feeling proper to extension or movement.

By drawing the hand over a surface, as, for example, six inches of wire, we have an impression of the quality of the surface, and also of its length. Transferring the hand to another wire twelve inches long, the increased sweep necessary to reach the extremity is the feeling and the measure of the increased extent. By practising the arm upon this last wire, we should at last have a fixed impression of the sweep necessary for a foot of length, so that we could say of any extended thing, whether it was within or beyond this standard. Nay more, whenever anything brought up a foot to our recollection, the material of the recollection would be an arm impression, just as the material of the recollection of greenness is a visual impression.

If we pass from mere length to some area, as, for example, the *surface* of a pane of glass, we have only a greater complexity of movement and of the corresponding impression. Moving in one direction we get the length, in the cross direction we bring other muscles into play, and get an impression of movement on a different portion of the moving system. In this way we should have the impression of a right angle, or a builder's square. The full impression of the pane of glass would result from a movement from side to side over its whole length, or from a movement round the edge and several times across, so as to leave behind the sense of a possibility of finding surface anywhere within certain limits of length and breadth. In this shape, and in no other that I know of, would an extended surface be conceived by the mind through muscularity and touch. (The action of vision will be afterwards discussed.)

A cubical block, exemplifying all the three dimensions of *solidity*, presents nothing radically new. A new direction is given to the hand, and a new class of muscles are brought to contribute to the feeling. The movement must now be over the length, over the breadth, and over the thickness, and the resulting impression will be a complication of the three movements. To get a hold of the entire solidity, it is necessary to embrace all the surfaces one after another, which makes the operation longer, and the notion more complex and more difficult to retain. But the resulting impression, fixed by being repeated, is of the same essential nature as the notion of a line or a superficies; it is the possibility, the potentiality, of finding surface in three different directions within given limits. A cubical block of one foot in the side means that, commencing at an angle, and going along one edge, a foot range may be gone over before the material cease, that the same may then be done across, and also downwards, and that between every two edges there is an extended solid surface.

The multiplication of points of contact, by our having a plurality of fingers, very much shortens the process of acquiring notions of surface and solidity. In fact we can by means of this plurality measure a length without any movement; the degree of separation of the fingers made sensible by the tension of their muscles being enough. Thus I can appreciate a distance of six or eight inches by stretching the thumb away from the fingers, as in the *span* of the hand. By keeping the fingers expanded in this way so as to embrace the breadth of an object, and then drawing the hand along the length, I can appreciate a surface by a single motion combined with this fixed span of the thumb and fingers. I may go even farther; by bringing the flexibility of the thumb into action, I can keep the fingers on one surface and move the thumb over another side, so as to have a single impression corresponding to solidity, or to three dimensions. We are, therefore, not confined to one form of acquiring the notion, or to one way of embodying it in the recollection; we have many forms, which we come to know are equivalent and convertible, so that where we find one, we can expect another. But the most perfect combination of perceiving organs remains to be mentioned, namely, the embrace of the two hands. The concurrence of the impressions thus flowing from the two sides of the body to the common centre produces a remarkably strong impression of the solidity of a solid object. The two separate and yet coinciding images support one another, and fuse together in such a way as make the most vivid notion of solidity that we are able to acquire by means of touch. The parallel case of the two eyes, to be afterwards explained, will be found still more striking.

The notion of solidity thus acquired is complex, being obtained through a union of touch and muscularity, and combining perception of surface with perception of extended form. By the swing of the arms alone we have a notion of empty *space*, which means to us nothing more than scope for movement, and consequently for extended matter. Even when vision is superadded, I can find nothing more in our conception of space than this potentiality of movement. We measure space by the extent of movement permitted in it; this movement being, in the last resort, the movement of our own body or limbs; the very material of the conception in its most refined form, can never, so far as I can see, get beyond an impression of movement, engrained by repetition on the muscular frame-work, just as colour becomes a permanent impression on the visual organs, in connexion with the brain.

13. *Distance, direction,* and *situation,* when estimated by touch, involve, in the very same manner, the active organs; the tactile sensations merely furnishing marks and starting-points like the arrows between the chain-lengths in land-measuring. *Distance* implies two fixed points, which the touch can ascertain and identify; the actual measurement is by means of the sweep of the hand, arm, or body from the one to the other. *Direction* implies a standard of reference; some given movement must fix a standard direction, and movement to or from that will ascertain any other. Our own body is the most natural starting point in counting direction; from it we measure right and left, back and fore. For the up and down direction we have a very impressive lead, this being the direction of gravity. When we support a weight we are drawn downward; when not sustaining the arms by voluntary effort, they sink downward; when our support gives way, the whole body moves downward. Hence we soon gain an impression of the downward movement, and learn to recognise and distinguish this from all others. If a blind man is groping at a pillar, he identifies the direction it gives to his hand, as the falling or the rising direction. Circumstances do not, perhaps, so strongly conspire to impress the standard directions of right and left, but there is an abundant facility in acquiring them

too. The right deltoid muscle is the one chiefly concerned in drawing the right arm away from the body, and without our knowing anything about this muscle, we yet come to associate the feeling of its contraction with a movement away from the body to the right. All directions that call forth the play of the same muscles, are similar directions as respects the body; different muscles mean different directions. The great pectoral bringing the arm forward, the deltoid lifting it away from the side, the trapezius drawing it backward, indicate to our minds so many different positions of the guiding object; and we do not confound any one with the other. We learn to follow the lead of each one of these indications; to make a forward step succeed the contraction of the pectoral, a step to the right the deltoid, a step backward the trapezius.

If distance and direction be known, we have everything implied in *situation* which is measured by those two elements. The situation of another person towards me, is either right, left, before, behind, up, or down, or a medium between some of these; and at a given distance of so many inches, feet, or yards.

Form or shape is appreciated as easily as situation. It depends upon the course given to the movements in following the outline of a material body. Thus we acquire a movement corresponding to a straight line, to a ring, an oval, &c. This is purely muscular. The fixed impressions engrained upon the organs in correspondence with these forms have a higher interest than mere discrimination. We are called to reproduce them in many operations—in writing, drawing, modelling, &c.—and the facility of doing so will depend in great part upon the hold that they have taken upon the muscular and nervous mechanism. The susceptibility and retentiveness of impressions necessary to draw or engrave skilfully are almost entirely muscular properties.

14. So much for the qualities revealed to us by touch, either alone or in conjunction with movement. The accompaniment of activity belongs to every one of the senses; it serves to bring about or increase the contact with the objects of the sense. There is in connexion with each of the senses a parti-

cular verb, or designation, implying action; *to taste* implies the movement for bringing the substance upon the tongue; *to smell*, or *to snuff*, means an active inhalation of the odorous stream; *to feel* signifies the movement of the hand or other organ over the surface in search of impressions; in like manner, to hear and to see are forms of activity. In the cases of taste and smell, the action does not contribute much to the sensation or the knowledge; in the three others (two especially) it is a material element, since in all of them, direction and distance are essential parts of the information. Now, since movement is required to bring objects within reach, the value of any of our senses will depend very greatly upon the activity of the organs that carry the sensitive surface, the *tentacula*, so to speak. This activity grows out of the muscular and nervous energy of the frame, and not out of the particular endowment of the sensitive part. It is a voluntary exertion, at first spontaneous purely, always spontaneous in some degree, but linked to, and guided by, the sensibility. The flush of activity lodged in the arm and fingers is the first inspiration towards obtaining impressions of touch; the liking or disliking for the impressions themselves comes in to modify and control the central energy, and to reduce handling to a system.

15. Touch being concerned in innumerable handicraft operations, the improvement of it as a sense enters largely into our useful acquisitions. The graduated application of the force of the hand has to be ruled by touch; as in the potter with his clay, the turner at his lathe, the polisher of stone, wood, or metal, the drawing of the stitch in sewing, baking, taking up measured quantities of material in the hand. In playing on finger instruments, the piano, guitar, organ, &c., the touch must measure the stroke or pressure that will yield a given effect on the ear.

16. The observations made on persons born blind have furnished a means of judging how far touch can substitute sight both in mechanical and in intellectual operations. These observations have shown that there is nothing essential to the highest intellectual processes of science and thought that may not be attained in the absence of sight. The integrity of the

moving apparatus of the frame renders it possible to acquire the fundamental notions of space, magnitude, figure, force, and movement, and through these to comprehend the great leading facts of creation as taught in mathematical, mechanical, or physical science.

17. The skin is liable to feelings not produced by an external pressure, but resembling what would arise from particular actions, and suggesting them to the mind. These are called 'subjective sensations.' The tingling of a limb asleep, formication, or a sensation as of the creeping of insects, heat, chilliness, &c., are examples.—(TODD and BOWMAN, I. 433.)

SENSE OF HEARING.

This sense is more special and local than the foregoing, but agrees with Touch in being a mechanical sense as distinguished from what I have chosen to consider as the chemical senses—Taste and Smell.

1. The *objects* of hearing, are material bodies in a state of tremor, or vibration, brought on when they are struck, which vibration is communicated to the air of the atmosphere, and is thereby propagated till it reach the hollow of the ear.

All bodies whatever are liable to the state of sonorous vibration; but they differ very much in the degree and kind of it. The metals are the most powerful sources of sounds, as we see in bells; after these come woods, stones, earthy bodies. A hard and elastic texture is the property needed. Liquids and gases sound very little, unless impinged by solids. The howling and rustling of the wind arise from its playing upon the earth's surface as on the Æolian harp. The thunder is an example of a pure aerial sound, the intensity, great as it is, being very small in comparison to the mass of air put in agitation.

It belongs to the science of Acoustics to explain the production and propagation of sound, and the forms of sounding instruments of all kinds. Here we are considering the effects, and not the instruments of sound. Even the human voice, whose description cannot be omitted in a treatise on mind, will come in under another head.

2. The *organ* is the Ear. 'It is divisible into three parts; the external ear, the tympanum or middle ear, and the labyrinth or internal ear; and of these the first two are to be considered as accessories or appendages to the third, which is the sentient portion of the organ.'

The *external ear* includes 'the pinna—the part of the outer ear which projects from the side of the head,—and the meatus or passage which leads thence to the tympanum, and is closed at its inner extremity by the membrane interposed between it and the middle ear (membrana tympani).'

'The *tympanum*, or drum, the middle chamber of the ear, is a narrow irregular cavity in the substance of the temporal bone, placed between the inner end of the external auditory canal and the labyrinth. It receives the atmospheric air from the pharynx through the Eustachian tube, and contains a chain of small bones, by means of which the vibrations, communicated at the bottom of the external meatus to the membrana tympani, are conveyed across the cavity to the internal ear, the sentient part of the organ. The tympanum contains likewise minute muscles and ligaments which belong to the bones referred to, as well as some nerves which end within this cavity, or only pass through it to other parts.'

As to the cavity of the tympanum, I shall content myself with quoting the description of the anterior and posterior boundaries by which it connects itself with the outer and inner portions of the ear, and which are therefore the main links in the line of communication from without inwards.

The outer boundary, formed by a thin semi-transparent membrane, the membrana tympani, which may be seen by looking into the ear, 'is nearly circular, and is slightly concave on the outer surface. It is inserted into a groove at the end of the passage of the outer ear, and so obliquely that the membrane inclines towards the anterior and lower part of the canal at an angle of 45°. The handle of one of the small bones of the tympanum, the malleus, descends between the middle and inner layers of the membrane to a little below its centre, and is firmly fixed to it; and as the direction of the handle of the bone is slightly inwards, the outer surface of the membrane is thereby rendered concave.'

The *inner wall* of the tympanum, which is formed by the outer surface of the internal ear, is very uneven, presenting several elevations and foramina. The foramina or openings are two in number, the oval foramen (fenestra ovalis) and the round or triangular opening (fenestra rotunda). Both are closed with membranes, which render the inner ear, with its containing liquid, perfectly tight. To one of them, the oval foramen, a small bone is attached, the other, the round foramen, has no attachment. These two openings are the approaches to the internal ear, and through them lies the course of the sonorous vibrations in their progress towards the auditory nerve.

The small bones of the tympanum are named from their appearance as follows (beginning at the outermost): the *malleus*, or hammer, attached to the membrane of the tympanum ; the *incus*, or anvil; and the *stapes*, or stirrup, which is fixed to the oval opening in the inner ear, called the *fenestra ovalis*. The incus is thus intermediate between the other two, and the result of the whole is, ' a species of angular and jointed connecting rod between the outer and inner walls of the tympanic cavity, which serves to communicate vibrations from the membrana tympani to the fluid contained in the vestibule of the internal ear.'

There are certain small muscles attached to those bones for the regulation of their movements. On the number of these muscles Anatomists are not agreed, owing to the minuteness and ambiguous appearance of the fibres. As to one of them there is no dispute, namely, the *tensor tympani*, a muscle inserted into the handle of the malleus, and by its contraction drawing inwards and tightening the membrane of the tympanum. A second muscle, admitted by most anatomists, is that named the *stapedius*, from its attachment to the stapes, or stirrup-bone, at the other end of the chain from the malleus. Mr. Toynbee considers the action of these two muscles as antagonistic.

The *internal ear*, or *labyrinth*, 'which is the essential or sensory part of the organ of hearing, is contained in the petrous portion of the temporal bone. It is made up of two very different structures, known respectively as the osseous and membranous labyrinth.'

(1.) 'The *osseous labyrinth* is lodged in the cancellated structure of the temporal bone, and presents, when separated

FIG. 7.*

from this, the appearance shown in the enlarged figure. It is incompletely divided into three parts, named respectively the vestibule, the semicircular canals, and the cochlea. They are lined throughout by a thin serous membrane, which secretes a clear fluid.

'(2.) The *membranous labyrinth* is contained within the bony labyrinth, and, being smaller than it, a space intervenes between the two, which is occupied with the clear fluid just referred to. This structure supports the numerous minute ramifications of the auditory nerve, and encloses a liquid secretion.'

The minute anatomy of these parts I must pass over. The *vestibule* is the central chamber of the mass, and is the portion

* 'An enlarged view of the labyrinth from the outer side:—1. Vestibule. 2. Fenestra ovalis. 3. Superior semicircular canal, 4. External semicircular canal. 5. Posterior semicircular canal. 6. First turn of the cochlea. 7. Second turn. 8. Apex of cochlea. 9. Fenestra rotunda. * Ampullæ of semicircular canal.—The smaller figure represents the osseous labyrinth of the natural size.'—(QUAIN.)

of the labyrinth turned towards the tympanum, and containing the cavities of communication above described. The *semicircular canals* are three bony tubes, situate above and behind the vestibule, into which they open by five apertures; each tube being bent so as to form the greater part of a circle. The cochlea is a blunt cone, having its surface 'marked by a spiral groove, which gives to this part of the labyrinth somewhat of the appearance of a spiral shell—whence its name.' Its interior is a spiral canal divided into two by a thin partition, deficient at the apex of the cochlea. The canal opens freely into the cavity of the vestibule.

'Within the osseous labyrinth, and separated from its lining membrane by a liquid secretion, is a membranous structure, which serves to support the ultimate ramifications of the auditory nerve. In the vestibule and semicircular canals this membrane has the form of a rather complex sac, and encloses a fluid called the endolymph; in the cochlea the analogous structure merely completes the lamina spiralis (the partition of the cochlea), and is covered by the membrane which lines the general cavity of the osseous labyrinth.'

The labyrinth is thus to be considered as a complicated chamber full of liquid, and containing also a membranous expansion for the distribution of the nerve of hearing. Let us next advert to the *action* of these different parts in producing the sensations of sound.

3. The waves of sound enter the passage of the outer ear, and strike the membrane of the tympanum. The structure of the outer ear is adapted to collect and concentrate the vibrations like an ear trumpet. The form of the shell gives it a reflecting surface for directing the sound inwards; while the passage is believed to increase their intensity by resonance. Reaching the membrane of the tympanum, the beats communicate themselves to its surface and set it a vibrating, which is done all the more easily that the membrane is very thin and light in its structure. Experiments have shown that the only means of receiving with effect the vibrations of the air is to provide a thin stretched membrane such as this. The vibrations of the membrane are communicated to the chain of

bones traversing the middle ear, and connecting through the oval foramen with the enclosed liquid of the inner ear. By this means a series of beats are imparted to this liquid, which diffuse themselves in waves all through the passages of the labyrinth, and act by compressing the membranous labyrinth, and through it the imbedded fibres of the auditory nerve, which compressions are the immediate antecedent of the sensation of hearing. The character of the sensation will of course vary with the character of the waves, according as they are violent or feeble, quick or slow, simple or complex, and so forth.

There is little difference of opinion as to the general course of the action now described. The transitions have all been imitated by experiments, and it has been found that the arrangement is a good one for bringing about the ultimate effect, namely, the gentle compression of the filaments of the nerve of hearing. No other medium could serve the final contact so well as a liquid, but in order to impress the liquid itself, an intermediate apparatus between it and the air is requisite. This intermediate apparatus is solid, and composed of two parts, the first slender and expanded, so as to be susceptible to the beats of the air, the second dense and contracted (the chain of bones), to produce a sufficiently powerful undulation in the liquid. The membrane once affected is able to communicate vibrations to the bones, and the end of the stapes is able to impress the labyrinthine fluid. So far the process has been rendered sufficiently intelligible.

Sonorous vibrations are also communicated in a feeble way from the tympanic membrane to the inner ear through the air in the tympanic cavity. The membrane of the fenestra rotunda is acted on by these aerial pulses, while the membrane of the fenestra ovalis is impinged by the stirrup bone.

When, however, we come to inquire minutely into the uses of the different parts, and the meanings of the different complications of form and arrangement, the answer is not in all cases to be had. The inner ear especially, with its labyrinthine windings, is a subject of great perplexity. It can easily be understood that those windings, like the cavities of the nose, give a greater expansion to the membrane supporting the auditory nerve, and thus increase the effect of the vibrations; there may also be a multiplication of effect by resonance in the canals. Whether any other more special purpose is served by them has not as yet been made out.

What would be most interesting from the point of view of this treatise, would be to ascertain the precise uses of the muscles of the ear. But this subject is unfortunately very obscure. There are, I am informed, three muscles whose existence cannot be questioned: the tensor tympani, whose purpose undoubtedly is, as the name signifies, to tighten the membrane of the tympanum; the stapedius inserted into the stirrup bone, and considered by Mr. Toynbee to be antagonistic to the other; and the laxator tympani minor, inserted into the handle of the malleus, whose action cannot be guessed with any probability.

It has not been well ascertained on what occasions and with what effect the tensor tympani is brought into play. The only distinct observation on the matter is that made by Dr. Wollaston, namely, that when the membrane of the tympanum is stretched, the ear is rendered less sensible to grave sounds, such as the deep notes of the organ, or the sounds of thunder and cannon. When therefore the ear is exposed to very intense sounds of the deep kind, such as the firing of artillery, the tensor tympani coming into play would in some measure deaden the effect. The action would make little or no difference to the hearing of acute sounds, such as the sharp notes of a call whistle. Probably these muscles are excited by the reflex action of the sounds; possibly, also, they may be of the voluntary class, that is, they may come into play in the voluntary acts of listening and of preparing the ear to resist loud sounds. The only circumstance I can assign as determining the reflex action of the tensor tympani is simply the intensity of the sound. We may suppose that every sound whatever brings on a reflex action to stretch the membrane, and the stronger the sound the greater the action. When sounds are too loud, and of the grave kind, this tension mitigates them; when too loud and acute, it either has no effect, or makes the evil worse.

'Dr. Wollaston performed many experiments upon the effects of tension of the membrana tympani, and he found that deafness to grave notes was always induced, which, as most ordinary sounds are of a low pitch, is tantamount to a general deafness. Shrill sounds, however, are best heard when the tympanic membrane is tense. Müller remarks, and we have frequently made the same observation, that the dull rumbling sound of carriages passing over a bridge, or of the firing of cannon, or of the beating of drums at a distance, ceases to be heard immediately on the membrana tympani becoming tense; while the treading of horses upon stone pavement, the more shrill creaking of carriages and the rattling of paper, may be distinctly heard.'—TODD and BOWMAN, vol. ii. p. 95.

4. Passing now to Sounds considered as Sensations, I might distinguish these into three classes; the first would comprise the general effects of sound as determined by Quality, Intensity, and Volume or Quantity, to which all ears are sensitive. The second class would include Musical sounds, for which a susceptibility to Pitch is requisite. Lastly, there is the sensibility to the Direction and Articulateness of sounds; on these properties depend much of the intellectual uses of the sense of hearing.

5. *Quality. (Emotional).* This regards sounds as in themselves agreeable or disagreeable, apart from the intensity or quantity of the sonorous influence. Like sweet and bitter in Taste, there is a qualitative distinction of sounds into such as intrinsically possess the power of gratifying the sense of hearing, and those that give in an unmingled form the peculiar pain that we are capable of deriving through this organ. The terms, sweet, rich, mellow, are applied to the pleasing effects of pure sound. Instruments and voices are distinguished by the sweetness of their individual tones; there is something in the material and mechanism of an instrument that gives a sweet and rich effect, apart altogether from the music of the airs

performed upon it. Other instruments and sounds have a grating, harsh, unpleasant tone, like bitterness in taste, or a stink in the nostrils. We cannot explain the cause of this difference in the material of sounding bodies; we only know that some substances, by their texture, have a greater sweetness of note than others. Thus silver is distinguished among the metals; and glass is also remarkable for pure rich tones. The hard woods are usually better than the soft for the construction of instruments. It is hopeless to attempt to explain those astonishing differences that occur between one make of instrument and another, or to probe the mysterious structure of a Cremona violin.

This sensation of the sweet in sound I have characterised as the simple, pure, and proper pleasure of hearing; a pleasure of great acuteness but of little massiveness. The acuteness of it is proportioned to the rank of the ear as a sensitive organ, or to the susceptibility of the mind to be stirred and moved through the channel of hearing. Now in the generality of mankind the ear is extremely sensitive; perhaps in none of the senses are we more keenly alive to pleasure and pain than in this, although we do not obtain from it that bulky enjoyment that comes through the organic feelings.

There is however a great superiority in the endurableness of sweet sounds over the sweets of the inferior senses. In touch this distinction exists in the comparison with Taste and Smell; in hearing there is a farther progress, and we shall have to note the crowning pitch of this important property when we come to the sense of sight. By virtue of this fact we can obtain from sight and hearing a larger amount of enjoyment within the same degree of fatigue or exhaustion, or before reaching the point of satiety. Hence one reason for terming these the 'higher senses.'

I may remark that great sweetness of tone is not a usual property of the sounds about us, nor are we often exposed to very harsh or repulsive effects on the ear. The majority of actual sounds are indifferent in their emotional influence.

Sweetness of sound, as of taste and smell, is a pure and serene emotion; there is nothing in it of an appetite or a craving so as to be a spur to the volition.

As regards persistence in the intellect, there is a common superiority in sounds in general over Tastes and Smells, which will be alluded to at the close of our remarks upon the sense of hearing. By virtue of that character the pleasure of sound is more extended in its influence over our mental life, by being more realizable in idea, than the pleasures of these other senses.

6. *Intensity, Loudness.*—Sounds may be either faint or loud, and as such they affect the ear differently. A faint gentle sound, otherwise not disagreeable, is a source of pleasurable stimulus to the ear. The tone of a steady breeze, the distant hum of a city, the rush of a rivulet, are instances of gentle sounds yielding pleasure to the ear disposed to listen to them. If we attend to the nature of this sensation, we shall probably consider it as not very powerful or massive, but as acutely or keenly felt.* It does not count for much if weighed in the balance with the feelings of exercise, warmth, &c., but it has the effect common to sonorous influences on susceptible ears, of setting on trains of recollection and reverie. It may thus originate states of excitement without being much in itself.

When the sound passes from the gentle to the loud, we have as a matter of course a more intense stimulus. The sensation then becomes keen and pungent, like the action of ammonia on the nose, or a smart stroke on the skin. The rattle of carriages, the jingle of an iron work, the noise of a

* The words 'acute' and 'keen,' which I have introduced extensively in the description of emotional states, are probably almost synonymous in their acceptation. They both serve the purpose of contrasting with the 'massive' or 'voluminous' in effect; but when I wish to indicate, at the same time, the extreme opposite of 'obtuseness,' or bluntness of sensibility, I think the word 'keen' is rather the more expressive of the two. Hence, in discussing the sense of hearing, so much more sensitive, and, so to speak, raw, than touch, I feel disposed to use this word very liberally in my descriptions; although possibly many readers may feel that the term 'acute' really amounts to the same thing. In using both together, I indicate, as strongly as I can, the quality of sensitiveness as attaching to the organ in the special case.

cotton mill, the ringing of bells close to the ear, the discharge of ordnance, are all exciting from their intensity; to fresh and vigorous nerves plunged into them after quietness, these noises are an intense pleasure. They may be described, however, as a coarse excitement; there is a great cost of tear and wear of nerve for the actual satisfaction.

The intensity rising beyond a certain pitch turns to pain; and in proportion to the keenness of the feeling of the pleasurable, is the repulsion of the painful state of the over-excited nerves. The screeching of a parrot-house, the shrill barking of the smaller species of dogs, the whistling in the fingers practised by boys in the streets, the screaming of infants, are instances of painful pungency. It is in pain that the delicacy of the ear makes itself most apparent; the annoyance of a fatigued and jaded ear is very difficult to overcome, and the agony of acute suffering arising from sounds, in certain disorders of the ear, is known to be of the most unendurable kind.

The *suddenness* of sounds is a feature allied with intensity, and marks a contrast between two successive states of nerve, one little excited, and the other much. In producing anger, terror, and mental discomposure, a sudden sound is very effective; in this resembling an unexpected shock or check to the movements of the body, which has already been adverted to as causing a peculiar and painful emotion.

7. *Volume* or *Quantity.*—This means the sound coming from a sounding mass of great surface or extent. The waves of the 'many sounding sea,' the thundery discharge, the howling winds, are voluminous sounds. A sound echoed from many sides is made voluminous. The shouts of a great multitude is a powerful instance of the voluminous. Grave sounds, inasmuch as they require a larger instrument, are comparatively voluminous.

This multiplication of sounds, without increase of individual intensity, has a very powerful effect on the ear. The stimulus is greatly increased, but not fatiguingly so. The sensation is extended in volume and amount without becoming pungent; like the difference between a warm bath and the immersion of the feet in tepid water. Apart from music, the greatest pleasure that sound can give is derived from voluminous effects.

8. *Pitch*, or *Tune*.—This is the musical character of sounds. By it is meant the acuteness or graveness of the sound, as determined by the ear, and this is found to depend on the rapidity of vibration of the sounding body, or the number of vibrations performed in a given time. Most ears can mark a difference between two sounds differing in acuteness or pitch: those that cannot do so are incapable of music. The gravest sound audible to the human ear is stated by the generality of experimenters at 32 vibrations per second; the limit of acuteness is various for different individuals, the highest estimate is 73,000 vibrations in the second. The cry of a bat is so acute as to pass out of the hearing of many persons. The extreme audible range would amount to between nine and ten octaves.

The perception of pitch must resolve itself into the discrimination by the nerve of the frequency of the pulses or compressions given to it by the surrounding liquid of the labyrinth, set in motion through the bones and membrane of the tympanum. The auditory nerve would require to propagate to the brain a different form of excitement according as the beats are few or many; and in order to great delicacy of ear, extremely minute differences of pitch would have to impress themselves discriminatively on the fibres. We may suppose that the quality of the membrane of the tympanum itself, and of the connecting chain of bones, may be very unequal as regards the transmission of the beats of the air; in some ears these being imparted to the labyrinth with more precision than in others; but the difference between an ear that is musical and one that is not, cannot be other than a difference in the organization of the auditory nerves and in the connected centres in the brain.

An ear sensible to pitch is also sensible to the difference between a musical sound and a noise; the one having a sustained note, the other being a jumble of innumerable notes. Such an ear derives pleasure from the equal tone, while from the other none, or worse than none is derived. A musical note is in itself a harmony; being the equal timing of successive vibrations or pulses. It is, in a minute or microscopical subdivision, the same effect as equality of intervals or time in a musical performance; although the one may be a thousand beats per second, the other not more than two in the same time. It is a keen, lively, stirring sensation of pleasure, more refined and exquisite than mere pungency, or the effect of loudness; and is the basis or foundation of one of the great pleasure-giving arts of life.

9. The *waxing* and *waning* of sound. The gradual increase or diminution of the *loudness* of a sound, is one of the effects introduced into musical composition, owing to the power it has to excite keen and intense emotion. The howling of the wind has sometimes this character, and produces a deep impression upon all minds sensitive to sound. The dying away of sound is perhaps the more exciting of the two effects; 'that music hath a dying fall.' I think it not unlikely, that a muscular effect enters into this sensation: the gradually increased or relaxed tension of the muscles of the ear being a probable accompaniment of the increase or diminution of loudness. On this supposition, the influence on the mind would be one of the very delicate effects of movement. From the character of the sensation itself, I think that muscular motions would account for it in part; but I am not prepared to say that the heightened or lower intensity of the pulses on the auditory nerve would not suffice to produce the effect. Be this as it may, the sensation itself is powerful and stirring; and wakens up an intense current of emotion; in general, I believe, of a very solemnising kind. That such is its usual character is testified by the use made of the tempest howl or moan in poetic compositions.

The waxing and waning of a sound in acuteness or *pitch* is still more properly a musical effect. To pass from one note to another by imperceptible change, is the essence of 'sing-song' or 'whine,' both in speech and music; and is apt to degenerate into a very coarse effect, such as good taste repudiates; a circumstance proving how powerful the action is.

The mixture of the two effects of waning or waxing loudness and pitch is doubtless the most common, both in natural sounds, in music, and in speech. In the notes of birds we may trace this effect; in the execution of accomplished singers, in the violin and other instruments, and in the cadences of a musical orator, we may likewise observe it; in all cases telling powerfully; the plaudits of an admiring audience leave no doubt as to its influence in stirring up some favourite and powerful emotion.

10. *Complexity* is a notable character of sounds, yielding peculiar sensations of various kinds. The sounds concurring upon the ear at the same moment may be many or few. The membrane of the tympanum may be affected by several series of undulations, which will be transmitted with all their primitive distinctness to the fibres of the nerve of hearing; and the nerve may also transmit them without confusion to the ganglionic centres. But in the consciousness the distinctness is not well preserved; some degree of fusion takes place; and this may be grateful or otherwise according to the nature of the separate sounds. Sometimes a multitude of sounds falling upon the ear together, are perfectly indifferent to one another, as in the ordinary din of a market-place, or a crowded city. At other times a most painful action ensues from the confluence of sounds, as in the jarring sounds of an instrument out of tune. This we call a *discord*. The effect is a feeling of acute pain, intense in proportion to the musical sensibility of the ear. Discords may be produced more unendurable than a surgical operation, the sensibility of the ear itself being more keen than the tissues of organic life. Some of the intensely disagreeable sounds, as the well-known sound of sharpening a saw, are probably discords; the effect is apparently much more intolerable than the mere shrillness would bring about. On this, however, I cannot speak with certainty.

The opposite of discord is *harmony*, or the combination aimed at in music. The sounds that harmonize are well known to be related to one another numerically in the number of their vibrations. Of the mental effects of harmonies I should have to speak at length if I were discussing the Emotions of Art in general.

11. *Clearness*, or purity.—A clear sound is one that has a distinct, uniform character, and is not choked or encumbered with confusing ingredients. Clearness is a property that affects both the perception of meaning and the pleasure of music. A clear-toned instrument is one that yields, unmixed and in perfection, the notes that the performer aims at producing. The perception of tone or pitch must needs depend very much on the clearness of the sound. In instruments, the purity varies with the substance. Silver, among the metals, is clear-toned. Glass, from the uniformity of its texture, is noted for this quality. In instruments of wood, a hard and uniform tissue is indispensable. In the human voice *musical* clearness and *articulate* clearness depend upon totally different qualities. The first arises from the structure of the larynx and the molecular nature of the resonant skull; the second depends upon the sharpness and suddenness of the articulate actions of the mouth. In every kind of expression clearness is a cardinal virtue; the merit of musical or articulate performances must rise or fall according as the effect intended stands out apart from other effects not intended.

12. *Quality* (*Intellectual* or *Discriminative*).—This relates to the feeling of difference, that difference of material gives, whereby we discriminate between one substance and another, as in the ring of a shilling or a sovereign, and in the difference already alluded to between one person's voice and another. This discriminativeness of the ear, corresponding to a distinctiveness of sonorous quality in bodies, is of the greatest consequence in our daily operations.

13. *Direction*.—This is a purely intellectual sensation, in other words, is of importance as leading us to perceive the situation of the objects of the outer world whence the sound takes its rise.

Some have supposed that the labyrinthine apparatus is intended to give us the perception of distance at once and independent of experience. This view has been put forth by Professor Wheatstone. But so far as I can judge of the matter, I prefer the explanation that refers this perception entirely to experience. The following extract from Longet expresses what I mean :—

'With regard to the direction of the sonorous waves we can at present only say, that the knowledge of it is owing to a process of reasoning applied to the sensation. Thus, we hear distinctly a sound emanating from a given point, whatever be the position of the head; but the ear being able to judge of slight differences in the intensity of sounds, we remark that, in certain positions of the head, the sound seems stronger. We are hence led to place our head in one fixed position as regards the sounding body. But our sight tells what is this direction of most perfect hearing; and we then apply the observation made on bodies that we can see to those that are not seen.'

The sense of direction is by no means very delicate, even after being educated to the full. We can readily judge whether a voice be before or behind, right or left, up or down; but if we were to stand opposite to a row of persons, at a distance, say, of ten feet, we should not be able, I apprehend, to say which one emitted a sound. This confusion is well known to schoolmasters. So it is next to impossible to find out a skylark in the air from the sound of its song.

The combined action of the two ears undoubtedly favours the perception of direction of sound very materially. A person who has lost the hearing on one side, is usually unable to say whether a sound is before or behind. The change of effect produced by a slight rotation of the head, is such as to indicate direction to the mind. For while the sound becomes more perceptible on one ear,—the ear turned to face the object more directly,—the sound in the other ear is to the same degree obscured. When the head is so placed, after various trials, that the greatest force of sensation is felt on the right ear, and the least on the left, we then infer that the sounding body is away to the right; when the two effects are equal, and when any movement of the head makes them unequal, we judge the sound to be either right in front, or behind; and we can further discriminate so as to determine between these two suppositions.

14. The perception of *distance* can result from nothing but experience. I quote again from Longet. 'As soon as the organ presents a sensibility and a development sufficient for discerning easily the relative intensity of two consecutive sounds, nothing farther is necessary in order to acquire the notions of distance and direction of the body from which the sonorous waves emanate. In fact, if a sound is already known to us, as in the case of the human voice, or an instrument, we judge of its distance by the feebleness of its impression upon the nerve of hearing; if the sound is one whose intensity, at a given distance, is unknown, as, for example, thunder, we suppose it nearer according as it is louder.'

15. *Articulate form.*—This quality relates almost exclusively to the effect produced by the sounds issuing from the human voice, as modified by the shape of the mouth during their utterance. By widening the mouth during the emission of sound a broad vowel, *ah*, is sounded; and we have a very distinct feeling of the difference between this sound and the sound issuing from a contracted mouth, as in the vowel *u* of 'put.' Whether this difference is due solely to the greater area or expansion of the stream of sound in one case, I cannot pretend to say; but it is probable that this must be looked upon as a leading circumstance. We have already seen that sounds affect us differently according to their volume, or the extent of sounding surface; and the present case may repose in part upon this distinction. When a number of sounds proceed together to the ear, we may have every variety of perception according as the individual sounds are varied; thus there is something articulate in the uproar of a multitude from the waving of the sound to and fro, now from one corner, now from another, and again from the whole in chorus. When a vowel sound emanates from the mouth, the thickness and shape of the column of sound are modified, and this modification has a characteristic influence upon the ear, owing to the distinction felt between a wide and narrow origin of

sound. So much as regards the vowels. In the consonants, the discrimination must hinge upon something different from the area and shape of the stream as diffused from the mouth. It is easy to understand the difference of the labials or dentals according as they are mute or vocal, the difference between *p* and *b*, or between *t* and *d*; what is to be explained is the difference in the mutes, namely, *p*, *t*, *k*, which are produced by the abrupt opening or closure of the lips, the teeth, and the throat respectively, these two last being closed by the tongue; the difference in short between the articulations *ap*, *at*, *ak*. The question is, what is the peculiarity in the formation of those sounds that makes them felt as different to every ear? We must confess that there is no adequate reply to this question; there appears to me to be somewhat of the same obscurity here as in the timbre or quality of sound issuing from different substances or voices. It seems at first sight not more wonderful that we should discriminate between labial, dental, and guttural sounds, than that we should discriminate between one man's articulation and another; but the difficulty is not the same. It is likely that the difference lies in the mode of formation of the sound by the stroke of the parts: in the lips the blow seems softer and less abrupt, in the back part of the palate it is much harder; there we can produce a sharp click that could not be made to arise between two soft substances like the lips. Whether or not some other permanent difference holds between those sounds arising from the difference of locality of the opening and closure, I will not endeavour to decide.

Some people are distinguished by their susceptibility to articulate sounds, a kind of susceptibility or discrimination that makes an ear for language, as the discrimination of pitch makes a musical ear. There appears to be no necessary connexion between the two gifts, and experience shows that one may exist in a high degree along with deficiency in the other. At the same time, I believe that a good ear will for the most part be good for all the points of hearing. The sense of pitch is probably the least bound up with other sensibilities.

As a general rule, the emotional sensibility of any sense bears no relation to the intellectual sensibility. An ear may be very inflammable to exciting effects of sound, and may at the same time be very dull to all those differences of quality and degree that constitute the meaning of sounds as well as their delicate harmonies. It is like the difference to the eye between a bonfire and a landscape, between the glare of noon and an algebraical formula.

16. The duration of an impression of sound can be appreciated by noting at what intervals a succession of beats seems an uninterrupted stream of sound. This makes, in fact, the inferior limit of the audibility of sounds. From the experiments of Savart, it would appear that a series of beats begins to be felt as continuous when they number from ten to twelve in a second; so that the impression of each must continue not less than the tenth part of a second.

SENSE OF SIGHT.

1. The *objects* of sight include nearly all material bodies. Their visibility depends on their being acted on by Light, the most inscrutable of natural agents. Certain bodies, such as the Sun, the Stars, flame, solids at a high temperature, give origin to rays of light, and are called self-luminous. Other bodies, as the Moon, Planets, and the greater number of terrestrial surfaces, are visible only by reflecting the rays they receive from the self-luminous class.

The reflection of light is of two sorts: mirror reflection, which merely reveals the body that the light comes from; and reflection of visibility, which pictures the reflecting surface. In this last mode of reflection the light is broken up and emitted in all directions exactly as from a self-luminous original. Visible surfaces receiving light from the sun have thus the power of absorbing and reissuing it, while a mirror simply gives a new direction to the rays. When we look at a picture in a bad light, we find that the rays of reflection overpower the rays arising from the coloured surface of the picture, and consequently the picture is imperfectly seen.

As regards vision, bodies are either opaque or transparent.

There is a scale of degrees from the most perfect opacity, as in a piece of clay, to the most perfect transparency, as in air. According as bodies become transparent they cease to be visible.

The transparency of air is not absolutely perfect; that is to say, light in passing through the atmosphere is to a certain small extent arrested, and a portion reflected, so as to make the mass faintly visible to the eye. When we look up into the sky through a cloudless atmosphere, all the illumination received from the surface is light reflected by the atmosphere itself. Liquids are still less transparent; although they transmit light so as to show objects beyond them, they also reflect a sufficient portion to be themselves visible. Light falling upon the surface of water is dealt with in three different ways. One portion passes through, a second is reflected as from a mirror, a third very small portion is absorbed and radiated anew, so as to make the surface visible as a surface. The same threefold action obtains in transparent solids, as glass, crystal, &c. It is to be remarked of solid bodies that they are almost all transparent to a certain small depth, as shown by holding up their plates or laminæ to the light. Gold leaf, for example, permits the passage of light; and any other metal, if similarly attenuated, would show the same effect. There is, however, in this case, an important difference to be noted, inasmuch as objects are not distinctly seen, although light is transmitted; hence the name 'translucent' is applied to the case to distinguish it from proper transparency. There may be something more than a difference of degree between the two actions.

Opaque bodies may diffuse much light or little: some substances, such as chalk and sea foam, emit a large body of light; charcoal is remarkable for absorbing without re-emission the sun's rays. This is the ordinary, perhaps not the full, explanation of white and black, the one implying a surface which emits a large portion of the rays of visibility, the other few or none.

Besides that difference of action which makes white and black, and the intermediate shades of grey, there is a difference in the texture of surfaces giving birth to what we recognise as colour. Upon what peculiarity of surface the difference between, for example, red and blue, depends, we cannot at present explain. But this fact of colour is one among the many distinctions presented by the various materials of the globe. Along with colour a substance may have more or less of the property that decides between white and black, namely, copiousness of radiation. This makes richness of colour, as in the difference between new and faded colours, between turkey red and dull brick clay of a similar hue.

Bodies that are translucent to a certain depth have from that circumstance a distinct appearance, named their lustre. The effect of this property on the sense I shall discuss when we come to the Sensations of Sight.

Mineral bodies present all varieties of light, colour, and lustre, but the prevailing tone of rocks and soils is some shade of grey. The reddish tint of clays and sandstones is chiefly due to the prevalence of iron. Vegetation yields the greenness of the leaf, and the variegated tints of the flower. Animal bodies present new and distinct varieties.

2. We come next to consider the *organ* of sight, the Eye.

'Besides the structures which compose the globe of the eye, and constitute it an optical instrument, there are certain external accessory parts, which protect that organ, and are intimately connected with the proper performance of its functions. These are known as the 'appendages of the eye,' (they have been named likewise tutamina oculi); and they include the eyebrows, the eyelids, the organs for secreting the sebaceous (or oily) matter, and the tears, together with the canals by which the latter fluid is conveyed to the nose.'

'The eyebrows are arched ridges, surmounting on each side the upper border of the orbit, and forming a boundary between the forehead and the upper eyelid. They consist of thick integument, studded with stiff, obliquely set hairs, under which lies some fat, with part of the two muscles named respectively the orbicular muscle of the eyelids and the corrugator of the eyebrows.' By this last-named muscle the eyebrows are drawn together, and at the same time downwards, so as to give the frowning appearance of the eye; the opposite action of lifting and separating the eyebrows is performed by a muscle lying beneath the skin of the head termed the occipito-frontalis. In regulating the admission of light to the eye, and in the expression of the passions, these two muscles are called into play; the one is stimulated in various forms of pain and displeasure, the other in an opposite class of feelings.

'The *eyelids* are two thin moveable folds placed in front of each eye, and calculated to conceal it, or leave it exposed, as occasion may require. The upper lid is larger and more moveable than the lower, and has a muscle (levator palpebræ superioris) exclusively intended for its elevation. Descending below the middle of the eye, the upper lid covers the transparent part of the organ; and the eye is opened, or rather the lids are separated, by the elevation of the upper one under the influence of the muscle referred to. The eyelids are joined at the outer and inner angles of the eye; the interval between the angles varies in length in different persons, and, according to its extent, (the size of the globe being nearly the same,) gives the appearance of a larger or a smaller eye. At the outer angle, which is more acute than the inner, the lids are in close contact with the eyeball; but at the inner angle, the caruncula lachrymalis (a small red conical body) intervenes. The free margins of the lids are straight, so that they leave between them, when approximated, merely a transverse chink. The greater part of the edge is flattened, but towards the inner angle it is rounded off for a short space; and where the two differently formed parts join, there exists on each lid a slight conical elevation, the apex of which is pierced by the aperture of the corresponding lachrymal duct.'—QUAIN, p. 903.

The lachrymal apparatus is constituted by the following assemblage of parts—viz., the gland by which the tears are secreted at the outer side of the orbit; the two canals into which the fluid is received near the inner angles; and the sac with the duct continued from it, through which the tears pass to the interior of the nose. The description of these parts need not be quoted in detail here. Suffice it to say that the tears are secreted by the lachrymal gland, and poured out from the eyelids upon the eyeball; the washings afterwards running into the lachrymal sac, and thence away by the nose.

The parts now dwelt upon are not so much concerned in vision, as in expression and other functions auxiliary to vision. Though not directly bearing on the object of the present section, they will be of importance when we come to consider the emotions and their outward display. From them we now turn to the ball or globe of the eye.

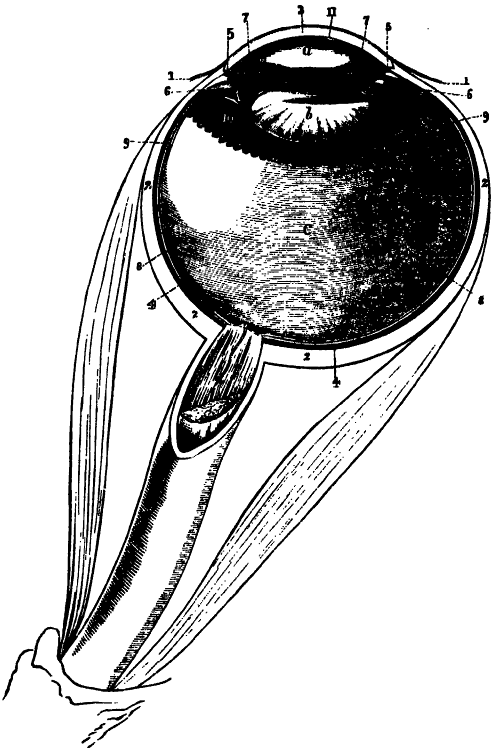
'The globe, or ball of the eye, is placed in the fore part of the orbital cavity, fixed principally by its connexion with the optic nerve behind, and the muscles with the eyelids in front, but capable of changing its position within certain limits. The recti and obliqui muscles closely surround the greater part of the eyeball; the lids, with the caruncle and its semilunar membrane, are in contact with it in front; and behind, it is supported by a quantity of loose fat. The form of the eyeball is irregularly spheroidal; and, when viewed in profile, is found to be composed of segments of two spheres, of which the anterior is the smaller and more prominent; hence the diameter taken from before backwards exceeds the transverse diameter by about a line. The segment of the larger sphere corresponds to the sclerotic coat, and the portion of the smaller sphere to the cornea.'

'Except when certain muscles are in action, the axes of the eyes are nearly parallel; the optic nerves, on the contrary, diverge considerably from one another, and consequently each nerve enters the corresponding eye a little to the inner or nasal side of the axis of the globe.

'The eyeball is composed of several investing membranes, concentrically arranged, and of certain fluid and solid parts contained within them. The membranes, not one of which forms a complete coat to the eye, are the conjunctiva, sclerotica, cornea, choroid, iris, retina, membrane of the aqueous humour, capsule of the lens, and hyaloid membrane. The parts enclosed are the aqueous and vitreous humours, and the crystalline lens.'

The *conjunctiva* is more an appendage of the eye than a portion of the globe. It is a thin, transparent membrane covering only the front or visible portion of the ball, and

FIG. 8.*



reflected on it from the interior of the eyelids, of which it is the lining mucous membrane. Over the clear and bulging portion of the eye it is perfectly transparent, and adheres closely to the surface; on the parts surrounding the clear

* Horizontal section of the right eye, with two of the muscles,—the external and internal recti,—and the optic nerve. *a.* Aqueous humour. *b.* Crystalline lens. *c.* Vitreous humour. 1. Conjunctiva. 2. Sclerotica. 3. Cornea. 4. Choroid. 5. Canal of Fontana. 6. Ciliary processes. 7. Iris. 8. Retina. 9. Hyaloid membrane. 10. Zone of Zinn, or ciliary processes of the hyaloid. 11 Membrane of aqueous humour.—(WHARTON *on the Eye.*)

portion it is less transparent, and contains a few straggling blood-vessels, which are seen as red streaks on the white of the eye.

'The *sclerotic*, one of the most complete of the tunics of the eye, and that on which the maintenance of the form of the organ chiefly depends, is a strong, opaque, unyielding, fibrous structure, composed of bundles of strong white fibres, which interlace with one another in all directions. The membrane covers about four-fifths of the eyeball, leaving a large opening in front, which is occupied by the transparent cornea, and a smaller aperture behind for the entrance of the optic nerve. The sclerotic is thickest at the back part of the eye, and thinnest in front.'

'The *cornea* is a transparent structure, occupying the aperture left in the fore part of the sclerotic, and forming about one-fifth of the surface of the globe of the eye.' The two together complete the encasement of the eye, and no other portion is employed for the mere purpose of maintaining the form and rigidity of the ball.

Spread over the inner surface of the sclerotic lie two other membranous expansions, likewise termed coats or tunics, but of totally different nature and properties. Next the sclerotic is the *choroid* coat, which is a membrane of a black or deep-brown colour, lining the whole of the chamber up to the union of the sclerotic with the cornea, and then extending inwards as a ring stretching across the eye. It also is pierced behind by the optic nerve.

The choroid coat is an extremely vascular structure—that is to say, it is composed of a dense mass of blood vessels, which lie in two layers, the outermost of the two being the veins, and the other the arteries. Inside of these two vascular expansions is the layer containing the black pigment which gives to the coat its colour, and which it is the object of the numerous blood vessels to keep supplied. The pigment is enclosed in the cells of a membrane, and these cells are packed very closely together, and are about the thousandth part of an inch in diameter. Each cell has a transparent point in its centre, surrounded by a dark margin.

Within the choroid, and lining its surface, is the *retina*, which is a nervous expansion branching out from the optic nerve, and covering the interior chamber of the eye with a fine *transparent* network as far as the angle where the choroid bends inward to form the circular ring above-mentioned. The retina is a very delicate membrane, of almost a pulpy nature, and but loosely attached, although lying close, to the blackened surface of the choroid. In the middle of the back of the eye, and in a line with the axis of the eyeball, is a round yellow spot, about a line or a line and a half in diameter ($\frac{1}{12}$ or $\frac{1}{8}$ of an inch), and in the centre of this spot is what appears like a minute hole, called the *foramen* of Sœmmering. About a fifth of an inch from the inner or nasal side of the yellow spot is a flattened circular papilla corresponding with the place where the optic nerve pierces the choroid coat.

The retina is a compound membrane, consisting of three distinct layers, only one of three, the middle layer, being made up of purely nervous matter. The outer layer, in contact with the choroid, termed the membrane of Jacob, is made up of small columns or rods standing perpendicular to the surface, and each sharpened to a point at their outer extremities. The columns are of two different kinds, the one being smaller and more numerous than the other. The small rods are solid, six-sided bodies, grouped round the larger, these last being also the shorter of the two, and cleft at the point where they touch the choroid. Each one of the pigment cells of the choroid (of which there are about a million to the inch) receives as many as six or eight of the larger cleft twin cones, with the smaller single rods grouped about them ; consequently the diameter of the smaller bodies must be only a fraction of the thousandth part of an inch.

The middle layer of the retina is the proper nervous portion. This is made up of radiating nervous fibres proceeding from the optic nerve, and spreading over the inner chamber of the eye. The fibres become more slender and spread more apart as they approach towards their termination in front. On both sides of the nervous expansion there are layers of nerve cells or vesicles, being the kind of substance composing the grey matter of the brain, and occurring also at the terminations of the nerves of special sense. The inner ends of the rods that make up the membrane of Jacob are therefore in contact, not with nervous fibres, but with nerve cells.

The innermost of the three fibres of the retina is the vascular layer, or the network of arteries and veins for supplying blood to the nervous portion.*

Before pointing out the different bodies that make up the bulk of the eye, and enable it to act as an optic lens, I must call attention to several other substances of a membranous or fibrous character lying under the cornea and near the junction with the sclerotic coat. The first of these is a narrow circular band, of a greyish-white colour, close behind the junction above-named. The foremost margin, the thicker of the two, gives attachment to the circular curtain called the *iris*. The thinner and posterior margin is blended with the choroid coat, which here prolongs itself inwards in a series of radiated folds called the *ciliary processes*. The band, or ligament, thus giving the two-fold attachment to the iris and the choroid is called the *ciliary ligament*. The ciliary processes lie behind the iris, and make a black, wrinkled, narrow rim, concealed from external view.

'The *iris* may rightly be regarded as a process of the choroid; it is continuous with it, although of a modified structure. It forms a vertical curtain, stretched in the aqueous humour before the lens, and perforated for the transmission of light. It is attached all round at the junction of the sclerotic and the cornea, so near indeed to the latter that its anterior surface becomes continuous with the posterior elastic lamina.' 'The anterior surface of the iris has a brilliant lustre, and is marked by lines accurately described by Dr. Jacob, taking a more or less direct course towards the pupil. These lines are important as being indicative of a fibrous structure.' When the pupil is contracted, these converging fibres are stretched;

* For a minute description of the retina, see the 'Eye,' in Todd and Bowman's *Physiology*.

when it is dilated, they are thrown more or less into zigzags. The pupil is nearly circular, and is situated rather to the inner side of the centre of the iris. By the movements of the iris it is dilated or contracted, so as to admit more or less light to the interior; and its diameter under these circumstances may vary from about $\frac{1}{20}$ to $\frac{1}{3}$ of an inch.'—TODD and BOWMAN, Vol. II. p. 25.

The iris is thus to be considered as a muscular structure, its fibres being of the unstriped variety, or of the kind that prevail among the involuntary muscles, as the muscular fibres of the intestine. It is abundantly supplied with nerves. While the radiating fibres above described serve to dilate the pupil, a second class of fibres, arranged in circles round the opening and best seen at the inner margin and behind, operate in contracting it. The action is purely reflex, and is regulated by the intensity of the light. In the dark, or in a very faint light, the dilating fibres are tense and contracted to the full, making the pupil very wide. The stimulus of light brings the circular or contracting fibres into play by a reflex or unconscious action, and contracts the opening. The changes thus effected are useful in adapting the eye to different lights, admitting a larger quantity with a feeble light, and a smaller quantity with one that is too strong. When this reflex power of adaptation reaches its limit, and the brilliancy is still too great, we then put forth the voluntary efforts of closing the eye, or turning the head away from the object.

Behind the ciliary ligament, and covering the outside of the ciliary processes is a greyish, semi-transparent structure, known as the *ciliary muscle*. 'It belongs to the unstriped variety of muscle, and its fibres appear to radiate backwards from the junction of the sclerotic and cornea, and to lose themselves on the outer surface of the ciliary body. The ciliary muscle must have the effect of advancing the ciliary processes, and with them the lens, towards the cornea. The muscular nature of this structure is confirmed by its anatomy in birds, where it is largely developed, as noticed by Sir P. Crampton.'—TODD and BOWMAN, II. 27.

A peculiar interest has come to attach to this muscle from its supposed action in the ill-understood operation of adapting the eye to objects at different distances.

Passing now from the coats of the eye to the substance, we find three *humours*, or transparent masses occupying it in the following order: in the front is the *aqueous humour;* next, the *crystalline lens;* and backmost the *vitreous* humour.

The *aqueous* or watery humour is a clear, watery liquid lying under the cornea in front, and bounded behind by the crystalline lens and the folds of the ciliary processes. This humour is very nearly pure water, containing in solution a small quantity of common salt and albumen; and is enclosed in a membrane which is in contact with the inner surface of the cornea in front and the ciliary processes and lens behind. The liquid is partly before and partly behind the iris.

The *vitreous* or glassy humour lies behind the crystalline lens, and occupies the entire posterior chamber of the eye, being about two-thirds of the whole. It consists of a clear, thin fluid enclosed in a membrane, which membrane not merely surrounds it, but radiates inwards into its substance like the partitions of an orange, so as to make up a half-solid gelatinous body—the vitreous body, or posterior lens of the eye. These partitions are very numerous, and point to the axis of the eye, but do not reach to it; and consequently there is a central cylinder passing from front to back, composed only of the fluid of the body. The form of the vitreous body is convex behind, while before there is a deep cup-shaped depression for receiving the crystalline lens. The membrane that surrounds it on all sides, as well as entering into the interior, has a twofold connexion in front; it doubles so as to receive the crystalline lens between its folds, and it unites with the ciliary processes, which surround the lens without reaching its border. Thus the partition between the aqueous humour in front and the vitreous humour behind is made up of three successive portions enclosing one another; the wrinkled black ring of the ciliary processes outermost; within this a ring of the doubled membrane of the vitreous humour; and inmost of all the crystalline lens, enclosed between the two folds of the membrane.

The *crystalline lens* is a transparent solid lens, double convex in its form, but more rounded behind than before. It is suspended between the aqueous and vitreous humours in the manner already described. Its convexity in front approaches very near the curtain of the iris stretched in front of it. The lens is enclosed in a capsule, and of this the front portion is thick, firm, and horny, while the portion on the back is thin and membranous, adhering firmly to the membrane of the vitreous humour. The substance of the lens varies in its character; the outside portion is soft and gelatinous; beneath this is a firmer layer; and in the centre is the hardest part, called the nucleus. It is supplied with blood vessels in the edges, but none appear to penetrate within except in a very early stage of life. It undergoes altogether a great change during the development of the individual. In the fœtus it is nearly spherical, and it is not perfectly transparent; in mature life it is of the form and character described above; while in old age it becomes flattened on both surfaces, loses its transparency, and increases in toughness and density.

Of the six *muscles* of the eye, four are called *recti* or straight, and two *oblique*. The four recti muscles arise from the bony socket in which the eye is placed, around the opening where the optic nerve enters from the brain, and are all inserted in the anterior external surface of the eyeball, their attachments being respectively on the upper, under, outer, and inner edges of the sclerotic. The superior oblique or trochlear muscle arises close by the origin of the superior straight muscle, and, passing forward to a loop of cartilage, its tendon passes through the loop, and is reflected back, and inserted on the upper posterior surface of the eyeball. The inferior oblique muscle arises from the internal inferior angle of the fore part of the orbit, and is inserted into the internal inferior surface of the eyeball, behind the middle of the ball.

The motions of the eyeball that would be caused by the contractions of any of these muscles are not difficult to trace. The inferior muscle, by its contraction, will make the ball revolve so as to look downwards; the superior straight muscle will make it look upwards. The internal and external recti will give it their respective directions, the one inward, the other outward. The action of the trochlear muscle is peculiar. Inasmuch as it is reflected backwards to be inserted in the globe of the eye, it will turn the eyeball downwards and outwards—that is, the eye would, by its action, look obliquely downwards and outwards. This muscle tends also to draw the ball of the eye a little forward, or to make it protrude. The inferior oblique muscle having its origin in the fore part of the orbit, and its insertion in the inner side of the eyeball, will, by its contraction, also draw the eye forward, and turn it upwards and inwards.

The four recti muscles are the voluntary muscles principally engaged in moving the eye for the purposes of vision. By means of them each ball can be made to sweep round over the whole field of view, and the two eyes converged to suit near or far objects. The oblique muscles probably assist in the same functions; acting together they would draw the eyes inward, or converge the two axes. But the exact occasions of bringing these oblique muscles into play are not agreed upon by physiologists. That they are voluntary muscles like the others seems certain; but it has been supposed that they act sometimes involuntarily. This is particularly the case with the inferior oblique; to it is ascribed the usual position of the eyes in sleep, when they are turned upwards and inwards. In winking, also, there is an involuntary upward movement of the eyeball, which may be due to this muscle. The other oblique muscle, the trochlear, has been called the pathetic muscle, on the supposition of its being concerned in the appearances of the eye under pathetic emotion, and in laughter. But this is very doubtful.*

* Speaking of the oblique muscles, Dr. Sharpey observes, 'on the whole, it appears most probable that these muscles produce the revolving movements which have been described, and little more, and that they may, with Dr. Jacob, be regarded as 'rotatory muscles,' their office being, when acting together, to revolve the eye 'round a longitudinal axis, directed from the open [the anterior] part of the orbit to its bottom.' But, supposing them to act singly, the axis would, in all probability, be slightly altered during the rotation.'—(Quain, p. 265). There is nothing that I can see to object to this view, except the difficulty of saying what purpose is to be

3. Such being the mechanism of the eye, I must now touch briefly upon its mode of acting as the organ of sight. The optical part of the process is well enough understood. When the eye is directed to any object, an image of that object is depicted on the back of the eye, by means of the rays of light entering the pupil, and duly refracted by the different humours. The image, which is inverted, produces an impression somehow upon the retina, with the assistance of the choroid coat, and this impression passes inwards to the nervous centres, whence the optic nerve takes its rise. In order to perfect vision the following conditions are necessary:—

(1.) A sufficiency of light or illumination in the object viewed. This is an obvious necessity. We judge of the quantity of light present by the power we have of seeing objects distinctly. Some animals can see with much less light than others, and to such the noonday sun must be painful.

(2.) The formation of the image exactly on the retina, and not before or behind. The focus of the image must coincide with the retina. If this is not the case the image is indistinct; the rays of light either do not converge, or have begun to disperse at the back of the eye. The perfect convergence of the image by the lenses of the eye depends on the distance of the object, and also in some degree on the self-adjustment of the eye. 'As this power of adaptation of the eye itself for vision, at different distances, has its limits, there is in every individual a distance at which he sees most distinctly, and at which the focus of the image, formed by the refracting media of the eye, corresponds most accurately with the situation of the retina. This distance may be stated at from five to ten inches, in the majority of individuals. Objects which are too near the eye throw very indistinct images upon the retina; a slender body, such as a pin, held close to the eye, cannot be seen at all, or produces only an undefined im-

served by the rotation of the eyeball. I do not know of any occasion when such a rotatory motion is necessary to vision. The eye can take in a picture equally well in all positions, and there appears to be no need for whirling it a little way round its axis to improve the view.

pression on the retina. Few persons, on the other hand, are able to read print at a much greater distance than twenty inches.'

(3.) 'The third condition is the minute size of the ultimate divisions of the retina capable of independent sensation. An illustration of this is afforded by bodies of which the surfaces are marked with very fine alternate white and black lines. Engravings viewed at such a distance, that the images of the black and white lines fall together upon portions of the retina of a certain degree of minuteness, cannot be distinguished as separate lines, and produce merely the mixed impression of grey; the same remark applies to very fine lines of different colours, regularly alternating with each other,—for instance, blue and yellow lines; in this case the impression of green will be produced. There must therefore be ultimate portions of the retina, in which all simultaneous impressions are perceived as one only, and are not distinguished as occupying distinct places in the field of vision, even when they really are distinct in the image formed by the refracting media. The idea immediately suggests itself, that these ultimate sentient portions of the retina may be the papillæ, or rod-shaped bodies of its internal lamina; and it would appear probable, that different luminous rays impinging simultaneously on different points of the surface of such minute portion or papilla of the retina will not be perceived as distinct rays, but that each papilla will receive one mixed impression only, and will propagate such an impression to the optic nerve. On this supposition, the image perceived in the eye must be composite, like a piece of mosaic-work, in which each elementary portion is itself homogeneous.' In accorddance with this view, some anatomists have found a correspondence between the size of the ultimate anatomical elements of the retina and the smallest portions found by experiment to be capable of separate sensation. 'According to other data, however, no such agreement is found to prevail; and Volkmann's observations render it probable that the discriminating power of the retina is much greater than it could be, were the nervous fibres its ultimate elements.'

Estimating from the observed discrimination of an eye of ordinary power, he calculates that the retina is distinctly sensible to about the forty-thousandth part of an inch, whereas the ultimate fibres of the retina are reckoned at about the eight-thousandth of an inch; the power of discrimination being thus five times greater than the subdivision of the nerve fibres.*

This is one of the many difficulties that remain unsolved on the subject of vision. The only fact that I know of, as throwing light upon it, is that formerly stated regarding touch.—namely, that the discriminating power of the skin is increased by moving the object over the part. Possibly the movement of the eye over the field of view, may in the same way lead to the discrimination of distances smaller than the interval between two papillæ or fibres. I cannot venture to assert that the movement of the hand increases the discrimination so much as fivefold; but it does not follow that the eye with its more delicate muscular sensibility may not approach the requisite amount.†

The great superiority of the eye, as a medium for perceiving the outer world, lies in this power of independent sensibility to minute points. I have already adverted to the distinction between the lower and higher senses in this particular. The nerve of vision must needs consist of a number of independent fibres maintaining their distinctness all the way to the brain, and capable of causing distinct waves of diffusion throughout the entire cerebral mass; every one of these many thousand impressions making a separate mental experience, and originating a distinct volition. We shall probably meet with no fact attesting more conspicuously the complexity, and yet the separateness of action, of the cerebral system. We can easily satisfy ourselves of the reason why the cerebral hemispheres should be necessary to vision, considering what is thus implied in every instance of seeing whatsoever.

* MÜLLER's *Physiology*, by BALY, 1134–6.

† Sir William Hamilton remarks upon this difficulty, and hints at an explanation, in *Dissertations on Reid*, p. 862.

It must, however, be observed that perfect discrimination resides only in a limited spot of the eye, or in that part where an object lies when we concentrate our attention upon it. Thus, although I see a wide prospect, my power of minute discrimination is confined to the place where I am said to be looking, that is, on the line of the axis of the eye. In the borders of the field of view everything is dim and vague.

4. *On the Adaptation of the Eye to Vision at different Distances.*—If I see an object distinctly six inches distant from the eye, all objects at a greater distance are indistinct. The image of the near object falls correctly on the retina, the images of remote objects are formed in front of the retina. By a voluntary effort I can adapt the eye to see a far off object with tolerable clearness, but it then happens that any near body becomes confused. The question arises what is the change produced upon the eyeball in the course of this adaptation from near to far, and from far to near, and what apparatus effects the change. Many answers have been given to this question, but no one is yet completely established. The following remarks are all that are admissible in this place.

(1.) The change, whatever it be, seems not to depend upon the external muscles of the eye. It has been conceived that the recti and oblique muscles might by being strongly exerted alter the shape of the globe, and with that its focal distance, but such idea does not now obtain credence. On the other hand, the convergence of the two eyes is exclusively effected by these muscles, and along with this convergence the internal adjustment of each eye is found to take place, implying some fixed association between the movements of convergence or divergence and the alteration of the ball.

(2.) The ciliary muscle already alluded to, from its position and attachments, would draw the crystalline lens nearer to the cornea, and thus alter, it is believed, the focal distance of the lens. In the effort to view near objects this muscle would be contracted; in the case of more remote objects it would be relaxed, and the eye would have to recover its shape by means of the elasticity of the parts. 'It is interesting to notice that this adjusting faculty of the eye is greatly impaired or altogether lost by extraction of the lens, or by paralysing the ciliary and iridial muscles by belladonna.'

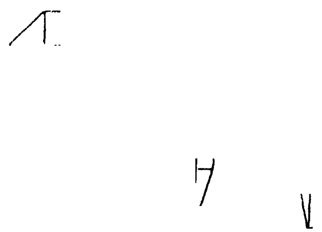
(3.) The movements of the iris itself have some connexion with the distance of the objects. The pupil is found to contract during near vision, and to expand in looking at remote objects. This is believed to be a coincidence with the converging and diverging action of the two eyes; but there is no sufficient proof that the eye is adjusted by this circumstance. It is convenient in remote vision to have the pupil expanded for the sake of light, and in near vision to contract it, in order to exclude a portion of the extreme rays, and thereby obtain a more distinct image.

(4.) The eyeball is subject to alteration chiefly for near distances. Between the smallest visible distance, say four inches, and three feet, nearly the whole range of the adjustment is gone through. When we compare distant objects of varying remoteness, as, for example, thirty feet with one hundred, or a thousand, very little change is effected on the form of the eyeball, the adjustment then depending on the greater or less convergence of the two eyes. This leads us to the subject of double vision.

5. *Of single Vision with two eyes. Binocular Vision.*—Among the questions long discussed in connexion with sight, was included the inquiry, why with two eyes do we see objects single? Answers more or less satisfactory were attempted to be given; but since the year 1838, an entirely new turn has been given to the discussion. In that year, Professor Wheatstone gave to the Royal Society his paper on Binocular Vision, wherein he described his 'stereoscope,' or instrument for imitating and illustrating the action of the two eyes in producing single vision. The following quotation is from the opening paragraph:—

'When an object is viewed at so great a distance that the optic axes of both eyes are sensibly parallel when directed towards it, the perspective projections of each, seen by each eye separately, are similar, and the appearance of the two eyes is precisely the same as when the object is seen by one eye only. There is in such case no difference between the visual appearance of an object in relief, and its perspective projection on a plane surface; and hence pictorial representations of distant objects, when those circumstances which would prevent or disturb the illusion are carefully excluded, may be rendered such perfect resemblances of the objects they are intended to represent as to be mistaken for them; the Diorama is an instance of this. But this similarity no longer exists when the object is placed so near the eyes that to view it the optic axes* must converge, and these perspectives are more dissimilar as the convergence of the optic axes becomes greater. This fact may be easily verified by placing any figure of three dimensions—an outline cube, for instance,—at a moderate distance before the eyes, and while the head is kept perfectly steady, viewing it with each eye successively while the other is closed. The figure represents the two perspective projec-

FIG. 9.



tions of a cube; *a* is seen by the right eye, and *d* is the view presented to the left eye, the figure being supposed to be placed about seven inches immediately before the spectator.'

'It will now be obvious why it is impossible for the artist to give a faithful representation of any near solid object, that is to produce a painting which shall not be distinguished in the mind from the object itself. When the painting and the object are seen with both eyes, in the case of the painting two

* The optic axis of the eye is the line of visible direction for distinct vision, or a line proceeding from the central point of the retina, and passing through the centres of the lenses of the eye.

similar pictures are projected on the retinæ, in the case of the solid object the pictures are *dissimilar;* there is therefore an essential difference between the impressions on the organs of sensation in the two cases, and consequently between the perceptions formed in the mind; the painting, therefore, cannot be confounded with the solid object.'

Mr. Wheatstone then goes on to describe his stereoscope, or apparatus for imitating the effect of double vision. This instrument is now so common that I need not insert a description here. Two forms of it are in use, but the principle of both is the same; that is, to present two different pictures of an object, such as the cubes above figured, one to each eye exclusively, and so as that they may appear only one picture. By so doing, a vivid appearance of solid effect starts forth to the view. While the two pictures are seen apart from each other they are looked upon simply as pictures, but when they are made as it were to cover one another in the field of view, there is no longer a picture but a solid reality. The effect must be experienced in order to be appreciated. It is impossible to resist the conclusion that our perception of solidity or of three dimensions, is most powerfully aided by the concentration of the two eyes upon the same object, and by the view thus derived through the two dissimilar pictures.

The drawing of figures to suit the stereoscope was a troublesome and tedious operation. But no sooner was Daguerre's discovery announced than Professor Wheatstone laid hold of it to furnish him with his binocular views; and since then the use of the stereoscope has been vastly extended. It is only necessary to daguerreotype two views of the same object corresponding to the views of the two eyes, that is, to turn it slightly round for the second view; the two pictures placed in the stereoscope give the perfect appearance of relief.

When the two different pictures seem to cover one another in the field of view, the singleness of vision takes place along with the effect of solidity above mentioned. This fact is supposed to imply a certain correspondence of the two eyes, or the existence of corresponding points or places in each, such that when binocular pictures fall on any pair, one single effect arises in the brain. Doubtless some general correspondence must exist, but this cannot be maintained as an invariable fact.

There are still difficulties in the way of the full explanation of double vision, and of the perception of solidity arising from it. What remains to be said upon it in the present chapter will fall properly under the last head of the subject, the Sensations of sight.

6. Before quitting the consideration of the Eye, I should mention that *the seeing of objects erect by means of an inverted image on the retina* has been conceived as a phenomenon demanding explanation. But to make this a question at all is to misapprehend entirely the process of visual perception. An object seems to us to be up or down according as we raise or lower the pupil of the eye in order to see it; the very notion of up and down is derived from our feelings of movement, and not at all from the optical image formed on the back of the eye. Wherever this image was formed, and however it lay, we should consider that to be the top of the object which we had to raise our eyes or our body to reach.

7. And now as to the Sensations, or the proper mental elements of Sight. The feelings arising from Sight alone make only one class of these sensations; the combination of the optical and muscular states gives birth to the most various and interesting department of feelings connected with vision.

8. I shall commence with the sensation of mere *light*, and shall take the diffused solar radiance as the leading example. This is one of the most powerful of the simple influences that affect the human sense. Light is eminently a source of pleasure, which rises in degree, within certain limits, in proportion to the abundance of the luminous emanation. In clear strong sunshine, filling the entire breadth of the eye and freshly encountered, there is a massive powerful influence of pleasurable elation, acutely felt. The effect is sufficiently intense, massive, and keen to make a predominating or engrossing emotion, like alimentation, warmth, or the other powerful forms of organic and muscular feeling formerly described. The quality that most distinguishes it from these

other feelings is the endurableness of it. The physical influence of light, although able to excite a first class sensation in point of power, is yet so gentle that we can endure it far longer than we can any other sensuous influence of similar efficacy. This is one of the peculiarities of pleasure or emotion that we understand by the term 'refinement;' the pleasures of the eye in general are said to be the most refined of the enjoyments of sense; those of the ear rank second in this respect. The influence of the solar ray is evidently favourable to the animal functions—the respiration or digestion, &c., probably through both physical and mental causes; at any rate the feeling engendered is freshening and cheering, and can often suffice to support the frame of mind against the depressing organic influences, thus manifesting by a neutralising efficacy the full equality above asserted between it and them.

The emotion now described is in a high degree tranquil and serene, like the best forms of pleasure of the other senses. There is a kindred character between it and agreeable warmth, independent I believe of the usual association of light and heat. The painter speaks of a warm colour, as if there were certain modes of light that impart to the sensitive framework the peculiar tremor of genial warmth. The feeling of light is as much akin to the sweet in taste and smell, the soft in touch, and the sweet in sound, as the great differences of organ will permit.

There is a strong sympathy of nature between this feeling and the respective emotions of love and beauty. Probably this resemblance is merely greater in degree than what obtains between the proper pleasures of the other senses and these emotions.

The distinction of the sensations of sight as respects the intellect is well marked, as I shall have occasion to notice again. These are more persistent and recoverable than any others as a general rule, and hence we are able to live them over again in the life of ideas. This is a second circumstance entering into our notion of refinement. The intellectual character of the feelings of vision, besides alimenting our intellect proper, enhances their value as mere emotion or pleasure. The impress of vivid illumination remains in the mind when the original is gone, and becomes an object of recollection, anticipation, and longing, more than any other pleasure of sense, excepting always the strong appetites at their periods of pressing urgency. To the blind Milton, the emotions of light could become powerfully present, and suggest a lofty and apposite train of descriptive imagery.

It will be necessary next to advert to the different forms and varieties of the sensation of light. I have supposed in the above description, the case of abundant but not excessive or painful sunshine; it was necessary also, in order to state the full force of the feeling, to imagine the first or fresh outburst of light after comparative darkness. Notwithstanding the endurability of the eye, the sunlight may be too strong, and too long continued: there arises, then, a painful form of fatigue in the eye and in the head. But as the light that reaches us is nearly all reflected light from the surfaces about us, the sky, the landscape, the walls of buildings, &c., there are many varieties of it, and many different effects on the internal sensibility. There is this peculiarity, however, in a time of sunshine, that a large portion of the sun's unaltered rays reach the eye by reflection, so that we have predominating the sensation proper to pure sun-light. Next in character to the original ray and its mirrored reflection, is the radiance of strong white surfaces, as the clouds, the sea-foam, white walls, chalk cliffs, white dresses, &c. This gives us very much of the sensation of light, but in a less intense form; indeed the richness of these surfaces consists in reflecting abundantly the solar ray when abundantly receiving it.

The course of the day and of the year gives us all degrees of illumination, from outer darkness to the radiance of midsummer noon. Of darkness, or the total absence of light, as a habitual thing, I could only speak by contrasts, or opposites to the language above used. As the repose from light it is not only endurable but welcome; with shade and shadow we have no necessarily unpleasant associations. The mixing up of the proper amount of dark with the daily sun-shower is one of our arts for adjusting and regulating our pleasures. The grateful emotion of light is perfect only when we stop short, having attained the exact amount that the eye can bear; and for this adjustment the command of darkness is necessary. In cold, moist climates, such as ours, there is probably too little sun-light; a greater quantity would undoubtedly increase the pleasures of life in these islands. In what places the balance of light and shade is best struck, I cannot pretend to say. Too much sun-light, even if not hurtful, is probably unfavourable to active exertion.

9. Before taking up the sensations of colour, it is worth while to remark on the artificial lights; their ray being different in character from the solar. A fire, or a lamp, is so much weaker than the sun's face, that we can gaze upon them directly for hours together. We have, then, what I might term a pungent luminous sensation, more intense, concentrated, and coarse, than the diffused radiance of day-light. When the eyes are feeble, this is an unsafe luxury. There is an apparently involuntary attraction of the eye towards the flame of a candle; the real fact is, that we voluntarily turn to it to drink in a strong sensation. The flickering blaze of the hearth, the furnace glare, the bonfire illumination, are all highly exciting as the cause of strong luminous sensations. I call these effects coarse and pungent, because of the inferiority of the terrestrial lights to the solar ray, in delicacy and in balanced mixture, as well as of the obvious difference of sensation. Nevertheless, our experience of a brilliantly lighted room, exemplifies strikingly the pleasurable and exciting influence of a copious illumination.

10. The effect of *colour* is distinct from the effects of light and shade, or of pure whiteness and the mixtures of this with black. I am disposed to use the same term, 'pungency,' to express this difference. The optic nerve would seem to be more powerfully irritated or inflamed, by colour than by whiteness, but also it may be more readily fatigued. Of all colours, *red* is the most pungent and exciting. In the midst of other tints this intoxicates the eye, and satiates the appetite for luminous effect. Red is the colour of state,

glitter, and display—avoided by a taste for sobriety and retirement. This colour does not greatly abound in nature, and is therefore sought out by art. The discovery of the scarlet and purple dyes was the introduction of a new pleasure. *Green* is much less pungent than red, but is nevertheless an effective and stimulating colour. *Yellow* is probably next to red in intensity of stimulus, after which would come *blue*. There is a general belief that of these four prominent colours, green is the one that can be longest endured without fatigue. The mild blue of the sky may be as little fatiguing, but is certainly less exciting than the first bloom of spring vegetation. The effect of red upon the bull and other animals is probably a proof of its fiery and exciting character. The eye fatigued either with white sunshine, or with the pungent colours, finds repose in green; hence the character of *freshness* belonging to this colour.

11. It has been believed, since the time of Sir Isaac Newton, that white light is not a simple but a complex effect; for by mixing colours together, in certain proportions, whiteness will be produced. Red, yellow, and blue are supposed to be the primitive or elementary colours; out of these any other colour can be formed, and by combining them in certain proportions, colour can be made to disappear in favour of white light. This fact is the physical foundation of *harmony* of colouring. When different tints occur together, as in a picture, the total effect is most pleasing when they are in the proportions requisite for producing whiteness. Two colours harmonize, if one is a primitive colour, and the other a certain mixture of the two remaining colours: thus red harmonizes with green (formed out of yellow and blue); blue harmonizes with orange or gold (a mixture of red and yellow); yellow harmonizes with violet (red and blue). The eye, excited by one of these colours, desiderates, and feels refreshed by the other. When the white ray is thus resolved into two colours, they are termed *complementary* colours; such are red and green, blue and orange, yellow and violet. These complementary colours are to one another like light and shade, they enable the eye to support a greater amount of coloured

touch and movement. The movement of the eye now supposed generates an additional pleasure, by superadding the excitement of muscular sensibility to mere optical sensation. It does more; for there is left behind an impression not of light alone, but of light and movement, and if the object comes to be recalled in idea, this is not a mere idea of luminosity restored to the optic nerve, but a joint restoration upon this nerve and the nerves and muscles of the eyeball and head. If the light moves to the right, the right muscles are engaged in following in it; if to the left, the left muscles, and so on; and thus we have several distinct combinations of light and muscular impression marking distinctness of direction, and never confounded with one another. The feeling or sensation caused by movement involves also definite direction according to the muscles engaged, and this compound feeling is the mental or subjective element corresponding to the external fact of a moving object as seen by the eye.

Motion may be not only in any one continuous direction, but may change its direction, and take a course crooked or curved. This brings into play new muscles and combinations, and leaves behind a different trace of muscular action. The right muscles of the eye may have to act along with the superior muscles, and at a shifting rate. This will give an oblique and slanting direction; which we will ever afterwards identify when the same muscles are similarly brought into operation. We have thus a perfect discrimination of varying directions through the distinct muscles that they excite.

Our muscular sensibility also discriminates rate or velocity of movement. A quick movement excites a different feeling from one that is slow; and we thereby acquire graduated sensations, corresponding to degrees of speed, up to a certain limit of nicety.

While the retina of the eye thus receives one and the same optical impression (in the supposed case of the candle flame), this may by movement be imbedded in a great many different muscular impressions, and may constitute a great variety of pictorial effect. By changing the muscles and by varying their rate of action, we may so change the resulting impressions that any one motion shall be recognised by us as distinct from every other, while each may be identified on a recurrence. I do not say that we have yet the *perception* or notion of a thing external to ourselves, moving through space at a certain speed, because this perception implies a concurrence of senses; such a concurrence of these combined eye-sensations with other senses and movements being, as I believe, the only thing needed to make up the perception as we find it.

Nearly all the pleasures of muscular movement, described in the previous chapter, may be experienced in the *spectacle* of moving objects. The massive, languid feeling of slow movement, the excitement of a rapid pace, the still higher pleasure of a waxing or waning speed, can all be realized through the muscles of the eye and the head. The slow procession, the gallop of a race-horse, the flight of a cannon-ball, exhibit different varieties of the excitement of motion. In the motion of a projectile, where a rapid horizontal sweep is accompanied with a gentle rise and fall, we have one set of muscles in quick tension and another set in slow tension, making a mixed and more agreeable effect. Motions in curves are the best means of giving this pleasing combination, and also the still more pleasing effect of increasing and dying motion. When a projectile flies across the field of view the horizontal motion is uniform, but the pace upwards diminishes, and at last dies away at the highest point; the body then recommences a downward course, slow at first, but accelerating until it reach the ground. Whatever gratification there may be in the increase and diminution of movement is obtained through the muscles concerned in raising and lowering the eyes, while the muscles that give a horizontal movement would not be similarly gratified unless by an effect of perspective in an oblique view.

The pleasures of moving objects and stirring spectacle count for much in the excitement of human life. They are really pleasures of action; but inasmuch as only a very limited portion of muscle is excited by them, they do not constitute bodily exercise, and are therefore to all practical intents passive pleasures, like music or sunshine. Thus dramatic spectacle, the ballet, the circus, the horse race, the view of parties engaged in sports—although engaging the activity of the eye, do not belong properly to active enjoyments.

15. Among the permanent imagery of the intellect, recalled, combined, and dwelt upon in many ways, we are to include visible movements. The flight of a bird is a characteristic that distinguishes one species from another, and the impression left by it is part of our knowledge or recollection of each individual kind. The gallop of a horse is a series of moving pictures that leave a trace behind them, and are revived as such. The motions that constitute the carriage and expression of an animal or a man, demand particular movements of the eye in order to take them in, and store them up among our permanent notions. All the gestures, modes of action, and changes of feature that emotion inspires are visible to the eye as an assemblage of movements, and we recognise such movements as marking agreement or difference among individuals and between different passions. Many of the aspects of the external world impress themselves upon the moving apparatus of the eye. The waves of the sea, the drifting of clouds, the fall of rain, the waving of the trees under the wind, the rushing of water, the darting of meteors, the rising and setting of the sun, are all mixed impressions of spectacle and movement. In like manner, in the various processes of the arts, there are characteristic movements to constitute our notions and means of discrimination of those processes. The evolutions of armies have to be remembered as movements, and therefore need to be embodied among the muscular recollections of the system.

16. We ought next to consider the sensations of Form, or of the outlines of objects at rest. For this purpose it is advisable to allude first to the sensations of *distance* from the eye, these being in fact included in the imagery of movement just discussed. We have already seen that there is a double adaptation of the eye to distance, namely, a change in the ball, for near distances, and an alteration in the direction of the two eyes, or in the parallelism of the axes, for all distances near and far. These adaptations are undoubtedly muscular;

that is, they consist in the greater or less contraction of particular muscles. Now, the contraction of muscles in any part whatever yields a distinct feeling; we are conscious not only of the fact of tension, but of different degrees of tension. Hence every change in the interior of the ball by muscular influence, and in the convergence of the axes, causes a change of feeling; we have a discriminative consciousness of all the different stages of adaptation. The consciousness of sight at six inches is never confounded with the consciousness of a foot, and this last is widely different from the feeling of a hundred feet. Thus it is that our minds are differently affected by different distances, so that we cannot confound an object at five feet with an object at fifty feet. The discrimination is of the same nature, although not so nice, as in drawing the hand across a table from an object thirty inches off to another object close at our side. The difference of muscular tension is unmistakeable.

In this way, therefore, the eye gives us a means of distinguishing objects, according as they are far or near, through the feelings consequent on the muscular adaptation for securing distinctness of vision. An object moving away from the eye in a straight line would give us a changing sensation no less than an object moving across the field of view. An object moving obliquely, that is receding or approaching, while going across the view, would give a complex feeling embodied in the movements of the eye and head, and in the movements of adaptation.

There is a distinct emotional sensibility in the feeling of distance, more especially of remote distance. A far object exalts the muscular feeling of the eye, and is a source of lively pleasure:—the pleasure of muscular tension in muscles peculiarly sensitive. The principal effort for a distant view is concentrated in the two adductor muscles of the two eyes, which have distinct nerves supplied to them. By these, the axes of the eye are drawn from a converging to a parallel position. This exercise of the adductor muscles is part of the pleasure derived from the outside prospect after in-door confinement.

17. We may pass now to the consideration of *form*, shape,

or outline. The difference between the sensation of form in a still object, as a rainbow, and a moving object, as a flying bird, is not so great as appears at first glance. In both there occurs the feeling of movement. In taking a picture of the rainbow, we must pass the view along the whole curvature exactly as if it were a moving thing describing the extended arc of the heavens. The image that is left is therefore still an impression of movement combined with the optical impression. The main difference lies in this, that in the case of a bird we have the entire image comprehended in the centre of the retina, where the stress of observation lies; in the case of the rainbow, we have an image continued over the whole breadth of the retina, extending from the central point of observation into the vague regions of the circumference. This last makes up our feeling of a continuous image. We have an impression of all the objects that can enter the pupil at one time, which would include a range of about a third of a circle right and left, up and down; and although distinct observation can occur only at a narrow part in the centre of the view, yet some kind of impression is made by the whole, sufficient to give us a sense of continuity. But it is only by moving the eye hither and thither that any distinct view can be obtained, and the impression that the view leaves behind is therefore an impression of lights, shades, and colours, combined with movements. In the observation of still life, there is not the same stimulus to move the eye over the outlines of objects as in the case of moving bodies, hence our attention to still forms is more languid. When the eye is once fixed on an object we are reluctant to lose it, and if the object moves, we follow its course; but we have not the same alacrity in moving the eye along a continuous line or circle. Nevertheless there is a sufficient amount of spontaneous activity in the movements of the eye to prompt this kind of observation, though in a less degree than the other; and by this means we acquire our distinctive impressions of form, figure, or shape. By a circular sweep we are impressed with a ring; by a straight sweep we take in a line; by a sudden change of direction we imbibe an angle. By movements confined to the head and eyes we grasp objects lying directly across the view, or with all parts equally distant from the eye; by these movements, combined with altered adaptation to distance, we have figures of objects that retreat from the view, as in looking down a street.

By means of the movements of the eye, we acquire impressions of the *visual expanse or apparent magnitude.* This visual expanse of bodies is determined by the range or sweep of the eye in passing over their whole extent, or by the fraction of the field of view that they take in. We see a rainbow spanning one-third of the heavens; we see a cloud encircling the sky; we appreciate the dimensions of a picture on the wall as compared with other pictures beside it. The different degrees of movement and tension of the muscles that make the sweep are distinctly felt, and we set down one sweep as more or less than another. We also acquire by repetition standards of comparison for expanses in general, as we acquire standards of weight in the sensibility of the arms.

18. The combination of our feeling of varying distances from the eye, resulting from the movements of adaptation, with the feeling of visual expanse, gives, as we have already seen, the feeling of *solidity*, or of three dimensions in one continuous object. It has been remarked above, that in seeing a line which crosses the field of view, the impression left consists of a distinct portion of the line corresponding to the centre of the retina continued into indistinctness in the circumference of the retina. So in looking at a retreating line, we have to describe a movement of adaptation as we pass along, and the effect at any one instant would be a distinct view of one portion, while the other portions are indistinct and confused. Thus in a vista of houses, the adaptation that suits the nearest makes the others confused, although still within the field of view, or pictured on the retina; if the middle house is distinct, the two ends of the line will be confused or indistinct. This is the strict visual impression or effect of varying distance, and the combination of this with sweep or expanse realizes the impression of three dimensions, and of solidity. When I look at a cubical block, I have to make a series of movements, right and left, up and down, to

take in the figure and expanse, and as my eye gets on the retreating side I must also adapt for distance, and there results from all this the visual impression of solidity.*

19. The sensation of *position* or relative situation contains nothing peculiar. The place of an object is ascertained by the distance and direction of it as regards other objects. Thus the place of the sun is determined by the apparent height above the horizon, or the upward sweep of the eye, and by the distance from a cardinal point as determined by a horizontal sweep.

20. I have adverted to the large class of impressions that we receive from moving objects, and to the emotions that they produce, and the permanent imagery that they contribute to the intelligence. A parallel illustration might be afforded in the class of *forms*, or of objects conceived as having extent and outline, whether at rest or in motion. Every visible thing has dimensions and shape as well as some shade of light or colour, and by these qualities each individual body is discriminated, and impressed upon the optical and mechanical susceptibility of the eye. Some objects have a wide expanse, others are limited; some are straight, others curved; some have a simple outline, as a square or a triangle, others are very complex, and demand many movements to follow them out; as a human figure, a building, or a mass of decorative tracery. The variety of sensation thus arising is very great.

As regards the emotional effect of the visual sensations of objects, I have already remarked on the influence of light and colour, and also on the effect of the single element of distance. When this element is combined with great visual expanse, we have then the sensation of *largeness*, and of a wide prospect.

* We shall have to remark on this subject again, when considering the acquired perceptions of the eye. In fact, the above statement, as to the indistinctness of the parts of the field of view not falling in the centre of the eye, and not corresponding to the adjustment for distance at the moment, will scarcely correspond to our ordinary experience. The reason of this is, that the mind supplies from the past what the eye does not distinctly see at the time, so that the picture actually realized is not the bare optical impression of the moment, but a much fuller picture which that impression suffices to suggest.

This feeling is very powerful, and not unlike the feeling of the voluminous in sound; it is a massive and keen emotion allied with the sense of power or great expenditure of force, yet without the feeling of painful exhausting effort. I refer it to the complex sensibility of the eye to colour, expanse, and distance; an aggregate of large and keen sensibility in a minute organ, highly pleasurable for a considerable length of time, and pre-eminently enduring and recoverable as an intellectual element. This is the simplest form of the feeling that we term the *sublime*.

I may also notice the difference of emotion in straight and in curved forms. Curves appear to gratify the liking we have for waxing and waning motions, as explained when speaking of movements. For this among other reasons to be afterwards considered, they are in general more pleasing than straight forms. Of the three dimensions of space, the up and down is more impressive than the lateral dimension, owing to the sense of weight and support that comes to be inseparable from elevation.

The intellectual imagery derived through the eye from the forms of still life is co-extensive with the visible creation. For the purposes of discrimination and of identification of natural things, and also for the storing of the mind with knowledge and thought, the sensations of objects of sight are available beyond any other class. The eye is kept constantly at work upon the surrounding scene, following the outlines and windings of form, as these extend in every direction; and by the movements thus stimulated each several object is distinguished from those that differ in shape, size, or distance, and identified with itself and those that coincide with it in these peculiarities. The train of movements for a square are recognised as distinct from the train that describes an oval: the outline of a pillar brings on a cycle of motions wholly different from those dictated by the figure of a tree. The property belonging to the mental system of causing movements to cohere that have been described in succession, fixes the series for each different view, and gives a permanent hold of all the distinct forms presented to the eye. This cohering and storing up process belongs to the intellect, and will be fully treated of in the proper place. What is chiefly notable here is the fact that the impressions of light made on the retina of the eye, and the accompanying muscular impressions rising out of its form-tracing mobility, are, both the one and the other, of a very enduring kind; they take on the coherence that gives them an existence after the fact more easily than any other class of sensible impressions. Neither tastes, nor smells, nor touches, nor sounds, can compare with sights in the property of mental persistence and revivability. Probably no other muscles are equal in susceptibility to the muscles of the eye; hence their educational accomplishments, that is to say, the number of separate forms and combinations that they can retain a hold of, is pre-eminent among the acquirements of the muscular system.

CHAPTER III.

OF THE APPETITES.

1. IN taking up at this stage the consideration of the Appetites, I do not mean to assert that these entirely belong to our primitive impulses, or that in them the operation of intellect and experience is excluded. On the contrary, I am of opinion that Appetite, being a species or form of Volition, is like all our other effective forms of volition, a combination of instinct and education. But the process of acquisition is in this case simple and short; while, on the other hand, the stimulus to action, or the source of the craving, is usually one of the sensations or feelings discussed in the two previous chapters. Indeed, if we look at the craving alone, without reference to the action for appeasing it, that craving is merely what we have all along styled the volitional property of the sensation. Accordingly there is a certain convenience in passing at once from the subject just left, to advert more particularly to this special aspect of certain of the feelings therein delineated that have their chief interest in the circumstance in question.

I have observed that all painful states (the exceptions are unimportant in the present discussion), and many pleasurable states, are volitional; the one class exciting action for appeasing and terminating them, the other for continuance or increase. If a spur to action were to constitute Appetite, all our pains and a number of our pleasures would come under this designation. But the Appetites commonly recognised are a select class of the volitional sensations and feelings; and are circumscribed by the following property,—namely, that they are *the cravings produced by the recurring wants and necessities of our bodily, or organic life.* The taking in of nourishment, the ejection of what is formed to be thrown out, the supply of air, the alternation of exercise and rest, the gratification and repose of the various senses,—all these operations are attended to through the prompting of uneasy sensation. The avoiding of a scald, a cut, or a fall, is an energetic impulse of volition, and yet not a case of Appetite; there being no periodic or recurring want of the system in these cases. *Sleep, Exercise, Repose, Thirst, Hunger, Sex,* are the appetites most universally present throughout the Animal tribes.

2. The fact of periodic recurrence is in no case more strikingly exemplified than in *Sleep.* After a certain period of waking activity, there supervenes an intense and massive sensation, of the nature of a craving for repose. If we give way to it at once, the state of sleep creeps over us, and we pass through a few moments of luxurious repose into unconsciousness. If we are prevented from yielding to the sleepy orgasm, its character as an appetite is brought out into strong relief. The voluminous uneasiness that possesses all the muscles and organs of sense stimulates a strong resistance to the power that keeps us awake, the uneasiness and the resistance increasing with the continued refusal of the permission to sleep, until the condition becomes intolerable, or a reaction ensues, which drives off the drowsiness for some time longer.

The overpowering influence of drowsiness is best seen in infants, there being scarcely anything that will effectually appease the mental disturbance caused by it. The strong emotions that extreme pain sets loose—tears and rage—are never more closely at hand than in the sleepy condition. In a comparison of volitional states, to ascertain their respective degrees of strength, the appetite for sleep at its highest pitch would bear the palm over nearly every form of sensation.

3. The necessity of alternating *Exercise* with *Repose,* through the entire range of our active organs, brings on the like periodic cravings and deep-seated uneasiness. The fresh condition of the muscles is of itself a sufficient stimulus to action; without any conscious end, in other words, without our willing it, action commences when the body is refreshed and invigorated. If this spontaneous outburst is resisted, an

intense uneasiness or craving is felt, being one of the conscious states incident to the muscular system. This craving is of the nature of all the other appetites, and increases with privation, unless, by some organic change, the fit passes over for the time. The dog chained up to his couch, the exuberancy of childhood restrained from bursting out, the bird in its cage, the prisoner in his cell, experience all the pains and desire of the active organs for exercise. On the other hand, after exercise comes an equally powerful craving and impulse to rest, which, if resisted, produces the same intense uneasiness, until a febrile reaction ensues, and disorders the indications that the system gives respecting its wants.

Under this head of Exercise and Repose I may include the more active of our senses, that is, Touch, Hearing, and Sight. These senses all embody muscular activity along with the sensation peculiar to each; and both the muscular activity and the tactile, auditory and visual sensations, lead to weariness of the parts, with a craving for rest; while after due repose they resume the fresh condition, and crave for the renewal of their excitement. But the alternation of exercise and rest of the senses is in a great measure involved in the rotation of sleeping and waking; inasmuch as the involuntary torpor of the nervous system is almost the only means of giving repose to such constantly solicited senses as Sight, Touch, and Hearing.

A similar train of remarks might be extended to the activity of the thinking organs. But in these the periodic cravings are less distinctly marked, and more frequently erroneous than in the case of muscular exercise. There is often a reluctance to engage in thought, when the brain is perfectly vigorous and able to sustain it; and on the other hand, there is in nervous temperaments a tendency to excess of mental action, uncorrected by any regular promptings to take repose.

I may further remark, what is probably familiar to most persons, that a sense of fatigue often arises soon after commencing any laborious operation, which disappears after a time, and is not connected with real exhaustion.

4. *Thirst* and *Hunger* I have already touched upon. In

describing them as Sensations, it was impossible to omit their character as cravings. A certain amount of liquid being indispensable to every function of the system, a deficiency in this element breeds a wide-spread disorder and intolerable oppression. Not in the stomach alone, but also in the skin, in the capillary circulation, and in the various secreting organs, may we infer that the want of water rouses up sensations of distress. The prompting to seek out and imbibe liquid is correspondingly great, in spite of the enfeebling influence of the state upon the activity of the frame.

'What is called *thirst* is, however, sometimes rather a call for the cooling influence of cold drinks, as, for instance, in the dry, hot state of the air-passages, mouth, and skin, produced in fevers by the increased temperature and diminished turgescence of the parts. Exhalation is in such cases often rather diminished, and the dryness of the surface arises from the circumstance that although blood still flows through the capillary vessels, the reciprocal action between the blood and the living tissues, which is denominated turgescence, or *turgor vitalis*, is depressed.'*

Hunger, unlike Thirst, is a state of the stomach as yet not exactly understood, while the feeling of inanition that also grows out of long fasting must be considered as a general feeling of the system. The urgency of hunger ought to be in accordance with the actual deficiency of nutritive material, but very frequently the case is otherwise. 'It is heightened by cold baths, by friction of the skin, by friction of the abdomen, and by the agitation to which the abdomen is subjected in horse exercise, as well as by muscular exertion.' It is diminished by all nauseating influences, which probably at the same time weaken the digestion. 'The local sensations of hunger,' says Müller, 'which are limited to the digestive organs, and appear to have their seat in the nervous vagus, are feelings of pressure, of motion, contraction, qualmishness, with borborygmi (gripings), and finally pain.'

In the case of hunger and in most of the appetites there is

* Müller, by Baly, p. 530.

a double spur to the taking of food; first, the stimulus of uneasiness, and next the impulse arising out of the pleasure of eating. It is well understood that these two things are quite different, for on their difference hangs the whole art of refined cookery. Very plain food would satisfy the craving for nutrition, but there is a superadded pleasure that we have to cater for. The one is the appetite in its strictest signification, and as found in the lower animals; the other I might call a desire, because it supposes the remembrance and anticipation of a positive pleasure, like the desire for music, or for knowledge.

It is in the act of taking food and drink that we best see exemplified the activity springing out of the sensations of hunger and thirst. The actual assuaging of the uneasiness produces an intense pleasurable sensation that sets on the most vigorous movements for being continued and increased; while the moving organs themselves, beginning to be invigorated, display a spontaneous and lively energy in the cause. To bring together and make to cohere the sensation of the appeasing of hunger with the acts of sucking, swallowing, or prehension, is perhaps the earliest link of volition established in the animal system. This is the first case of action for an end, or under the prompting and guidance of a feeling, that the newly born infant is capable of. Eating is the most animated display of movement and action that a healthy carnivorous creature can present. There is something intensely kindling in the appetite of the carnivora for food, which rises to fury when the flesh is scented out and begins to be tasted.

Besides the natural craving for the elements of nutrition required by the tissues, we may acquire artificial cravings by the habitual use of certain forms of food, and certain accompaniments, as peppers, flavours, &c. Thus we have the alcoholic craving, the craving for animal food, for tea, coffee, &c. The use of these articles having given a peculiar tone to the stomach or the nerves, a want is felt when they are withheld; and according to the degree of uneasiness manifested is the difficulty of resisting them.

5. The Appetite that brings the Sexes together is founded on certain secretions which periodically accumulate within the system, producing a feeling of oppression until they are either discharged or absorbed, there being a certain intense pleasure in discharging them for the ends of reproduction. If we were to place these feelings among Sensations, they would either form a class apart, or they would fall under the first class above described, namely, the Sensations of Organic Life. If the subject were open to full discussion, like the other feelings of human nature, it might be best to treat them as the foundation of one of the Special Emotions expounded at large in a treatise on Emotion in general. We have in this case as in Hunger, both Appetite and Desire; but we have also, what does not occur to a like degree in the former mentioned craving, a many-sided susceptibility to inflammation,—through all the senses, through the trains of thought, and through emotions that are not sensations. The circumstances that concur in an individual of one sex to produce the excitement in the opposite sex, by sight, sound, or smell, as well as by touch, have not hitherto been fully investigated.

6. The accustomed routine of life leads to a craving almost of the nature of Appetite. As the time comes round for each stated occupation, there is a tendency or bent to proceed with that occupation, and an uneasiness at being restrained: the feeling being probably of the same character as that arising from confining the fresh and spontaneous energy of the frame.

7. All the appetites are liable to be diseased and perverted, so as to give false indications as to what the system needs. They are likewise liable to artificial and unseasonable inflammation, through the presence of the things that stimulate and gratify them. In the lower animals, it is assumed, I know not with what truth, that appetite rarely errs; in humanity error is extremely common. We are apt to crave for warmth when coolness would be more wholesome; we crave for food and drink, far beyond the limits of sufficiency; we indulge in the excitement of action when we ought to cultivate rest, or

luxuriate in repose to the point of debility. So false is the appetite for sleep that it is still a dispute how much the system requires. Perhaps the complicacy and conflicting impulses of the human frame are the cause of all this uncertainty and mistake, rendering it necessary for us to resort to experience and science, and a higher volition than appetite, for the guidance of our daily life.

CHAPTER IV.

OF THE INSTINCTS.

1. IN the present chapter, I mean to consider the various primitive arrangements for action that may be traced as belonging to the human system. It is a part of the plan of this work to attempt to strip off the covering of acquired faculties, and ascertain what is the original mechanism that we start from in making our various acquisitions. This is to descend to the instinctive, intuitive, or primordial, in the human mind.

Instinct is defined by being opposed to acquisition, education, or experience. We might express it as the *untaught* ability to perform actions of all kinds, and more especially such as are necessary or useful to the animal. In it a living being possesses, at the moment of birth, powers of acting of the same nature as those subsequently conferred by experience and education. When a newly dropped calf stands up, walks, and sucks the udder of the cow, we call the actions instinctive.

2. In all the three regions of mind,—Emotion, Volition, and Intellect,—there is of necessity a certain primordial structure, the foundation of all that a human being ever becomes. There are also certain arrangements not included in the sphere of consciousness, or mind proper, that yet form links in our mental actions; as, for example, the reflex movements already noticed. In order to exhaust the various primitive arrangements, both unconscious or involuntary, and conscious or voluntary, I shall proceed in the following order:—

1. The *Reflex Actions.*—These are not proper mental elements, but their discussion is of value, both because they illustrate mind by contrast, and because certain useful func-

tions are served by them, such as would otherwise have to be provided for by volition, or true mental activity.

II. The primitive arrangements for *combined and harmonious actions.* These have already been glanced at in the description of the functions of the cerebellum. The use of the locomotive members,—in walking, flying, swimming, &c.,—is the most prominent instance. These arrangements, if not mental in the strict sense, are at least auxiliary to the voluntary operations.

III. The instinctive play of *Emotion,* or the primitive mechanism provided for the outburst and manifestation of feeling. Here I shall have to assume the law of diffusion, already hinted at, respecting Emotion or consciousness; the verification of this law will not be entered upon in the present chapter.

IV. The instinctive germ of *Volition.* That activity, which we call the power of the will, has to be traced back, if possible, to some inborn or primitive stimulus, connecting together our feelings and our actions, and enabling the one to control the other. This is perhaps the most interesting inquiry that our science presents.

The primitive foundations of Intellect, I shall defer till the whole subject is entered on in the next Book.

V. The description of the special mechanism of the *Voice* will receive a place at the conclusion of this chapter. This is a subject not to be omitted in a treatise on the Human Mind, and I did not think proper to append it to the chapter on Action and Movement in general.

OF THE REFLEX ACTIONS.

3. In discussing the functions of the Spinal cord and Medulla Oblongata, I enumerated the actions termed automatic or reflex, see p. 47. They are, 1st, those connected with Digestion, namely, Deglutition, and the propulsion of the food through the alimentary canal. 2nd, Those connected with Respiration, including the movements of the lungs in Breathing, Coughing, Sneezing. 3rd, The winking of the

Eyes. 4th, The permanent contraction of the Muscles. Of these some are wholly free from the participation of consciousness, as Breathing, Alimentary Movements, and Muscular Tone. The winking of the eyes is also independent of consciousness, to this extent, that it operates whether we feel it or not, but the action ceases in sleep. Coughing and sneezing are essentially conscious, but they are also involuntary; that is, the mechanical irritation works the riddance of itself by a reflex act. If a voluntary effort were needed in the case of coughing, that effort would probably be made, in answer to the painful feeling produced by the substance in contact with the surface of the bronchia. In sneezing, the feeling is not always painful, but may be simply pungent, as in taking snuff or applying the nose to smelling salts. But although these actions are usually accompanied with feeling, they may be stimulated when we are in an unconscious state. The act of coughing will come over a person in sleep from the accumulation of phlegm. So, by applying snuff to the nose of a sleeper, the sneezing action will be brought on, and will precede and cause his awakening. These remarks on the partly unconscious and partly conscious character of the automatic actions are necessary to clear up the distinction between the actions that are properly mental or voluntary, and those that are not.

4. There is a certain amount of reflex action generated in the operation of the various senses. A stimulus of any one of the organs of sense, besides rendering us conscious, and wakening up the movements constituting the expression of feeling, seems to excite a peculiar responsive action in the member where the organ is placed, or where the stimulus is applied. Thus an object placed in the hand not only gives a feeling or sensation of touch, together with the attitudes and expressions proper to that feeling, but also directs a special response towards the muscles that move the fingers. There is a reflex tendency to close the hand upon anything placed on the palm, as may be seen by trying the experiment upon a child before its voluntary movements are developed, and still more strikingly if the child is asleep. If the finger is pricked or scalded, there is a keen emotion felt and a lively

excitement is seen all over the body in consequence, but the movement excited in the arm and hand affected is the most vehement of all. This renders it not unlikely that a certain number of the nerves rising out of the hand terminate in the spinal cord, from which point of termination there are reflected back motor fibres to the muscles of the region. So by stimulating the sole of the foot, movements of the leg are excited, over and above the general excitement due to every sensation according to its intensity. Some physiologists regard the contact of the foot with the ground as a stimulus that aids in keeping up the act of walking. In like manner, by pinching the cheek or the face, the head is put in motion even in infants yet unable to localise their sensations. These reflected acts are to be included among our useful or practical instincts. In the matter of retracting a member from injury, the tendency is a protective one.

In the sense of taste we see a special responsive stimulus of the parts about the mouth, where the seat of sensation lies. A bitter taste produces wryness and contortion of the mouth: just as a bad smell operates most energetically upon the muscles of the nose. The responsive action of sight would naturally fall, either upon the muscles of the eyeball itself, or upon those that surround the orbit, and move the eyebrows and eyelids. By an action purely and unconsciously reflex and involuntary the pupil of the eye is contracted under a strong light; by an action partly voluntary, but possibly in some degree due to a special reflex connexion between the optic centres and the muscles of the orbit, the eyelids and eyebrows are drawn down under the same influence. This last action I would compare to the retractation of a pinched limb, the wry mouth under a bad taste, and the contortions of the nose by a powerful smell. I do not profess to attach very great importance to this sensori-reflex action, the whole extent of the influence of it being, as I think, but small; so much so that it would be difficult to supply an incontestable proof of its being precisely of the nature that I here suppose. At one time I was disposed to agree with Dr. Carpenter's view of Sensori-motor actions as a class apart from others, and having a distinct and prominent efficiency, but although I freely admit the principle of a sensori-motor excitement directed especially to the organs where the seat of sensation is lodged, I think it comparatively (not entirely) insignificant both in nature and in amount.*

* Dr. Carpenter, in endeavouring to constitute a class of sensori-motor actions (*Human Physiology*, § 748, 4th edit.), has laid hold of a number of movements and effects due, as I conceive, to the proper diffusive influence of emotion. 'The involuntary laughter produced by tickling' is a part of the emotional excitement of feeling, just as the contortions of the system under pain are a part of the pain. If it be true, as I believe, that every emotional state has a diffusive influence over the body, just in proportion to the intensity of the emotion or consciousness, an infinity of movement and display must follow from the causes that stimulate pleasure or pain. So, again, to select another instance from Dr. Carpenter's enumeration, 'those involuntary movements of the body and limbs, excited by uneasy sensation, (probably muscular), which are commonly designated as the 'fidgets;''—this is exactly the description of an emotional outburst or expression of pain, like a start, or a groan, or a puckered countenance. He goes on to say, 'when the reflex activity of the sensory ganglia is more strongly excited, in consequence either of an unusual potency of the sensory impressions [that is, the sensations or feelings], or of an unusual excitability of these nervous centres, a much greater variety of sensori-motor actions is witnessed.' In other words, as the impressions are stronger, the diffused excitement is greater. This happens, however, not in the case of any limited number or class of sensations, but under every possible emotion that can occur to the human mind. A feeling that produces a certain excitement when feeble, produces a stronger and more varied display by being made stronger; the fact being, that such display and such movements are a constituent element of feeling, a part of its embodiment in the human frame. The movements and cries of animals during a tempest might be called sensori-motor actions; they are more properly termed, I think, the movements belonging to the emotional condition of the mind for the time being.

These movements incorporated in our constitution as a portion of the very fact of being conscious, (we are often said to be 'moved,' when it is only meant that an impression is made on the mind), may be called 'sensori-motor,' inasmuch as a sensation, when sufficiently powerful, always visibly stimulates them, rendering them, as it were, the return or response of the outward impression. They may also be styled 'reflex,' for the very same reason. They are, farther, 'involuntary' movements, being quite distinct from our volitional acts. But they are very far from being unconscious: they are, if I am not mistaken, inseparable from consciousness, being entwined with the conscious condition in the mechanism of our frame. When consciousness is feebly excited so are they, so feebly that no visible manifestation results; when a stronger excitement is applied, they waken up in proportion. In a cultivated shape, they make the gesticulation and display that constitutes the usual expression or natural language of feeling, which no man and no people is devoid of, while some nations show it in a remarkable degree. The painter, sculptor, poet, actor, seize hold of these movements

OF THE PRIMITIVE COMBINED MOVEMENTS.

5. The explanation already gone into respecting the functions of the cerebellum has led us to recognise certain cases of concurring or associated movements, wherein the associating link is found in the original conformation of the nerves and nerve centres. The movements of the two eyes are an example; it is by no process of education that the eyes go always together. Again, there are instances of regular sequences of movement, as in the successive strokes of the heart's action, the alternating movements of breathing, the movements of the pharynx, gullet, and intestines for propelling the food in its course through the system. There is a pre-established connexion between the consecutive acts in these various functions, such that when one movement is completed, this brings on the next, and so on, without intermission. It is interesting for us to find out to what lengths these pre-established arrangements are carried in the animal, and especially in the human, system. My object all through the present chapter is to ascertain what number of our actions grow out of primitive impulses of the muscular and nervous mechanism, in other words, what is the range or capability of the original structure of our being.

I regret to say that on this subject less assistance is to be derived from Physiologists than one would naturally have expected. Much has been written on the mechanism of animal movements, but I have not met with any writer that

as the basis of artistic forms; and the interest of the human presence is greatly dependent on them, and on the attitudes that result from them.

If I am correct in supposing that these so-called 'sensori-motor' actions are the movements due to the state of feeling or emotion that a sensible stimulus kindles, then the cerebral hemispheres are essential to their manifestation, for the cerebrum is proved to be indispensable to consciousness. Indeed, the wonderful and various diffusion of active display, that any intense feeling seems to require, as the physical part of its essence, can hardly be operated without that intermedium of multifarious connexion between all parts of the frame, which the cerebrum, with its masses of white conducting fibres, appears to afford.

has aimed at separating the primitive tendencies from the acquired Thus, for example, while the locomotive action has been most abundantly analysed, no attempt has been made to settle how far the original structure of the nerve centres determines the alternating movements of the limbs requisite for this function. It seems constantly assumed that, in the human subject at least, the power of walking is wholly acquired, like playing on the trumpet or handling a musket, an assumption that I feel myself compelled to dissent from for reasons to be presently adduced. Whether any physiologist of eminence would stand forward and deliberately affirm and defend what is thus tacitly assumed, I cannot pretend to say.

6. The *locomotive rhythm* involves all the arrangements that I regard as primitive in the class of combined movements of succession, apart from those organic movements of heart, lungs, and intestines above alluded to. I shall therefore proceed to adduce the grounds for believing that the combined movements of locomotion are original or instinctive.

(1.) The analogy of the inferior quadrupeds is in favour of the existence of a germ of locomotive harmony of the limbs in man. The community of structure of the vertebrate type is sufficiently close to involve such a deep peculiarity of the nervous system as this. That which nature has done for the calf towards one of the essential accomplishments of an animal, is likely to be done in some degree for man. To equip a creature for walking erect would doubtless be far more difficult, and might surpass the utmost limits of the primitive structural arrangements; but seeing that the very same alternation of limb enters into both kinds, and that nature gives this power of alternation in the one case, we may fairly suppose that the same power is given in the other also.

(2.) It is a matter of fact and observation, that the alternation of the lower limbs is instinctive in man. I appeal to the spontaneous movements of infancy as the proof. Mark a child jumping in the arms, or lying on its back kicking; observe the action of the two legs, and you will find that the child shoots them out by turns with great vigour and rapidity. Notice also when it first puts its feet to the ground; long before it can balance itself, we may see it alternating the limbs to a full walking sweep. It is in virtue of this instinctive alternation that walking is so soon possible to be attained. No other combination equally complex could be acquired at the end of the first year. Both a vigorous spontaneous impulse to move the lower limbs, and a rhythmical or alternating direction given to this impulse, are concerned in this very early acquisition. Let the attempt be made to teach a child to walk sidewise at the same age, and we should entirely fail for want of a primitive tendency to commence upon.

(3.) It has been already seen that the cerebellum is concerned in the maintenance of combined or co-ordinated movements. It is proved that these movements can be sustained without the cerebral hemispheres, but not without the cerebellum. But that the cerebellum should be well developed in man, and yet not be able to effect those harmonized arrangements found in the inferior vertebrata, is altogether improbable.

Unless some mode of invalidating these facts can be pointed out, the reasonable conclusion will be that there is in the human subject a pre-established adaptation for locomotive movements, which adaptation I shall now attempt to analyse.

7. First, it involves the *reciprocation* or vibration of the limb. Confining ourselves to one leg, we can see that this swings back and fore like a pendulum, implying that there is a nervous arrangement such that the completed movement forward sets on the commencing movement backward, and conversely. The cerebellum, or some other centre, must be so connected with the two antagonizing classes of muscles, that when one class has completed a contraction, a stimulus shall be transmitted to a ganglionic mass with returning nerves to the other class, by which nerves these are stimulated in turn, and on contracting repay the act by reviving the operation of the first. The two antagonist sets of muscles concerned in walking are chiefly members of the two great general divisions of flexor and extensor muscles. Every moving member must have two opposing muscles or sets of muscles attached to it, and

between these the limb is moved to and fro at pleasure. Now the analogy of the limbs would justify us in supposing that there is an organized connexion between antagonist muscles generally, so as to give spontaneously a swinging or reciprocating movement to the parts; in other words, that when any member is carried to its full swing in one direction, there is an impulse generated and diffused towards the opposing muscles to bring it back or carry it in the other direction. This impulse may be feeble, may be very unequal in different parts, or may be entirely overborne, but I am disposed to look upon it as a pretty general result of muscular and nervous organization. Of course this reaction will be most strongly brought out on occasions when the commencing movement takes a wide and energetic sweep. Thus in a swing of the arm carried up so as to point perpendicularly upward, I think we may discern an impulse in the opposing muscles to come into play in order to bring it back. Every swinging motion, whether of arm, leg, trunk, head, jaw, if not entirely due to volition, which it would be difficult to prove, must be supported by an arrangement of the nature now described.*

* On the antagonism of muscular movements generally, I quote the following statements from Müller:—

'There are groups of muscles opposed to each other in their action in almost all parts of the body. The extremities have flexors and extensors, supinators and pronators, abductors and adductors, and rotators inwards and rotators outwards. Frequently the opposed groups of muscles have different nerves. Thus the flexors of the hand and fingers derive their nervous fibrils from the median and ulnar nerves; the extensors theirs from the radial nerve; the flexors of the fore-arm are supplied by the musculo-cutaneous; the extensors by the radial nerve. The crural nerve supplies the nervous fibres for the extensors of the leg; the ischiadic those for the flexors. The perineal muscles, which raise the outer border of the foot, derive their nervous fibres from the perineal nerve; the tibialis posticus, which raises the inner border of the foot, is supplied by the tibial nerve. The circumstance of the convulsive motions in affections of the spinal cord being frequently such as to curve the body in a particular direction, shows that there must be something in the disposition of the nervous fibres in the central organs which facilitates the simultaneous excitement to action of particular sets of muscles, as the flexors, or extensors, &c.; although Bellingeri's opinion, that the anterior columns of the spinal cord serve for the motions of flexion, the posterior for those of extension, is based on no sufficient facts. Too much importance, however, must not be given to the above remark relative to distinct nerves supplying the different groups of muscles; it is

I do not overlook the fact that in certain cases an antagonism not muscular occurs to bring about a returning vibratory impulse. Thus in walking there is a pendulous swing of the leg, arising out of mere mechanical causes. Like any other body hanging loose, the leg is really and truly a pendulum, and when thrown back begins to move forward of its own accord. Again, the extensor muscles, which maintain the body in an erect position, are antagonised by the weight of the parts; hence in dancing up and down, the downward movement may take place by simply relaxing the tension of the supporting muscles. In the same manner the jaw would drop of its own accord. We must also allow for the natural tendency to relax a muscle freely, after a great effort, whereby the ordinary tension of its antagonist coming into play would overpower it. It is difficult to say how much is due to this cause, or how far a muscle by being dilated to the full stretch is, by virtue of that circumstance, rendered more ready to contract, in other words, stimulated. But notwithstanding all these considerations, I feel compelled to suppose a specific arrangement in the nervous centres for bringing about alternate movements of the class now described. We know such an arrangement to exist in the involuntary movements of the heart, lungs and intestines, and we are therefore justified in interpreting similar tendencies to alternation among voluntary muscles on the same principle of mechanism.

8. Secondly, there is further implied in locomotion, an *alternate* movement of corresponding limbs, or an alternation of the two sides of the body. After one leg has made its forward sweep, an impulse must be given to the other leg to commence a movement in the same course. The two sides of

not a constant fact. Sometimes the same nerve gives branches to muscles opposed in action; the ninth, or hypo-glossal nerve, supplies both the muscles which draw the hyoid bone forwards, and one muscle which retracts it, the perineal nerve supplies the perineal muscles, which raise the outer border of the foot, and the tibialis anticus, which opposes this motion. Antagonist muscles can, moreover, be most easily made to combine in action; thus the perineal muscles and the anterior tibial, acting together, raise the foot. The flexor carpi radialis and the extensor carpi radialis can combine so as to abduct the hand.'—p. 925.

the body must be so related, that the full stretch of the muscles of the one side originates a stimulus to those of the other. Nothing less would suffice to enable a new-born calf to walk. The alternation between the right and left legs, both fore and hind, must be firmly established in the animal's organization by a proper arrangement of the nerves and nerve centres. And if the power of walking in human beings be assisted by primitive impulses and arrangements, this specific provision is necessarily implied. The commissural nervous connexions between the two sides, in the spinal cord, medulla oblongata, cerebellum, &c., will have to transmit indications from one side to the other with the view of bringing on the due rhythm or alternation of right and left members.

The alternation of the two sides in locomotion extends much beyond the muscles of the limbs; the whole trunk and head sway in harmony with the members, both in quadrupeds and in man.

There are some important exceptions to this alternating arrangement, but these are of a kind to place in a stronger light the examples of it now quoted. The two eyes are made to move together, and never alternate. This too demands an express commissural connexion of the nerve centres, even more decided than the other case. No question can arise about this being a primitive fact of the mechanism; the arrangement is the most prominent, but not the only, example of associated simultaneous movements, depending on the structure of the nerve centres. It has doubtless much to do with the unity and singleness of the act of vision. If also we observe the early movements of the arms in children, we shall find in them more of the tendency to act together than to alternate, showing, as we might otherwise infer, that the impulse of alternation of the limbs is not so deep-seated an instinct in man as in quadrupeds. In like manner the movements of the features are for the most part the same on both sides of the face. Both classes of facts must proceed upon commissural nervous connexions, but while in some cases the one kind of connexion seems to prevail, the alternating, in the others the associating connexion is strongest.

9. Thirdly. The locomotion of animals moving on all fours suggests a further necessity of primitive adjustment. It is requisite that there should be some provision for keeping the fore and hind legs in proper relation and rhythm. Something of the nature of the *vermicular* movement, (that is, the locomotion of worms) or the movements of the alimentary canal, would need to be assumed in this case. Such a connexion must exist between the fore and hind segments in order that the movements of the one may stimulate in succession the movements of the other, by a nervous propagation along the spinal cord to the cerebellum, or other centre governing the instinctive rhythmical motions. In the crawling of reptiles it is obvious that the muscular contraction in one segment or circle must yield a stimulus to a nerve in connexion with the next circle, which is made to contract in consequence, and furnish a stimulus to the third, and so on through the whole line of the body: the action of the intestines being precisely the same. I cannot conceive how quadrupeds could walk as they do without a provision of a similar kind. In a dog we see the movement of the limbs propagated to the tail. Each species of animal has its particular formula of ordering the legs in walking, determined it may be in part by the shape of the body, but duly transmitted in the breed as a property of its structure. The shamble of the elephant represents one species of rhythm, while the horse can pass through all the varieties of trot, gallop, and canter. In climbing, too, both the alternation and propagation come into play as helps. In swimming, both are likewise apparent.

10. Fourthly. I must now mention more particularly the *associated* or consensual movements, or those that are so connected as to act together. Here we need an organization of a different kind from the foregoing. The combining or associated muscles have to be supplied with a common nerve, so that the stimulus of one is a stimulus of the whole group that are in union. The most perfect example of this is the eye. In order to make the two eyes act together, the corresponding muscles of each must be simultaneously excited

by the nerves. The following are the facts connected with this interesting case. I quote again from Müller.

'Some of the most remarkable facts illustrating the association and antagonism of muscular actions, are presented by the muscles which move the eyes. The corresponding branches of the third, or motor oculi, nerve of the two sides have a remarkable innate tendency to consensual action, a tendency which cannot be ascribed to habit. The two eyes, whether moved upwards, downwards, or inwards, must always move together; it is quite impossible to direct one eye upwards and the other downwards at the same time. This tendency to consensual action is evidenced from the time of birth; it must therefore be owing to some peculiarity of structure at the origins of the two nerves. The association in action of the corresponding branches of the two nervi motores oculi, renders the absence of such tendency to consensual motion in the two external recti muscles and the sixth nerves more striking. We do, it is true, in a certain measure cause the two external recti muscles to act together when we restore the two eyes, of which the axes are converging, to the parallel direction; but there the power of consensual action ends; the two eyes can never be made to diverge, however great the effort exerted to do so. There is an innate tendency and irresistible impulse in the corresponding branches of the third nerve to associate action; while in the sixth nerves not only is this tendency absent, but the strong action of one of these nerves is incompatible with the action of the other. These innate tendencies, in the third and sixth nerves, are extremely important for the functions of vision: for if, in place of the sixth nerves, the external recti muscles had received each a branch of the third nerve, it would have been impossible to make one of these muscles act without the other; one eye, for example, could not have been directed inwards while the other was directed outwards, so as to preserve the parallelism, or convergence of their axes, but they would necessarily have diverged when one rectus externus had been made to act voluntarily. To render possible the motion of one eye inwards, while the other is directed outwards, the external straight muscles have received nerves which have no tendency to consensual action. In consequence, however, of the tendency in the two internal straight muscles to associate motion, it is necessary when one eye is directed inwards and the other outwards, that the contraction of the rectus externus of the latter should be so strong as to overcome the associate action of the rectus internus of the same eye; and in the effort to direct one eye completely outwards, we actually feel this stronger contraction of the external rectus. These considerations enable us to understand perfectly the hitherto enigmatical fact that, in all vertebrata, the external rectus muscle receives a special nerve.' (p. 929.) The author then goes on to show the relation of the corresponding oblique muscles to each other, and the similar reason there is for having distinct nerves to the superior oblique or trochlear muscle.

An association exists between the adjustment of the iris and the other movements of the eye; thus, whenever the eye is voluntarily directed inwards, the iris contracts. This brings about the fact already stated, that the iris is contracted during near vision.

Müller also remarks that 'the motions very prone to be associated involuntarily, are those of the corresponding parts of the two sides of the body. The motions of the irides, of the muscles of the ear, of the eyelids, and of the extremities, in the attempt to effect opposed motions, are examples of such associations.' I have already remarked that this coincidence of movements on the two sides, co-exists, in the case of the limbs at least, with an organization for an alternating motion.

The same author further observes, that 'the less perfect the action of the nervous sytem, the more frequently do associate motions occur. It is only by education that we acquire the power of confining the influence of volition in the production of voluntary motions to a certain number of nervous fibres issuing from the brain. An awkward person, in performing one voluntary movement makes many others, which are produced involuntarily by consensual nervous action.' (p. 928.) This, however, introduces much larger considerations, involving the whole mechanism of emotion and volition, and cannot be done justice to in the present connexion.

11. Fifthly. There are various appearances that suggest the existence of a law of general *harmony* of state throughout the muscular system. In stretching the lower limbs we feel at the same time an impulse to stretch the arms, the trunk, the head, and the features, or to put in action the whole class of extensor or erector muscles. The act of yawning propagates a movement over the whole body. I cannot positively affirm that this may not be explained by similarity of state producing everywhere a similar impulse, but the appearances are more in favour of a certain organized connexion that operates in producing a harmony of condition. When the eye is gazing attentively on an object, the whole body is spontaneously arrested, the features are tensed, the mouth open; the same harmonizing fixity is observed in the act of listening. So a movement in one part propagates itself to other parts unless a special check is maintained. The movements of the eye excite the whole body. Vocal utterance brings on gesticulation. The *pace* of movement is also rendered harmonious. Rapid movements of the eye from exciting spectacles make all the other movements rapid. Slow speech is accompanied by languid gestures. In rapid walking, the very thoughts are quickened.

I feel a difficulty in classing these movements with the foregoing, on account of the emotional element that is present in them rendering them more probably a portion of the complex fact of emotion. The other movements are cerebellar, these are more likely to be cerebral. Nevertheless, although they are connected with emotion or consciousness, they are to be ranked among the primitive impulses that serve the useful ends of the animal; they count among the *practical* instincts now under discussion. They cause the animal to come into harmony with the circumstances that surround it,—to be quiet when the scene is still, to rouse up and join the chase when others are stirring.

This property imparts character to individuals. A person is either slow, or vivacious, generally; the cast of movement is the same in all organs, in action and in thought. From it arises, likewise, a means of rousing and controlling the actions, thoughts, and passions of men and animals. It is a fact too pervading and important to be dismissed with this brief allusion; we shall have to recur to it afterwards, if we are ever enabled to overtake the entire subject of mind.

12. Sixthly. There are certain primitive links between different sensations that deserve to be noticed in an attempt like the present to set forth all that is instinctive in the animal constitution. I refer to those cases where one sense can apparently act for another previous to experience, as when an animal detects wholesome or unwholesome food by the smell before tasting it. That the sense of taste should act to inform us of what is good for digestion (which it does to an imperfect degree in the human subject), is not surprising, seeing that in the mouth the alimentary canal is already commenced; we feel more difficulty in discovering how smell should have this power of anticipating digestion and nutrition. An instinctive connexion of a like nature is exhibited in the aquatic birds, who are said to recognise water by sight, that is, to connect the view of water with the use of their swimming organs.

With regard to the first of these two cases, the pre-established association between smell and digestion, I would remark that the effluvia that bodies emit to the nostrils may be a specimen or representative of their substance as applied to the stomach, and may have something of a like effect on the nervous system. We know that the smell of putridity causes loathing and disgust, and that an attempt to eat such material would only complete the effect already begun; while, on the other hand, substances that have a fresh or sweet flavour would in all probability be free from nausea in the stomach. The fact may be, that the disgust is often excited not by the stomachic contact so much as by the offensive effluvia or smell developed in the act of eating; in which case the forewarning of the olfactory sense would be simply to protect itself.

On the general fact of one sense acting for another by way of warning or invitation, it is to be remarked that a deep harmony appears to exist among the different senses, in consequence of which we apply common epithets to the objects of all of them. Thus the effect we call 'freshness,' determined, I have no doubt, by the stimulus of the lungs, the digestion, or the general nervous tone, is brought out through all the senses. The only difficulty is to find the *same external object*, acting in the same manner upon two or more of them, as in the case of discerning food by the sight, or by the smell. I am disposed to think that these coincidences recognised before experience are very few in number, and that the great safeguard of animals lies in making the direct experiment of eating what comes in their way, and deciding according to the feelings that result therefrom.*

OF THE INSTINCTIVE PLAY OF EMOTION.

13. In following out our present object, which is to pass in review all that is primitive among the impulses and susceptibilities of the mental system, an explanation must be given of the instinctive or original mechanism for the expression of Emotion.† It is well known that some of the most conspicuous among the manifestations of human feeling, as Laughter and Tears, belong to us from our birth. Education

* It is a fact that lambs commence eating, not the short tender grass, but the long and dried tops.

† I have already referred (see § 4 of this chapter, and p. 86), to the general law which I believe connects together emotion or feeling and those physical activities of the frame known as the expression or manifestation of feeling. The movements and display caused by mental excitement have been generally regarded as merely incidental to certain of the stronger feelings, and little attention has been paid to them in the scientific consideration of the mind. For my own part, however, I look upon these active gestures as a constituent part of the complex fact of consciousness in every form and variety. I do not say but that we may have feelings that do not give rise to any visible stir of the active members, either in consequence of voluntary suppression, or because the diffused stimulus is too weak to overcome the inertia of the parts to be moved,—but I mean to affirm that with feeling there always is a freely diffused current of nervous activity, tending to produce movements, gesture, expression, and all the other effects described in the course of the next few pages. It does not fall within the scope of my present volume to give the complete elucidation of this general principle; my only desire is that the reader should clearly understand the position that I have taken up in this matter.

here finds work in repressing original impulses, no less than in imparting new and artificial forms of emotional display.

It will be convenient to extract entire the section devoted to this subject in Müller's *Physiology*. The professed title of the section is, *Movements due to the Passions of the Mind.*

'It is principally the respiratory portion of the nervous system which is involuntarily excited to the production of muscular actions by passions of the mind. Here, again, we see that any sudden change in the state of the brain, propagated to the medulla oblongata, immediately causes a change of action in the respiratory muscles, through the medium of the respiratory nerves, including the respiratory nerve of the face. There are no data for either proving or refuting the hypothesis, that the passions have their seat of action in a particular part of the brain, whence their effects might emanate. But these effects are observed to be transmitted *in all directions** by the motor nervous fibres, which, according to the nature of the passion, are either excited or weakened in action, or completely paralysed for the time.

'The exciting passions give rise to spasms, and frequently even to convulsive motions affecting the muscles supplied by the respiratory and facial nerves. Not only are the features distorted, but the actions of the respiratory muscles are so changed as to produce the movements of crying, sighing, and sobbing. Any passion of whatever nature, if of sufficient intensity, may give rise to crying and sobbing. Weeping may be produced by joy, pain, anger, or rage. During the sway of depressing passions, such as anxiety, fear, or terror, all the muscles of the body become relaxed, the motor influence of the brain and spinal cord being depressed. The feet will not support the body, the features hang as without life, the eye is fixed, the look is completely vacant and void of expression, the voice feeble or extinct. Frequently the state of the feelings under the influence of passion is of a mixed character;

* Italics mine.

the mind is unable to free itself from the depressing idea, yet the effort to conquer this gives rise to an excited action of the brain. In these mixed passions the expression of relaxation in certain muscles,—in the face, for example,—may be combined with the active state of others, so that the features are distorted, whether in consequence merely of the antagonizing action of the opposite muscles being paralysed, or by a really convulsive contraction. Frequently also, both in the mixed and the depressing passions, some muscles of the face are affected with tremors. The voluntary motion of a muscle half paralysed by the influence of passion is frequently of a tremulous character, in consequence of its being no longer completely under the influence of the will. We experience this particularly in the muscles of the face, when, during the sway of a depressing or mixed passion, we endeavour to excite them to voluntary action; the muscles of the organ of voice also, under such circumstances, tremble in their action, and the words attempted to be uttered are tremulous.

'The nerve most prone to indicate the state of the mind during passion is the facial;* it is the nerve of physiognomic expression, and its sphere of action becomes more and more limited in different animals, in proportion as the features lose their mobility and expressive character. In birds, it has no influence on the expression of the face; those only of its branches exist which are distributed to the muscles of the hyoid bone and the cutaneous muscle of the neck; and the erection of the skin of the neck, or, in some birds, of the ear feathers, is in them the only movement by which the facial nerve serves to indicate the passions. Next to the facial, the respiratory nerves,—those of the internal organs of respiration, the laryngeal and phrenic nerves,† as well as those of the external thoracic and abdominal muscles, are most susceptible

* 'The facial nerve is the motor nerve of the face. It is distributed to the muscles of the ear and of the scalp; to those of the mouth, nose, and eyelids; and to the cutaneous muscle of the neck.'

† The laryngeal nerves are distributed to the different parts of the larynx, and are, therefore, instrumental in stimulating the voice. The phrenic, or diaphragmatic nerve, is the special nerve of the diaphragm.

of the influence of the passions. But when the disturbance of the feelings is very intense, all the spinal nerves become affected, to the extent of imperfect paralysis, or the excitement of trembling of the whole body.

'The completely different expression of the features in different passions shows that, according to the kind of feeling excited, entirely different groups of the fibres of the facial nerve are acted on. Of the cause of this we are quite ignorant.

'The disturbed action of the heart during mental emotions is a remarkable instance of the influence of the passions over the movements of organs supplied by the sympathetic nerve.' —p. 932-4.

14. With regard to the movements of the face, Sir Charles Bell is of opinion that many of them are secondary to the movements of respiration. He considers the heart and lungs as the great primary source of expression, the organs first affected by the emotional excitement of the brain. He calls attention to 'the extent of the actions of respiration; the remoteness of the parts agitated in sympathy with the heart. The act of respiration is not limited to the trunk; the actions of certain muscles of the windpipe, the throat, the lips, the nostrils, are necessary to expand those tubes and openings, so that the air may be admitted through them in respiration with a freedom corresponding to the increased action of the chest. Without this, the sides of these pliant tubes would fall together, and we should be suffocated by exertion or passion. Let us consider how many muscles are combined in the single act of breathing—how many are added in the act of coughing—how these are changed and modified in sneezing; —let us reflect on the various combinations of muscles of the throat, windpipe, tongue, lips, in speaking and singing,* and we shall be able justly to estimate the extent of the muscles which are associated with the proper or simple act of dilating and compressing the chest. But how much more numerous

* These, however, are not primitive or instinctive associations, the class we are most interested in tracing out at present.

are the changes wrought upon these muscles when nature employs them in the double capacity of communicating our thoughts and feelings; not in the language of sounds merely, but in the language of expression of the countenance also; for certainly the one is as much their office as the other.'

'Let us see how the machine works. Observe a man threatened with suffocation: remark the sudden and wild energy that pervades every feature; the contractions of his throat, the gasping and the spasmodic twitchings of his face, the heaving of his chest and shoulders, and how he stretches his hand and catches like a drowning man. These are efforts made under the oppressive intolerable sensation at his heart; and the means which nature employs, to guard and preserve the animal machine, giving to the vital organ a sensibility that excites to the utmost exertion.'—*Anatomy of Expression*, 3rd Edition, p. 91.

This last illustration does not decide the point as to the dependence of the contortion of the features upon the respiratory organs, inasmuch as the state of intense pain supposed would excite every part of the body by direct action. The previous remarks on the necessity there is for movements of the respiratory passages,—the throat, mouth, and nostrils,—to accompany the action of the lungs, are very much in favour of the author's view.

But that the action on the face is not wholly a consequence of respiratory excitement is decisively proved by the expression of the eyes, for this in no way ministers to the breathing function. We are, therefore, bound to presume that while a certain amount of the facial expression is due to the sympathy or association of the parts with the movements of the lungs, there still remains a source of independent excitement derived from the brain at first hand, and by the same common impulse that affects the respiratory, vocal, and other organs. This distinctness of action is recognised in the passage above quoted from Müller.

15. Let us next, therefore, review the parts of the face concerned in expression. The muscles of the face, whereby all the movements are sustained, are arranged round three

distinct centres,—the mouth, the nose, and the eyes. The mouth has the largest number of muscles, and is the most easily affected by states of feeling. The nose is the least endowed with mobility.

The muscles of the eyebrow have been already pointed out. The *occipito-frontalis* descends over the forehead, and is inserted into the eyebrow; this it raises or arches; it is opposed by the *corrugator supercilii*, which corrugates or wrinkles the forehead, drawing the eyebrows together. These are pre-eminently muscles of expression, although also employed as voluntary muscles for the purposes of vision. They are emotionally moved by opposite states of feeling, the one in the more pleasing emotions, the other in pain, doubt, and embarrassment, and the appearance they cause to a spectator comes to suggest, by association, the corresponding states of mind. The *orbicular muscle* of the eyelids, which closes the eye, is of the nature of a sphincter, like the muscle surrounding the mouth and constituting the lips. This is opposed by the *levator palpebræ*, or the elevating muscle of the upper eyelid, which opens the eye, both voluntarily and under emotion. The *tensor tarsi* 'is a very thin, small muscle, placed at the inner side of the orbit, resting against the fibrous covering of the lachrymal sac and behind the tendon of the orbicularis.'

'The corrugator muscle being fixed at its inner extremity, draws the eyebrow and eyelid inwards, and throws the skin into perpendicular lines or folds, as in frowning. The occipito-frontalis will, on the contrary, elevate the brow, and wrinkle the skin transversely; which actions are so frequently repeated by most persons, and so constantly by some of a particular temperament, that the skin is marked permanently by lines in the situations just referred to. The orbicular muscle is the sphincter of the eyelids. It closes them firmly, and at the same time draws them to the inner angle of the orbit, which is its fixed point of attachment. The levator palpebræ is the direct antagonist of the orbicular muscle; for it raises the upper eyelid, and uncovers the globe of the eye. The tensor tarsi draws the eyelids towards the nose, and presses the orifices of the lachrymal ducts closely to the surface of the globe of the eye. It may thus facilitate the entrance of the tears into the ducts, and promote their passage towards the nose.'—QUAIN, p. 248.

16. The muscles of the nose are, first, the *pyramidal*, 'which rests on the nasal bone, and appears like a prolongation of the occipito-frontalis, with whose fibres it is intimately connected. It extends from the root of the nose to about half-way down, where it becomes tendinous, and unites with the compressor nasi. Its chief effect seems to be that of giving a fixed point of attachment to the frontal muscle: it also wrinkles the skin at the root of the nose.'

The *common elevator of the lip and nose*, lies along the side and wing of the nose, extending from the inner margin of the orbit to the upper lip. It raises the wing of the nose and the upper lip together.

The *compressor naris* 'is a thin, small triangular muscle, which lies close upon the superior maxilla and the side of the nose, being transverse from without inwards and upwards.' Contrary to its name, the principal action of it must be to expand the nostril by raising the lateral cartilage. This is an action in obvious harmony with respiration, seeing that it opens the nasal passage.'

The *depressor alæ nasi* 'is a small flat muscle, lying between the mucous membrane and the muscular structure of the lip, with which its fibres are closely connected.'

Of these and other bundles of muscular fibres, traceable on the small cartilages of the nose, the only considerable or powerful muscle is the common elevator of the lip and nose, which is thoroughly under the command of the will, and produces a very marked contortion of feature, wrinkling the nose and raising the upper lip. In expressing disgust at a bad smell, this muscle is very readily brought into play, and thence it comes to be employed in expressing disgusts generally. It is, however, employed without any such intention.

17. There are ten muscles connected with the movements of the mouth. One of them, the *orbicularis*, is single, and

surrounds and forms the aperture itself, the other nine are pairs, and radiate from this as from a centre.

The *proper elevator of the upper lip* extends from the lower border of the orbit to the upper lip, lying close to the border of the common elevator of lip and nose. When the lip is raised without raising the nose, which is not a very easy act, this muscle is the instrument.

The *elevator of the angle of the mouth* 'lies beneath the preceding, and partly concealed by it.'

'The *zygomatici* are two narrow fasciculi of muscular fibres, extending obliquely from the most prominent point of the cheek to the angle of the mouth, one being larger and longer than the other.' The elevator of the angle of the mouth, and the zygomatic muscles, serve to retract the angle of the mouth in smiling; they are therefore muscles of expression.

The two former of these four muscles are concerned in raising the upper lip, but they do not act very powerfully, or conspicuously. In fact, the upper lip is a feature remarkable for fixity, as compared with the under lip, and is not often elevated in man, and, on the occasions when it is raised, this is done by the common elevator rather than by its own proper muscles.

The region of the lower jaw contains three muscles, the depressor of the angle of the mouth, the depressor of the lower lip, and the elevator of the lower lip.

The *depressor of the angle of the mouth* lies at the side and lower part of the face, being extended from the angle of the mouth to the lower jaw.

The *depressor of the lower lip* is a small square muscle, lying nearer to the middle line of the chin than the preceding, by which it is partly concealed. It arises from the fore part of the lower jaw-bone, and is inserted into the lower lip, its fibres becoming blended with those of the orbicular muscle of the mouth, having been previously united with those of its fellow on the opposite side.

The *elevator of the lower lip* arises from a slight pit below the teeth-sockets of the lower jaw, near the middle line of the jaw, and is inserted into the tegument of the chin, which it lifts when in action.

The remaining muscles of the mouth are unconnected with either jaw, having a sort of middle position between them.

'At each side of the face, in the part called the 'cheek,' is a muscle,—the *buccinator;* and, round the margin of the mouth, one—the *orbicularis oris.*

'The *buccinator* is a thin, flat plane of muscular fibres, quadrilateral in figure, occupying the interval between the jaws.' This muscle is exerted in masticating the food, and receives nerves from the same source as the masseter, which is one of the principal muscles engaged in the act of mastication.

The *orbicularis oris* 'belongs to the class of sphincter muscles, and like them is elliptic in form, and composed of concentric fibres, so placed as to surround the aperture of the mouth, but with this peculiarity, that the fibres are not continued from one lip into the other. The muscle is flat and thin; its inner surface being in contact with the coronary artery of the lips, labial glands, and the mucous membrane; the external with the skin and the fibres of the different muscles which converge towards the margin of the mouth.'

'The aperture of the mouth is susceptible of considerable dilatation and contraction; the former being affected by the different muscles which converge to it, and which may be compared to retractors drawing with different degrees of obliquity the lips, or their angles, in the direction of their respective points of attachment. The elevators are necessarily placed at the upper part of the face, the depressors in the opposite situation, and the proper retractors on each side; and these are the zygomatici and the buccinators. The buccinators also contract and compress the cheeks; this power is brought into play when any substance becomes lodged in the interval between them and the jaws.'—QUAIN, p. 256.

18. With regard to the instinctive play of those various muscles under Emotion, the first remark to be made is, that in the gay and pleasing emotions the face is opened out

laterally by the action of the muscles that draw the parts away from the middle line. The principal muscles engaged in this action are the buccinator and zygomatici for the mouth, and the occipito-frontalis for the eyebrows. On the other hand, in painful states, the features are drawn towards the middle line by the action of the corrugator for the eyebrows and the orbicularis for the mouth. The expansion and contraction are also observable from above downwards; for the action that separates the eyebrows lifts them, while the corrugator both draws together and depresses the same parts. Again, in the mouth, the contraction takes place partly by the closing of the lips, but also by the action of two of the muscles of the lower lip, namely, the depressor of the angle of the mouth and the elevator of the lower lip. These last are remarkably uniform in the expression of painful feeling, and are seen at the earliest stage of infancy. They curve the mouth downwards, as the smile curves it slightly upwards. Thus it is that in painful states the features are puckered and contracted, both from without inwards and from above downwards; while in the opposite state they are expanded in all ways.

19. The second remark is, that 'it is often the *relaxation* of a certain class of muscles, more than their excitement, which gives expression; of this, smiling and laughter furnish the most apposite examples.' The relaxation of the orbicular muscle of the mouth allows the retracting muscles to preponderate, without any unusual exertion being thrown into those muscles. We may even go so far as to assert that while the milder forms of gaiety and satisfaction are associated with a relaxed state of the orbicular and other muscles, pain produces an intense and energetic contraction generally, and this intensity is even more a part of its character than the excitement of special muscles. Thus, in pain we may have an energetic expansion of the face as well as a contraction, but we are sure to have an intense exertion of some kind or other. The tones of the voice are sharp and loud, indicating a vivid stimulus of the organs. So in the gestures of the body; it is not easy to specify any one gesture that always accompanies a painful excitement, for we usually calculate on seeing a

general excitement and energy of gesture in various forms. If a person sitting at ease is seized with a painful spasm, the excitement will probably throw him into an erect posture; if he happens to be standing, the flexor muscles are likely to be stimulated so as to bend or crouch the body with violence. When intense pleasure excites the system there is the same indiscriminate vehemence of action, and it is only by the more expressive organs—the voice and the features—that we know which passion is prevailing.*

20. I remark, in the third place, that a certain class of emotional states are marked out by their depressing action, or by their depriving all the muscles and motor centres of tone and energy. This is noted by Müller in the passage already quoted. Terror and grief, especially in their later stages, or after a certain amount of excitement has been discharged, are of this nature. The depression is first felt, like all other emotional stimuli, in the lungs and heart, and passes from these to the voice, the features, the carriage. The enfeebled respiration is occasionally assisted by a forced or voluntary act suggested by the sense of oppression, and this yields a sigh. The relaxation of the retractor muscles of the face, from exhaustion, has an effect the opposite of the smile, and the mouth is undistended, being opened only for the purpose of breathing. The whole expression is a sort of undress of the features, as during a general weariness.

'In sorrow, a general languor pervades the whole countenance. The violence and tension of grief, the lamentations and the tumult, like all strong excitements, gradually exhaust the frame. Sadness and regret, with depression of spirits and fond recollections, succeed; and lassitude of the whole body, with dejection of the face and heaviness of the eyes, are the

* 'In pain, the body is exerted to violent tension, and all the emotions and passions allied to pain, or having their origin and foundation in painful sensations, have this general distinction of character, that there is an energetic action or tremor, the effect of universal and great excitement. It must at the same time be remembered, that all the passions of this class, some more immediately, others more indirectly, produce in the second stage exhaustion, debility, and loss of tone, from over-exertion.'—BELL, *Anatomy of Expression*, p. 154.

most striking characteristics. The lips are relaxed, and the lower jaw drops; the upper eyelid falls and half covers the pupil of the eye. The eye is frequently filled with tears, and the eyebrows take an inclination similar to that which the depressors of the angles of the lips give to the mouth.'—*Anatomy of Expression*, p. 151.

21. There are states marked by the opposite of this character. Astonishment, for example, has a stimulating effect upon the organs of movement, and probably all that is peculiar in its expression may be attributed to this effect. The lungs are quickened, the mouth is opened and fixed to facilitate the breathing; the nostrils may be slightly distended for the same reason. The wide stare of the eyes is a result of anything strongly arresting the gaze, partly reflex, partly voluntary, and, it may be, in some degree emotional. This expression may be studied to great advantage in infants; in them we may see both the respiratory effects and the arrested gaze, the eyelids and eyebrows both being strongly elevated. The throwing out of the arms is a usual accompaniment of the state, and may be either secondary to the increased action of the chest, or that along with a primary effect of the emotion. There is a great tendency to throw the arms outward in making a vigorous respiration; but this would probably not of itself account for the action to the full extent that we see it, and I therefore assume also that the emotional state extends its influence to the extremities, as any emotional state is free to do.

The following is an interesting sentence on Laura Bridgeman, the blind deaf-mute at Boston. 'When Laura is astonished or amazed, she rounds and protrudes her lips, opens them, breathes strongly, spreads her arms, and turns her hands with extended fingers upwards, just as we do when wondering at something very uncommon.' These being in her case as unprompted by imitation as the earliest movements of infancy, we may look upon them as the original or instinctive effects of the emotion.

The case of respiratory action quickened to convulsion I shall speak of under the special instances where it occurs.

22. It is necessary now to advert to the effects of emotion not muscular, or the influences upon the secretions, excretions, the circulation, &c. Hardly any portion of the system seems exempt from the diffusive action of an emotional excitement. All functions liable to be affected by influence at a distance conveyed through the nerves, as digestion, perspiration, the action of the heart and of the capillaries, and many other processes, are quickened or deranged by mental commotion.

The Lachrymal Secretion claims attention in the first place. The Anatomy of the apparatus has been touched upon in speaking of its associated organ, the Eye. The effusion of tears from the gland over the eyeball is constantly going on during waking hours. Certain emotions, to be afterwards defined, specifically affect the effusion (just as pain and anger curve the under lip), and cause the liquid to be secreted and poured out in large quantities, so as to moisten the eye, and overflow upon the cheek. By this outpouring there is a relief afforded to the vessels of the brain, which are congested under the pressure of painful emotion. A strong sensibility lodges in the lachrymal organ, which will require to be minutely described at another time. For the present, we may remark of emotional diffusion in general, that every part excited into action, whether moving organ, secretion, or excretion, is itself the source of a distinct sensibility which mixes with and often greatly modifies the original emotion; in pleasure enhancing, and in pain neutralizing it.

Perhaps one of the most notable of the effects now under consideration is Blushing. This is an action on the vascular system, or the capillary blood-vessels of the face, neck, and breast. According to Sir C. Bell, it is too sudden to be traced to the heart's action, and we must therefore compare it to a cold sweat, or to some of the actions of the nervous system upon the capillary circulation. Blushing is an expression apparently dormant until the individual has become strongly susceptible to the human presence, and is one of the effects of any great excitement from this cause.

The bursting out of a Cold Sweat is an action diffused from fear, and does not come alone. The same influence extends to the inward secretions, to the intestines, the kidneys, the liver, &c. The cold perspiration is a sudden discharge from the sudorific glands of the skin, like the outburst of tears from the lachrymal gland. The character of the insensible or gaseous perspiration is changed under strong excitement.

The salivary and gastric secretions are extremely susceptible to emotional influence. But the same may be said of Digestion at every stage. This is only one of the many consequences of the intimate connexion between the brain and the alimentary canal, which makes the sensations from this last organ so massive and prominent. The depressing and perturbing passions impair all the functions of the stomach, destroying appetite, and relaxing the tone of the intestinal canal. A hilarious excitement, within limits, stimulates those functions, but joy may be so intense as to produce the perturbing effect.

The Secretion of Milk from the breast is notoriously liable to mental influences; some favourable to a healthy flow, while depressing passions check and poison it.

I am unable to give an exhaustive catalogue of this class of influences, or to define precisely those now cited. Knowledge on this subject appears to be as yet imperfect. These, however, will serve as examples to show how essentially connected with Emotion is the fact of a free diffusion over every part that is reached by the nervous ramifications of the central brain.

23. It now remains for us to advert to the two convulsive outbursts, Laughter and Tears.

Laughter is properly an expression of joyous emotion. This remarkable perturbation of the system is brought on in many ways, and often by very slight causes. Mere hilarity, or animal spirits; cold, and acute pains, when not so intense as to stimulate the expression proper to pain; tickling; hysterical fits; self-complacency, and a feeling of triumph at some striking effect produced by self or others, (the point insisted on by Hobbes in his theory of Laughter); kindly feeling; the spectacle or notion of filthy, degraded, or forbidden things; the so-called ludicrous, which is usually the clash of dignity with meanness;—these, and perhaps other circumstances besides, rank among the causes of laughter. The medulla oblongata, which is the immediate organ in bringing on the outburst, is very prone to be irritated to a discharge of this special influence. We find that some temperaments are peculiarly liable to be excited to laughter; the liability may be so great as to be a positive weakness, indicating a sort of dissolute incontinence of the nervous system.

24. The action is of the respiratory class. 'Observe,' says Sir Charles Bell, 'the condition of a man convulsed with laughter, and consider what are the organs or system of parts affected. He draws a full breath, and throws it out in interrupted, short, and audible cachinnations; the muscles of his throat, neck, and chest, are agitated; the diaphragm is especially convulsed. He holds his sides, and, from the violent agitation, he is incapable of a voluntary act.' The expiratory muscles are strongly convulsed in laughter, those namely, of the chest and abdomen; and by 'convulsions' we mean those rapid and violent contractions which the will cannot resist, any more than in the spasms of nervous disease. A sudden discharge of nervous energy from the medulla oblongata is the immediate cause of the extraordinary excitement and acceleration of the respiratory system of movements. Passing next to the sympathies or accompaniments of the face, we find the relaxation of the mouth and of the corrugator of the eyes, should this last happen to be in action; with this there may be an additional tension imparted to the antagonising muscles which open the features; 'hence, by a lateral stretching of the mouth, and a raising of the cheek to the lower eyelid, a smile is produced. If the idea be exceedingly ridiculous, it is in vain that we endeavour to restrain this relaxation, and to compress the lips. The muscles concentring to the mouth prevail; they become more and more influenced; they retract the lips, and display the teeth. The cheeks are more powerfully drawn up, the eye-lids wrinkled, and the eye almost concealed.'—BELL, *Anatomy of Expression*, p. 147.

The convulsion of the respiratory muscles in laughter is doubtless one distinct effect, namely, the discharge of an increased shock of nervous excitement from the centre that supports the ordinary movements. The action on the muscles of the face we may look upon as another effect, not growing out of the respiratory stimulus, but arising apart, although in concert with the first. The tension of the larynx, which renders laughter vocal, may likewise be a distinct impulse from the common centre of Emotion. Although all these influences spring immediately from the medulla oblongata, and may there receive an impress of harmony, yet their remote and primary stimulus is in the seat of emotion, the cerebral hemispheres.

The Respiratory Organs are convulsed in different ways according to the nature of the stimulus; at all events the effects are very different in such acts as coughing, sneezing, yawning, hiccup, &c. The difference of effect is most marked, in the midst of much that is common, in comparing Laughter with the manifestations of grief or pathetic emotion.

25. The convulsive outburst of *grief* is described by Sir Charles Bell as follows:—

'The lachrymal glands are the first to be affected; then the eyelids; and finally, the whole converging muscles of the cheeks. The lips are drawn aside, not from their circular fibres relaxing, as in laughter, but from their being forcibly retracted by the superior influence of their antagonist muscles. Instead of the joyous elevation of the cheeks, the muscle which pulls down the angle of the mouth, *triangularis oris*, is more under influence, and the angle is depressed. The cheeks are thus drawn between two adverse powers; the muscles which surround the eyelids, and that which depresses the lower lip.

'The same cause which drew the diaphragm and muscles of the chest into action in laughing, is perceived here. The diaphragm is spasmodically and irregularly affected; the chest and throat are influenced; the breathing is cut by sobbing; the inspiration is hurried, and the expiration is slow, with a melancholy note.

'In the violence of weeping, accompanied with lamentation, the face is flushed, or rather suffused with stagnant blood, and the veins of the forehead distended. In this we see the effect of the impeded action of the chest.'

In laughter, the lachrymal effusion is last in the series of effects; here it comes first. It would seem as if this organ were affected sooner than the chest, and had an influence in bringing on the respiratory convulsions. There is a cry of pain, often manifested by infants, without tears, and capable of being instantly arrested. This is a mere vocal disturbance, implying a sharp but not convulsive expiration, and a tension of the vocal ligaments. This is the cry of anger likewise, which is marked by being very sharp and violent. When the lachrymal organs are affected to profuse flooding, the larynx and chest are usually convulsed at the same time, and sobbing ensues. In this case the diaphragm, the chief muscle of inspiration, is affected with convulsions, and the glottis being usually closed, no air really enters, so that the action of the lungs is impeded all the while. Here lies the great contrast between the two opposite emotions; in laughter, the expiration is excited to convulsion; in sobbing, the inspiration is convulsed, and the expirations are forced on as a consequence. The hysterical sensation at the throat is produced by the stimulus that convulses the larynx closing the glottis, and affecting the vocal cords.

The muscles of expression of the face brought into play in this emotion are those already cited as characteristic of painful states. The depressor of the angle of the mouth is a specific muscle of pain, as the zygomatic and elevators of the angle of the mouth are of pleasure.

The coincidence of a certain muscular expression with a specific secretion, as the contortion of pain with the flow of tears, is to be ranked among the pre-established harmonies of the system operated through the central organs of the brain. In other emotions, the feelings of sex, for example, there are similar coincidences.

OF THE INSTINCTIVE GERM OF VOLITION.

26. In a former chapter I endeavoured to establish, as an important fact of the human system, that our various organs are liable to be moved by a stimulus flowing out from the nervous centres, in the absence of any impressions from without, or any antecedent state of feeling whatsoever. This fact of spontaneous activity, I look upon as an essential prelude to voluntary power, making indeed one of the terms or elements of Volition; in other words, Volition is a compound, made up of this and something else.

Neither the existence of spontaneous actions, nor the essential connexion of these with voluntary actions, has been, so far as I am aware, advanced as a doctrine by any writer on the human mind; but the following interesting extracts from Professor Müller will show that he has been forcibly impressed with both the one and the other of these views.

'It is evident that the ultimate source of voluntary motion cannot depend on any conscious conception of its object; for voluntary* motions are performed by the fœtus before any object can occur to the mind, before an idea can be possibly conceived of what the voluntary motion effects; we must therefore view the question in a much simpler manner. On what do the first voluntary movements in the fœtus depend? All the complex conditions which give rise to voluntary motions, in the adult, are here absent. Its own body is the sole world from which the obscure conceptions of the fœtus that excite its actions can be derived. The fœtus moves its limbs at first, not for the attainment of any object, but solely *because it can move them.* Since, however, on this supposition, there can be no particular reason for the movement of any one part, and the fœtus would have equal cause to move all its muscles at the same time, there must be something which determines this or that voluntary motion to

* I should say 'spontaneous.'

be performed,—which incites the retraction, first of this foot or arm, and then of the other.'—MÜLLER, p. 935.

This last supposition, as to the equal tendency of all the muscles to come into action through the spontaneous activity of the centres, is, I think, too absolutely stated. There can hardly exist such a perfectly balanced charge of the centres, as to make all of them equally ready to commence a stimulus of the muscles under their control.* It will always happen that some one will be more prone to act than another, from the mere state of constitutional or nutritive vigour belonging to it: and when that one has exhausted itself the discharge of some other may be expected. Then, as to the tendency to move first one foot and then the other, we have already seen that this alternation is provided for by a distinct arrangement referable, in all probability, to the cerebellum; so that when by any means a motion of the legs is commenced, that motion is guided in an alternating cycle. I continue the quotation from Müller.

'The knowledge of the changes of position, which are produced by given movements, is gained gradually, and only by means of the movements themselves; the first play of the will on single groups of the radicle motor fibres of the nerves in the medulla oblongata, must therefore be independent of any aim towards change of position; it is a mere play of volition, without any conception of the effects thereby produced in the limbs. This voluntary [say rather spontaneous] excitation of the origins of the nervous fibres, without objects in view, gives rise to motions, changes of posture, and consequent sensations. *Thus a connexion is established in the yet void mind between certain sensations and certain motions.* When subsequently a sensation is excited from without, in any one part of the body, the mind will be already aware that the voluntary motion, which is in consequence executed, will manifest itself in the limb which was the seat of sensation; the fœtus in utero will move the limb that is pressed upon, and not all the limbs simultaneously. The voluntary

* Like the ass of Buridan between two bundles of hay.

movements of animals must be developed in the same manner. The bird which begins to sing, is necessitated by an instinct to incite the nerves of its laryngeal muscles to action; tones are thus produced. By the repetition of this blind exertion of volition, the bird at length learns to connect the kind of cause with the character of the effect produced.

'We have already learned from many other facts, that the nervous principle in the medulla oblongata is in a state of extraordinary tension, or proneness to action; that the slightest change in its condition excites a discharge of nervous influence, as manifested in laughing, sneezing, sobbing, &c. While the tension of the nervous principle is not disturbed, we are equally ready to excite voluntary movements in any part of the body, and such is the state of rest or inaction. Every mental impulse to motion disturbs the balance of this tension, and causes a discharge of nervous influence in a determinate direction,—that is, excites to action a certain number of the fibres of the nervous motor apparatus.'—p. 936-7.

This last view I conceive to be an accurate statement of the nature of nervous energy. The nervous system may be compared to an organ with bellows constantly charged, and ready to be let off in any direction, according to the particular keys that are touched. The stimulus of our sensations and feelings, instead of supplying the inward power, merely determines the manner and place of the discharge. The centres of speech and song, for example, when fresh and healthy, may either overflow so as to commence action in a purely spontaneous way, or they remain undischarged till irritated by some external influence, as, for example, the sound of another voice. The bird whose morning song has lain dormant for a time, flows out at the stimulus of another songster just begun.

27. We must now therefore specifically consider what there is in volition over and beyond the spontaneous discharge of active impulses upon our various moving organs,—limbs, body, voice, tongue, eyes, &c. If we look at this kind of impulse closely, we shall see wherein its defect or insufficiency lies, namely, in the random nature of it. Being

dependent on the condition of the various nervous centres, the discharge is regulated by physical circumstances, and not by the ends, purposes, or uses of the animal. When the centres of locomotion are fresh and exuberant, as in the dog unchained of a morning, the animal sets off at the top of his speed; the force once exhausted, the creature comes to a stand-still in the same spontaneous way, like a watch run down. But this moment of exhausted energy is the very moment when an animal ought properly to be active in procuring food and replenishment to the system; and there ought to be in the state of exhaustion itself a stimulus to act, just as a watch run down would require, in order to be self-sustaining, to touch some chord that would set a-going a power to wind it up, or as a dying fire ought to act on a spring for putting on fresh coals. Mere spontaneity, therefore, stops far short of what our volition does for us in the way of self-preservation; a power that dies out when action is most needed cannot be the appropriate support of our existence.

Müller's application of the term 'voluntary' to the initial movements prompted solely by the state of tension of the nerve centres is not strictly correct; these movements are but one term of the couple that makes up an act of volition; both a feeling and a movement are necessary parts of every such act. A morsel of food on the tongue sets a-going the movements of mastication; this is a voluntary effort, an effort prompted and controlled by a feeling, namely, the sensation of taste or relish. Acts performed without any stimulus of feeling are usually described as involuntary; such are the spasms of disease and the reflex movements already noticed.

There is a power in certain feelings or emotions to originate movements of the various active organs. A connexion is formed either by instinct or by acquisition, or by both together, between our emotional states and our active states, sufficient to constitute a link of cause and effect between the one and the other. And the question arises whether this link is original or acquired.

Dr. Reid has no hesitation in classing the voluntary command of our organs, that is, the sequence of feeling and action implied in all acts of will among instincts. (See his chapter on Instincts, *Essays on the Active Powers.*) The power of lifting a morsel of food to the mouth is, according to him, an instinctive or pre-established conjunction of the wish and the deed; that is to say, the emotional state of hunger coupled with the sight of a piece of bread, is associated through a primitive link of the mental constitution with the several movements of the hand, arm, and mouth, concerned in the act of eating.

This assertion of Dr. Reid's may be simply met by appealing to the facts. It is not true that human beings possess at birth any voluntary command of their limbs whatsoever. A babe of two months old cannot use its hands in obedience to its desires. The infant can grasp nothing, hold nothing, can scarcely fix its eyes on anything. Dr. Reid might just as easily assert that the movements of a ballet-dancer are instinctive, or that we are born with an already established link of causation in our minds between the wish to paint a landscape and the movements of a painter's arm. If the more perfect command of our voluntary movements implied in every art be an acquisition, so is the less perfect command of these movements that grows upon a child during the first year of life. At the moment of birth, voluntary action is all but a nonentity.

28. According to this view, therefore, there is a process of acquirement in the establishing of those links of feeling and action that volition implies: this process will be traced and exemplified in the following Book, and also, at some future time, in a detailed discussion of the whole subject of volition. But the acquisition must needs repose upon some fundamental property of our nature that may properly be styled an Instinct. It is this initial germ or rudiment that I am now anxious to fasten upon and make apparent. There certainly does exist in the depths of our constitution a property, whereby certain of our feelings, especially the painful class, *impel to action of some kind or other.* This, which I have termed the volitional property of feeling, is not an acquired property. From the earliest infancy a pain has a tendency to excite the active

organs, as well as the emotional expression, although as yet there is no channel prepared whereby the stimulus may flow towards the appropriate members. The child whose foot is pricked by a needle in its dress is undoubtedly impelled by an active stimulus, but as no primitive link exists between an irritation in the foot and the movement of the hand towards the part affected, the stimulus is wasted on vain efforts, and there is nothing to be done but to drown the pain by the outburst of pure emotion. It is the property of almost every feeling of pain to stimulate *some action* for the extinction or abatement of that pain; it is likewise the property of many emotions of pleasure to stimulate an action for the continuance and increase of the pleasure; but the primitive impulse does not in either case determine *which action*. We are left to a laborious and tedious process of acquisition in so far as the singling out of the requisite movement is concerned.

If there exist at the commencement only a vague indeterminate impulse attaching to our painful or pleasurable states, how can we ever get these vague impulses to run into the true channels, or to be associated with the appropriate movements? We seem as yet no nearer the solution of the grand difficulty.

29. I will endeavour to indicate what seems to me to be the circumstance that leads to this remarkable union between the two great isolated facts of our nature, namely, on the one hand, feelings inciting to movement in general, but to no action in particular, and, on the other hand, the spontaneous movements already spoken of.

If, at the moment of some acute pain, there should accidentally occur a spontaneous movement, and if that movement sensibly alleviates the pain, then it is that the volitional impulse belonging to the feeling will show itself. The movement accidentally begun through some other influence, will be sustained through this influence of the painful emotion. In the original situation of things, the acute feeling is unable of itself to bring on the precise movement that would modify the suffering; there is no primordial link between a state of suffering and a train of alleviating movements. But should the proper movement be once actually begun, and cause a felt diminution of the acute agony, the spur that belongs to states of pain would suffice to sustain this movement. Once assume that the two waves occur together in the same cerebral seat—a wave of painful emotion, and a wave of spontaneous action tending to subdue the pain,—there would arise an influence out of the former to sustain and prolong the activity of the latter. The emotion cannot invite, or suggest, or waken up the appropriate action; nevertheless, the appropriate action once there and sensibly telling upon the irritation, is thereupon kept going by the active influence, the volitional spur of the irritated consciousness. In short, if the state of pain cannot awaken a dormant action, a present feeling can at least maintain a present action. This, so far as I can make out, is the original position of things in the matter of volition. It may be that the start and the movements resulting from an acute smart, may relieve the smart, but that would not be a volition. In volition there are actions quite distinct from the manifested movements due to the emotion itself; these other actions rise at first independently and spontaneously, and are clutched in the embrace of the feeling when the two are found to suit one another in the alleviation of pain or the effusion of pleasure.

An example will perhaps place this speculation in a clearer light. An infant lying in bed has the painful sensation of chillness. This feeling produces the usual emotional display, namely, movements, and perhaps cries and tears. Besides these emotional elements there is a latent spur of volition, but with nothing to lay hold of as yet owing to the disconnected condition of the mental arrangements at our birth. The child's spontaneity, however, may be awake, and the pained condition will act so as to irritate the spontaneous centres, and make their central stimulus flow more copiously. In the course of a variety of spontaneous movements of arms, legs, and body, there occurs an action that brings the child in contact with the nurse lying beside it; instantly warmth is felt, and this alleviation of the painful feeling becomes immediately the stimulus to sustain the movement going on at that moment. That movement, when discovered, is kept up in preference to the others occurring in the course of the random spontaneity.

Possibly some little time may be requisite in the human infant to develop this power of clutching the right movement when it comes. But the power must be an original endowment; no experience could confer such a faculty as this. We are driven to assume some fundamental mode of connexion between the detached elements of feeling and movement occurring in the same brain at the same moment; and I know of no better way of expressing this primordial tendency of the one to embrace the other than by saying that, when both are present together, the volitional spur of the feeling can stimulate the continuance of the movement, provided a soothing and pleasurable effect is the conscious result.

By a process of cohesion or acquisition, which I shall afterwards dwell upon, the movement and the feeling become so linked together, that the feeling can at after times waken the movement out of dormancy; this is the state of matters in the maturity of volition. The infant of twelve months, under the stimulus of cold, can hitch nearer the side of the nurse, although no spontaneous movements to that effect happen at the moment; past repetition has established a connexion that did not exist at the beginning, whereby the feeling and action have become linked together as cause and effect. A full-grown volition is now manifested, instead of that vague incitement that could do nothing until the right movement had sprung up in the course of a series of spontaneous discharges of the central sources of power.

30. We must then assume it as a fact that as soon as a clear consciousness of movements sensibly remedial comes into play, that consciousness has the power of stimulating a concurring activity; in other words volition begins. It may be by a reflex action that a child commences to suck when the nipple is placed between its lips; but the continuing to suck so long as the sensation of hunger is felt, and the ceasing when that sensation ceases, are truly volitional acts. All through animal life, down to the very lowest sentient being, this property of consciousness is exhibited, and operates as the instrument for guiding and supporting existence. To whatever lengths the purely reflex instincts, or the movements

divorced from consciousness, may be carried on in the inferior tribes, I can with difficulty admit the total absence of feeling in any being that we are accustomed to call an animal; and with feeling I am obliged also to include this property which links the state of feeling with the state of present movement. Inferiority in the animal scale is marked by the fewness of the sensations, not by an entire blank in this region; and it does not follow that because a living creature has no consciousness saving hunger, repletion, and the feeling of being hurt, that these feelings should be feeble and insufficient to stimulate and guide the animal's movements. The earthworm leaves the earth when soaked with rain, in obedience to a stimulus of uneasiness, and continues crawling until its consciousness is again serene. When the ground has dried to the proper degree, the animal makes its way back to its shelter and food. If perchance in the movements stimulated by an uneasy state, the uneasiness comes to be sensibly increased, the worm would feel itself arrested; the spur would be towards putting a stop to the movement causing pain, and some other movement would go on instead; if relief came by the change, the volitional spur would sustain the new action so long as the agreeable effect continued. Here too, I should be disposed to assume the existence of a separate spontaneous tendency to crawl in the new-born worm, a tendency growing out of its nervous and muscular organization. An animal moves and also feels; these are distinct facts, separate properties of the mental system; nevertheless, when both take place together, the feeling can, according to the nature of it, stimulate or repress the movement; and this I believe to be volition in the germ.

31. To reduce the complicacy of this speculation, I shall repeat in numerical separateness the distinct considerations that are mixed up in it.

(1.) There is a power of spontaneous movement in the various active organs anterior to, and independent of, the feelings that such movement may give birth to; and without this no action for an end can ever be commenced.

(2.) There exists consciousness, feeling, sensation or emotion, produced from movements, from stimulants of the senses and sensitive parts, or from other causes. The physical accompaniment of this is a diffused excitement of the bodily organs constituting the outburst or expression of it, as the start from a blow.

(3.) There is a property of consciousness,—superadded to and by no means involved in, this diffused energy of expression,—whereby a feeling can influence any present active exertion of the body so as either to continue or abate that exertion. This is the property that links feeling to movement, thereby giving birth to volition. The feelings that possess this power—including nearly all pains and many states of pleasure,—I have hitherto described as volitional feelings; those that are deficient in this stimulus, being principally of the pleasurable class, are the pure, un-volitional, or serene emotions.

32. There are various actions, commonly called Instincts, that are only phases or results of this fundamental property of mind. *Self-preservation*, implying the revulsion from pain and injury, and the appropriation of the means of subsistence, is an example of volition as now explained. We have no original tendency to protect ourselves from injurious influences if they do not affect us as pains, nor to lay hold of beneficial influences that give no present pleasure. Excepting under the sweep of volition, self-preservation does not exist.

There are certain special instances of early precaution against harm that are often remarked upon as a portion of the original provision of nature in our behalf. Thus *the dread of falling* is very strong in early life, and stimulates powerful efforts by way of prevention. But this is no other than an instance of the general fact we are now considering. The remembrance of the acute pain of a past fall is one source of the spur to preserve the stability of one's footing. And even still earlier, and before experienced hurts can operate as a warning, there is a severe and distressing sensation in the sudden loss of support, that prompts us vigorously to act for restoring the firm position. The case is distinguished only by the remarkable virulence of the pained condition and the corresponding degree of volitional stimulus manifested by it.

OF THE SPECIAL ACTIVITIES AND INSTINCTS.

Under this head would fall to be considered Locomotion, the Voice, Mastication, and the Constructive and Destructive apparatus, &c. Locomotion is an interesting subject in itself, but for the purposes of the present treatise I do not consider the full exposition of it at all necessary. The notice already taken of the subject in the earlier part of this chapter must suffice.

33. So deeply does the act of Speech enter into the operations of Mind—Emotion, Action, and Intelligence—that the mechanism of the organ deserves a full description in this place.

Of the Voice.

I shall first make a few quotations from the Anatomy of the Voice.

'The upper part of the air passage (from the lungs) is modified in its structure to form the *organ of voice.* This organ, named the larynx, is placed at the upper and fore part of the neck, where it forms a considerable prominence in the middle line. It lies between the large vessels of the neck, and below the tongue and hyoid bone, to which bone it is suspended.'

'The larynx is cylindrical at the lower part, where it joins the trachea (or windpipe), but it widens above, becomes flattened behind and at the sides, and presents a blunted vertical ridge in front.

'The larynx consists of a framework of cartilages, articulated together and connected by proper ligaments, two of which, named the *true vocal cords*, are immediately concerned in the production of the voice. It also possesses muscles, which move the cartilages one upon another, a mucous membrane lining its internal surface, numerous mucous glands, and lastly, blood-vessels, lymphatics, and nerves, besides cellular tissue and fat.'

Cartilages of the Larynx.—'The cartilages of the larynx consist of three single and symmetrical pieces, named respectively the *thyroid cartilage*, the *cricoid cartilage*, and the *cartilage of the epiglottis*, and of six others, which occur in pairs, namely, the two *arytenoid cartilages*, the cornicula laryngis, and the cuneiform cartilages. Of these, only the thyroid and cricoid cartilages are seen on the front and sides of the larynx (see fig. p. 302); the arytenoid cartilages, surmounted by the cornicula of the larynx, together with the back of the cricoid cartilage, on which they rest, form the posterior wall of the larynx, whilst the epiglottis is situated in front.'—QUAIN, p. 1159.

Confining ourselves as much as possible to the parts immediately connected with voice, I require to call attention principally to the thyroid and cricoid cartilages, the two arytenoid cartilages, the true vocal cords, and the muscles that move the cartilages and thereby affect the tension and position of the vocal cords.

'The *thyroid* (shield-shaped) cartilage (see fig. 10) is the largest of the pieces composing the larynx. It is formed by two flat lamellæ, united in front at an acute angle along the middle line, where they form a vertical projection which becomes gradually effaced as it is traced from above downwards. The two lamellæ, diverging one from the other backwards, embrace the cricoid cartilage, and terminate posteriorly by two thick projecting vertical borders, separated widely from each other; hence the thyroid cartilage is altogether wanting behind. The angular projection on the anterior surface in the median line is subcutaneous, and is much more prominent in the male than in the female, being named in the former the *pomum Adami*.'

'The *cricoid* cartilage, so named from its being shaped like a ring, is thicker in substance and stronger than the thyroid cartilage; it forms the inferior, and a considerable portion of the back part of the larynx, and is the only one of the cartilages which completely surrounds this organ. It is deeper behind, where the thyroid cartilage is deficient, measuring in the male about an inch from above downwards, but is much narrower in front, where its vertical measurement is only two lines and a half. The cricoid cartilage is circular *below*, but *higher* up it is somewhat compressed laterally, so that the passage through it is elliptical, its antero-posterior diameter being longer than the transverse.'

'The *arytenoid* (ewer-shaped) cartilages (fig. 11) are two in number, are perfectly symmetrical in form. They may be compared to two three-sided pyramids recurved at the summit, measuring from five to six lines (half an inch) in height, resting by their bases on the posterior and highest part of the cricoid cartilage, and approaching near to one another towards the median line. Each measures upwards of three lines in width, and more than a line from before backwards.'—p. 1162.

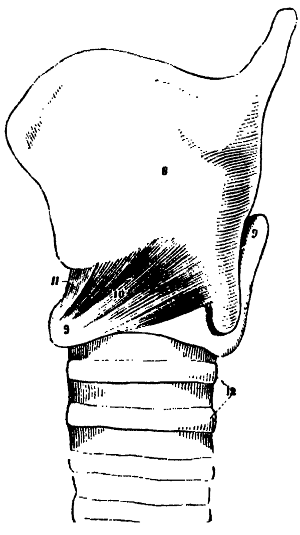
The cartilages are bound together by ligaments, of which I omit the description. The appearance of the *interior* of the larynx is given as follows (see fig. 11):

'On looking down through the superior opening of the larynx (where it communicates with the pharynx above and is bounded by the epiglottis, &c.), the air passage below this part is seen to become gradually contracted, especially in its transverse diameter, so as to assume the form of a long narrow fissure running from before backwards. This narrow part of the larynx is called the *glottis*. Below it, at the upper border of the cricoid cartilage, the interior of the larynx assumes an elliptical form, and lower down still it becomes circular. The glottis is bounded laterally by four strongly marked folds of the mucous membrane, stretched from before backwards, two on each side, and named the *vocal cords*. The *superior* vocal cords are much thinner and weaker than the inferior, and are arched or semi-lunar in form; the *inferior* or *true* vocal cords are thick, strong, and straight. Between the right and left inferior vocal cord is the narrow opening of the glottis, named the *rima glottidis*, and sometimes the *glottis vera*, or *true glottis*.'—p. 1167.

The inferior or true *vocal cords*, by whose vibration the voice is produced, are two bands of elastic substance, attached in front to about the middle of the depression between the wings of the thyroid cartilage, and behind to the arytenoid cartilages; from this connexion they are called thyro-arytenoid ligaments. They consist of closely arranged parallel fibres, of that peculiar tissue occurring in some other parts of the body, named the *yellow elastic tissue,* being probably the most perfectly elastic substance of a ligamentous kind that nature has produced. India-rubber is employed, as an extremely inferior imitation, in making artificial instruments resembling the larynx. The upper and free edges of the cords, which are sharp and straight, are the parts thrown into vibration during the production of the voice.

34. With reference to the *muscles* of the larynx I may state beforehand that the principal movements to be effected by them relate to the change of tightness and change of distance of the two cords, for which purposes opposing pairs are necessary. By one action the cords are tightened, by another relaxed; by a separate action they are approximated, and by the antagonist of this they are parted asunder.

FIG. 10.*

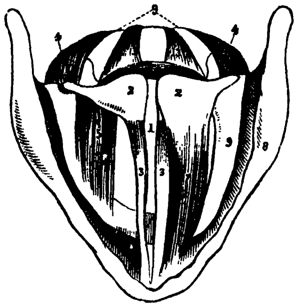


The great muscle of tension of the cords, the foremost and most powerful of all the muscles of the voice, is the *crico-thyroid* exhibited in the figure. 'It is a short, thick triangular muscle, seen on the front of the larynx, situated on the fore part and side of the cricoid cartilage. It *arises* by a broad origin from the cricoid cartilage, reaching from the median line backwards upon the lateral surface, and its fibres, passing obliquely upwards and outwards, and diverging slightly, are *inserted* into the lower border of the thyroid cartilage.' The

* 'Side view of the thyroid and cricoid cartilages, with part of the trachea; after Willis.—8. Thyroid cartilage. 9. 9. Cricoid cartilage. 10. Crico-thyroid muscle. 11. Crico-thyroid membrane, or ligament. 12. Upper rings of the trachea.'—(QUAIN, p. 1171.)

contraction of the two crico-thyroid muscles causes the thyroid and cricoid cartilages to turn on each other behind; thus if we suppose the cricoid cartilage to remain fixed, the upper part of the thyroid is carried forward or away from the other, drawing with it the ends of the vocal cords, which are attached behind to the cricoid cartilages through the arytenoid (see fig. 11). In this way the vocal cords are stretched in proportion as the muscle contracts itself. The counteracting or antagonistic muscles are exhibited in the fig. (No. 7) passing between each arytenoid cartilage and the thyroid near the extremity of the vocal cords.

FIG. 11.*



In governing the aperture of the glottis, we find a muscle passing between the two arytenoid cartilages (6), and therefore by its contraction drawing them together, and thus approximating the cords. The cords are separated and the glottis widened by a pair of muscles exhibited in the figure (4, 4) passing between the arytenoid and cricoid cartilages behind. No. 5 in the figure is another muscle connecting the same two cartilages laterally, and operating to contract the glottis.

35. *The Larynx, considered as an instrument for the production of sound.*—It has long been a question what kind of instrument the larynx should be compared to, in order to illustrate the manner of its action in giving out sound. From the existence of two vibrating strings or cords, the first

* 'A diagram, slightly altered from Willis, showing a bird's-eye view of the interior of the larynx.—1. Opening of the glottis. 2. 2. Arytenoid cartilages. 3. 3. Vocal cords. 4. 4 Posterior crico-arytenoid muscles. 5. Right lateral crico-arytenoid muscle; that of the left side is removed. 6. Arytenoid muscle. 7. Thyro-arytenoid muscle of the left side; that of the right side is removed. 8. Upper border of the thyroid cartilage. 9. 9. Upper border and back of the cricoid cartilage. 13. Posterior crico-arytenoid ligament.'—(QUAIN, p 1172.)

and obvious supposition was to rank it with stringed instruments, such as the violin, where the same string produces a higher or lower note according to the degree of tightness given to it. But that two strings, about an inch long, should so vary in tension as to give out a range of notes, extending to more than two octaves, is altogether unparalleled in the experience of stringed instruments. A more accurate comparison appears to hold with *reed instruments*, such as the pipe of an organ, where the sound is produced by a vibrating reed. Professor Müller imitated the human voice by stretching two elastic membranes across the mouth of a short tube, each covering a portion of the opening, and having a chink left between them. By prolonging the membranes downward into the tube, so that not merely their edges, but their whole planes, might be thrown into vibration, Mr. Willis carried the imitation of the Human Glottis still farther. By experimenting on an artificial glottis thus formed, it appeared that various notes could be obtained by altering the tightness of the tongues: the more tense they are, the higher is the note produced. 'It is true that a scale of notes, equal in extent to that of the human voice, cannot be obtained from edges of leather; but this scale is much greater in india-rubber than in leather; and the elasticity of them both is so much inferior to that of the vocal ligaments, that we may readily infer that the greater scale of the latter is due to its greater elastic powers.' It is also found that in membranous tongues the increased strength of the blast can somewhat raise the pitch, the tension remaining the same.

I quote a summary of the action of the Voice from Müller:—

'The following will be the mode of production of the notes of the natural voice:—The vocal ligaments vibrate in their entire breadth, and with them the surrounding membranes and the thyro-arytenoid muscles. For the deepest notes, the vocal ligaments are much relaxed by the approximation of the thyroid to the arytenoid cartilages. The lips of the glottis are, in this state of the larynx, not only quite devoid of tension; they are, when at rest, even wrinkled and plicated; but they become stretched by the current of air, and thus acquire the degree of tension necessary for vibration. The medium state, in which the cords are neither relaxed and wrinkled, nor stretched, is the condition for the middle notes of the natural register, those which are most easily produced. (The ordinary tones of the voice, in speaking, are intermediate between these and the deep bass notes.) The higher notes are produced, and the corresponding falsetto tones avoided, by the lateral compression of the vocal cords, and by the narrowing of the space beneath them, and further by increasing the force of the current of air. The muscular tension given to the lips of the glottis by the muscles above-mentioned must also be taken into account as contributing to the production of the notes of the natural register.

'The falsetto notes are produced by the vibration of the inner portion or border of the vocal ligaments; their variation as to height or sharpness being effected by a variation of tension of the ligaments.'—p. 1015-6.

It is a question not perfectly decided, how the cords are adjusted for the production of voice, in other words, what is the difference between their situation when the breath is passing through without causing vocal sound, and when sound is actually produced. Mr. Willis is led by his experiments to believe, that 'in the ordinary position of the glottis, during respiration without vocalization, the lips of the glottis are inclined from each other, and that to produce voice they must assume the parallel state. He attributes to the thyro-arytenoid muscles the office of placing the arytenoid cartilages and the lips of the glottis in the vocalizing position.'—(MÜLLER, p. 1016, note.)

The fact, apparently well ascertained, that by simply increasing the force of the blast a higher note is produced, constitutes one of the difficulties of a person learning to sing. The attempt to increase the loudness or strength of a note is sure to raise the pitch, until such time as the voice has been taught to relax the cords at the same moment. It is only a very accomplished singer that can swell a note, or make it fade away, without in any degree raising or sinking the pitch.

Another change that may occur in the vocal cords to alter the pitch, is the shortening of the slit between them, by causing their sides to come together. When this happens the note is raised, while the tension remains the same. This change has been brought forward as one explanation of the falsetto voice.

'The *width* of the aperture of the glottis, has no essential influence on the pitch of the notes, except inasmuch as it is difficult to elicit sounds from the larynx, by blowing through the trachea, when the aperture of the glottis is wide; the sound is then not only devoid of musical tone, but the note can be raised by increased force of the blast a trifling degree only above the fundamental note; while, when the aperture of the glottis is narrow, it may be raised by this means a succession of semitones up to the 'fifth,' or beyond it.'—MÜLLER, p. 1028. Thus the narrowing of the glottis is not an act for regulating pitch, like the tension of the cords, but a condition of the production of musical tones, and of the action of the chest in altering the pitch.

Other circumstances concurring in the adjustment of the larynx to high and low notes, are still but imperfectly explained. 'Thus, during the ascent of the voice from the deeper to the higher notes of the scale, we find the whole larynx undergoing an elevation towards the base of the cranium:' this change, however, is not considered so essential to the pitch, as to the quality of the note when the pitch is high.

The difference between the male and female voice lies in the size of the larynx and length of the vocal cords; both which are greatest in the male. Within the same sex there are gradations in these particulars.

36. The musical voice is entirely dependent on the larynx, with its vocal cords and muscles, coupled with the resonance of the adjoining parts, namely, the nostrils, sinuses, and the cranium at large. The *articulate* voice involves the action of the mouth in addition. Articulate sounds are those simple distinguishable sounds that can be united or fused into the compounds called syllables and words. Of

their two divisions, Vowels and Consonants, the vowels are produced by an open and immoveable position of the mouth; while the consonants require a shutting more or less complete. and also a movement of the parts. Compare the sound of 'awe' with the sound of 'cup': the one a vowel, the other containing two consonants.

The following experiment illustrates the nature of *vowel* formation:—

'Open the mouth to its greatest possible extent—with the lips naturally drawn back, so that the edges of the teeth are visible—and emit an utterance of voice; it will sound *ah!* Continue sounding this vowel while you *cover the mouth* firmly with the hand, laying the fingers of the left hand on the right cheek, and slowly bringing the whole hand across the mouth; the vowel quality of the sound will be changed with every diminution of the vocal aperture, progressively becoming *uh, aw, oh, oo,* as the hand gradually covers the mouth.'*

The changes of the mouth for different vowels are chiefly two, expressed by the terms *buccal* and *oral,* the one referring to the size of the cavity of the mouth, the other to the opening the lips. The modifications of these, coupled with the position of the tongue, give rise to all the varieties of vowel sound. An estimate has been made of the comparative dimensions of the two openings in the principal vowels. Admitting five degrees of size, both of the opening of the mouth and of the space between the tongue and palate, Dr. Carpenter, slightly altering from Kempelen, states the dimensions of these parts for the different vowels as follows:—

Vowel.	*Sound.*	*Size of oral opening.*	*Size of buccal cavity.*
a	as in *ah*	5	5
a	as in *name*	4	2
e	as in *theme*	3	1
o	as in *cold*	2	4
oo	as in *cool*	1	5

Of the *consonants* a great many divisions have been

* BELL'S *Elocutionary Manual,* p. 21.

made. A certain play of the tongue, teeth, or lips is necessary in all of them. This play may vary from the mere quiver of the tongue in sounding *s*, to the forcible shutting off of the sound by the sudden closure of the lips in *p* final. The sounds *p*, *t*, and *k*, are connected either with sudden closures or explosive openings of the vocal current, and are called *mutes* and also *explosive* letters. Of these three, *p* being formed by the lips, is called a *labial;* *t* being formed by the contact of the tongue with the palate, is a *palatal* and also a *dental;* and *k* is a *guttural* or throat-formed letter, the contact of the tongue being much farther back in the palate. As all the consonants are formed more or less nearly in one or other of these three positions, a general division of them can be made into labials, palatals, and gutturals. Six distinct Labials are enumerated, depending on different ways of sounding with the lip closure. The mute or explosive *p* has been mentioned; next to it is *b*, produced by a less violent closure, which allows the voice to be heard during the act, as any one will feel by sounding *cup* and *cub*. The third labial is *m*, which is still farther removed from the sudden extinction occurring with *p;* a free communication is opened with the nose for the egress of the air, and the sound can be made continuous like a vowel; in other words, we have the humming sound; this is the *nasal* labial, while *b* is called the *vocal* labial. The fourth labial is *f*, produced by the upper teeth and the lower lip coming together, and the breath passing through them without voice; this is the whispered or *aspirate* labial. When voice is heard through this last closure, we have *v*, or the second vocal labial, called the *vocal aspirate.* Lastly, a sound may be emitted through the closed lips, making them vibrate or shake like a reed, as in the sound *prr:* this is the *vibrating* labial, or the labial *r*. A similar series can be described in the Palatals. The mute being *t*, the vocal is *d;* there are two forms of the nasal, *n* and *l;* the aspirates are *th* (*th*umb), *s*, *sh*, arising from slightly differing positions of the tongue in its contact with the palate; the vocals, or audible forms of these, are *th* (*th*y), *z*, *j:* the vibratory palatal is the common *r*. The Gutturals likewise show the same list of varieties. First *k* the mute; then the vocal *g*; the nasal *ng*, a simple sound, though spelt in our language with two letters; the aspirate *ch* (Scotch and German) as in *loch*, together with its fainter form *h*; the vocal aspirate *gh* unknown, and almost unpronounceable by us; and the vibratory *ghr*, occurring as a burr in some people's utterance. This classification, for which we are indebted to Dr. Arnott, may be summed up in the following table:—

	Labials.	*Palatals.*	*Gutturals.*
Mute	*p*	*t*	*k*
Vocal	*b*	*d*	*g*
Nasal	*m*	*n, l*	*ng*
Aspirate	*f*	*th, s, sh*	*ch, h*
Vocal Aspirate	*v*	*th, z, j*	*gh*
Vibratory	*prr*	*r*	*ghr*

37. *Mental Phenomena of Voice.*—The voice, being a moving or active organ, presents all the mental facts and phenomena belonging to the moving organs in general. Exercise gives birth in it to a mass of feeling of the muscular kind, pleasurable when within due limits, with sense of fatigue and need of repose. Considering the smallness of the muscles concerned, the sense of vocal activity must be considered very acute; a circumstance arising out of the comparatively large contingent of nerves supplied to the organ. In this respect the voice resembles the eye and probably also the ear, in both which a diminutive amount of muscular substance is the seat of a powerful sensibility.

The tension of the vocal organs is always accompanied with an action of the chest, and this action needs to be stronger than an ordinary expiration. When the cords are made vocal without any reinforcement of the chest, we have a groan, or a wail, according as the tension is small or great, the one being a deep tone and the other acute. But such is the association between high notes and increased exertion of the lungs that it is difficult to produce a wail with only the ordinary breathing force.

In appreciating the pleasure springing out of vocal exercise, or the sensibility of the larynx under exertion, we must allow for this action of the respiratory organs, and also for the sensation of the resulting sounds on the ear. There can be little doubt, however, that when both these are deducted from the effect, there still remains a very considerable source of pleasure due solely to the play of the laryngeal muscles, and which renders the free employment of the voice an important item of bodily gratification.

38. Besides the feelings of pleasure or of pain diffused from the vocal apparatus, there is as in all the other muscles a distinctive sense of the degree of tension of each separate muscle, such as to indicate the varying positions of the tube and the vocal cords. We have one feeling for the absence of tension, another for a low degree, a third for a higher degree, and so on. The sound produced by each of those stages comes to be associated with the corresponding muscular condition of the organ, and hence we get the power of imitating sounds or of producing them at pleasure. The association between the sound in the ear and the vocal position and movement producing it, enables the one to recal or reinstate the other; which could not be if there were not a distinctive feeling or consciousness due to each separate vocal position. This sensibility belongs to all muscles whatever, and according to the degree of delicacy of it is the fineness of execution belonging to the several organs. If very small differences of vocal tension can be distinctively appreciated, the voice will be able the sooner to fix with precision all given sounds, just as the hand will acquire delicacy in handicraft operations through the same circumstance.

The voice is thus pre-eminently a *voluntary* organ. It has that abundant spontaneous activity which I consider the foundation circumstance, the first term, the earliest fact, of volition; pouring itself forth of its own accord in many various forms, each ready to be linked with the sound produced, in the process of voluntary acquisition. The centres that determine vocal action seem disposed to take on a highly charged condition, and to discharge themselves at intervals without any stimulus from without; while with the aid of a stimulus their exertion becomes most profuse.

39. In all probability, the high tension of the medulla oblongata or other vocal centres is what makes the voice so ready to burst out under Emotion. Intense feelings affect the whole of the moving organs, but all organs are not equally moved. The parts first acted on by any feeling are the features and the respiratory and vocal organs, which are therefore by pre-eminence the organs of *expression*, some of them, indeed, serving hardly any other purpose.

In following out, under the head of Intellect, the processes of acquisition, the voice will have to be repeatedly adverted to. The acquirements made by it both in music and in articulation are exceedingly numerous and complicated. As a medium in the processes of intelligence the vocal powers also hold a very high position.

There is no other special activity important enough to be described in similar detail. The organs of mastication are all very intelligible, and the process is an acquired one. The destructive and constructive Instincts are remarkable chiefly in the inferior Animals.

BOOK II.

INTELLECT.

LET us now proceed to view the Intellect, or the thinking portion of the mind. The various faculties known under such names as Memory, Reason, Abstraction, Judgment, &c., are modes or varieties of Intellect. Although we can scarcely ever exert this portion of our mental system in separation from the other elements of mind, namely, Emotion and Volition, yet scientific method requires it to be described apart.

The full meaning and extent of this branch of the subject will be best seen from the ample detail that we are now to enter upon. The general characters that distinguish the Intelligence from the two other fundamental properties of mind may be expressed as follows:—

1. The persistence or continuance of sensations and other mental states, after the withdrawal of the external agent, or stimulus, is a notable characteristic of the mind, not implied, as it seems to me, in the mere fact of consciousness. In consequence of this property we are enabled to live a life in ideas, in addition to the life in actualities.

2. The power of recovering, or reviving, under the form of ideas, past or extinct sensations* and feelings of all kinds, without the originals, and by mental agencies alone. These mental agencies are not included either in Emotion or in

* Although we can hardly avoid using such terms as 'recover,' 'revive,' 'reproduce,' 'recollect,' with reference to Sensations, it is to be borne in mind that there is a radical difference between the Sensation and the recollection of the Sensation, or what is properly termed the Idea. This fundamental and unerasable difference relates to the sense of objective reality which belongs to the sensation, and not to the idea. The sensation caused by the sight of the sun is one thing, and the idea or recollection of the sun is another thing; for although the two resemble each other, they yet differ in this vital particular. For many purposes, the idea can stand in the room of the sensation; the recollection of things often answers the same ends as the real presence. But there is one great question connected with our science, in which this distinction is the turning point of the problem, namely, the question as to our perception and belief of an external world. In discussing that subject, we shall have to attend closely to the circumstances that characterise a sensation as distinct from the counterpart idea.

Volition, and therefore require a place of their own. The two properties of continuance and recoverability by mental causes, which are probably at bottom the same property, make the fundamental and comprehensive distinction of Intellect.

3. The discrimination of conscious states, or the comparing of them one with another, with sense of agreement and difference, belongs to this department of mind. The fact of persistence is herein implied, for comparison cannot take place unless the traces of the past exist along with the present. I have already exemplified this power of discrimination, in speaking of the more intellectual part of the feelings of movement and sensations.

4. The acquired powers grow out of the properties of Intellect, and are not involved in Emotion, or in Volition.

5. Originality, or invention, is sustained by processes purely intellectual. By these processes, the compass of both Emotion and Action is enlarged in a most remarkable degree.

6. It is, I believe, a fact that Consciousness is not indispensable to the operations of Intellect.* If so, this is a broad line of distinction between Intellect and the other regions of mind, for Consciousness makes up one of those regions, and is an essential part of the other.

Intellect may work in different degrees of combination with the remaining functions of mind. Science is the best example of its most pure manifestation. When blended with Emotion, the most interesting product is Fine Art; as the handmaid of Volition, directed to practical ends, it yields the higher combinations of Industry and Business.

* 'Mr. Stewart has made an ingenious attempt to explain sundry of the phænomena referred to the occult principle of habit, in his chapter on Attention, in the first volume of his *Elements of the Philosophy of the Human Mind*. It is to be regretted that he had not studied (he even treats it as inconceivable) the Leibnitzian doctrine of what has not been well denominated, *obscure perceptions, or ideas*—that is, acts and affections of mind, which, manifesting their existence in their effects, are themselves out of consciousness or *apperception*. The fact of such latent mental modifications is now established beyond all rational doubt; and on the supposition of their reality, we are able to solve various psychological phænomena otherwise inexplicable. Among these are many of those attributed to Habit.'—SIR W. HAMILTON, *Edition of Reid*, p. 551.

The revival, or reappearance of past states of mind by mere mental operations, is subject to fixed laws. These became the subject of investigation soon after the commencement of speculative thought. They are termed Laws of Mental Association, Suggestion, or Reproduction; and the first explicit statement of them is due to Aristotle.* I shall treat them as four in number, two being simple and fundamenal, and two complex. The exposition of Intellect in the present Book will be the exposition of these Laws.

* See Sir W. Hamilton's *Contribution towards a History of the Doctrine of Mental Suggestion or Association.*—Reid, Note D.* *

CHAPTER I.

LAW OF CONTIGUITY.

1. THIS associating principle is the basis of Memory, Habit, and the Acquired Powers in general. Writers on Mental Science have described it under various names. Sir William Hamilton terms it the law of 'Redintegration,' regarding it as the principle whereby one part of a whole brings up the other parts, as when one syllable of a name recals the rest, or one house in a street suggests the succeeding ones. The associating links called Order in Time, Order in Place, and Cause and Effect are all included under it. We might also name it the law of Adhesion, Mental Adhesiveness, or Acquisition.

The following is a general statement of this mode of mental reproduction.

> Actions, Sensations, and States of Feeling, occurring together or in close succession, tend to grow together, or cohere in such a way that when any one of them is afterwards presented to the mind, the others are apt to be brought up in idea.

There are various circumstances or conditions that regulate and modify the operation of this principle, so as to render the adhesive growth more or less rapid and secure. These will be best brought out by degrees in the progress of the exposition. As a general rule, repetition is necessary in order to render coherent in the mind a train or aggregate of images, as, for example, the successive aspects of a public way, with a sufficient degree of force to make one suggest the others at an after period. The precise degree of repetition needed depends on many circumstances, the quality of the individual mind being one.

MOVEMENTS.

2. I shall commence the detailed exposition of the Law of Contiguity with the case of Muscular Activity, including under this head all kinds of movements, attitudes, and efforts of resistance.

Through the intellectual property of adhesiveness or plasticity, as expressed by this principle of contiguous association, movements can be linked together in trains and made to succeed each other, with the same certainty and invariable sequence as we find in the instinctive successions of rhythmical action already discussed. The complicated evolutions of a dance come to flow of their own accord, no less than the movements on all fours of the newly dropped lamb.

We may begin with remarking the operation of the adhesive principle upon the spontaneous and instinctive actions themselves. These actions are plainly confirmed and invigorated by repetition. Although many creatures can walk as soon as they are born, they walk much better after a little practice. Here, however, we cannot easily make allowance for the growth of the parts themselves, apart from the effect of exercise. The muscles of the limbs increase in size, and the nerve-centres that stimulate and organize the rhythmical movements acquire more development through time alone. We are, therefore, not in a good position, in the case of the instincts, to trace and estimate the force of adhesive growth due to this principle of contiguity. But knowing, as we do, how the force operates in all the voluntary operations, we are entitled to presume that it works also in the various instinctive operations. By practice, that is, by repetition, the infant sucks with more ease and vigour. In learning to walk, exercise undoubtedly concurs with the primitive alternating tendency of the limbs. The muscles of the body are strengthened by the mere action of growth; this growth is accelerated if they are regularly exercised within limits; and the very same is likely to be true of the nerves and nerve-centres that dictate the flow and alternation of muscular movements.

I have endeavoured to establish as a fact the spontaneous commencement of all the actions that we term voluntary. Thus the limbs, the features, the eyes, the voice, the tongue, the jaw, the head, the trunk, &c., commence to move in consequence of an unprompted flow of stimulus from the nerve-centres; this flow will be sometimes to one set of members and sometimes to another, so that the organs may act separately and independently, under the influence thus imparted. Now such spontaneous movements are without doubt confirmed by repetition, and are thereby made to recur more readily in the future. Any movement struck out by central energy leaves as it were a track behind, and a less amount of nervous impulse will be required to set it on a second time. By a spontaneous stimulus the hands are closed; the act of closing determines a current or bent in that direction, and the next exertion is so much the easier. By one prompting the arms are raised and lowered alternately; by another they are moved forwards and backwards; in the course of a few repetitions adhesiveness comes in aid of the inward stimulus, and the movements grow more frequent and more decided. Through the spontaneous action of the centres the eyes are moved to and fro, and iteration gives facility to the exercise. So the voice is moved variously by an impulse from within, and each movement and note is made easier for the next occasion when the centres discharge their energy by that channel. The tongue is an organ with many movements, and all voluntary; these commence of their own accord, and are strengthened and as it were developed by repetition. The inclinations and sweep of the head, and of the trunk generally, are of the same class. The iteration of all these various movements does not make them voluntary movements in the proper sense of the expression; but it prepares them for becoming such by a future and distinct acquisition. It makes them recur more frequently and more readily, enhancing the spontaneous impulse of the centres. At one time the voice sounds a high note. As to the first stimulus of this effort, we can say nothing farther than that with all the active organs there is associated a nervous battery for commencing their movements. After an interval, the same high note is hit upon by a like discharge from the proper centre. When several repetitions have occurred in this way a facility is gained; either a less tension of the centre will originate the note, or it will be better sustained when it comes. On a different occasion a stream of sound is stimulated at a low pitch, which after a number of opportunities comes to be a ready effort of the organ. Thus it is that a variety of detached movements are getting themselves prepared for subsequent use.

To persons that have not reflected on the very great difficulty and labour attending the growth of voluntary movements in infancy, this hypothesis of spontaneity so much dwelt upon will seem uncalled for and unlikely. But I shall have to show at a later stage how impossible it is to account for the origin of volitional acts without a supposition of this nature.

The movements inspired by Emotion are also cultivated and confirmed by repetition; and a certain increase of power is gained in this way. The voice is developed by crying, the trunk and limbs and features by gesticulation. There is no proof that the emotional stimulus of the movements contributes in any degree to give the voluntary command of them; there seems to be a great gulf permanently fixed between these two sources of active display. Emotion cultivates itself solely. The vigour of gesticulation may be increased, but not the vigour of setting on movements independently of the excitement of the feelings.

3. We pass next to the acquisition of trains and aggregates of movements in the ordinary course of education in mechanical art and handicraft. I assume the case of an individual already able to command the limbs, or other parts, as directed by another person, or by an example set for imitation; and postpone the consideration of the mode in which this voluntary power is itself acquired, as demanding a far more subtle line of investigation.

The simplest acquisition is the case where something is added to a movement already established. Take the case of walking, and suppose that we desire to communicate a peculiar set of the limb, for example the turning out of the toes. A voluntary act, directed to the muscle that rotates the thigh outward, gives the requisite position to the foot; and the act is sustained while the walking movement goes on. By this means there grows up in course of time an adhesion between the tension of the rotator muscles and the several movements of walking, and at last they coalesce in one complex whole, as if they had been united in the original mechanism of the system. This agglutination of acts is very common among our mechanical acquirements. Thus in learning to walk, a vast deal of adjustment is necessary before we can maintain our balance. We require, along with the movements of the limbs, to execute coinciding movements of the head, arms, and trunk, in order that the body may never depart from a balanced posture. These remoter movements become so fused with the main action as to be inseparable from it. The same stream of nervous action that keeps up the alternation of the limbs, directs a measured current towards specific muscles of the body and upper extremities, and the entire complication seems as if it were but a single member.

In the foregoing examples we have included two different cases, both coming under the head of agglutination, or coinciding actions: the one is where a fixed tension is maintained in the accessory action, as in walking with the foot turned outwards, the other supposes two trains of movements fused together. There is abundance of instances of both kinds, and the principle of operation is identical in the two. I shall now take an illustration of a succession of actions formed exclusively by the adhesive principle. The sequence of acts in eating is an example taken from our earliest acquirements. The lifting of the morsel by the spoon or fork, the carrying it to the mouth, the opening of the mouth at the right moment, the action of the jaws and tongue, all exhibit a succession of regulated acts fixed into mechanical coherence and certainty by the mere fact that they have been made to succeed each other a great number of times. The action of carrying the hand to the mouth is followed by the opening of the jaws, as surely as the two alternate acts concerned in breathing give birth to each other.

In a great number of mechanical successions, the feeling of the effect produced at each stage is an essential link in the transition to the next. Thus in writing, the sight of the part last formed is the preamble to what comes next, as much so as the motion executed; in which case the sequence is not one of pure motions—one motion bringing on the next in the habitual order. But the mixture of sensations and motions in complex trains will form a separate head; I am desirous, at this stage, to confine the illustration to examples of movements linked together, without any other element being present. As, however, the guidance of the feeling is necessary in the course of *learning* any mechanical effort, the fixing of movements in a train independently of such guidance is the last stage, or highest perfection, of mechanical acquirement. Thus, in playing on a pianoforte, and attending to something else at the same time, the sequence must be one almost entirely of movements: that is to say, each stroke is associated with another definite stroke or touch through the whole succession of the piece. But even in this case, it is difficult to say how much there is of a kind of latent sensation in the fingers and the ear, sufficient for the purposes of association, acting along with the association of pure movements.

A deaf person speaking must depend almost entirely on the associated sequence of movements; the only other assistance being the muscular feelings themselves, which always count for something. In saying over words committed by rote, the sequence of articulate motions is perfect. One word uttered brings on the next independent of either hearing or the feeling of articulation. This is a proof of the very great aptitude for associated movement belonging to the vocal organs; for hardly any other part of the body, not even the hands, can acquire such perfection of unconscious dexterity. In knitting, there is probably the same sequence of movements, acquired after thousands of repetitions. The simpler figures of dancing can be gone through with this mechanical and unconscious certainty after a great amount of practice; but the docility of the lower limbs is far inferior to the hands, while I should be disposed to reckon these second to the voice.

The difficulty of forming a perfect association of mere movements, and the dependence of most of the mechanical trains upon the sense of the effect produced are curiously illustrated in the cases of paralysed sensibility. Thus there is an often quoted case of a woman who could not hold a baby in her arms except by keeping her eyes fixed upon it. She had no sense of weight in the arms, and the sustained tension of the muscles was not sufficiently associated with the taking up of the child, by the muscular link alone. The sight of the eye was able to supply the want of arm sensibility, but both could not be dispensed with.

It is the linking together of unconscious movements that makes the human framework purely automatic and mechanical; constituting a series of actions exactly parallel to the instinctive arrangements so often alluded to. To get rid of consciousness as an essential part of any piece of execution is to eliminate the foremost characteristic of mind; this is not done so long as the sense of effect is necessary to keep up the action.

Although very few of the cases of mechanical acquirement in general can belong to the class we are now considering, there are important distinctions of character founded on the facility of acquiring trains of movement so as to keep them up with the least possible help from the guiding sensations and ideas. The trains of action thus acquired cost the smallest amount of mental fatigue in the performance; they may, moreover, go on with the mind employed upon other things. In the execution of work these are valuable characteristics; on the other hand, inasmuch as all such actions cease to occupy the mind, they leave it a prey to ennui if other occupation is not provided. Thus in devotional ceremonies that have reached this point of adhesion, there is apt to be a loss of interest.

4. The inward process whereby movements repeated in the same succession acquire coherence and bring on one another

in the proper order is one of the hidden qualities of mind. We may describe the effect, and specify some of the important physical conditions that control it, but we can go no further. It is a fundamental property of the mental and nervous system, and is unique in its kind, there being nowhere any other instance of it known to us, no other substance but nerve possessing the like property.

The actions thus associated are voluntary actions; they are stimulated from the cerebral centre, and it is within the cerebral hemispheres that the adhesion takes place. A stream of conscious nervous energy, no matter how stimulated, causes a muscular contraction, a second stream plays upon another muscle; and the fact that these currents flow together through the brain is sufficient to make a partial fusion of the two, which in time becomes a total fusion, so that one cannot be commenced without the other commencing also. The current that directs the lifted arm to the mouth is part of a complex stream that opens the jaw; the current that gives position in the fingers of a flute-player is associated with another that fixes the lips, and a third that compresses the chest with a measured force. In virtue of passing through the common centre of the nervous system together, the many different coinciding streams become after due continuance an aggregated unity, broken up only by some more powerful alliance.

In the same manner may we express what happens in successions of acts. If the brain stimulates a given movement, such as the utterance of an articulate syllable, and if after that a second syllable is pronounced, there is a continuity established between the two, a sort of highway made, and a bent given to pass from the one act to the other; in the course of time and repetition the connexion is fully knit, and the transition becomes mechanical or automatic. The acts must be mental or conscious acts, lying in the course of the common stream of mental activity: which stream is turned first upon the one, passes next to the other, thereby, as the effect shows, establishing a tendency towards the same direction ever afterwards.

It may be very fairly assumed that this is a process of growth like the natural development of the nerves and muscles themselves. This view is ably expressed by Dr. Carpenter. Whether the growth lies in forming new cells, or in modifying the internal conductibility of the nerve fibres and vesicles, we are unable to say; there is no reason why both effects should not take place. But the circumstances connected with the process of education strongly favour the above comparison. We find, for example, that new acquirements are easiest and most rapid during early life, the time of most vigorous growth of the body generally. We find also that rest and nutrition are as much needed for educating the organs as for keeping up the bodily health. There is, moreover, a bound fixed to the rate of acquirements, and no amount of practice can enable us to get over it. The plastic or hardening operation takes a certain interval of time, and although the current be never so much sustained, by keeping at a thing, the rate of acquisition is not increased in the same degree.

In successions of movement, the completed act of one movement is the link that sets on the next. But it is in vain, at the present point of our knowledge, to enquire minutely into the steps of this subtle sequence.

5. The conditions that regulate the pace of acquisition, or the cohesion of set trains of movement have a high practical, as well as a theoretical interest. Some of these conditions are common to all kinds of acquisitions, while others are limited in their application. Those that relate to movement are the following:—

(1.) The command already acquired over the organs. This throws us back upon previous acquisitions, and upon deep peculiarities of character, that need not at present be discussed. But it is well known that some persons, in commencing manipulation, have a much better command of their movements than others; that is, they get more readily at a posture or movement pointed out to their imitation. Previous to the plastic fusion must come the proper performance of the separate acts that have to be made coherent. It is necessary to sound each note well before singing an air. So with all the minute shades of movement entering into a delicate operation requiring flexibility of organ, and the power of graduating the stress exerted according to the nicest shades of difference.

(2.) There is a natural force of adhesiveness, specific to each constitution, and distinguishing one individual from another. This property, like almost every other assignable property of human nature, I consider to be very unequally distributed. We can get at an estimate of such primitive differences only after allowing for all the differences in the other circumstances that do not depend upon character. In the case now before us—the acquisition of movements—the difference is apparent in the very unequal facility shown by boys in the same school, or recruits drilled together, in mastering their movements. The power of acquiring trains of movements easily is the prime requisite in the education of the army, and in all mechanical arts, both as enabling the individual to attain a high pitch of dexterity and effectiveness, and as dispensing with the sense of effort and consciousness in general, in other words, with mental exertion and fatigue.

(3.) The main circumstance, next to original endowment, is Repetition or Continuance. In proportion to the repetition is the rate of cohesion, regard being had to the necessity of reposing the organs. It is possible to make up for all other defects by repetition. We term that constitution most adhesive by nature, that needs the fewest repetitions to become perfect.

(4.) The amount of nervous energy concentrated in the act is a vital circumstance in determining the rapidity of fixing it. This is a variable thing in the same individual.

In the first place it depends on the nervous vigour of the moment, as contrasted with feebleness, exhaustion, or lassitude. The voluntary energy that sustains an action rises and falls with the condition of the body; hence the freshness of the morning and early part of the day determines the best time for drill. So also good health is a condition of education in general.

But the concentration of nervous energy may be prevented by the diversion of the mind into some other channel, or the expenditure of the inward power on other efforts. Distraction or pre-occupation effectually checks our progress in any attempt; the motions may be made, but the coherence is feeble. Thus a child may go through the repetition of its lessons, but while the mind is diverted elsewhere, there is no progress in fixing them. Intense pleasure or pain, or emotion of any kind, excited by causes foreign to the work in hand, use up the mental expenditure, the currents of circulation and nutrition, that ought to go to the plastic process.

The nervous energy may be called forth by mere volition. A strong determination to learn a movement is very much in our favour. Some people cannot determine anything vigorously; in others the energy wrapt up in any act of volition is very high.

This voluntary effort may be stimulated by emotion or excitement. Terror is a very common stimulus applied to a learner. The objection to it is the cost, both in suffering and nervous waste. The best of all stimulants is a strong liking for the thing in hand.

It is one of the peculiarities of what is called the nervous temperament, or a nervous system naturally prone to vigorous exertion (just as some constitutions are strong in muscle, and others in digestion), to expend itself copiously in all its efforts, voluntary or emotional. This is necessarily favourable to acquisitions, as to every other mental manifestation.

(5.) In mechanical acquirements we must not omit bodily strength as a favouring circumstance. The power of continuing the exercise without fatigue, and the great determination of nutritive matter to the muscle at least, which is implied in a strong bodily frame, cannot but be favourable to the fixing of movements and the forming of habits. Hence strong men may be expected to acquire athletic and handicraft accomplishments more easily than others. But although

I am disposed to put some stress upon this point, I must account the quality of the muscle of far inferior importance, and indeed quite trifling in comparison with the quality of the nervous framework.

(6.) This leads me therefore to the last condition proper to be noticed in connexion with acquired movements, namely, the spontaneous activity of the system. The abundance of the natural or spontaneous activity makes the active or energetic temperament, and promotes the acquisition of new movements. The proof of this affirmation comes principally from an inductive examination of active temperaments, from which I believe it will receive ample confirmation, allowing always for the other conditions above enumerated, some of them quite as important as the present. It is usually the men of natural and abounding activity that make good sportsmen, adroit mechanics, and able contenders in games of bodily skill. Nor is the coincidence at all unlikely in itself; the same nervous power that disposes the frame to spontaneous movement is likely to aid the plastic operation that fixes movements in consecutive trains.

We have now before our view the principle of growth that confers upon human beings mechanical art and the power of labour and endurance. By it we can create new circles of power, make others fall into decay, and distribute the human forces anew, so as to adapt them more expressly for each man's necessities and position in life.

FEELINGS OF MOVEMENT.

6. The continuance and revival of a *feeling* of movement, without the movement itself, make a new and distinct case for the associating principle to work upon: a case, too, of very great interest as introducing us into the sphere of Thought.

This transition from the external to the internal, from the Reality to the Idea,—the greatest leap that can be taken within the compass of the present work,—needs to be introduced by a consideration of the question, what is the probable seat, or local embodiment, of a sensation or mechanical feeling, when persisting after the fact, or when revived without the reality? The discussion of this question will interrupt, for a few pages, our exemplification of the law of contiguous adhesiveness.

A movement is a complex thing; looked at from without, it is an exertion of physical or mechanical force; to the inward consciousness it yields a manifestation such as we have endeavoured to describe.* Both the one and the other may be associated in trains, by virtue of the same law of adhesiveness on repetition; but what is more, the Feelings of a series of movements may be associated and revive one another without the movements themselves being revived. A mechanic can repeat to his mind all the operations of a day's work just as well as he can go through the reality. This implies the possibility of separating the feelings from the acts. We can easily conceive these two to have been constituted inseparable. We can suppose such an arrangement of things, that the feeling of movement or resistance should continue during the movements of exertion, and become extinct when exertion ceases, like the disappearance of light when a lamp is blown out. So in the various sensations of taste, smell, touch, hearing, sight, the same limit might have existed; the sensibility might have lasted only during the actual contact or presence of the object, and the consciousness have become blank and silent the instant a sound ceased or the eye turned itself aside from a spectacle. This, however, is not what we actually find. A state of feeling or sensation, once stirred, remains for a longer or shorter time after the stimulus ceases; the nerve currents, once commenced, persist of themselves by their own natural energy, and only die away by degrees. Much depends on this quality of perseverance; it is one of the conditions on which thought and intelligence depend. The life of ideas, the enjoyment and suffering derived from the Past, would be extinct but for this; and intellectual comparisons and combinations would be impossible.

7. All feelings do not persist alike; the most persistent are the most intellectual. In all minds the persistence is not

* See Book I., chap. I.

equally good, whence some minds are better fitted for the operations of intelligence than others. The first impetus depends on the outward cause, the retention of the echo is a quality of the recipient mechanism. A cadence falls on the ear and produces a wave of feeling; whether that feeling shall last for some seconds or minutes in all its strength or distinctness, or whether it shall immediately fade into dimness and confusion, depends on the quality of the ear and of the nerve circles associated with it, and on the cerebral mechanism at large; the difference is recognised in common language; we speak of a good ear or a bad ear. The retentiveness of impressions is the foundation of everything else in the intellectual fabric. The power of the chords once struck to vibrate by their own energy is the beginning of the second stage of mind, of that wherein the past and the present are brought together. We cannot look at two outward things in the same instant of time; and if the impression of the first were to die when we pass to the second, there could be no comparison and no feeling of preference. Volition would be impossible; for that supposes a preference of one state of mind to another, a past to a present, or a present to a past.

8. In discussing the Sensations and Muscular feelings in the first Book, we were obliged to assume this quality, although it belongs properly to Intellect. The degree of persistence in the absence of the original, made one of the distinguishing features in describing sensations, some, as the organic feelings, having a low order of persistence; touch, hearing, and sight being much more endowed in this respect. It is always to be remembered, that although scientific method requires us to take the different aspects of mind apart, yet in the mind itself they are always working together; Emotion, Intellect, and Volition, concur in almost every manifestation. In treating of one we are obliged to assume the others, if we do not specifically bring them forward. Thus it was impossible to do justice to the Sensations without touching on their persistence or Intellectual quality, and on their power to excite action, which is their Volitional quality. It was necessary to imply the sense of discrimination based on this retentiveness,

in order to show the use of the different senses in making us acquainted with the outer world, a point to be more fully brought out in the present Book.

9. All the muscular feelings already described, both the organic feelings of Muscle, and the states produced by exercise in its various forms, can be sustained for some time after the physical cause has ceased. All the Sensations of the senses can be sustained in like manner, some more and some less easily; and they can afterwards be revived as ideas by means of the associating forces. What then is the mode of existence of these feelings bereft of their outward support and first cause? in what particular form do they possess or occupy the mental and cerebral system? This question carries us as far as we are able to go into the cerebral process of intelligence. It admits of two different answers or assumptions, the one old and widely prevalent, the other new but better founded. The old notion supposes that the brain is a sort of receptacle of the impressions of sense, where they lie stored up in a chamber quite apart from the recipient apparatus, to be manifested again to the mind when occasion calls. But the modern theory of the brain already developed in the Introduction suggests a totally different view. We have seen that the brain is only one part of the course of nervous action; that the completed circles take in the nerves and the extremities of the body; that nervous action consists of a current passing through these complete circles, or to and fro between the ganglia and the organs of sense and motion; and that short of a completed course no nervous action exists. The idea of a cerebral closet is quite incompatible with the real manner of the working of nerve. Seeing then that a sensation in the first instance diffuses nerve currents through the interior of the brain outwards to the organs of expression and movement, the persistence of that sensation after the outward exciting cause is withdrawn, can only be a continuance of the same diffusive currents, perhaps less intense, but not otherwise different. The shock remaining in the ear and the brain after the firing of artillery must pass through the same circles, and act in the same way, as during the actual sound. We have

no reason for believing that in the self-sustaining condition the impression changes its seat, or passes into some new circles that have the special property of retaining it. Every part actuated *after* the shock must have been actuated *by* the shock, only more powerfully. With this single difference of intensity, the mode of existence of a sensation enduring after the fact is essentially the same as its mode of existence during the fact; the same organs are occupied, the same current action goes on. We see in the continuance of the attitude and expression the identical outward appearances; and these appearances are produced by the course of power being still by the same routes. Moreover, the identity in the inward mode of consciousness implies that the manner of action within the brain is unaltered.

10. Now if this be the case with impressions persisting when the cause has ceased, what view are we to adopt concerning impressions reproduced by mental causes alone, or without the aid of the original, as in ordinary recollection? What is the manner of occupation of the brain with a resuscitated feeling of resistance, a smell, or a sound? There is only one answer so far as I can see. *The renewed feeling occupies the very same parts and in the same manner as the original feeling, and no other parts, nor in any other manner that can be assigned.* I imagine that if our present knowledge of the brain had been present to the earliest speculators, no other hypothesis than this would ever have occurred to any one. For where should a past feeling be re-embodied if not in the same organs as the feeling when present. It is only in this way that its identity can be preserved; a feeling differently embodied must to all intents and purposes be a different feeling, unless we suppose a duplicate brain on which everything past is to be transferred. But such duplication has no proof and serves no end.

It is possible, however, to adduce facts that set in a still clearer light this re-occupation of the sentient circles with recovered impressions and feelings. Take first the recovery of feelings of energetic action, as when reviving the exploits and exertions of yesterday. It is a notorious circumstance that if there be much excitement attending their recollection, it is with difficulty that we can prevent ourselves from getting up to repeat them. The rush of feeling has gone on the old tracks, and seizes the same muscles, and would go the length of actually stimulating them to a repetition. A child cannot describe anything that it was engaged in without acting it out to the full length that the circumstances will permit. A dog dreaming sets his feet a-going, and sometimes barks. The suppression of the full stage of perfect resuscitation needs actually an effort of volition, and we are often even incapable of the effort. If the recollection were carried on in a separate chamber of the brain, it would not press in this way upon the bodily organs engaged in the actual transaction. The truth can only be that the train of feeling is re-instated on the same parts as first vibrated to the original stimulus, and that recollection is merely a repetition which does not usually go quite the same length; which stops short of actual execution. No better example could be furnished than the vocal recollections. When we recal the impression of a word or a sentence, if we do not speak it out, we feel the twitter of the organs just about to come to that point. The articulating parts,—the larynx, the tongue, the lips,—are all sensibly excited; a suppressed articulation is in fact the material of our recollection, the intellectual manifestation, the *idea* of speech. Some persons of weak or incontinent nerves can hardly think without muttering—they talk to themselves. The excitement of the parts may be very slight; it may hardly go the length of affecting the muscles in a sensible way, but in the brain and communicating nerves, it still passes the same rounds in a greatly enfeebled degree. The purposes of intellect can be served even after this extreme enfeeblement of the currents, but their nature and their seat have not changed. They have not abandoned the walks of living articulation because they no longer speak out fully; they have not taken refuge in new chambers of the mind. We feel at any moment how easy it is to convert the ideas into utterances; it is only like making a whisper audible,—the mere addition of mechanical power. The tendency of the idea of an action to produce the fact, shows that the idea is already the fact in a weaker form. If the disposition to yawning exists, the idea anywise brought up will excite the action. The suppressive effort usually accompanying ideas of action, which renders them ideas and not movements, is too feeble in this case, and the idea is therefore a repetition to the full of the reality.

11. Although at present engaged in preparing the way for the association of muscular feelings, yet the doctrine in hand being general for all states of mind, I must add some parallel instances of Sensation. Müller has furnished several in point. He says, 'the mere idea of a nauseous taste can excite the sensation even to the production of vomiting. The quality of the sensation is the property of the sensitive nerve, which is here excited without any external agent. The mere sight of a person about to pass a sharp instrument over glass or porcelain is sufficient, as Darwin remarks, to excite the well-known sensation in the teeth. The mere thinking of objects capable when present of exciting shuddering, is sufficient to produce that sensation of the surface in irritable habits. The special properties of the higher senses, sight and hearing, are rarely thus excited in the waking state, but very frequently in sleep and dreams; for, that the images of dreams are really seen,* and not merely present in the imagination, any one may satisfy himself in his own person by accustoming himself regularly to open his eyes when waking after a dream. The images seen in the dream are then sometimes still visible, and can be observed to disappear gradually. This was remarked by Spinoza, and I have convinced myself of it in my own person.'—p. 945.

These and other cases that might be adduced clearly confirm what has been said as to the return of the nervous currents exactly on their old tracks in revived sensation. We see that when the revival is energetic it goes the length of exciting even the surface of sense itself by a sort of back movement. We might think of a blow in the hand until the skin was actually irritated and inflamed. The attention very

* Under opium, images are actually seen.

much directed to any part of the body, as the great toe, for instance, is apt to produce a distinct feeling in the part, which we account for only by supposing a revived nerve current to flow there, making a sort of false sensation, an influence from within mimicking the influences from without in sensation proper.*

12. The emotions and passions distinct from, but often accompanying sensations, are likewise similarly manifested in the reality and in the idea. Anger takes exactly the same course in the system whether it be at a person present or at some one remembered or imagined. Nobody ever supposes in this case that the ideal passion is in any way different from the actual, or has any other course or seat in the brain. So with affection, egotism, fear, or any other sentiment or passion. In like manner, the remembrance of being angry, or puffed up, or terrified, will be a resuscitation of the identical state, and will actuate the same part, although the centrifugal wave may not be strong enough to agitate the surface as strongly as the original did. The recollection of the intenser feelings is necessarily weaker than the reality; the recollection of some of the less agitating sensations and feelings may be quite equal to the reality. We can more frequently afford the expenditure necessary for [illegible] mild and gentle emotions.

13. As regards the resuscitation of emotional states, and the more or less perfect resemblance between the revived form and the original, there is an exceedingly important observation to be made. We have seen again and again that an emotion taken in its whole range is a highly complex thing. It may begin in some local stimulus, as in a sensation of one of the senses, but it creates along with the feeling or the conscious state, a wave of diffused action of muscles, secreting organs, &c., including gesture, expression of features, and utterance,—all which become incorporated as part and parcel of the phenomenon. We may divide this total into three distinct

* This subject has been well illustrated by the experiments of Mr. Braid, of Manchester.—See his various writings on Hypnotism, &c.

stages; the local stimulus, the feeling or mental manifestation, and the diffused action throughout the body. This last effect, although inseparable from Emotion, constitutes of itself a new stimulus of feeling to mix up with the other. When the respiration is quickened, the face flushed, the features animated, under a strong passion, these effects are the beginnings of a new wave of excitement mingling with and modifying the original wave. Some portions of the apparatus of expression are the seats of very keen sensibility, as, for example, the lachrymal secretion; when this is strongly excited by a mental cause a new feeling is generated, which may completely submerge the other and give the tone to the mind for the time being.

What I have, therefore, to remark on the re-instatement of an emotion is this, that of its various parts and manifestations now enumerated, the peculiar mental tone proper to the emotion may be difficult to revive while the collateral wave of expression is generally easy to re-assume and remember. In going over the Sensations, I have had to note some as little apt to remain in idea; this is the case with digestion and the organic feelings in general. The exact tone of feeling, the precise inward sensation due to a state of hunger, is almost irrecoverable and unimaginable in a state of comfortable repletion. But the uneasy movements, the fretful tones, the language of complaint, are all easy to recal; they belong to a more intellectual part of the system; and by these we can recover some portion of the total fact, which is also just about as much as we can communicate to a second person. The digestive state for the time being rules the tone of sensation so effectually that we cannot by any effort restore the currents due to an entirely opposite state; we can only recover the more revivable accompaniments. By this recollection of the accompanying expression we may be effectually spurred to action for avoiding the evil and attaining the good, but this does not imply that we completely regain the past condition. One may for ever avoid the repetition of something that brought on a rheumatic attack, without having the full pain brought back to the mind from time to time; it is enough that we recal the gesticulation, accents, language, and trains of thought that the state inspired at the time; these will carry along with them a strength of repulsive feeling sufficiently great to control the actions for the future. Those organic states are in strong contrast to the sensations of sight and hearing, which may be revived nearly to the letter. We can recover a picture or vision of fancy almost as exactly as we saw it, though not so strongly. This gives to these senses their *intellectual* character. We do not require the help of the collateral movements to restore the sensation of a landscape; we can repossess ourselves of the exact scene as it lay to the eye; in fact, the sensation itself is the most retainable part of the whole. In organic states the remembered expression with difficulty brings up some faint shadow of the sensation; in the higher senses the sensation persists better than the collaterals.

This explanation is both pertinent for future purposes, and necessary in order to understand precisely in what acceptation we have spoken of some feelings as more intellectual than others. A state of suffering wholly irrecoverable in its exact mental character, may leave a life-long impression through the attendant circumstances, the actions, sights, sounds, thoughts, and aversions, all which, being pre-eminently recoverable in idea, can be lived over again at any distance of time. Thus it is that the less enduring states of mind may be buoyed up by the more lasting impressions that keep them company.

14. It seems not improper to introduce here a caution against a diseased persistency of impressions that sometimes occurs, and is the very opposite of the retentiveness now under consideration. In states of terror, feverish anxiety, and nervous weakness, particular subjects take hold of the system and cannot be shaken off. Doubtless such things make themselves remembered, but at a great expense; for the diseased flow of the currents of the brain wastes a vast amount of its natural and healthy adhesiveness. It is a notorious fact that when through fear, fascination, or other excitement, an object possesses the mind, all other things are unheeded and forgotten. The climax of the state is reached in insanity. In ordinary

life we are liable at times to become engrossed with an idea presented in circumstances of great excitement, which we are unable to dismiss, however much we may desire it. The healthy endurance of an impression is always compatible with dropping it from the immediate view when other things solicit our notice. We acquire ideas to rise up when they are wanted, not to haunt us unbidden. It is one of the peculiarities of the nervous system, and of all the other tissues, to suffer themselves to run into a wasting excitement, which leaves the organs weaker, and requires to be made up for by more than ordinary repose. The flow of nervous action during the excitement of the ear by music or the voice in speech, when pushed to a certain point, runs into the state of diseased overflow, and the mind is not calmed down until some considerable interval has elapsed. A constitution liable to run into this condition is 'nervous,' in the sense implying weakness, and not vigour of nerves. A vigorous system is one that can endure a great amount of excitement, still retaining the power of becoming calm and clearing the mind at pleasure. This kind of power shows itself in easy self-command.

Herein lies the objection to the use of severe punishments and terror in education; for although in this way a preternatural attention is forced to some one thing, the mind is rendered much less retentive of things on the whole, not to speak of the positive suffering inflicted for the sake of the object.

15. The general doctrine now contended for as to the seat of revived impressions is not a barren speculation; if true, it bears important practical inferences. In expressing and describing thought and the thinking processes, an operation of great subtlety essential to our subject, the doctrine is of great service; it helps us in some measure to localize these processes, and the language that might otherwise be deemed figurative becomes literal. The imagination of visible objects is a process of seeing; the musician's imagination is hearing; the phantasiès of the cook and the gourmand tickle the palate; the fear of a whipping actually makes the skin to tingle.

The identity between actual and revived feelings shortens our labour by enabling us to transfer much of our knowledge of the one to the other. The properties that we find to hold of sensation in the actual, we may after a certain allowance ascribe to the ideal. Thus the qualities of the sense of sight in any one person, as, for example, its discriminating power, would belong likewise to his visual ideas. The senses are in this way a key to the mind. Sensation is intellect already in act; it is the mere outward manifestation of the ideal processes. When the ear or the eye discriminates, it has already brought intelligence to the test.

This doctrine has, therefore, important bearings upon the long-disputed question as to the origin of our ideas in sense. So far as it goes it appears unfavourable to the doctrine of innate ideas. I do not mean, however, at the present stage, to enter into this great controversy, although we have been endeavouring, both here and in the previous Book, to pave the way for discussing it afterwards.

16. I return now to the association of Feelings of Movement. It generally happens that if we can perform a movement actually, we can also perform it mentally. Thus we can go through in the mind the different steps of a dance; in other words, the feelings of the successive evolutions have been associated as well as the movements themselves. It must not be supposed, however, that the adhesion of actual movements and that of mental movements run exactly parallel, and that if the one is perfect so is the other. We may sometimes see a mechanic able to go through the actual steps of a process, but unable to go through them in his mind; the proof being that in describing them to another party he often forgets a step, and only remembers it by doing the thing. In this case the actions are more adhesive than the traces of them. I cannot at present produce any instance to show, on the other hand, that a series of actions can be repeated mentally and yet not bodily; for as the mental actions are performed in the same circles, it usually needs only a volition, often the removal of a restraint merely, to bring them to the full length of actuating the muscles. But as there is a class of persons whose activity

is chiefly mental, while others come to the actual in most of their trains, I can easily suppose instances to arise in the first-named class where the mental succession is perfect, while the bodily succession would fail if it came to a trial.

17. The principal field of examples of the association of pure feelings of muscular action is the voice. Most other cases are so complexed with Sensation that they do not answer our present purpose. But in speech we have a series of actions fixed in trains by association, and which we can perform either actually or mentally at pleasure, the mental action being nothing else than a sort of whisper, or approach to a whisper, instead of the full-spoken utterance. The child can repeat its catechism in a suppressed voice, as well as aloud. We can even acquire language mentally or without speaking it out at all; that is to say, we can bring about a mental adhesion by itself, or with the bodily action wanting. In language this happens continually; for in reading a book to oneself we do not speak the words vocally, whence the articulate adherence takes place within the mental circles purely. So children, learning their lessons in school, as they do not get them aloud, must acquire the verbal successions in the same way. In going over the spelling book, they have to articulate the letters of each word a number of times, and then the whole word; after a sufficient repetition the train of articulations coheres, and the one brings on the next without fail, whether spoken inwardly or aloud.

As a general rule, it is best to rehearse verbal exercises aloud, if they are to be performed aloud: just as in the case of other mechanical operations. Experience, I think, shows that the trains are sooner fixed in this way than in the other. By coming to the actual execution we set on a current that is both more energetic and larger in its sweep, inasmuch as it takes in the full operation of the muscles. In the early school acquirements, where everything has to be spoken out to the master, the audible repetition is the best; in after days, when we go over a great deal of language merely as thought or the silent links of action, the outspeaking is not called for; it would be an unnecessary waste of time and muscular exertion.*

18. The circumstances that favour the cohesion of mental trains of movement are nearly the same as those already detailed for actual movements. A certain repetition is requisite; more or less according as the other circumstances are favourable, namely, the natural adhesiveness of the system, the concentration of nervous energy, and the spontaneous activity. In mere mental acquirement, the condition of bodily strength is of course not an essential; but the natural and healthy activity of the organs which arises from central vigour cannot be dispensed with.

There is such a thing as a common character of the active organs in the same individual; an activity of temperament that shows itself in every kind of exertion, in limbs, voice, eyes, and every part moved by muscle, or a sluggish feebleness extending alike over every kind of exercise. But this does not exclude specific differences of endowment in separate members, making the movements of one more adhesive and acquisitive than those of others. Thus we may have a special development of the cohesiveness of the articulating members, the voice, tongue, and mouth, through some special quality in the centres that actuate these organs. But, to the best of my judgment, if we confine ourselves closely to the active members, there is more usually a common character of adhesiveness than any marked inequality; and I am disposed to trace the actual differences to other circumstances, and chiefly to differences in the particular senses concerned in the case. I know no reason why a good hand and a dexterous foot should not generally go together; and he that can readily acquire a flow of words may also acquire a flow of fencing motions or dancing postures. What is special to the important case of speech will come out as we proceed.

* In the processes of meditation and thought we are constantly forming new combinations, and these we can permanently retain if we have dwelt upon them sufficiently long. A speaker meditating an address trusts to the adhesiveness of his verbal trains although they have been all the while in the state of mere ideas, he not having spoken them aloud.

SENSATIONS OF THE SAME SENSE.

19. The next class of associable elements to be considered is the Sensations; and I shall confine myself in the first instance to the adhesion of impressions of the same sense,—touches with touches, sounds with sounds, &c. There are various interesting operations that fall under this head; it embraces the early education of the several senses.

In the inferior senses, there is not much scope for exemplifying the process; the Organic Feelings do not form any striking associations among one another. We might note such cases as the expectation of a series of painful feelings from the occurrence of some one, as in an attack of illness; but there is no need for dwelling on instances of this description.

Even in Tastes, it is not common to have any important associations of one with another. One might easily suppose the formation of a train of tastes, such that any one would suggest the others, but I hardly know any set of circumstances where it occurs in a prominent way.

So with Smell; if it so happen that we frequently experience a succession of smells of one fixed order, an adhesion will be formed between the different impressions, and in consequence, when one is presented all the rest will be ready to arise in order without the actual experience. In passing frequently through a garden along the same track we might come to acquire a succession of odours, and from any one anticipate the next before we actually reach it.

But as regards both Taste and Smell, we rarely exist in a train of recollections of either one or other. They are very difficult to realize perfectly, and what we recover chiefly about them is the expression and the sentiment of liking or aversion that they produced. By a great effort of mind we may approach very near the recovery of a smell that we have been extremely familiar with, as for example the odour of coffee; and if we were more dependent on ideas of smell we might perhaps succeed much better; nevertheless, it must be admitted that the recoverability of these states by mere mental association is of a very low order.

20. But this leads me to remark on the effect of repetition in making any single impression adherent—in giving us a firm hold of it, so as to make it endurable and recoverable. The single taste of sugar by repetition impresses the mind more and more, and by this circumstance becomes gradually easier to retain in idea. The smell of a rose, in like manner, after a thousand repetitions comes much nearer to an independent ideal persistence than after twenty repetitions. So it is with all the senses, high and low. Apart altogether from the association of two or more distinct sensations in a group or in a train, there is a fixing process going on with every individual sensation, rendering it more easy to retain when the original has passed away, and more vivid when by means of association it is afterwards reproduced. This is one great part of the education of the senses. The simplest impression that can be made, of Taste, Smell, Touch, Hearing, Sight, needs repetition in order to endure of its own accord ; even in the most persistent sense, the sense of seeing, the impressions on the infant mind that do not stir a strong feeling will vanish as soon as the eye is turned some other way.

21. We pass on to the more intellectual senses, Touch, Hearing, and Sight.

In Touch we have various classes of Sensations ; the more purely emotional, as soft contacts and pungent contacts, and those entering into intellectual perceptions, as the feelings of roughness, weight, elasticity, size, &c. In all these there is room for the associating principle to operate, but our present illustration will keep in view chiefly the second of the two classes, or that concerned in the development of the Intellect. The full consideration of such sensations as have the emotional element predominating must be entered on apart.

The sensation of any one surface, with all its asperities, is a complex thing ; it is an aggregate of impressions made on the skin, and having a certain arrangement and intensity. The face of a brush yields a number of impressions all occurring together, which require to cohere in order that the sensation in its entireness may survive the actual contact. They must preserve their coexistence and return *en masse* at an after time. In comparing one surface with another, as in choosing a tooth brush, it is necessary only that a complex impression of one should survive a few seconds while the other is felt; in comparing one with some other long since worn out, the permanence behoves to be much greater. So with surfaces of cloth or wood, or stone or metal, judged of by their asperity; an associating process must fuse the multiplex impression before it can endure when the original is gone. Some surfaces are distinguished by an aggregate of asperity and temperature, as the cold touch of a stone or a lump of metal, in which case the feeling of cold must cohere along with the other parts of the tactual impression.

When muscular feelings and exertions are superadded to the impressions made on the skin, we obtain the more complex notions of touch,—those that combine feelings of size, shape, and situation with texture or surface. Here an adhesion needs to take place between the tactile and mobile impressions. In order that a workman may recognise his tool by the hand alone, he must have had a frequent experience of the complex feeling that characterizes its contact—the tactile impression of rough or smooth, cold or warm—with the muscular impression of weight, size, and shape, these two last qualities being determined by the muscular situation of the hand while grasping it. A sufficiency of repetition will so fuse all these together, that the tool can be identified the moment it is touched.

In plastic operations, or in dealing with soft viscid matters requiring a particular consistency, as dough, clay, mortar, &c., it is necessary to acquire firm impressions of different qualities and degrees of consistency in order to know when the proper point has been exactly reached. This demands the cohesion of a complex sensation of touch; that is, a certain skin feeling of clamminess and roughness, with the muscular feeling of resistance, will have to cohere into one fixed whole that shall never waver, or vary, or be obscured by the concurrence of other differing impressions. The repetition requisite for such practical discrimination as plastic operators require is usually very great, amounting to hundreds or thousands of contacts. Individuals seem to differ exceedingly in their facility of fixing standard contacts by adhesive association. This is a case where it is impossible to mistake differences of natural character. Some cannot in a whole life acquire the nicety that others possess after a few months' experience. The delicacy of the skin and of the muscular sensibility must combine in most cases of this kind; but it can be easily seen which of the two preponderates. A delicate muscular sensibility will show itself in other combinations besides touch, and in other senses; it will appear in the eye, the ear, and the voice. Moreover some of the feelings included under touch have scarcely anything to do with the skin, as for example, weight, size, and shape, and a great delicacy of discrimination in these has a purely muscular origin; while in judging of the texture of a cloth or the smoothness of a piece of mahogany, the skin sensibility is the proper test.

By touch, therefore, under the operation of the cohesive principle, we acquire fixed notions corresponding to the impressions made upon us by the objects that we handle. In this way we have a fixed coherent impression of all the articles that we are in the custom of handling and moving about in our daily life. Thus a workman is familiarised with his tools; and every person comes to know the instruments and furniture of their dwellings. But in order to represent to ourselves the acquisitions of touch in their highest form, we must refer to the experience of the blind, who have no other contact with solid and extended bodies excepting this. The impressions of sight are so much more enduring and revivable than any others, that we hardly ever think of a visible body otherwise than as seen by the eye; a workman desiderating a hammer thinks of its appearance to his eye, and not of its contact to his hand, although he is quite able to judge of it by this last feature. But a blind person must think of objects as *felt* things; the revived sensation in them is a projection on the hands not on the eyes, and they alone are in a position to judge what is the natural permanence of skin impressions and how far they can be recovered and lived in when the reality is absent. Their thoughts, reveries, and dreams, are touches, not sights. Not only is their power of mere discrimination of a very exalted kind, but they attain the higher state of realizing past touches as if fully present; if indeed this realization of touch is under any circumstances fully attainable.

We must refer to the blind also for the association of trains, sequences, or succession of touches, made so coherent that any one can recal the entire chain. A blind man feeling his way along a wall by the hand experiences in succession the different contacts; and these by repetition are so fixed in his mind that when he is placed at any one point he anticipates all that is to follow. Being under the necessity of threading his way through life by touch, he acquires coherent successions of feelings of contact, as other men acquire of sights. He knows his whereabouts in his room by touch; the progress of his work, if he is engaged in handicraft operation, is measured in the same way.

22. In acquiring associations of Sounds we have to encounter the supplanting tendency of the voice in the most interesting instances, namely, articulate and musical sounds. For while intently listening to a speech, we are very liable to follow the speaker with a suppressed articulation of our own, whereby we take the train of words into a vocal embrace, as well as receive it passively on the sense of hearing. The vocal association may thus be the more effective of the two in constituting our subsequent recollection of what was said. Notwithstanding this, there is much more room for exemplifying the associating principle in Hearing than in Touch.

By repetition, as already observed in the other senses, the ear becomes formed to individual sounds, so that they remain with ease after the cessation of the cause. It always takes time to give the proper set and fixity to the nervous currents accompanying each separate impression, and this process is as much a result of the associating force as the formation of chains of impressions. The ear of the child becomes formed to the lullaby of the nurse after repetition, or to the particular quality of her voice. The multiple impression made by the simplest sound needs an operation of coherence in order to fix it, or adapt it for self-subsisting endurance. At first, the effect of any sound is dissolved as soon as the sound ceases; it survives neither for comparison, nor identification, nor any other purpose. After a time it gets worked into the nerves, and these find themselves able to sustain it for a time when once set a-going; the more repetition it gets the more prolonged is the self-sustaining current; and in the end it may become perfectly easy to keep up for any length of time. At this stage it has become a fit subject for being revived by pure mental association, or apart from the physical or outward cause. Identification and feeling of difference mark the lowest stage of coherence, as when the child identifies the voice of the mother, and feels other voices to be distinct from that one. In Taste and Smell, and even Touch, the cohering principle is not often carried farther than to make comparisons and note agreements and differences; the complete revival of the sensations, so as to live them over again, belongs only to the two highest senses, and chiefly to sight.

The simplest sound is so far a complex impression that it needs a plastic operation to fix its parts together. Thus an articulate syllable, *ma*, *ba*, is a really complex effect; it gives rise to a plurality of nervous currents, and to make all these flow together in company and order demands a certain length of repetition. This is the lowest case of association of sounds. The next case is the coherence of trains or successions of sound, of which there are abundant examples. A good example for illustration is a simple air of music. Here a number of sounds follow one another in a fixed order, and by frequently hearing them we learn to pass from the one to the other by ideal anticipation. The mental currents for one note fuse themselves into the next, and the one brings the other on by virtue of this acquired coherence. A musical ear can revive sounds in this manner so perfectly as to enjoy the original over again with only a slight abatement of the keenness. But hardly any quality of the human constitution is so much subject to differences of degree as the associating force of the circles of hearing. Whether sounds shall cohere readily or with difficulty seems to depend far more upon the local peculiarity of the region of the ear than upon the quality of the brain in general. Moreover the rule is totally different for musical and articulate sounds; the one requires the nerves to be very susceptible to the quality of pitch, the other to articulate differences, these having nothing to do with pitch. There is a third quality of sounds, namely, cadence or accent in spoken language, distinct from either of those, and appealing to a distinctive susceptibility. This last quality I imagine to be related to the muscular sensibility of the ear. These three properties are the bases of three different susceptibilities,—music, languages, oratorical effect. Although previous to practice the ear can distinguish nothing, yet some ears are so constituted as to fall very soon into one line of discrimination, as the musical or the oratorical, while they come very slowly into another. All other things being the same, the length of repetition requisite measures the obtuseness, slowness, or defective plasticity of the ear and its connected circles. We call an ear quick that needs few repetitions.

In acquiring words and sentences, it is difficult to separate the action of the voice (which is true also in some degree of music), and therefore I do not discuss at this stage the whole class of lingual acquirements. But the adhesiveness of the ear for sounds possessing the articulate properties is one of the elements of the case.

23. Cohering trains and aggregates of the Sensations of Sight make, more than any other thing, perhaps more than all other things put together, the material of thought, memory, and imagination. The vocal trains of articulate speech are next in importance as furnishing the matter of the intellectual operations. That process of employing one sense as a substitute for others, avails itself principally of vision, the most retentive of them all. Thus it is that objects thought of on account of their taste or smell, are actually conceived under their visual aspect. The image of a rose dwells in the mind as a visual picture, and in a very inferior degree as a perpetuated impression of a sweet odour.

Sensations of sight, as we have seen, are compounded of visual spectra and muscular feelings. A visible picture is, in fact, a train of rapid movements of the eyes, hither and thither, over luminous points, lines, and surfaces.

The education of the eye goes through all the stages described for the other senses. There is first a fixed set or familiarity with certain Colours, the result of repetition, enabling their impression to endure in the absence of the original, and to exist at any time of their own accord when once suggested. On this is based the power of discrimination of colours and shades of colour, with sense of difference and agreement, which we have noted, again and again, as the first and lowest consequence of the mental persistence of sensations. But in the eye, sooner than in any other sense, are these various effects accomplished. The optical impressions, from the outset, more readily sustain themselves in the circles of the eye and the brain than the impressions of touch, smell, or taste. The impact of light is apparently a fine and gentle influence upon the nerve, which may be kept up with the lowest expenditure; and the currents originated by it are more liable to be prolonged than in the other senses. Hearing is a more delicate contact than touch, while touch itself is less rude than the concussion of nerve caused by a sapid body on the tongue; but light gives the most delicate impulse of all, and yet that impulse can sustain itself, and produce very keen emotion. These qualities impart to the sense of sight its distinguished place among the organs that connect us with the outer world.

The influence that gives the optical currents a facility in being induced and continued, so as to make one colour, as green, an object of comparison with other colours, is doubtless the same plastic power that forms aggregates of coloured expanse, connecting together a succession of tints, as a rainbow, or an optic spectrum. By passing repeatedly through the successive colours, the impression of one comes to induce the next, and that the following, and so on in order. But we can scarcely advance a step in this illustration without bringing in the movements of the eye, and the feelings belonging thereto. I can suppose a case where the eyes, in a state of rest, have before them a number of colours produced in a fixed succession, flash after flash—red, orange, green, blue, violet, white, black, &c.—in which case a train of pure optical impressions would become fixed in the mind, and the occurrence of the first would tend to revive an image of the second, third, &c., on to the last. The gradations of daylight and darkness are associated in this way. But in the ordinary case of associated colours, they exist side by side, as the colours of the landscape, and here we move the eyes to see them, and thereby incorporate the act and feeling of Movement with the sensations of light. If the eye is in this way habituated to a train of colours, the habituation consists in this, that with each colour are associated both a movement of the eye and a second colour, and with this last movement and colour are connected a third movement and a new colour, and so on to the limit of the picture. If we suppose, for example, a chain of fields of different length and varying tints; the eye first sweeps over a yellow corn field, then passes to a grass field of double the length, then to a plantation of wood still longer; the image of the first is an impression of yellow accompanied with a definite sweep of the eye, and a corresponding continuance of the yellow impression; the image of the second is a green effect, doubly prolonged, or accompanied with a double sweep of the eye, or the head, or both; the third image is a different tint of green, imbedded in a still wider muscular sweep. In these circumstances, and after due repetition, if the eye is possessed of the proper yellow hue along with the definite movement of the eye accompanying it, the image of the first field will be reinstated, and the mental movement set, as it were, in an old and accustomed groove, and there will be a transition from the optical impression of yellow and a given expanse, to the optical impression of a shade of green with a double movement, and, lastly, to another shade of green with a still greater movement. These impressions will be reinduced one after another upon the cerebral regions where sensations of sight go their rounds, by the force of the adhesive or transition force of contiguity.

Let us pass from this general illustration to some more specific and typical cases. In order to exemplify the class of Outline Forms, we will suppose a ring or a circle. Here we have a line of light and a round sweep of the eye concurring in one impression. The eye following the ring is receiving a continuous impression of light while performing a round movement; an optical and a muscular impression are conjoined in the effect, the muscular predominating; for the colour of the circumference is supposed merely sufficient to give the lead to the ocular movement. The fixing of the impression depends almost exclusively on the durability of muscular impressions in the muscles of the eye, and in the various circumstances that favour the cohesion in this instance. This case of the ring typifies a large class of forms employed in various purposes; including all the figures or diagrams of Geometry, the letters of written language, the cyphers or symbols of Algebra, Chemistry, and other sciences, the diagrams and plans of Builders, Engineers, and others. In all these cases the endurance of the object is a muscular effect, measured and determined by the muscular persistence or tenacity belonging to the moving apparatus of the eye.

To specify the precise organs whence the different kinds of talent and acquirement take their rise, is one of the most interesting and curious of the aims of mental science. We will dwell a little longer on this case of the engraining of simple forms and outlines. The cohesive effect of course depends in a great measure on the amount of repetition, but it is always important for us to note what those other circumstances are that render a less amount of repetition necessary, or, in other words, quicken the pace of the acquirement. Now of the innate qualities that hasten the plastic operation, I am disposed to single out two as the chief, or to divide the action into two stages. The one condition is the natural adhesiveness of the muscular impressions in the body in general and of the eye in particular; the other is the tendency to concentrate cerebral power upon a particular subject. I hold that there are good grounds for this distinction, and indeed that it is quite necessary in order to account for the differences that we find among individuals as respects the acquisition of forms.

That there is a real difference of natural adhesiveness in different constitutions I assume as a decided fact; nothing less being able to account for the enormous differences observable in the acquirements of persons similarly situated. In the present instance, the adhesiveness is principally muscular, and located in the eye. I do not say that it is a quality of the muscles purely; it belongs rather to the entire circles of nerve concerned in the movements of vision. Some persons can with more ease than others retain the impression of a muscular sweep of any kind, a circle, a square, an alphabet, an expanse, a building; fewer repetitions are necessary in order to make it self-existent to a certain pitch of vividness. Without any special concentration of mind, there is an unequal facility in maintaining the ideas of figure and outline.

With respect to the second point, namely, the differences of cerebral or mental concentration, we may illustrate it thus. There are three distinct classes of outline forms that would be all equally retainable so far as concerns the visual circles, but are nevertheless very differently retained in different constitutions. The muscular sensibility ought to be equally impressed with all kinds of form, seeing that it is the same effect in all; but in reality we find that taking minds in general this is not so; the same mind is not equally retentive of the forms of Euclid and the forms of an artistic design; a difference that must be explained by some circumstance deeper than the circles of vision. The three kinds of figure that I allude to are, symmetrical or mathematical forms, artistic forms, and arbitrary or neutral forms, as the characters of an alphabet, or the chance shapes of irregular objects. To make the brain peculiarly susceptible to some one of these kinds of form, there is wanted a special concentration of energy over and above the natural adhesiveness of the circles of vision. This concentration is due to some special attraction there is for one particular species in consequence of the secondary character belonging to it; in the case of Artistic forms it is the feeling of artistic effect powerfully manifested that arrests and concentrates the attention, a feeling not lodged in the eye, but in the mind at large. In the case of Geometrical forms, there is also a secondary or additional susceptibility springing from the depths of the mind and concentrating nervous energy upon them. What this susceptibility is there may be some difficulty in deciding. I am disposed to look upon it as the feeling that some minds have towards what is generalized and comprehensive—an intensity of regard drawn out by the concentration of meaning contained in the object. A circle viewed geometrically represents all the round forms in nature, and in it we may ascertain truths applicable to every one of these; and when the mind is of the kind strongly disposed towards truth and certainty, and naturally capable of being intensely concentrated, geometric forms ought naturally to arrest it. The hold that one must take of these figures is far more intense and severe than in any other class of forms; every line and every angle must be rigorously held up before the view. The nice degrees of curvature are not so necessary to retain as the lines and angles, these being the two elements that determine mathematical truth.

As regards forms that belong neither to Art nor to Science, and possess not the fascination of beauty or the interest of comprehensive truth, we must depend principally, I apprehend, upon the unheightened plasticity of the optic circles. Written language and arbitrary symbols in general are examples of this class. The power of remembering a great multitude of arbitrary marks appears to me to show the intrinsic adhesiveness of the muscular sense in the eye. The acquiring of the Chinese written language, with its many thousand characters, is perhaps the highest effort of this nature that could be fixed upon. When the forms are few and important, as the letters of Algebra, or the symbols of Chemistry, they will be seized by the mathematical mind, but when they are innumerable in amount, and not individually of stirring importance, they can be imbibed only by high natural or disinterested adhesiveness. This contrast of the intensive and the extensive expresses in a general way the difference of the man of science from the scholar; artistic considerations being equally foreign to both.

The retention of a map or a complex plan belongs to the scholarly and not the scientific memory. I do not deny the existence of an additional stimulus of the nature of a scholarly interest in the end and purpose of maps and languages, but I do not think that this occurs so manifestly to heighten the plastic adhesion as happens in the two other cases.

24. In the foregoing discussion, I have treated the luminous effect of the objects as nothing in the account. The next class of examples are those where light, colour, and shade are a material part of the impression, as in a landscape, a spectacle, a picture, a room, a human face. Here the object consists of an aggregate of masses of colour, which are associated by whatever force of retentiveness and adhesion belongs to the impressions of colour. By repeatedly gazing at a picture, its different patches of colour seize hold of the mind and connect themselves in their natural order, so that the one can recal the rest, and the whole can exist and be held in the view when the actual object is no longer present. The masses of coloured decoration seen in theatres, the colours of rich calicoes, and the variegated dresses of an assembly of people, exemplify the cases where colour predominates over form, and where the retentiveness is much more optical than muscular. The impressibility to colour is put to the test by the attempt to recal objects like these. The geometrician needs no such faculty. A natural persistence in the currents of luminous action, and a rapidity in acquiring the transitions that fix one to another at its side, which make but one and the same quality of the optical circles, are shown when the visible world, not in outline but in picture, is easily retained in idea. This attribute has no necessary connexion with the muscular susceptibility; the two follow different laws, and belong to independent organs. In some people we find the luminous susceptibility powerful and pre-eminent; such persons have one of the gifts of a pictorial artist. The easy recollection and revival of scenes and objects and human faces are necessary in order to work as a combiner in this kind of material.

25. The same distinction as that above drawn, may be made between a natural or disinterested adhesiveness (always

the best), and an adhesiveness stimulated by a flow of cerebral power in consequence of excitement kindled by the object. An artistic sense may operate here as well as in forms; and if so, the pictures retained will be in preference those that rouse an artistic feeling. A natural impressibility to light will show itself in things that are indifferent to any deeper sense; as in recollecting the succession of houses and shops in a street, of the dresses of a company, of the features of an indifferent landscape, and of visible coloured objects in general, whether they have interest or not. This kind of susceptibility must be very great in such a mind as that of Dickens, who revels in the description of mere surface, creating interest out of the mere act of describing, as a painter makes an indifferent object pleasing by the display of imitative power. The remembrance that some people have of the minute particulars of a room where they have been for a short time, its furniture, walls, decorations, and details, implies, in the first instance, a natural retentiveness to visible effect, and particularly colour. This original susceptibility may be heightened by the habit of attending to such things and by the interest attaching to them, but these would not suffice of themselves, nor probably would they exist without the primitive quality. For it is a fact, that the discovery of æsthetic effects in coloured scenes usually accompanies the natural susceptibility to colour. Minds furnished with a large store of visible pictures as a consequence of their retentive faculty, are apt to become artists; as may be seen from the whole class of poets and writers of romance.

26. There is necessarily a process of successive growth in the Sensations of the eye, or in the pictorial impressions derived through its instrumentality. We acquire first the mere discriminative retentiveness of simple colours and outlines; we can say if the object now in the hand recals a former impression of the same nature, or if it be different from any given past impression. We pass from this on to pictorial retentiveness; the full realization of the object as an idea existing by its own power. This ideal conception begins with simple forms and slightly varied colours, before taking in the more complex appearances. A ring, a ball, a spoon, a dish, a

table, a door, a window, are among the more elementary and easy objects; they imply a few simple motions and turns of the eye, and are mostly uniform in colour. These may all be conceived at an early period, and before a face or a human figure can be surveyed sufficiently often to hold its many phases in one cohesive embrace. I can easily suppose that it takes several years ere the retentiveness of visible aggregates is grown to the pitch of holding easily the whole picture of a human person, especially if we take an individual only once seen. But the differences of susceptibility and of cultivation on this point are enormous: not to speak of the element of human interest that assists us so much in forming a cohering picture of this particular subject.

It must never be forgotten that the inward operations for holding a remembered or ideal picture in the view are the very same as the actual examination of the original. They consist in movements hither and thither of the eyes (these movements not often actually executed), resting occasionally on single points, while the rest drops out of view, then passing to other points, now making a wide sweep over the whole, at another time inspecting narrowly the parts. The movements and colour are fused in one complex impression; this fusion is one of the effects of the associating power: and thus the two mutually sustain and revive each other.

27. To sum up the circumstances that affect the adhesive growth of visible images. Distinguishing between the mechanical and the optical elements of the eye, we note a different law for each, inasmuch as they spring from independent portions of our framework; the one following the rule for mechanical ideas generally, the other being special as regards the susceptibility of the eye to light and the natural retainability of the impressions of light and colour. We then remark that, time or repetition being in all cases necessary, the process is shorter in some minds by virtue of the primitive adhesiveness of the nervous system, in others by the flow of cerebral energy determined by the exciting character of the subject, as when artistic forms are impressed under the artistic sensibility. These are permanent causes; being always at work if

they exist at all. The more temporary influences are those mentioned already in speaking of the growth of Movements; namely, the fresh and healthy condition of the organs; the freedom from distracting excitements and depressing passions, and any stimulants that may be occasionally applied to the attention, as the force of sympathy, an appetite or passion, some purpose or end in view. Lastly, we should advert to the vividness and clearness of the original objects, as when a country is seen under a strong sun-light, or when a picture is forcibly and distinctly painted. Feebleness, haziness, or indistinctness in any sensible impression whatever, necessarily weakens the stimulus given to the sensorial circles, and makes them so much the less adherent.

28. Constant allusion has been made to the superior retentiveness of the traces of the sensations of sight. This permanency is the life of the intellect; for although intellectual forms would exist apart from luminous impressions, yet the superiority of this one sense represses the growth of the others, and causes it to monopolize the office of representing the outer world in the mind.

If we look for a few moments at a strong light, and then shut the eyes, the light still remains, the excited retina keeps up the currents of visibility in the brain, and produces for a time nearly all the effects of the original object. Newton made an experiment of gazing at the sun, until the solar image took possession of his eyes, and sustained itself for several weeks against his will. The overpowering strength of the impression in this case produced a diseased persistency. A similar persistency is often caused by intense emotions, such as terror; a fright will make an object haunt a person for a length of time. Intense affections have a like influence in sustaining the ideal presence of their subject.

In ordinary circumstances, and in ordinary minds, an idea falls short of the sensation; the recalled picture drops out much of the original, and presents itself under feebler lights: but in vision less is missed than in the other senses. The vividness and the ease of an actual view can rarely exist; but under an average impulse, form, outline, and parts can be recovered when the muscular grasp is good, and the fulness of colour when the optical adhesiveness is of a high order. The highest pictorial intellects may probably approach very closely to the facility and fulness of the real presence.

The recovery of past images is one of the commonest efforts of Volition. In this case the effort must direct itself towards the muscles of the eye, and these will imitate or recal the movements entering into the picture. If it is a building the muscles will ideally trace out the form, and give an opportunity to the imbedded luminous impressions to recover themselves. The more easily we can repeat some of the movements of the original view, the more likely we are to draw all the rest in their train, and, with the movements, the lights, shadows, colours, and all the minute imagery that makes up the detail of the building.

SENSATIONS OF DIFFERENT SENSES.

The concurrence of Sensations in one common stream of consciousness,—in the same cerebral highway,—enables those of different senses to be associated as readily as the sensations of the same sense. We will now therefore review the more remarkable instances that arise out of this concurrence, and in so doing it will be convenient to include Movements and their ideas along with Sensations.

29. *Movements with Sensations.*—Under this title I would cite the association of actions with sensible signs, as in all that department of lingual acquisition wherein names have the meaning of command, direction, guidance, control. Every movement that we make is connected with a certain form of words or a particular signal, for the purpose of setting it on at any time. The child learns to connect vocal sounds with its various actions, and thus becomes amenable to command and direction. This education is continued all through life, and the signs for indicating action may be varied without end. The notes of the bugle, the signals at sea, the directions posted up on the walls, have all this acquired power of commanding movements. The same association enters into the education of

animals; the horse and the dog soon learn to connect specific actions with the language, tones, and looks of human beings. Long before children possess the power of utterance themselves, many of their actions are associated with the sounds of language as uttered by others.

30. *Muscular Ideas with Sensations.*—The enduring forms, impressions, or ideas of movement, are associated with sensations, and the two things are in the habit of recalling each other. In the three higher senses we have seen that there is an association of these two elements; many tactile, audible, and visible sensations being a coalition of the two. There are instances, however, besides these. The most interesting that occurs to me is a case coming under Sight. We come to connect the visible appearances of objects with their weight, hardness, and tenacity,—qualities purely muscular in their perception. Having experience of the weight of a piece of stone of a certain appearance, we associate the appearance with the weight, and the one comes to recal the other; so with hardness or tenacity. In this way we have an associated connexion between substances and their uses founded on these properties. We acquire a strong feeling of the difference between timber and stone, and between stone and metal, so much so that we demand each to be differently applied in all kinds of erections and mechanical operations. It has been remarked that our sense of Architectural proportions is founded on our experience of stone, and would require to be readjusted if iron were as universally employed. If the specific gravity of the rocky materials of the globe had been equal to lead instead of being about two and half times water, our sense of the weight of every piece of stone would have been four times as great as at present, and we should consequently have demanded for the satisfaction of the eye far more massive proportions in every kind of stone-work.*

* That is, supposing there was no increased tenacity or power to resist crushing at the same time. Iron buildings are less massive than stone, notwithstanding the greater density of the material; but in that case the greater strength of the substance comes into play, and the employment of hollow and slender forms takes off from the weight to be supported.

31. *Sensations with Sensations.*—Under this head I might allude to all the combinations that would arise by taking each sense along with every other; organic sensations with tastes and smells, with touches, sounds, and sights; tastes with smells, &c., smells with touches, and so on. But any reader may supply for himself examples of all these cases. I shall merely touch on the associations among the three higher senses.

Touches are associated with Sounds, when the ring of a body suggests how it would feel, as in discriminating stone, wood, glass, pottery, &c. This is a very abundant and generally very secure adhesion. The discrimination and delicacy of the sense of hearing makes it thus a valuable means of knowing what is going on around us.

Touches are associated with Sights in the great comprehensive case of connecting the tactile properties of things with their visible appearance, whereby the one can instantly suggest the other. We associate the tangible qualities of roughness, smoothness, solidity, liquidity, viscidity, with the characteristic impressions they make on the eye, and we can at any time recal the touch by the sight, or the sight by the touch. So we can distinguish metallic, wooden, or rocky surfaces, cloths, leaves, flowers, by both senses; and by association the impression on the one can bring up the other. Every one has a large amount of knowledge existing in the shape of associated touches and sights. We connect likewise the form as revealed to touch with the seen form, and thus make the one confirm the other. Our notion of figure is in fact a coalition of different impressions, and this gives to it a more perfect character than any single impression can convey. I shall speak of this again presently.

Sounds are associated with Sights in innumerable instances. We connect the visible appearances of bodies with the noise they make when struck, as a glass, a spoon, a book, a hat. We associate an instrument of music with the peculiar quality of its note; we connect animals with their vocal utterance. So with human beings; every person known to us having a distinctive voice. In acquiring languages we have to associate the articulate sound with the alphabetical letters.

32. In this case and in all the other cases of heterogeneous association, I am disposed to think that the rapidity of the adhesion will vary with the adhesive quality of each of the two senses entering into the combination. Thus, when sounds are connected with sights, the goodness of the ear and the retentiveness of the eye will both contribute to make the adhesion quick and sure. Whence all associations with sight would come sooner to maturity than the connexions formed among the inferior sensations. This circumstance it is that puts sight forward as the representative sense. Things that are seen having a more glorious resurrection in the mind than any others, we choose to conceive the objects of nature as they appear to the eye rather than as they affect the ear or the touch. Of all the ways that an orange can strike the senses, the visible aspect is by pre-eminence its revived manifestation, in other words, its 'idea.'

OF EXTERNAL PERCEPTION.—THE MATERIAL WORLD.

33. The perception and knowledge of the material world come through the sensations by their association with one another. The manner of attaining to this knowledge, its exact nature and the degree of certainty attaching to it, give rise to some of the greatest questions of metaphysical philosophy. Two problems especially call for notice at this stage. The first is the origin of the perceptions we owe to vision, namely, the forms and magnitudes of external bodies, and their distances from the eye. Ever since these perceptions were affirmed by Berkeley to be not original but acquired, they have formed an interesting subject of demonstration and discussion with metaphysical writers. The second question relates to the grounds we have for asserting the existence of an external and material world; this question grew out of the other both historically and naturally, and was one of the prominent metaphysical questions of the eighteenth century.

34. *Of the Perception of the Distances and Magnitudes of External Bodies.*—In speaking of the sensations of vision we have adverted to the qualities of Colour, Form, and Solid Dimension, of which the eye gives us feelings or impressions. It is to be seen how far these last, together with distance and magnitude, are original and proper to the eye, and how far the result of a fusion of eye sensations with other feelings.

The distinctive impressibility of the eye is for Colour. This is the effect specific to it as a sense. But the feeling of Colour by itself implies no knowledge of any outward object as a cause or a thing wherein the colour inheres. It is simply a mental effect or influence, an emotion or conscious state, which we should be able to distinguish from other conscious states, as for example, a smell or a sound. We should also feel the difference between it and others of the same kind more or less vivid, more or less enduring, more or less expansive or voluminous. So we should distinguish the qualitative differences between one colour and another. Emotional effect, with discrimination in quality, intensity, duration, and volume, would attach to the mere sensation of colour. Knowledge or belief in an external or material coloured body there would be none.

But when we add the active or muscular sensibility of the eye, we obtain new products. The sweep of the eye over the coloured field gives a feeling of a definite amount of *action*, an exercise of internal power which is something totally different from the passive emotion of light. This action has many various modes, all of the same quality, but all distinctively felt and recognised by us. Thus the movements may be in any direction—horizontal, vertical, or slanting; and every one of these movements is felt as different from every other. In addition to these we have the movements of adjustment of the eye brought on by differences in the remoteness of objects. We have distinctive feelings belonging to these different adjustments, just as we have towards the different movements across the field of view. If the eyes are adjusted first to clear vision for an object six inches from the eye, and afterwards change their adjustment to suit an object six feet distant, we are distinctly conscious of the change, and of the degree or amount of it; we know that the change is greater than in extending the adjustment to a three-feet object, while it is less than we should have to go through for a twenty-feet object. Thus in the alterations of the eyes for near and far, we have a distinctive consciousness of amount or degree, no less than in the movements for right and left, up and down. Feelings of the same nature as active exertion in any part of the body gives rise to, are thus incorporated with the sensibility to colour; the luminous impression is associated with action on our part, and is no longer a purely passive state. We find that the light changes as our action changes, we recognise in it a certain connexion with our movements; an association springs up between the passive emotion and the active energy of the visible organ, or rather with the body generally; for the changes of view are owing as much to movements of the head and trunk as to the sweep of the eye within its own orbit.

We have not yet attained to the perception or knowledge of any outward thing as the source of colour, and the occasion of the varying movements and adjustments of the eyes. We have discriminating feelings of colour, the discriminative sense of active energies, and the association of the two in one fact, but nothing to reveal or suggest external things; we have merely the means of comparing a number of various mental states. Nor do I see how with the eye alone we can ever pass from the internal consciousness to the external perception, to the recognition, knowledge, and belief of things out of or apart from ourselves, the causes of those internal states. Many have contended for, and many more assumed, this power as attaching to vision. But in so doing they seem to me to have fallen into a confusion of idea respecting the mental nature of this perception of an outer world, as I shall now endeavour to explain.

35. It is I believe admitted on all hands that the recognition of an outer world apart from self is mixed up with the perception of such qualities as extension, form, and remoteness,

called Primary qualities of matter. Heat, odour, taste, colour alone, do not suggest external and independent objects, being for this reason termed the Secondary qualities of bodies. I shall fasten, therefore, on the two facts of remoteness and extension, both which imply outward existence in so far as we recognise and believe in the reality of a material world apart from the mind. With regard to those two qualities,—the distance of a thing from the seeing eye and the dimensions of a body in space, I affirm that they cannot be perceived through the medium of sight alone.

Take first the case of Distance or remoteness. It appears to me that the very meaning of this quality,—the full import of the fact implied in it,—is such as cannot be taken in by mere sight. For what do we mean when we say that an object is four yards distant from where we stand? I imagine that among other things we understand this, namely, that it would take a certain number of paces to come up to it, or to reduce the distance from four yards to two yards. The possibility of a certain amount of locomotion is implied in the very idea of distance. The eye would be distinctly aware of a change when the distance was reduced from four yards to two, but it has of itself no knowledge of the cause or accompanying incidents of that change. These are measured by our other activities, and in the case of great distances, by the locomotive energy and continuance requisite to pass from the one to the other. In the case of objects within reach of the hand, the movements of the arm give the measure of distance; they supply the accompanying fact that makes distance something more than an unknown visible impression. When we say that a thing has been shifted from a position of six inches distance from the eye to a position of twelve, we imply that with the change of ocular effect there has been another change corresponding to a certain definite movement of the hand and arm in a forward direction; and unless by supposing this additional action, we have no key whatever to the change that has come over our visible impression of the thing in question. I say, therefore, that distance cannot be perceived by the eye, because the idea of distance by its very nature implies feelings and measurements out of the eye, and located in the other active organs,—the locomotive and other moving members. If our notion of distance did not reveal to us the fact that by so many steps, or by a certain swing of the arm or bend of the body, we should make a definite change in the appearance of the object, it would not be a notion of distance; there might be an ocular effect, but not a revelation of distance. Granting that the eye is very distinctly affected by every change in the remoteness of a visible object from six inches to a mile, that it recognises a variation of impression all through this interval, this would not answer the question, how far is the object removed at each step? I do not see even how it could tell which way the thing was moving. The actual distance means so many inches, feet, or yards, and of these we have no measure by the eye; indeed they have no relevancy as regards the eye; they concern the locomotive and other mechanical movements, but not the movements of sight.

With the active exertion of the body in locomotion we have a definite muscular feeling; we recognise one exertion as greater or less than another; the feeling of a long stride is different from a short; six paces are attended by a different consciousness from four. We acquire permanent and revivable impressions of these exertions when any one has been often repeated, as for example, pacing the length of a room. We can compare any new case with this old habitual effort, and there results a consciousness of more or less. This I take to be our starting point in the feeling of distance traversed, or of linear extension in general: this is the source of our perception, and the measure and standard of reference when we arrive at the same notion by other means. When, along with a forward movement, we behold a steadily varying change of appearance in the objects before us, we associate the change with the locomotive effort, and after many repetitions we firmly connect the one with the other. We then know what is implied in a certain feeling in the eye, a certain adjustment of the lenses and a certain inclination of the axes, of all which we are conscious; we know that these things are connected with the further experience of a definite locomotive energy needing to be expended in order to alter this consciousness to some other consciousness. Apart from this association, the eye feeling might be recognised as differing from other eye feelings, but there would be no other perception in the case. Experience connects these differences of ocular adjustment with the various exertions of the body at large, and the one can then imply and reveal the others. The feeling we have when the eyes are parallel and vision distinct is associated with a great and prolonged effort of walking, in other words, with a long distance. An inclination of the eyes of two degrees, is associated with two paces to bring us up to the nearest limit of vision, or with a stretch of some other kind measured in the last resort by pacing, or by passing the hand along the object. The change from an inclination of 30° to an inclination of 10°, is associated with a given sweep of the arm carrying the hand forward over eight inches and a half.

36. I maintain therefore that distance from the eye, and lineal extent in any direction, means a definite amount of bodily movement experienced in connexion with the change of visible impression in passing from one point to another. If we next attend to the sweep of the eye over the field of view, as required by an object extended laterally, we shall find in the same manner that this sweep gives a most distinctive consciousness, so that a larger sweep can be discriminated from a smaller; but it gives no information besides. It tells of no outward thing, so far as I can make out; certainly it does not tell of extension, for this simple reason, that extension means a given movement of the body. If I say that a log of wood I see before me is six yards long, I mean that it would take a certain number of my paces to traverse its length: the visual impression of itself cannot mean or imply any fact of this kind, until experience has connected the sweep of the eye with the sweep of the legs or other moveable parts.

Accordingly, I hold, as regards extension in general, that this is a feeling derived in the first instance from the locomotive or moving organs; that a definite amount of movement of these comes to be associated with the sweep and adjustments and other effects of the eye; and that the notion when full grown is a compound of locomotion, touch, and vision, the one implying and recalling the others. A certain movement of the eye, as the sweep over a table, gives us the sense of that table's magnitude, when it recals or revives the extent and direction of arm movement necessary to compass the length, breadth, and height of the table. Previous to this experience the sight of the table would be a mere visible effect, differing consciously from other visible effects as one stomachic pain differs from another, but not suggesting any foreign effect whatever. It could not suggest magnitude, because magnitude is not magnitude if it do not mean the extent of movement of the arms or limbs that would be needed to compass the object; and this can be gained in no other way but by actual trial by these very organs.

37. The conclusion, therefore, is that extension, size, or magnitude, owes not only its origin but its essential import or meaning to a combination of different effects associated together under the cohesive principle we are now considering. Extension, or space, as a quality, has *no other* origin and no other meaning than the association of these different sensitive and motor effects. The coalition of sensations of sight and touch with felt motive energies explains everything that belongs to our notion of extended magnitude or space. This view has both its supporters and its opponents. Of the opposition, I shall content myself with referring to Sir William Hamilton, who expresses himself on the subject in the following terms:—'The opinions so generally prevalent, that through touch, or touch and muscular feeling, or touch and sight, or touch, muscular feeling, and sight,—that through these senses exclusively, we are percipient of extension, &c., I do not admit. On the contrary, I hold that all sensations whatsoever, of which we are conscious, as one out of another, *eo ipso*, afford us the condition of immediately and necessarily apprehending extension; for in the consciousness itself of such reciprocal outness is actually involved a perception of difference of place in space, and, consequently, of the extended.'—*Dissertations on Reid*, p. 861. The statement here made that all sensations, of which

we are conscious as one out of another, afford a condition ot apprehending extension, seems to me to imply and take for granted the point in dispute: for I do not see how one sensation can be felt as out of another, without already supposing that we have a feeling of space. If I see two distinct objects before me, as two candle flames, I apprehend them as different objects, and as distant from one another by an interval of space; but this apprehension presupposes an independent experience and knowledge of lineal extension. There is no evidence to show that at the first sight of these objects, and before any association is formed between visible appearances and other movements, that I should be able to apprehend in the double appearance a difference of place. I feel a distinctness of impression, undoubtedly, partly optical and partly muscular, but in order that this distinctness may mean to me a difference of position in space, it must reveal the additional fact, that a certain movement of my arm would carry my hand from the one flame to the other, or that some other movement of mine would change by a definite amount the appearance I now see. If no information is conveyed respecting the possibility of movements of the body generally, no idea of space is given, for we never consider that we have a notion of space unless we distinctly recognise this possibility. But how a vision to the eye can reveal beforehand what would be the experience of the hand or the other moving members, I am unable to see.

The conjoint experience of the senses and the movements appears to me to furnish all that we possess in the notion of extended matter. The association between sight and locomotion, or between touch and the movements of the arm, tells us that a given appearance implies the possibility of a certain movement; that a remote building implies a certain continuance of our walking exertions to change its appearance into another that we call a near view; and the power of motion, the scope for moving, exhausts every property in the idea of space. We estimate it first by our own movements, and next by other movements measured in the first instance by our own, as, for example, the flight of a bird, the speed of a cannon ball, or the movement of light. The mental conception that we have of empty space is scope for movement, the possibility or potentiality of moving; and this conception we derive from our experience of movements. The resistance to movement is our notion of a plenum or occupied space; the extent of movement is our measure of the linear extension of body or extended magnitude. No internal revelation, nothing in the nature of intuition or innate conception, is required for giving us such notions as we actually have of these qualities.

Perception and Belief of the Material World.

38. Inasmuch as knowledge and perception inhere in mind alone, it has been asked whether there be anything else than mind and its activities in the universe; or what reason have we for believing in the existence of counterpart objects apart from, and independent of, our sensations. May not waking thought be itself a dream? Or the problem may be illustrated thus: Baron Reichenbach has found a number of persons who see sparks and flames issuing from magnets; and it is disputed whether these are actual influences emanating from the magnetic bars, as much as their colour, lustre, weight, hardness, &c., or only phantasies of an excitable imagination. Such is the character of the controversy concerning the external and independent existence of the entire material world.* On this question the following remarks are submitted.

(1.) There is no possible knowledge of the world except in reference to our minds. Knowledge means a state of mind; the notion of material things is a mental thing. We are incapable of discussing the existence of an independent mate-

* See in the *Letters on the Philosophy of the Human Mind*, by Samuel Bailey, just published, an able exposure of the equivocations of language and confusion of ideas that have clouded the question relating to the perception of an external world. I quote a single sentence, giving a summary view of the position taken up by Mr. Bailey. 'It seems to have been only after a thousand struggles that the simple truth was arrived at, which is not by any means yet universally received,—the truth that the perception of external things through the organs of sense is a direct mental act or phenomenon of consciousness not susceptible of being resolved into anything else.'—p. 111.

rial world; the very act is a contradiction. We can speak only of a world presented to our own minds. By an illusion of language, we fancy that we are capable of contemplating a world which does not enter into our own mental existence; but the attempt belies itself, for this contemplation is an effort of mind.

(2.) Solidity, extension, and space,—the foundation properties of the material world,—mean, as has been said above, certain movements and energies of our own body, and exist in our minds in the shape of feelings of force allied with visible, and tactile, and other sensible impressions. The sense of the external is the consciousness of particular energies and activities of our own.

If we were the subjects of purely passive sensation,—such sensations as warmth, odour, light,—apart from any movement of any active member whatever, our recognition of the external world might be something very different from what we now experience. The state of the consciousness would then, so far as we are able to imagine it, be of the nature of a dream, and our perception of the universe would be sufficiently represented by a theory of idealism.

But in us sensation is never wholly passive, and in general is much the reverse. Moreover, the tendency to movement exists before the stimulus of sensation; and movement gives a new character to our whole percipient existence. The putting forth of energy, and the consciousness of that energy, are distinct and characteristic facts totally different in their nature from pure sensation; meaning thereby sensation without activity, of which we can form some approximate idea from the extreme instances occurring to us of impressions languidly received.

It is in this exercise of force that we must look for the peculiar feeling of externality of objects, or the distinction that we make between what impresses us from without and impressions not recognised as outward. Any impression that rouses a stroke of energy within us, and that varies exactly according as that energy varies, we call an outward impression. Dr. Johnson refuted Berkeley, as he thought, by kicking a stone. In fact, this view of Johnson's illustrates the real nature of our recognition of externality. It was his own action with its consequences, and not the optical impression of a stone on the eye, that satisfied him as to the existence of something outward. The sum total of all the occasions for putting forth active energy, or for conceiving this as possible to be put forth, is our external world.

Taking the order of the senses followed in our exposition in the previous book, Touch is the first that decidedly makes us cognizant of an external world. But if we were confining ourselves to the class of sensations of soft touch, where we have the passive pleasure of the sense in highest perfection, we should not find much superiority in this sense over smell in the matter now under consideration. It is hard contact that suggests externality ; and the reason is that in this contact we put forth force of our own. The more intense the pressure, the more energetic the activity called forth by it. This mixed state produced through reacting upon a sensation of touch by a muscular exertion, constitutes what is called the *sense of resistance*, a feeling which is the principal foundation of our notion of externality. 'There is no feeling of our nature of more importance to us, than that of resistance. Of all our sensations, it is the most unintermitted ; for, whether we sit, or lie, or stand, or walk, still the feeling of resistance is present to us. Everything we touch at the same time resists ; and everything we hear, see, taste, or smell, suggests the idea of something that resists. It is through the medium of resistance that every act, by which we subject to our use the objects and laws of nature, is performed. And, of the complex states of consciousness, there is hardly one in which the feeling or idea of resistance is not included.'* In fact we constantly carry about with us the feeling or the notion of resisting, in other words, the state where a sensation of touch is coupled with the putting forth of effort or force.

(3.) We experience certain uniformly recurring sensations,

* MILL'S *Analysis of the Human Mind*, vol. i. p. 47.

and certain uniform changes in these, when we exert particular energies. Thus the visible picture of our dwelling is a permanent and habitual experience, and the variations it is subject to, correspond principally to our own conscious movements. But at times the appearance is entirely withdrawn, and exists only in memory or idea. We then feel the difference between the two experiences, the ideal and the actual, and we assign some superiority in the mode of existence of the one over the other. The superiority we soon find to connect itself with the changes due to our movements; a mere picture or *idea* remains the same whatever be our bodily position or bodily exertions; the sensation that we call the *actual* is entirely at the mercy of our movements, shifting in every possible way according to the varieties of action that we go through. With a forward movement the visible impression enlarges, with a backward movement it diminishes. A movement of the eye shuts it off, another movement restores it. The carriage of the head alters it from side to side; the bending of the body varies it in other ways. We are constrained to make a distinction between the things that are thus shifted by all our movements, and the ideas or dreams that vary of themselves while we are still. Even if sensation were only in ourselves, we should still have to distinguish between present sensation and remembered or revived sensation; the reference of the one to our voluntary movements, and of the other to no such modifying causes, would oblige us to note a vital difference in the two classes of facts. Such is the uniformity of connexion between certain appearances and certain movements, that we come to anticipate the one through the other. We know that in some one position, as when lying in bed, a movement of the limbs will bring us to the sensation of a solid contact in the feet; that another series of movements will bring on a particular view to the sight; that a third movement will bring the sound of a bell to the ear, and so forth. We recognise all those sensible effects, thus brought uniformly into play by a regular series of waking voluntary actions, as totally different from our ideas, recollections, and dreams.

(4.) As our belief in the externality of the causes of our sensations means that certain actions of ours will bring the sensations into play or modify them in a known manner, this belief is easily furnished to us by experience; it is no more than our experience entitles us to entertain. Having felt again and again that a tree becomes larger to the eye as we move; that this movement brings on at last a sensation of touch; that this sensation of touch varies with movements of our arm, and a great many other similar coincidences; the repetition of all this experience fixes it in the mind, and from the sight alone we can anticipate all the rest. We then know that our movements will bring about all the changes and sensations above described, and we know no more; but this knowledge is to us the recognition of external existence, the only thing, so far as I see, that external existence can possibly mean. Belief in external reality is the anticipation of a given effect to a given antecedent; and the effects and causes are our own various sensations and movements.

(5.) When we find that one fixed set of movements brings on at the same time *sensations of various senses*, as when approaching to an orchard we have sights and sounds and touches and smells and tastes; the fact very much enhances the notion we have of the dependence of sense on action or movement, the richness, so to speak, of the external world, the value of our action as bringing on sensation. Moreover when successive movements bring forward endless varieties of new sensations, we are in this way also impressed with the abundance of effect brought on as a consequence of our own movements. We see the largeness of the possible world as compared with the appearance that self makes,—the expanse of our own body,—which is to us a unit of comparison and standard of reference. Whether the causes of appearances are external to our mind or not, we are at all events certain that they are external to our bodies; for between the world and each one's corporeal presence a comparison is possible; between the world and mind there is no comparison, the things are not homogeneous. We incur the absurdity of converting mind into a substance to be viewed by another mind, when we speak of our perceiving faculty as an extended thing. But a world extending beyond our own person we can understand; it implies that the movement that traverses the body must be many times multiplied to traverse the world, that is to bring forward the whole array of possible changes of sensation.

(6.) When we come to communicate with other beings, and ascertain by the signs of communication that they pass through the same experience as ourselves, this enhances still more the constancy of the association between our sensations and the corresponding active energies. We ascertain that at times when we ourselves are not affected by a particular sensation, as of light, other persons are affected by it. This leads us to generalize sensation still more, and to conceive to ourselves an abstraction that comprehends all our experience, past and present, and all the experience of others, which abstraction is the utmost that our minds can attain to respecting an external and material world. So often as I open my eyes I have the sensation of light (the exceptions are not material to the illustration). I thereupon associate this sensation with this action, and I expect in all future time that the action will lead to the sensation. Other persons tell me the same thing. I thereupon affirm as a general fact that an optical feeling will always follow a certain muscular feeling, to me and to other sentient beings; and I can affirm nothing more, nor can I have any possible interest or concern with anything more. The assertion that light and the sun have a permanent and independent existence has, for its basis and for its import, that I, and all other beings with whom I have had any communication, have had a certain optical feeling in conjunction with certain activities of which we have been conscious, and firmly anticipate the same coincidence in the future. The external existence of a stone wall means the association between certain optical impressions and a particular locomotive effort, and a further and still more decided association between touch and another effort, that, namely, which we call the sense of resistance. Finding the same sequence to exist with reference to beings in general, we generalize the fact to the very farthest limits, and affirm that it has always been so in the past, and will always be so in the future. Our language is apt to go beyond this; out of all the *particular* experiences (which alone constitute the real evidence for the proposition) we construct an experience in the abstract, a most anomalous fiction, that goes the length of affirming that the sensation is not only sure to occur along with the appropriate actions, but that it exists whether these actions take place or not. We seem to have no better way of assuring ourselves and all mankind that with the conscious movement of opening the eyes there will always be a consciousness of light, than by saying that the light exists as independent fact, with or without any eyes to see it. But if we consider the case fairly, we shall see that this assertion errs not simply in being beyond any evidence that we can have, but also in being a self-contradiction. We are affirming that to have an existence out of our minds which we cannot know but as in our minds. In words we assert independent existence, while in the very act of doing so we contradict ourselves. Even a possible world implies a possible mind to perceive it, just as much as an actual world implies an actual mind. The mistake of the common modes of expression in this matter, is the mistake of supposing the abstractions of the mind to have a separate and independent existence. This is the doctrine of the Platonic 'ideas,' or 'forms,' which are understood to impart all that is common to the particular facts or realities, instead of being derived from them by an operation of the mind. Thus the actual circles of nature derive their mathematical properties from the pre-existing 'idea,' or circle in the abstract; the actual men owe their sameness to the ideal man. So instead of looking upon the doctrine of an external and independent world as a generalization or abstraction grounded on our particular experiences, summing up the past, and predicting the future, we have got into the way of maintaining the abstraction to be an independent reality, the foundation, or cause, or origin of all those experiences.

39. Having touched on the metaphysical disputes concerning the first origin and precise import of our notions of distance and extension, I must now advert to the exact process whereby we come to be cognizant by sight of those pro-

perties that are out of the sphere of its immediate recognition. The relations between these four distinct facts, namely, ocular adjustment for seeing an object, the extent of the image on the retina, the distance, and the true magnitude of the object, are what we have to consider; for we find that in the educated eye these circumstances are suggestive of one another. On this subject I shall avail myself of the recently published observations of Professor Wheatstone, in his Bakerian Lecture, contained in the *Philosophical Transactions* for 1852. The question to be solved is, how do we come to connect a certain felt effect on the eye, with a knowledge of the distance and size of the object causing the impression; as when we say that a lamp-post is twenty feet off, or that a distant wood is within three or four miles. When the gaze is still, the optical impression implies no more than these two facts,—a certain effect of light and colour, and an adjustment of the eyes singly and conjointly; when the gaze is wandering, the movements and changes of adjustment operate in addition.

'Under the ordinary conditions of vision, when an object is placed at a certain distance before the eyes, several concurring circumstances remain constant, and they always vary in the same order when the distance of the object is changed. Thus, as we approach the object, or as it is brought nearer to us, the magnitude of the picture on the retina increases; the inclination of the optic axes required to cause the pictures to fall on corresponding places of the retinæ, becomes greater; the divergence of the rays of light proceeding from each point of the object, and which determines the adaptation of the eyes to distinct vision of that point, increases; and the dissimilarity of the two pictures projected on the retinæ also becomes greater. It is important to ascertain in what manner our perception of the magnitude and distance of objects depends on these various circumstances, and to inquire which are the most and which the least influential in the judgments we form. To advance this inquiry beyond the point to which it has hitherto been brought, it is not sufficient to content ourselves with drawing conclusions from observations on the circumstances under which vision naturally occurs, as preceding writers on this subject mostly have done, but it is necessary to have more extended recourse to the methods so successfully employed in experimental philosophy, and to endeavour, wherever it be possible, not only to analyse the elements of vision, but also to re-combine them in unusual manners, so that they may be associated under circumstances that never naturally occur.'—p. 2.

Accordingly Mr. Wheatstone has devised an instrument, being a modification of his reflecting stereoscope, whereby he can expose pictures to the two eyes in such a manner that the distance can be changed while the convergence of the two eyes remains the same, or the convergence be altered while the distance remains the same, thus disassociating two effects that constantly go together in ordinary vision. The result of the experiments showed the influence of both circumstances, namely, the convergence of the eyes and the size of the picture on the retina (which is greater as the object is nearer), in determining our judgment of distance. He finds that the distance of the object remaining the same, the greater convergence of the two eyes makes the object seem smaller, this increased convergence being required in ordinary vision when a thing is brought nearer. It appears, therefore, that while the retinal magnitude is unaltered, greater convergence gives a perception of smaller size. On the other hand, leaving the inclination of the axes unchanged, and bringing the pictures nearer, thereby increasing the picture on the retina, there is a perception of increased size in the object. 'The perceived magnitude of an object, therefore, diminishes as the inclination of the axes becomes greater, while the distance remains the same; and it increases when the inclination of the axes remains the same, while the distance diminishes. When both these conditions vary inversely, as they do in ordinary vision when the distance of an object changes, the perceived magnitude remains the same.'

Thus as regards the perception or appreciation of the real *magnitudes* of objects seen by the eye, the association lies between a certain magnitude (ascertained by other means than sight), and a certain inclination of the optic axes with a given size of the picture on the retina. Thus the image of a man, of which we have a certain muscular estimate by our movements, when viewed at some one inclination of the optic axes, yields an image on the retina of a particular size; with such inclination and size of image we associate the muscular appreciation of an object six feet high, &c. The concurrence of these two conditions always suggests a similar magnitude or extent of the thing viewed. And if the optic inclination is made smaller, that is, if the axes of the eyes approach more to parallelism, while at the same time the image on the retina is correspondingly less, as by removing the object to a greater distance, there will still be a perception of the same size, or the same muscular appreciation will be suggested to the mind. We have an association of the size of a man with a great many different combinations of those two circumstances produced by variation of actual distance.

40. And next, as respects our perception and estimate of *distance*, or the suggestion of a given locomotive exertion with a visual appearance. On this head Mr. Wheatstone's observations are somewhat different from the received views. He considers that the appreciation of distance, instead of preceding the estimate of magnitude, follows it. 'It is the prevalent opinion that the sensation which accompanies the inclination of the optic axes immediately suggests distance, and that the perceived magnitude of an object is a judgment arising from our consciousness of its distance and of the magnitude of its picture on the retina. From the experiments I have brought forward, it rather appears to me that what the sensation which is connected with the convergences of the axes immediately suggests, is a correction of the retinal magnitude to make it agree with the real magnitude of the object, and that distance, instead of being a simple perception, is a judgment arising from a comparison of the retinal and perceived magnitudes. However this may be, unless other signs accompany the sensation of convergence, the notion of distance we thence derive is uncertain and obscure, whereas the perception of the change of magnitude it occasions is obvious and unmistakeable.' According to this view, distance is more

firmly associated with the retinal magnitude than with the other circumstances of optical inclination. When we view an object receding, as a carriage, we are impressed with the change of distance more through the diminishing size of the picture it makes on the retina than through the approach of the optic axes to parallelism. I am not at all surprised at this, seeing that the change in the size of the retinal picture is so much more evident and distinct as a sensation than the very slight corresponding alteration in the inclination of the axes. When we once ascertain the real magnitude of a body, the approach or receding of it is very easily measured from this change of the picture. Now, according to Mr. Wheatstone, the inclination of the axes, in company with a given retinal picture, suggests the magnitude first, and from the true magnitude thus known and the retinal magnitude we infer the distance.*

* When a known object is magnified by a lens we suppose it brought nearer to us, owing to this increase of retinal magnitude while the convergence remains the same.

I have not adverted in the text to the signs of distance furnished by the colour and appearance of objects. This point has been well illustrated by Dr. Reid.—*Inquiry*, Chap. vi. Sect. 22. I quote the following paragraphs:—

'The colours of objects, according as they are more distant, become more faint and languid, and are tinged more with the azure of the intervening atmosphere; to this we may add, that their minute parts become more indistinct, and their outline less accurately defined. It is by these means chiefly, that painters can represent objects at very different distances, upon the same canvass. And the diminution of the magnitude of an object would not have the effect of making it appear to be at a great distance, without this degradation of colour, and indistinctness of the outline and of the minute parts. If a painter should make a human figure ten times less than other human figures that are in the same piece, having the colours as bright and the outline and minute parts as accurately defined, it would not have the appearance of a man at a great distance, but of a pigmy or Lilliputian.

'When an object has a known variety of colours, its distance is more clearly indicated by the gradual dilation of the colours into one another, than when it is of one uniform colour. In the steeple which stands before me at a small distance, the joinings of the stones are clearly perceptible; the grey colour of the stone, and the white cement are distinctly limited: when I see it at a greater distance, the joinings of the stones are less distinct, and the colour of the stone and of the cement begin to dilute into one another: at a distance still greater, the joinings disappear altogether, and the variety of colour vanishes.

'In an apple tree which stands at the distance of about twelve feet,

41. Passing now to the perception of *solidity*, or solid effect, on which the discovery of the stereoscope has cast a new light, by connecting it with the action of the two eyes, I find

covered with flowers, I can perceive the figure and the colour of the leaves and petals; pieces of branches, some larger others smaller, peeping through the intervals of the leaves—some of them enlightened by the sun's rays, others shaded; and some openings of the sky are perceived through the whole. When I gradually remove from this tree, the appearance, even as to colour, changes every minute. First, the smaller parts, then the larger, are gradually confounded and mixed. The colours of leaves, petals, branches, and sky are gradually diluted into each other, and the colour of the whole becomes more and more uniform. This change of appearance, corresponding to the several distances, marks the distance more exactly than if the whole object had been of one colour.

'Dr. Smith in his 'Optics' gives us a very curious observation made by Bishop Berkeley in his travels through Italy and Sicily. He observed, that in those countries, cities and palaces seen at a great distance appeared nearer to him by several miles than they really were; and he very judiciously imputed it to this cause. That the purity of the Italian and Sicilian air gave to very distant objects that degree of brightness and distinctness which, in the grosser air of his own country, was to be seen only in those that are near. The purity of the Italian air hath been assigned as the reason why the Italian painters commonly give a more lively colour to the sky than the Flemish. Ought they not, for the same reason, to give less degradation to the colours, and less indistinctness of the minute parts, in the representation of very distant objects?

'It is very certain that, as in air uncommonly pure, we are apt to think visible objects nearer and less than they really are, so, in air uncommonly foggy, we are apt to think them more distant and larger than the truth. Walking by the sea-side in a thick fog, I see an object which seems to me to be a man on horseback, and at the distance of about half a mile. My companion who has better eyes, or is more accustomed to see such objects in such circumstances, assures me that it is a sea-gull, and not a man on horseback. Upon a second view, I immediately assent to his opinion, and now it appears to me to be a sea-gull, and at the distance only of seventy or eighty yards. The mistake made on this occasion, and the correction of it, are both so sudden, that we are at a loss whether to call them by the name of *judgment*, or by that of *simple perception*.

'It is not worth while to dispute about names, but it is evident that my belief, both first and last, was produced rather by signs than by arguments, and that the mind proceeded to the conclusion in both cases by habit, and not by ratiocination. And the process of the mind seems to have been this—First, not knowing, or not minding the effect of a foggy air on the visible appearance of objects, the object seems to me to have that degradation of colour, and that indistinctness of the outline, which objects have at the distance of half a mile; therefore, from the visible appearance as a sign, I immediately proceed to the belief that the object is half a mile distant. Then, this distance together with the visible magnitude, signify to me the real magnitude, which, supposing the distance to be half a mile, must be equal to that of the man on horseback. Thus the deception is brought about. But when I am assured that it is a sea-gull, the real magnitude of to remark that the same circumstances that enable us to appreciate the distances of different objects, enable us also to appreciate solid effect, or the continuity of an object through varying distances. The change in the inclination of the axes and the retinal picture together, in proper proportions, suggests the width of a street to be the same all through, and this being the case, the diminished picture tells us of the remoteness of the different parts in succession. So with any other object extended in three dimensions.

A question has been raised as to our mode of perceiving the direction of an object from the eye. On this I would still repeat that direction is not a perception of sight alone; its very meaning precludes the supposition. It implies the locomotive or other movement that would lead us up to the object, or produce a definite change in its appearance. But there is a certain optical effect constantly associated with the sense of direction, as there is with the sense of magnitude or of distance, and this effect it is interesting as a matter of fact to ascertain. Now it appears most probable that the line of visible direction is a line passing from the place of an object's impression on the retina through the centre of the crystalline lens:* hence we associate an effect on the centre of the retina with a direction on the line of the axis of the eye, while an impression to the right of this point would suggest a position left of the axis. But without the experience of our moving organs generally we should never know either the meaning of direction or the fact that a certain impression of the retina implied a certain course for us to take in reference to the object. If the optical law had been entirely different, if, for example, an object were to lie in a direction inclined 45° to the plane of its image in the retina, we should equally well become acquainted with direction; experience would connect the locomotive estimate with the visual impression exactly as is done now. The question is very much of the same nature as that of inverted

* This line has been variously stated. Sir David Brewster affirms that it passes through the centre of the eye. See p. 216 of a work entitled, *Essai sur les Phosphènes, &c., par le* DR. SERRE, Paris, 1853.

vision, formerly discussed; it matters not where or how the optical effect takes place, association connects the true perception with it. In fact, when we dress by a mirror we perform a series of inversions, very difficult at first, but in the end as easy as it is to work under direct vision.

43. *Localization of Bodily Feelings.*—The localization of our bodily feelings presents an interesting case of acquired perception. Previous to experience we have no notion of the seat of any local sensation, as, for example, a pain in the shoulder, or the toe. It is impossible we should have such a notion instinctively, the very nature of the case forbids it, seeing that we must connect an internal feeling with a picture to the eye, or an estimate to the touch, of the part where the feeling arises.

Our own body is a thing exposed to all our senses and to the sweep of our movements like a table, or a statue, or a fowling piece. The eye can scan nearly the whole of it; the hand can sweep over it; the legs can move over parts of it; the ear can hear the sounds it makes; the mouth and tongue can co-operate with the hand. The eyes can appreciate the colour, outline, and solidity; the vision, accustomed to the perception of size and distance, can form an estimate of the remoteness of the parts and the magnitude of the whole; the body's own various movements concurring in the estimate.

So far the body is to us an external object; but it is also the seat of sensibility of various kinds, which sensibility we can usually refer to some locality at the head, arms, chest, &c. The question arises, how do we come to have this knowledge of locality? I answer, by experience and association, based on the distinctness of the nerve fibres supplied to the different parts. (See Touch, p. 184). A pinch in the toe is not sensibly different in quality from a pinch in the finger; but if both were happening together, we should have a sensation of two actions, and not of a single action made stronger. This is owing to the distinctness of the nerves, which keep their currents apart up to the cerebral centre; and through this distinctness we can form separate associations with each. I can associate one pain with the sight of my finger, another pain with the sight of my toe, and a third with the position of my arm that determines the crown of the head. An infant at the outset knows not where to look for the cause of an irritation when anything touches it; by and by the child observes a coincidence between a feeling and a pressure operating on some one part; whence a feeling in the hand is associated with the sight of the hand, and so for other members.

When the feeling is more internal, as in the interior of the trunk, we have greater difficulty in tracing the precise seat, often we are quite at a loss on the point. In this case we have to trust to some indications that come to the surface, or to the effect of superficial pressure on the deep parts. By getting a blow on the ribs we come to connect feelings in the chest with the place on our map of the body; we can thus make experiments on the deep-seated organs, and learn the meaning of their indications. But the more inaccessible the parts, the more uncertainty is there in assigning the locality of their sensations; if, in addition, they are not well supplied with distinctive nerves, the difficulty is still greater. The liver, the spleen, and the kidneys, are, I believe, all indistinct as regards the feelings connected with them. In those places on the skin where the sentient units of nerve are wide apart, as in the back, the calf of the leg, &c., we can never acquire a minute appreciation of locality; the limit of distinctness of the nerve fibres will be the limit of the acquired perception.

This association between an internal feeling and the sight or touch of the place where it originates, acts reciprocally, and produces singular effects. Fixing the eye on a part of the body, as the hand, and intently regarding it for some time, we can actually generate a sensation in the skin, by a sort of back current; the idea, which is a past experience revived on the same nervous tracks, has a tendency to induce the reality. In the artificial sleep known as the mesmeric state, this influence has been carried to great lengths. Mr. Braid has employed it to induce healthy actions upon diseased organs, being able also to cause the opposite effect of inducing unhealthy changes.

44. *Discrimination of Differences in Sensations.*—I have

assumed it as a fact of Sensation that we are conscious of degree, or of less and more, in the intensity of the feeling. The full and accurate meaning of this fact must now be ascertained; and the discussion is better brought in at the present stage than in the First Book under the head of Sensation.

The discrimination of degrees of a feeling of sense,—a relish, a coolness, a taste, an impression of colour,—has three aspects, in accordance with the threefold partition of mind; that is to say, it may be an Emotional, a Volitional, or an Intellectual discrimination.

We are *emotionally* sensible to an increase or decrease of a feeling when the general agitation of the frame, in other words, the expression of the feeling, is made to rise or fall. Thus in music, when the listener is stimulated to an increased expression of feeling by a particular stroke of melody, we say that he has an emotional sense of the difference between that and other parts of the performance. Another person listening to the same music, but not agitated by one part more than another, is not emotionally sensible of any difference in the stream of melody.

We are *volitionally* sensible to a difference of feeling when we are stimulated to more or less of action on account of it. Thus if I am warming my hands at a fire, and any one stirs the fire to greater intensity, so as to be too hot for my purpose, I withdraw my hands to a distance; the sense of difference here shows itself principally in action. Again, if I have before me on the table several kinds of fruit, and taste first one and then another, rejecting what I like least, and partaking of the best, I display my sense of difference volitionally. I may give vent to my expression of feeling as well, and exclaim how much better the pears are than the apples, which would be an emotional discrimination; but the eating of the one in preference to the other is a manifestation of volitional perception of the degree of relish produced by the several fruits. So the energy of my revulsion from an acute pain,—a stroke, a prick, or a scald,—is the volitional measure of my feeling of the pain.

45. Passing now to the *intellectual* discrimination of sen-

sations, we find a somewhat greater complexity. The two other kinds of difference are fundamental and original effects; they operate from the earliest dawn of sentient life. The first experience of a pleasure or a pain determines a certain amount of emotional display, or of volitional urgency, or of both; and if the pleasure or pain be increased so will those effects. If the constitution has great susceptibility, a very slight degree more or less of the outward or inward stimulus will manifest itself in a change of the emotional display; if there be little susceptibility, a considerable variation of stimulus will be required to produce a difference of emotion. This delicacy may bear no proportion to the vehemence of the expression on the whole; a loud and violent manifestation of feeling indicates nothing as to a sense of small differences of degree. This is to be shown by the number of shades of expression that can be interpolated, so to speak, between the faintest and the strongest manifestations within the compass of the individual. A coarse mental framework is one that has merely one howl for all strengths of excitement; a fine emotional nature, from the very beginning, quivers variously to the slightest shades of difference of touch. Precisely the same remarks apply to delicacy of Volition. It is not the fury of the action stimulated that shows the volitional sensitiveness; it is the finely graduated strength of it according to the degree of the stimulus. This graduated effect is shown in the infancy as well as the maturity of the individual; in the newest no less than in the most familiar impressions.

But the Intellectual discrimination, although a primitive fact like the other kinds, has not a distinct criterion at first. It is manifested after a certain amount of experience together with a process of association or acquirement. If there be two sensations that have no difference emotionally or volitionally, the only difference remaining is the intellectual, and that does not show itself by a direct and immediate display; it comes out when the two are used as pegs to hang different actions upon, or as marks for different emotions. For example, the difference of feeling between touching one point by the fingers and touching two points, is a difference that shows itself neither in emotion nor in volition, if we suppose the contact so slight as to give neither pleasure nor pain. But there is a difference, nevertheless; the mind is not identically affected by the two touches; it would not recognise in the one a repetition of the other. The difference thus felt is intellectual, and shows itself by connecting different associations with the two. Thus if with the feeling of the single point I see the object, namely, a piece of knitting wire, and if with the feeling of the double point I see a pair of compasses, the one feeling will be associated with the sight of the wire, and the other with the sight of the compasses; and the two sensations of touch will manifest their difference by bringing forward each its separate image to the view. If the mind were not differently affected in some way or other by these two contacts, it could not form distinctive associations with them, such that the single point always brought forward the wire and the double point the compasses; each impression would bring forward either object at random.

But perhaps a still more elementary instance of intellectual discrimination is that furnished by the appending of different actions to sensations distinct intellectually without being distinct emotionally or volitionally. The difference between the visible tint of brown sugar and the colour of mustard is very small; as objects to the eye yielding emotions of colour, they may be said to be hardly at all distinguished; they have no such difference as exists between a lump of mud and a brilliant nosegay. What distinction of colour really obtains between the two may serve an intellectual purpose, but as regards other purposes it is null. Now the way that the intellectual discrimination manifests itself is very obvious. A child has tasted sugar, and in an evil hour has partaken of mustard; the difference of the two objects to the taste is shown both emotionally and volitionally; there is a complacent expression and strong attraction for the one, and a contortion of feature with intense repulsion towards the other. With these exciting experiences, the difference of appearance of the two is noted and quickly associated; the difference of colour, in itself quite unexciting, acquires a factitious importance by being significant of other differences of the strong, self-manifesting kind. The sight of the sugar thenceforth spurs eager efforts to get hold of the reality, the sight of the other prompts repulsion. Thus it is that a purely intellectual difference is, as it were, latent, until an emotional or volitional difference is made to hang upon it. In the mature consciousness we can doubtless recognise it as an isolated fact, and express it by language, as when I say I feel a double or a triple-pronged fork with my fingers; but this instance itself shows that some association is needed to mark it to others and retain it in one's own mind.

The sensations of Touch furnish apposite instances of intellectual discrimination, in the midst of perfect identity as regards emotion and volition. Take, for example, the two hands. If we compare the feeling of touch in the right hand with the same kind of contact in the left, we find that they are absolutely identical; the one does not kindle up more emotion nor stimulate more volition than the other. But for intellectual purposes, these feelings are quite distinct; they can sustain totally different associations. With a touch upon my left hand, I associate a whole field of imagery seen on my left side, and with a touch on my right hand, I associate another set of imagery in connexion with my right side. If any one pinch my right hand, I incline my head and direct my eyes to the right; if my left hand is pinched in precisely the same manner, my movements are all towards the left. The feelings are identical in everything but association. This possibility of suspending different associations proves that there is a real difference in the sensations, that they are not confounded in the brain, but we should in vain endeavour to trace this difference in the immediate consciousness. Association alone brings it out, and hence we infer the purely intellectual nature of the discrimination.

The very same line of illustration can be followed if we fasten upon the muscular feelings. The feeling of a tensed muscle has a uniform character all over the body, the degree of tension being made equal, and allowing for differences in the size of muscles, and, perhaps also, in their degree of intimacy with the brain. Not to insist on the case of the two arms, or the two legs, or the rotation of the body in opposite ways, which would be identical with the foregoing illustration from touch, I can suppose a weight borne by the arm to give the same amount of muscular feeling as a pressure exerted by the foot. Under this supposition two feelings are produced, that have no difference either as yielding emotion or as stimulating volition; yet experience shows that they are recognised as distinct by the mind. The two muscular tensions are made manifest to the consciousness by different nerves, and, on this fact, the mind is able to build and maintain distinct associations, although it is not aware of any difference, either of quantity or quality, in the feelings as such. We have already called attention to the articulate character of the sense of Touch, arising from the independence of the nerves of the skin, as distributed over the general surface,—a remark applicable also to the nerves supplied to the different muscles. The same kind of feeling, coming from different parts, is recognised as different by taking on different associations. Before any associations are formed the difference is latent; after the growth of distinctive connexions it is unmistakeable. It is shown that the localizing of our feelings—the possibility of assigning a locality to each—is founded on this distinctness of the nerves arising from different parts. If a prick in the leg and a prick in the arm were as undistinguishable in every way, as they are to the mere sense of pain, we should never be able to connect the one with our notion of the leg and the other with our notion of the arm, or with any of the other discriminating features of those two members.

If not superfluous, after these examples, the eye might be adduced to the same effect. The place of the retina, impinged upon by a ray of light, is in the main unimportant as respects the feeling of light, but there is, notwithstanding, a real difference in the intellectual point of view, brought out, as in the other cases, by association. We can thus discriminate right and left, up and down, centre and circumference, in our field of view, as soon as any characteristic actions or consequences become connected with the different portions of the retina, impinged upon from these various outward positions of the rays of light. The retina is, in this respect, identical with the skin; it consists of a number of independent nerve fibres, each transmitting the same quality of impression, but to a distinct region of the common centre of visual impressions, and so as to form the starting point of a perfectly distinct series of accompanying impressions. A man at a telegraphic station, under the old system of signals, saw the same arm repeated to his view, but with its picture on the lower part of the retina he connects one action, on the upper part another action. This is intellectual discrimination.

Hence we can understand how purely intellectual is the whole machinery of signs, marks, ciphers, symbols, artificial representations, made use of in the business of life and in the various sciences.*

* *Sir William Hamilton's theory of the inverse relation between Sensation and Perception.* This theory has been stated by its author as follows—'*Though a perception be only possible under condition of a sensation; still, that above a certain limit the more intense the sensation or subjective consciousness, the more indistinct the perception or objective consciousness.*' By the 'sensation' is here meant the feeling as regards pleasure or pain, the emotional and volitional characters of the mental state; by the 'perception' I understand what is termed above the intellectual discrimination; it is the difference between the excitement of a blaze of sunshine and the discrimination of two natural history specimens. These two effects Sir William Hamilton believes to be inverse to one another; that is, in proportion as the one is strong the other is weak. I am disposed to admit the truth of this doctrine to a very considerable extent. Of the incorrectness of the opposite view, which would assert that feeling and discrimination are proportionally developed,—a view that seems to have been tacitly admitted by most previous philosophers,—I have no doubt. But it appears to me that the facts as to the relation of these two qualities,—the emotional on the one hand, and the intellectual on the other—show a greater degree of complexity than this law expresses, even although it be correct as to the prevailing character of the relation.

The following extract contains the statement of the facts adduced in support of this theory by its author. 'If we take a survey of the senses, we shall find, that exactly in proportion as each affords an idiopathic sensation more or less capable of being carried to an extreme either of pleasure or pain, does it afford, but in an inverse ratio, the condition of an objective perception more or less distinct. In the senses of Sight and Hearing, as contrasted with those of Taste and Smell, the counter proportions are precise and manifest, and precisely as in animals these senses gain in their objective character as means of knowledge, do they lose in their subjective character as sources of pleasurable or painful sensations. To a dog, for instance, in whom the sense of smell is so acute, all odours seem, in them-

ASSOCIATES WITH EMOTION.

46. The element of Emotion, or pleasure and pain, viewed as such, enters into alliance with the more intellectual elements of the mind, as for example those perceptions of outward things that we have just been considering. This alliance

selves, to be indifferent. In Touch or Feeling the same analogy holds good, and within itself; for in this case, where the sense is diffused throughout the body, the subjective and objective vary in their proportions at different parts. The parts most subjectively sensible, those chiefly susceptible of pain and pleasure, furnish precisely the obtusest organs of touch; and the acutest organs of touch do not possess, if ever even that, more than average amount of subjective sensibility.—The experiments of Weber have shown, how differently in degree different parts of the skin possess the power of touch proper; this power, as measured by the smallness of the interval at which the blunted points of a pair of compasses, brought into contact with the skin, can be discriminated as double, varying from the twentieth of an English inch at the tip of the tongue, and a tenth on the volar surface of the third finger, to two inches and a half over the greater part of the neck, back, arms, and thighs. If these experiments be repeated with a pair of compasses not very obtuse, and capable, therefore, by a slight pressure, of exciting a sensation in the skin, it will be found, that whilst Weber's observations, as to the remarkable difference of the different parts in the power of tactile discrimination, are correct; that, at the same time, what he did not observe, there is no corresponding difference between the parts in their sensibility to superficial pricking, scratching, &c. On the contrary, it will be found that, in the places where, objectively, touch is most alive, subjective feeling is, in the first instance at least, in some degree deadened; and that the parts the most obtuse in discriminating the duplicity of the touching points, are by no means the least acute to the sensation excited by their pressure.

'For example;—The tip of the tongue has *fifty*, the inferior surface of the third finger *twenty-five* times the tactual discrimination of the arm. But it will be found, on trial, that the arm is more sensitive to a sharp point applied, but not strongly, to the skin, than either the tongue or the finger, and (depilated of course) at least as alive to the presence of a very light body, as a hair, a thread, a feather, drawn along the surface. In the several places the phenomena thus vary:—In those parts where touch proper prevails, a subacute point, lightly pressed upon the skin, determines a sensation of which we can hardly predicate either pain or pleasure, and nearly limited to the place on which the pressure is made,' &c.—*Edition of* REID, p. 863.

On these last experiments I would remark, first, that the tongue is scarcely a fair subject of comparison with the skin, seeing that the two tissues are not of the same nature; a matter of considerable importance as regards a pleasurable or painful irritation; and, therefore, the fairest mode of conducting the trial is skin with skin.

Secondly, if trial were made of the cheek compared with the other parts, the inverse proportion contended for would not hold good. To a prick, or or association between feeling and imagery gives rise to a number of interesting phenomena, some of which may be introduced here as presenting a new case of the associating process.

In the pleasures and pains derived through the various senses and through the moving organs, associations spring up with collateral things, the causes or frequent accompaniments of those feelings. Thus we connect the pleasures of repose with an easy chair, a sofa, or a bed, and the pleasure of riding with a horse and carriage. The sight of food recals a certain part of the pleasure of eating. The preparation of meals and the catering for the table are interesting avocations through a reference to the end they serve. The representation to the eye of fragrant flowers in a painting has power to revive some

a smart blow, the cheek is at least as sensitive as any portion of the skin whatever; but it is certainly not the least discriminating in Weber's scale. In fact it stands high in the scale, being equal to the palm of the hand and the extremity of the great toe, and inferior only to the tongue, lips, and fingers. In this case, therefore, the inverse ratio of sensibility and discrimination does not subsist.

Taking the cheek and the back of the hand as compared with the palm of the hand, one would be disposed to say that the sensitiveness to pain varied with the structure of the cuticle, while the discrimination depends solely on the supply of nerves. Let the cuticle be thickened as in the hand and foot; the parts are rendered obtuse to a blow. But where the cuticle is thin, the skin is correspondingly tender or susceptible to painful or pleasurable irritation. This is a popular belief, whether scientifically true or not. Any one keenly alive to a smart or an attack is said to be *thin-skinned.* In addition to this, I am disposed to believe that the parts nearest the brain are in consequence more sensitive than remote parts. The agonies of tooth-ache, face-ache, pains of the nose and ear, appear to be more intense than would arise from similar irritations in the lower extremities. If this be a general rule, the skin of the face would be more sensitive than the skin of the arm or the hand, and these more than the leg or foot.

In so far as the differences of sensibility and discrimination depend on the *mind*, Sir W. Hamilton's theory of inverse relation is more strictly applicable. It is to me quite evident that if the whole mind and attention be concentrated on the sensation as a feeling, as giving pleasure or pain, there will be a lack of attention to the intellectual quality. But then it is possible that the mind should be awake to both qualities, and to the one for the sake of the other. Thus if I am exceedingly annoyed with the bitterness of a taste, I am also impressed with its character as distinguished from other bitters; the intensity of my dislike will impress upon me the discriminating character of the substance among other substances, an effect strictly intellectual.

of the pleasures that we derive from the reality through the sense of smell. The pleasures of music in so far as they can be enjoyed in the retrospect are evoked purely by association.

We have seen that it is a quality of some emotions to be more recoverable in idea than others; for example, the pleasures of music and spectacle are recovered from the past more completely than the pleasures of exercise, repose, warmth, or repletion. In those higher emotions, the association restores very nearly the actual experience of the reality; in the inferior sensations, the occasion of the pleasure or pain is remembered, but very little of the actual tone of the feeling.

47. Another fact respecting remembered emotions must now be added to the foregoing, and that is, that these are very often *perverted* in their character through some influence of the mind that comes to bear upon them at the moment of their being revived. This influence is most usually the temper or other emotion prevailing at the time; which temper may happen to be unfavourable to the spreading out of the past emotion in the accurate colouring of the original. Thus in remembering a period of joy and carousal, if the present temper is sour and melancholy, the recollection will be unfaithful and perverted as regards the emotion: we shall almost certainly underrate the feelings that we then experienced. If, on the other hand, the remembrance of a day passed in pleasure is brought forward at a time of high elation, the chance is that there will be a total omission of the shades of the original, and that the recollection will be too highly coloured. This is an exceedingly important consideration as regards practical life; for these remembered emotions are the data for governing our present actions; and any inaccuracy in the record of past feelings will be the cause of mistakes and disappointments as regards the future. Desire and hope, which are based upon remembered emotion, are liable to be perverted by false remembrance, and it becomes every one's interest to take precautions for preserving a sound estimate of the joys and pains that are past. There is a logic of emo-

tional experience as well as of other experience; and in this search after truthfulness of feeling, natural temper and the momentary dispositions are the great sources of fallacy.

Accurate recollection of past emotional states is most easy in the more recoverable emotions; that is to say, the pleasure of a spectacle will be more closely reproduced than the pleasure of a repast. Next to this consideration we must rank, as a ruling circumstance, the goodness of the associating bond either in consequence of much repetition or on account of the natural force of contiguous adhesiveness inherent in the character. In other words, we shall remember most accurately what we have experienced oftenest; and an intellectual and retentive mind will have a chance to be faithful in the recollection of pleasures and pains; a fact which is very much in favour of the sound guidance of the intellectual man's life. Then, too, there is to be taken into the account the habit of attending to one's states of mind; when this habit exists we make at each important epoch of our feelings a sort of estimate for future purposes, likely to be much more accurate than the recollection would be apart from such an estimate. There are occasions when a person should write down their feelings in order to preserve the most faithful record that can be had of them, just as a scientific observer distrusts recollection in the details of complicated facts. Such an occasion for carefully recording the feelings at the moment is furnished when one is making the experiment of new pleasures and new modes of life; for with many minds the memory of such feelings after a time, or in an altered situation, would be most treacherous. The difference between a faithful and a perverted recollection of past emotions, is the difference between reason and imagination as applied to present conduct.

48. It will not be out of place to select a few examples of the association of the deeper emotions of the mind with the notions that we have of outward things, by which connexion these emotions also can be made present in the absence of their proper stimulus. The emotions of tenderness, self-complacency, irascibility, terror, &c., when stimulated repeatedly in the presence of some one object, enter into mental partner-

ship with that object, and the two individuals of the couple are thenceforth able to revive each other, the object recalling the emotion, and the emotion restoring the object.

The emotion of natural tenderness is brought out chiefly towards sentient beings, and comes after a time to flow habitually in connexion with certain persons or living creatures, who are then said to be objects of affection or attachment. The feeling, moreover, overflows upon places and things, stimulating a tender regard towards inanimate nature. The associations with home, with one's native spot; with the tokens of friendship and the relics of the departed, are made powerful by all the causes that give force to the contiguous bond. The natural abundance of the emotion in the character, repetition, a good natural adhesiveness, the disposition to cultivate this peculiar region of associations, all contribute to strengthen the link that enables persons or things to diffuse tender feeling over the mind. There are some mental constitutions that have a natural retentiveness for special emotions, just as there are intellects retentive of visible pictures, music, or language; this retentiveness is not at all identical with the power of being moved by the full reality of an emotion. Such persons are peculiarly qualified to cultivate associated feeling, to derive pleasure from the relics and the memory of affection, and to make this pleasure an object of pursuit in life. All their actions that have reference to objects of special emotion become imbued with derived or associated feeling.

The illustration for objects of hatred and aversion, and for all the outgoings of the irascible passion, would be almost parallel to the above. This passion connects itself with persons, with places, things, events, &c., and may be revived by objects that of themselves have no natural power to stir it up. We are apt to feel an aversion to places where we have suffered deep injuries, and to the unwitting instruments of calamity and wrong. There is a certain moral effort sometimes needed to prevent the passion of hatred from spreading too widely over collateral and indifferent things. Minds at once irascible and weak have generally an excessive amount of associated dislikes.

Egotistic and selfish emotion diffuses itself over all matters related to self; and the objects that a man surrounds himself with come to reflect the sense of his dignity and importance. According as this feeling is indulged, associations grow up between it and a great variety of things. Possessions, office, the fruits of one's labour, the symbols of rank, are all overgrown with this connexion, and radiate the feelings of self-complacency and importance to the mind. The members of one's family are objects not simply of tender affection, but of affection and egotism combined. So with friends, and with all the objects of our habitual admiration. It is impossible to be in the constant practice of loving or admiring anything, without coming at last to connect the object with self; the disinterested regard that first attracts us to persons, becomes, by indulgence, interested affection.

The pleasure of *money* is a remarkable instance of associated emotion. The sum total of purchasable enjoyments becomes linked in the mind with the universal medium of purchase, and this medium grows into an end of pursuit. In the first instance, we are stimulated by these other pleasures, but an affection is often generated at last for money itself. This transfer is brought about when we allow ourselves to be so engrossed with the *pursuit* of wealth, that we rarely advert to the remote ends or the purchasable pleasures; the mind dwelling solely on the one object that measures the success of our endeavours. A moderate pursuit of gain, that leaves the mind free to dwell upon the pleasures and advantages that money is to bring, does not generate that intense affection for gold as an end which constitutes the extreme form of sordid avarice.

49. *Alisonian Theory of Beauty.*—This celebrated doctrine precisely exemplifies the case of contiguous association now in hand, in so far as we are disposed to admit the applications that its author makes of it. That he has carried his theory of associated pleasure too far might, I think, be shown in numerous instances. We have already seen that all the senses yield us sensations that are in themselves pleasurable without reference to any associated effect. There are fragrant odours,

sweet sounds, and pleasing effects of light and colour, in which the pleasure is owing to a direct and immediate action of the objects upon the organs of sense, and these pleasurable feelings never fail to be produced when we are in a condition to enjoy them. There would be nothing permanently or generally pleasing if we had not a certain number of such primary sources of enjoyment.

The doctrine of Alison satisfactorily explains the strong effects often produced on our minds by sensations and objects in themselves indifferent or wholly unequal to those effects. A few instances of this nature may be quoted as true examples of borrowed or associated emotion. To take the case of sounds: 'All sounds,' says Mr. Alison, 'are in general SUBLIME, which are associated with ideas of great Power or Might; the Noise of a Torrent; the Fall of a Cataract; the uproar of a Tempest; the Explosion of Gunpowder; the Dashing of the waves, &c.' Most of these sounds, however, are intrinsically impressive from their intensity and volume, and the effect that they have on the mind is not wholly due to association. The following is a better selection for the purpose in hand. 'That the Notes or Cries of some Animals, are Sublime, every one knows; the Roar of the Lion, the Growling of Bears, the Howling of Wolves, the Scream of the Eagle, &c. In all those cases, those are the notes of animals remarkable for their strength, and formidable from their ferocity.' In like manner, the Author exemplifies associations with the feeling of Beauty, as follows:—'The Bleating of a Lamb is beautiful in a fine day in spring; the Lowing of a Cow at a distance, amid the scenery of a pastoral landscape in summer. The Call of a Goat among rocks is strikingly beautiful, as expressing wildness and independence. The Hum of the Beetle is beautiful on a fine summer evening, as appearing to suit the stillness and repose of that pleasing season. The Twitter of the Swallow is beautiful in the morning, and seems to be expressive of the cheerfulness of that time.' A similar illustration can be derived from Colours and appearances to the eye. The impressive emotion roused by the discharge of thunder can be evoked by the transient flash in the window, an effect in itself very trivial, but able to recal the grander features of the phenomenon, and through these the emotion that we call the sublime. The relics of a storm, seen in the disorder and wreck, recal the feeling impressed by the height of its fury. The language that describes such phenomena, when aptly used, can arouse the emotions purely by the force of association. In proportion to the strength of the emotion, or of that feature of it that arrests and engrosses the mental movements, is the firmness of the adhesive link between it and those various accessories. Hence the very great influence of an element of awe, in such cases. Terror in every form is an engrossing passion, and lends this power to all emotions that it mixes with.

Alison extends the illustration of his doctrine to Forms and Motions as well as sounds and colours, and supplies examples in great abundance under all these heads. I believe he has here too in many instances put forward intrinsic effects as the effects of association, but, nevertheless, he has left no room for doubting that the associating principle operates largely in clothing indifferent objects with a power to raise emotion in the mind of the beholder.

There is, I am satisfied, a primitive influence in Form to produce a certain amount of emotion of the kind that enters into the compositions of Art. Curved forms and winding movements yield of themselves a certain satisfaction through the muscular sensibility of the eye. Yet we must add to this original impressiveness an influence of association; namely, the connexion of Ease and abandon with the curving line, and of Constraint with the straight line. The free movements of the arm make circular figures; to draw a straight line requires a painful effort.

In everything of the nature of a Tool or a machine, there are certain appearances that are pleasing to behold, as suggesting Fitness and Ease in their application to the end. A clear polish upon steel has this effect, while red rust is painful from the suggestion of a harsh grating action. So the absence of noise in the working of a machine gives us the agreeable feeling of smooth, easy action.

Before passing from this subject, I may remark that there is a certain refining effect frequently produced by keeping the original cause of a feeling at a distance, and viewing it thus through a medium. Thus the sensation of healthy functions is one of our principal enjoyments; the hue and fulness that are the outward aspect of health are pleasurable by association, and according to Alison are beautiful; the one degree of remove from direct consciousness converts a sensual pleasure into a sentimental one. Waving corn-fields, heavy and ripe, are agreeable objects by association with the supply of our bodily wants, and the delight is refined upon by keeping at some distance the actual and ultimate sensations that give all the force to the appearance. A feeling that in the reality would be called by comparison gross and sensual, becomes sentimental when the mind has some intervening object to rest upon.

50. *The reading of Emotional expression.*—An interesting case of associated feeling is our being able to interpret the signs of feeling in our fellow-beings, by which we are not merely made aware of their state of mind, but also derive a large amount of pleasurable and painful feeling in ourselves. The influence of the smile or the frown, so powerful in human life, is purely an associated influence. There is nothing intrinsic in the lines and forms of feature displayed in the act of smiling to cause the pleasure occasioned by this manifestation. Incidentally fine forms and curves may be produced in a face, and there may be a display of beautiful tints over and above, but when these things occur they make so much additional pleasure, they do not originate the pleasing effect of the act itself.

The meaning of a smile, together with the susceptibility to the cheering influence of it, are learnt among the early acquisitions of infancy. The child comes to see that this expression accompanies the substantial pleasures that need no association to give them their character. The smile of the parent, or of the nurse, means all the agreeables of food, dress, play, spectacle, excitement, society. The frown is as invariably connected with privation and pains. An enduring association thus obtains between one cast of feature and all the good things of life, and between another expression and the ills that human power can inflict; and hence the one is able to diffuse a gladdening influence, while the other tends to excite a feeling of depression and gloom. All through life we are subject to these influences of associated emotion. So there are tones of voice that in the same way can cause pleasure or pain by a power of suggestion. In this case, however, there is a certain intrinsic efficacy in the tones usually adopted to convey the intended effect. For conveying love and approbation we choose our soft and gentle tones; for the opposite we are led both by passion and by choice to use tones that are painful and grating. I cannot discern any original or intrinsic difference of effect between pleased and angry features, but in vocal utterance there is a manifest suitability of some tones for pleasing expression, and of others for the reverse.

There are many of our strong likings on the one hand, and strong antipathies on the other, that come under the class of reflected influences. The sight of blood affects some persons to fainting, which cannot be owing to anything in the mere appearance of it; apart from association, the rich scarlet hue would make this a really agreeable object to the eye.

ASSOCIATIONS OF VOLITION.

51. I have already adverted to the mistake committed by Reid in pronouncing the voluntary command of our limbs and other moving organs instinctive. If we observe the movements of infancy, we see plainly that for many months there is no such thing as a command of the active members in obedience to an aim or purpose present to the mind. An infant may have sufficient intelligence to form a wish, and be quite unable to execute the simplest movements for attaining the thing wished. A common example of this is the attempt to seize something with the hand, as a spoon; we see the most awkward movements occurring, evidently from the entire want of any definite direction of the limbs at that stage.

This definite direction is acquired; and the acquisition is the most laborious and difficult of all human attainments. The performance of the simple movements that we wish to perform, is the basis of our acquirement of more complex movements at a subsequent stage; but our first education is self-education. Until a child can of its own accord put its hand out and seize an object before its eyes, which for the first few months it cannot do, any attempt to direct it is in vain; and until of its own accord it can move its own body as it sees something else moved, it has not begun to be an educable being.

The voluntary command of the organs implies the following things. 1st. The power of continuing or abating a present movement in obedience to a present feeling, as when the child sucks while the appetite is gratified, and ceases when satiety comes on. This is a primary fact of the human constitution; it exists from the commencement of sentient life, and is not communicable by any known method. So far, therefore, Volition is an Instinct. 2ndly. The power of *beginning* a movement in order to heighten or abate a present feeling, as when the child directs its head and mouth to seize the nipple, and begins sucking. There may be a few instances of instinctive movements of this kind, but in general they are acquired, being determined by means of association. The coincidence of the movement and the feeling must be first accidental; the movement springing up of its accord, and finding itself able to control the feeling, the two become after a time so firmly connected that the one suggests the other. Thus the movement of the eyes and head is at first spontaneous, but the agreeable feelings of light brought on by these movements prompt their continuance, and the pleasure gets to be associated with these movements; whereupon when this feeling is present to the mind as a wish, it prompts the requisite exertions. Thus it is that a child learns to search out a light in a room in order to enjoy the maximum of the illumination; it learns to turn its view to the fire, or the window, or some face that it has begun to recognise agreeably. Volition means, 3rdly, the performance of some intermediate actions in order to gratify the sense; as when things are seized with the hand in order to be carried to the mouth, and when animals, recognising their food at a distance, set themselves to move forward to lay hold of it. These intermediate actions are most manifestly the result of experience, in the human subject at least. The power of locomotion has first to be developed, and being put in exercise the exertion becomes associated with its various consequences, and among others that of bringing the individual within reach of the objects of its desires. 4thly. The voluntary command of the organs means the power of Imitation, or of performing actions in consequence of seeing them performed. Here a link has to be established between a certain appearance to the eye and the movement of corresponding organs in the individual's self; or in the case of vocal imitation, a sound is the antecedent of an utterance, each sound heard being associated with a distinct movement of the chest and larynx, under the proper attitudes of the mouth. It is not uncommonly supposed that imitation, both of actions and sounds, is instinctive; but I believe the supposition is incorrect. 5thly. Under volition we understand the power of moving our organs merely on the wish to see them moved; as when I look at my hand, and will to raise it. Here a connexion is formed between the sensible appearance of any member, or the idea left by that sensible appearance, and its being moved. Lastly, we can make a movement on being directed to do so by naming the part; 'up head,' 'down hands,' &c. This is a further association, formed between certain names or sounds and a particular class of movements. All these various actions are employed in the most elementary efforts of the will to control the body. Others could be named that transcend their range of influence, as, for example, the control of the passions and the command of the thoughts.*

* The following are notes of observations made upon the earliest movements of two lambs seen during the first hour after birth, and at subsequent stages of their development. The two came from the same mother, and their actions were in the main alike.

One of the lambs on being dropped was taken hold of by the shepherd and laid on the ground so as to rest on its four knees. For a very short time,

52. In order to illustrate the acquired character of these several voluntary actions, excepting always the first, I shall select the case of Imitation. If we can prove to satisfaction

perhaps not much above a minute, it kept still in this attitude. A certain force was doubtless exerted to enable it to retain this position; but the first decided exertion of the creature's own energy was shown in standing up on its legs, which it did after the pause of little more than a minute. The power thus put forth I can only describe as a spontaneous burst of the locomotive energy, under this condition, namely, that as all the four limbs were actuated at the same instant, the innate power must have been guided into this quadruple channel in consequence of that nervous organization that constitutes the four limbs one related group. The animal now stood on its legs, the feet being considerably apart so as to widen the base of support. The energy that raised it up continued flowing in order to maintain the standing posture, and the animal doubtless had the consciousness of such a flow of energy, as its earliest mental experience. This standing posture was continued for a minute or two in perfect stillness. Next followed the beginnings of locomotive movement. At first a limb was raised and set down again, then came a second movement that widened the animal's base without altering its position. When a more complex movement with two limbs came on, the effect seemed to be to go sideways; another complex movement led forwards; but at the outset there appeared to be nothing to decide one direction rather than another, for the earliest movements were a jumble of side, forward, and backward. Still, the alternation of limb that any consecutive advance required seemed within the power of the creature during the first ten minutes of life. Sensation as yet could be of very little avail, and it was evident that action took the start in the animal's history. The eyes were wide open, and light must needs have entered to stimulate the brain. The contact with the solid earth and the feelings of weight and movement were the earliest feelings. In this state of uncertain wandering with little change of place, the lamb was seized hold of and carried up to the side of the mother. This made no difference till its nose was brought into contact with the woolly skin of the dam, which originated a new sensation. Then came a conjunction manifestly of the volitional kind. There was clearly a tendency to sustain this contact, to keep the nose rubbing upon the side and belly of the ewe. Finding a certain movement to have this effect, that movement was sustained; exemplifying what I consider the primitive or fundamental fact of volition. Losing the contact, there was as yet no power to recover it by a direct action, for the indications of sight at this stage had no meaning. The animal's spontaneous irregular movements were continued; for a time they were quite fruitless, until a chance contact came about again, and this contact could evidently sustain the posture or movement that was causing it. The whole of the first hour was spent in these various movements about the mother, there being in that short time an evident increase of facility in the various acts of locomotion and in commanding the head in such a way as to keep up the agreeable touch. A second hour was spent much in the same manner; and in the course of the third hour, the animal, which had been entirely left to itself, came upon the teat, and got this into its mouth. The spontaneous workings of the mouth now yielded a new sensation, whereby they were animated and sustained, and unexpectedly the creature found itself in the possession of a new pleasure; the satisfaction first of that this is not instinctive, but acquired, little doubt will remain on the other cases.

The imitations practised in early life are, first, the vocal, led by the ear,—speech, song, and cadence; secondly, the external organs led by the eye,—the hands, feet, trunk, head, and mouth; and thirdly, the features, which we are longer in acquiring a command over. I speak not at present either of the complex case of dramatic imitation and mimicry, or of the sympathies with emotion, as in laughter, tears, &c.

(1.) The first argument against instinctive imitation is the fact that no imitation whatever takes place during the first few months of infant existence. So far as my observation goes, there is very little during the first year. But a primitive impulse ought to show itself much earlier than this. The instinctive movements discussed in the preceding Book show

mouthing the object—next, by-and-bye, the pleasure of drawing milk; the intensity of this last feeling would doubtless give an intense spur to the co-existing movements, and keep them energetically at work. A new and grand impression was thus produced, remaining after the fact, and stimulating exertion and pursuit in order to recover it.

Six or seven hours after birth the animal had made notable progress. Locomotion was easy, the forward movement being preferred, but not predominant. The sensations of sight began to have a meaning. In less than twenty-four hours, the animal could at the sight of the mother ahead, move in the forward direction at once to come up to her, showing that a particular visible image had now been associated with a definite movement; the absence of any such association being most manifest in the early movements of life It could proceed at once to the teat and suck, guided only by its desire and the sight of the object. It was now in the full exercise of the locomotive faculty; and very soon we could see it moving with the nose along the ground in contact with the grass, the preliminary of seizing the blades in the mouth.

I am not able to specify minutely the exact periods of the various developments in the self-education of those two lambs, but the above are correct statements to the best of my recollection. The observations proved distinctly these several points, namely, first, the existence of spontaneous action as the earliest fact in the creature's history; second, the absence of any definite bent prior to experienced sensations; and third, the power of a sensation actually experienced to keep up the coinciding movement of the time, thereby constituting a voluntary act in the initial form. What was also very remarkable, was the rate of acquisition, or the rapidity with which all the associations between sensations and actions became fixed. A power that the creature did not at all possess naturally got itself matured as an acquisition in a few hours; before the end of a week the lamb was capable of almost anything belonging to its sphere of existence; and at the lapse of a fortnight, no difference could be seen between it and the aged members of the flock.

themselves from the very commencement of life. There is no new development or manifestation of power at the time when the imitative propensity comes on; there is nothing parallel to the physical changes that show themselves at puberty along with the new feelings of that period. The child is seen to go through a great deal of active exertion of its own in the course of those unimitative months; the power of repeating the actions of others would be exceedingly valuable at this time, and would save much fruitless endeavour; but in truth, the very faintest tendency in this direction cannot be discerned for nearly a whole year after birth. There may be instances of a more precocious faculty than any that I have observed, but these would not affect in any material degree the present argument.

(2.) In the second place, imitation, when it does begin, is slow and gradual in its progress; a fact that looks like acquisition, and not like Instinct. We find, for example, that in speech the imitation is at first limited to one or two articulations, and that others come on by degrees at considerable intervals. If there were any primitive connexion in the brain between a sound heard, and the reproduction of that sound with the voice, it ought to be as good for one letter of the alphabet as for another. So with the movement of the hand; why should one be possible while no amount of example will bring out another, not in itself more difficult?

(3.) The imitation very often fails after it has once been hit. A child has caught a certain sound, and will at particular times produce it, and yet at other times there may be no possibility of bringing on the utterance. This is constantly seen in the first efforts of children. It is in vain that we repeat in their ear a sound, a letter, or a syllable that they have shown themselves able to pronounce; the association between the audible impression and the specific vocal exertion has plainly not yet been formed; it cannot therefore be instinctive. The child has in the course of its spontaneous articulate movements come on the sound *hum*, and this sound once pronounced is likely to recur in the cycle of its spontaneous actions, but to utter the syllable at the instance of another person's utterance is something additional. As an acquisition, I can easily render to myself an account of the process. The sound spoken is also heard; besides the vocal exertion there is a coincident impression on the ear; an association grows up between the exertion and the sensation, and after a sufficient time the one is able to recal the other. The sensation anyhow occurring brings on the exertion; and when by some other person's repeating the syllable, the familiar sound is heard, the corresponding vocal act will follow. Experience, I think, proves that the time that elapses between the ability to utter a sound, and the readiness to utter it on its being heard, corresponds to the time requisite for an adhesion to grow up between two heterogeneous elements, the one a spontaneous action, the other a sensation. These early sounds come out more frequently of themselves than under the stimulus of imitation, which proves that the exertion precedes the power of imitating.

To assert that imitation is instinctive, is to maintain the existence of an infinity of pre-existing associations between sensations and actions. Every letter of the alphabet, and every word, would require to be connected by a primitive adhesion with the movements of the larynx and mouth, whereby they are uttered. Every movement of the hand would need to be associated with the visible appearances of the same movement in other human beings. We should have to affirm the manifest absurdity that associations could be formed between things yet unexperienced; between sounds, and sights, and actions, long before anything had been heard, seen, or done.

(4.) It is notorious to observation, that more is done by the nurse imitating the child, than by the child imitating the nurse. When an articulation is stumbled on, it is caught up by all around, and the child is made familiar with the sound as proceeding from other voices, in addition to its own. This would obviously promote the growth of the needful adhesive connexion.

(5.) Imitation follows the spontaneous displays of activity, and is greatest in cases where the spontaneous variety and flexibility are good. A child will learn to imitate singing according as, of its own accord, it falls into musical notes. Its own native song must come first: the goodness of that will be a condition of its acquiring the song of others. In whatever department any individual shows spontaneous and unprompted facility, in that department will the same individual be imitative or acquisitive. This makes the connexion between native parts and high acquirements in everything,—mechanical skill, fine art, business, science.

(6.) Imitation progresses with the acquired habits. In learning to dance, the deficiency of the association between the pupil's movements and the sight of the master's, renders the first steps difficult to acquire. The desired movements are not naturally performed at the outset. Some movements are made; sufficient voluntary command of the limbs and body has been acquired, in other shapes, to set a-going action of some kind; but the first actions are seen to be quite wrong; there is a manifest want of coincidence, which originates a new attempt, and that failing, another is made, until at last we see that the posture is hit. The grand process of trial and error brings on the first coincidence between a movement and the appearance of that movement in another person; while repetition of the coincidence leads to a cohesion sufficient to render the imitation perfectly easy. Upon this acquisition other new acquisitions of the same kind are based, and the improvement is accelerating. Thus it is that we pass through an alphabet of imitation in all arts; the fixing of the association, in the case of the first links, is the most difficult part of the process.

(7.) It is in harmony with all that has now been advanced, that imitation depends likewise on the delicacy of the sense that perceives the effect. A fine and retentive musical ear is one of the essentials of musical imitation; the natural or spontaneous production of musical tones being the other essential. The delicacy of the ear means its discriminative power; the retentiveness includes the power of forming associations with the voice, or any other mechanical effort. A delicate appreciation of the positions of the fugleman, and a tenacious retention of that class of impressions, helps the recruit forward in his imitative exercises.

This is not the place to exhaust the subject of Imitation in particular, or of the acquisitions that enter into volition in general. It is enough, for the present, to show that the associative principle is an indispensable requisite here as elsewhere. All the conditions already specified, as affecting the rate of adhesiveness in other acquirements, might be exemplified likewise in these. The great peculiarity in their case arises from the circumstances of their commencement. Being the starting point of every other branch of education, they must find their own way through struggles and accidents, trials and failures. Reposing upon the great fundamental link between consciousness and present action,—between pleasure or pain, and the activity happening at the time,—they come at last to supply definite connexions between our feelings and exertions, so as to enable us not merely to control a movement at work, but to call dormant actions into being at the instance of our reigning emotion.

Of the various circumstances affecting the progress of these volitional associations, the engagement of the cerebral energy or concentrated attention is of signal consequence. This condition, necessary at any age, seems the all-important one in the early months of our existence. The moment of an acquisition seems generally to turn upon some happy concurrence of aroused attention or mental engrossment with the action: an impression not detained for a time by the influence of some feeling is void of effect. When the child hits upon an exercise that gives it pleasure, and is thereby led to repeat the act, earnestly and intently, the occasion is sure to be a good one for a sensible advance in fixing the whole connected train. The first discovery of being able to blow with the mouth, and set light objects in motion, would be an instance of what I mean.

NATURAL OBJECTS—AGGREGATES OF NATURAL QUALITIES.

53. One of the principal forms of human intelligence consists in a permanent hold of the external world as it strikes the senses. The more perfectly we can anticipate the appearances of nature while they are yet out of sight, the better able are we to calculate our way and regulate our actions.

External objects usually affect us through a plurality of senses. The pebble on the sea shore is pictured on the eye as form and colour. We take it up in the hand and repeat the impression of form, with the additional feeling of touch. Knock two together, and there is a characteristic sound. To preserve the impression of an object of this kind, there must be an association of all these different effects. Such association, when matured and firm, is our idea, our intellectual grasp of the pebble.

Passing to the organic world, and plucking a rose, we have the same effects of form to the eye and hand, colour and touch, with the new effects of odour and taste. A certain time is requisite for the coherence of all these qualities in one aggregate, so as to give us for all purposes the enduring image of the rose. When fully acquired any one of the characteristic impressions will revive the others; the odour, the sight, the feeling of the thorny stalk,—each of these by itself will hoist the entire impression into the view. Should we go to work and dissect the flower botanically, we shall obtain new impressions to enter into the common aggregate.

The rapid association of these qualities, the quick adhesion of the sensations of sight, touch, &c., into an intellectual product, enables us to acquire a large stock of impressions corresponding to mineral and vegetable bodies. This is the gift of the naturalist, who, having to retain in his mind many hundreds or thousands of distinct notions, must not put off time in the work of acquisition. In him the sensations of sight and touch must be vigorous and enduring. Mere colour and its varieties must make an abiding impression; unmeaning shapes also must be easily remembered. The persistence of

NATURAL AND HABITUAL CONJUNCTIONS—STILL LIFE.

55. The things about us that maintain fixed places and relations become connected in idea as they are in reality, and the mind thus takes on a phantasmagoric representation of our habitual environment. The house we live in, with its furniture and fittings, the street, town, or rural scene that we encounter daily,—by their incessant iteration cohere into abiding recollections, and any one part easily brings all the rest into the view. These familiar haunts exemplify the highest degree of pictorial adhesion that we can ever attain to, being impressed by countless repetitions and strong natural interest. We likewise associate a number of human beings with their abodes, dresses, avocations, and all other constant accompaniments.

Objects at a distance from our daily circle afford the best opportunity of trying the adhesiveness of the mind for extended pictures. A house we have visited only once or twice, a strange street, a new scene, will put to the test the visual persistence of the character. This case resolves itself partly into the case of coloured impressions, and partly into that of visual forms, the tenacity for colour being the essential point. A coloured decoration is quite irrecoverable if the sense of colour is not very powerful; the same may be said of a heterogeneous and formless collection of ornaments or curiosities. The recollection of dresses turns principally upon the hold we have of colour. The interior of a room implies form, and may be retained as such; but if the sense of colour is indifferent, it will be revived only in outline. A garden, a shrubbery, an array of fields, rely very much upon the coloured element. The more irregular the outlines of things are, the more do we depend upon our tenacity of coloured impressions to make them cohere.

For the easy retention of the variegated imagery of the world about us in all its richness, a powerful adhesiveness of colour is the first requisite. Whether this adhesiveness and persistence is a property of the eye and its nerve centres, or of the cerebrum generally, I cannot say; but wherever it occurs it is a powerful determining circumstance of the character. It gives to the mind a pictorial character, an attraction for the concrete of nature, with all the interests that hang upon it. We have just seen that it is one of the qualifications of the naturalist; it is also the general basis of character in the painter and poet, for although both these have to select from the multitude of appearances such of them as have an interest in art, yet it is well that they should easily keep a hold of anything that presents itself to the eye, whether beautiful or not. A luxuriant imagination proceeds on the facility of retaining scenes of every description; nothing less could sustain the flow of our greatest poets. Although all objects are not beautiful or picturesque, yet there is hardly any appearance that may not come in well in some composition, and the poet-painter ought to be a person of strong disinterested retentiveness for everything that falls on his view. Any one stopping short at this point would be a naturalist simply; but when the poetic sense is added to lay a special stress upon the beautiful, grand, or touching objects, the naturalist passes into the artist. A strong artistic sense, without the broad disinterested hold of nature's concretes in general, may make a man a genuine or even an exquisite artist, but thin and meagre in his conceptions; great taste with feeble invention. Instances both of this and of the opposite coincidence—richness without delicacy—occur in all the fine arts.

It will thus appear that no great difference obtains between the last head and the present, as regards the faculty at work. The aggregate of impressions in a single mineral, or plant, is made coherent by the same force of growth that groups these individuals together into the totals that make up the face of nature. In the latter case we are more completely dependent on impressions of sight; in the others, tactual inspection often enters, but even in these, sight forms our principal hold and medium of discrimination. Between the apple that appeals to every sense and yields a complex notion made up of all, and the starry heavens that affect the eye alone, there is less of intellectual difference than there seems, for even the apple is retained in the mind principally as an object of sight.

56. Among the greater aggregates implied under the present head I may include those artificial representations intended to aid the conception of the outer world, as, for example, maps, and diagrams, and pictorial sketches. A very great utility is served by these devices, and much intellectual power and practical skill depend on our being able to associate and retain them. The geography of the globe is summed up in an artificial globe or a set of maps, with outline, shade, and colour, to correspond with the differences of sea and land, mountain and plain. There are very great differences among individuals in the hold that they take of a map, with all the information it conveys. It appears to me that a good adhesiveness for colour is the important element in a case of this kind, just as in the recollection of the actual surface of a country. It is a case of that easy retentiveness of a great multitude of impressions, that contrasts with the severe hold of a few selected ones; an extensive rather than an intensive mind. Next to a map we may class natural history sketches, which contain a great variety of appearance depending mainly upon differences of colour. Anatomical diagrams and machinery are much of the same nature, but incline to the diagrams of abstract science, where attention has to be strongly concentrated on narrow points. When we come to the figures of Euclid, colour entirely disappears as an element; the pictorial retentiveness above descanted on is of no avail. Form is everything, and that form is not various but limited, and exceedingly important. This illustrates by contrast the power of seizing nature's aggregates and concretes, where thousands of distinct impressions must fall into their places and cohere with ease and in a short time. A crowded theatre and the forty-seventh of Euclid are equally objects to the eye, and also to the conceiving mind when they are gone; but the region of the brain that determines the adhesiveness must be quite different in the two cases; in the one, colour and variegated form, in the other, a few regular forms with absence of colour. The pos-

session of this last class of objects is an example of the intensive adhesiveness required in the abstract sciences.

57. There is an interesting class of artificial conjunctions, wherein the obvious appearances of things are associated with other appearances brought out by manipulation and experiment. The properties of a mineral, the complete notion that we can attain respecting it, are a combination of the sight and touch with the artificial aspects made by a scratch, a fracture, the blowpipe, the application of an acid, the measurement of the angles. A complex impression is thus made up and, by repetition, stamped on the mind; and at an after time, any one of the characteristic properties will revive the total conception of the mineral. So in chemistry, each substance is conceived not simply as seen and handled by itself, but as acted on by many other substances, by changes of temperature and the like. The chemist's notion of sulphur is a large aggregate of appearances and sensations produced in various ways; it is, in fact, the notion of a great collection of substances—the compounds of sulphur—as odour of burnt brimstone, oil of vitriol, salts of sulphuric acid, compounds of sulphur with metals, &c. In like manner, the properties of a plant are not completely summed up and aggregated in the mind, till in addition to all the aspects it presents by itself, other plants are taken along with it, as of the same species, genus, and family. These cases are nearly parallel to an example occurring under the immediately preceding head, namely, tools and machinery, where the present aspect has to be augmented with other appearances manifested when they are put to their practical uses.

In these mineral and chemical aggregates there is great scope for proving the force of contiguous association, but still more for testing the disposition to dwell upon artificial combinations, the results of previous analysis or forced separation of natural conjunctions. Science, as I shall afterwards have occasion to illustrate, is painful from the necessity of dis-associating appearances that go naturally and easily together, of renouncing the full and total aspect of an object by which it engages agreeably the various senses, and of settling upon some feature that has no interest to the common eye. Those compounds of sulphur that have to be conjoined with the simple substance as a part of its idea, are constantly viewed by the chemist under the one aspect of composition or decomposition in the contact with other bodies; the appearance of any single substance to the eye signifies nothing, and may be wholly irrelevant to any purpose of his.

SUCCESSIONS.

58. If we except complex and coinciding muscular movements, and the concurrence of sensations through different senses at the same moment, all associations are successive to the mind, seeing that we must pass from the one to the other, both in the original experience and in the subsequent recollection. The features of a landscape can be conceived only by successive movements of the mind, as it can be seen only by successive movements of the eye. But I here contrast the successions, movements, events, and changes of the world, with still life, the status quo, or the contemporaneous aspect of nature, and I mean now to allude to the procession of the universe in time, as a consequence of the properties of movement and change impressed upon it.

We may notice first the successions that go round in a *cycle*, without shock or interruption, as day and night, the phases of the moon, the course of the seasons. The different aspects presented by the sky above and the world around, in the course of the solar day, are associated in our minds in their regular order, and anticipated accordingly. This cyclical association makes up one part of our knowledge, or experience, of the world, and guides our actions in accordance with it. These slow and tranquil changes become coherent under almost the very same conditions as the aspects of still life that we view in succession by moving from place to place. The two cases are very different in themselves, but to the mind the contemporaneous in reality is the successive in idea. The chief distinction lies in this, that the flow of moving nature is associated in one constant direction; whereas the succession of still nature is backward and forward in various directions. But the same mental adhesiveness that can embrace the one, will with equal facility embrace the other.

A second class, under the present head, is comprised by successions of *evolution*, as the development of a plant, or animal, through all its stages, from the germ to the decadence. The associations of these, as they occur in nature, make up our knowledge of the history of living things. The peculiarity of this case is the continuity and identity of the main subject, and the likeness that prevails in the midst of change. Both these circumstances assist in impressing the different stages upon the recollection. If we have already formed an enduring picture of a fir sapling, we have not much difficulty in conceiving the same merely expanded in dimensions, the form and texture remaining the same; and so with any other plant or animal. Where a creature undergoes a radical transformation, as a butterfly, or a frog, we have to conjoin two different appearances, and are therefore not so ready to retain the succession. In reality, however, the stages of evolution are more frequently learned by seeing them altogether on different subjects, as in a plantation of trees, or in the mixture of all ages in human society. The evolution of living beings, plants, or animals, in their growth and decay, usually excites a strong and interested attention, which operates in fixing the successive stages in the recollection. The same happens in historical evolutions, and it is particularly aimed at in the artificial evolutions of the drama and the romance. There is also a strong interest attached to the successive stages of a constructive operation, a process in the arts, a case in a court of law, or the course of a disease. A mind naturally adhesive to sensible impressions would, as a matter of course, acquire out of its opportunities of observation a large store of these successions, but the bent of interest concentrating the mind upon some, in preference to others, is perhaps the most operative circumstance. One man is engrossed with the progress of the field and the garden, from the seed to the fruit;

another looks with especial eye to the human development in body or in mind. The romantic interest seizes all classes, and fixes with ease the successions of a plot or story.

Apart from this circumstance of special interest in the unwinding of the future, the associations of evolution are not materially different from the conjunctions of still life, these being also unavoidably successive. The pages of a book, or the houses of a street, exist contemporaneously, but cannot be viewed otherwise than successively. The mind formed to associate with little repetition the flowers of the same garden-plot, can likewise retain the different phases of the growing plant. The lapse of time between the different views may occur when things are contemporaneous no less than when they succeed one another.

59. Relating to the recovery of trains of imagery there is a fact of the nervous system to be attended to; namely, that a mental movement once set on tends to persevere and feed itself. We can remark in the eye a tendency to continue in any motion once commenced, as in following a projectile, or sweeping round the sky line that bounds a prospect. The spontaneous vigour of the moving organs carries them forward in any direction that they may chance to enter on; and, in addition to the spontaneity of the active system, the stimulus of the sensation itself operates in sustaining a movement that has been commenced. Thus it is that the eye so naturally follows out a vista, or traces the course of a stream. Seeing the beginning of a straight line, or the fraction of a circle, we feel ourselves led on to the conception of other parts hidden from the view. A tall spire carries the regards upwards far into the heights beyond itself, while a descending current gives a downward direction to the bodily or mental eye. Just as we acquire an almost mechanical persistence in walking, or in handling a tool when once under way, so the sight falls into a given movement and goes on of its own accord along the line that has been chalked out for it. When our eye sweeps along the line of a procession, it acquires such a persevering tendency that it is apt to go beyond the termination until its view in that direction is completely exhausted. When a succession of

objects is very rapid, as in a railway train, it sometimes impresses a diseased persistence on the visual circles, and we feel the dizzying sensation of everything about us being still in motion. Like all the other actions of the brain, this persistency has a moderate and healthy pace, which easily subsides, and a hurried or diseased pace that we cannot check without great difficulty.

Now in the operation of recalling the steps or members of a succession at the prompting of those that go before, our recollection is aided by this tendency to go forward, or to leap from the one at present in the view to the next in order. This restless forward impulse, in some constitutions very strong, will not suffice of itself to recal the next member without an adequate adhesive growth between it and the preceding, but it counts for something in the act of recovering any object that we are in want of in that particular train. It determines very much the degree of rapidity of the mental action ; and from this circumstance gives a very marked character to the individual. It does not confer intellectual power,—this depends on the proper forces of the intellect—but it favours promptness and quickness in perceiving whatever it is within our power to perceive, a quality often useful in the emergencies of life. This attribute of mental movements whereby they are enabled to sustain themselves, is to be looked upon as one of the properties of the volitional energy of the brain.

60. The successions designated as *Cause and Effect*, are fixed in the mind by Contiguity. The simplest case of this connexion is that where our own actions are causes. We strike a blow, and a noise succeeds, with a fracture. The voluntary energy put forth in the act becomes thenceforth associated with the sound or the breakage. It may be remarked that hardly any bond of association comes sooner to maturity than the bond between our own actions and the sensible effects that follow from them. There are reasons for such unusual rapidity of growth ; certain circumstances can be mentioned that favour the concentration of the mind upon this particular sequence.

In the first place, these effects are often themselves energetic, startling, and impressive. This is indicated by the employment of the word 'effect' to mean what yields a strong sensation, something that takes the mind by storm, and excludes for the time all other objects of attention. The stronger kinds are those that produce some startling change in the still routine of things. The firing of a cannon in the quiet of the night; the shattering of a window; the upsetting of a table covered with crockery; the kindling of a conflagration; the taking away of a life,—are all intensely exciting to the nervous system; and the excitement takes the particular form of engrossing the entire action of the mind for a length of time. It becomes difficult to form any other adhesions at such a moment; the wits are occupied in the direction given by the violent stimulus. One single occasion is sufficient to connect in the mind for ever one of these startling events with its immediate antecedent or cause. According as the effects are milder in their character, their connexion with the causes is less speedily established in the circles of the brain. But as a general rule, causation, when distinctly apparent,—that is, when the two or more members of the succession are clearly ascertained and contemplated by the mind,—impresses itself much more easily than the successions of things in a sweep of landscape, or the stages of vegetable or animal life. There is in man a natural liking for effects, owing to the mental stimulus they give; and much of the pleasure of life is made up of this kind of excitement.

But we must remark, in the second place, that the active impulses of human nature, which are in many instances the causes of the effects we see, and are assumed as the type of all other causes, are very easily impressed on the mind as permanent ideas; that is to say, it is easy to recal the notion of any action of ours that has been concerned in producing a startling change. Our moving members being always with us, their movements are the most familiar facts that we possess; it is easy to remember a kick, a wrench, or any other common action. Hence in a succession of two steps, one a familiar action of our own, the other a striking effect on our senses, the first is already formed into a permanent idea by repetition, and the second arrests a powerful current of attention, and the fixing of the two is therefore comparatively rapid and sure. Unfamiliar actions as causes are not readily remembered; hence effects of intricate construction and mechanism do not impress themselves without due repetition.

In imagining the causes of unknown effects, human power is the first thing to suggest itself from the facility the mind has of entering into this cause, and also from the pleasure derived by the very idea of human energy put forth in the accomplishment of effects. The universal tendency to personify all the powers of nature has its origin in this circumstance; and is a confirming illustration of what I have been endeavouring to enforce in the present paragraph.

61. The action and reaction of one man on another is a notable example of cause and effect, under circumstances favourable to an impressive recollection. In this case, both the cause and the effect are human manifestations, readily conceivable from the fact that we ourselves have been frequently actuated in the same way. When we witness, for example, an encounter of hostility, both the provocation and the retort are actions that we can completely realize from our own past experience. Here, too, as in the cases above noted, the rousing of a human being from quiescence to animation, is a startling effect which arrests and impresses the beholder. Most persons are susceptible to these sudden changes in the expression of living beings; they constitute a great part of our interest in society and in the drama. By noting those various movements of expression in connexion with the causes of them, we become impressed with innumerable sequences of cause and effect, of which one member can at any time recal the other; and the recollections thus formed make up a large portion of our knowledge of the ways and characters of mankind.

Some minds are peculiarly susceptible to this class of effects; the movements that constitute the expression of men and animals take a deep hold of their attention, and are proportionably impressed on the memory. Such minds are thereby rendered more than usually knowing in human nature;

while at the same time they feel a lively interest in the numerous manifestations of living creatures.

62. Our impression of any individual man or woman is made up of their permanent image and their various movements and activity in a number of situations and circumstances. These, repeated to our view, at last fix themselves in our mind with sufficient force to be revivable on the occasion of any link being present. Thus we have seen a person made angry by a blow; we connect the occurrence with the anger in our minds, and this connexion is an item of our knowledge of his character. When the anger is brought before our view we are reminded of the blow as a cause; when the provocation is present, it recals the anger. We can use this sequence for the purpose of either avoiding or bringing on the effect; we can generalise it as a fact of human nature in general; we can reproduce it dramatically; we can explain other men's anger by it. Other sequences come in addition to this, and by sufficient length of time and opportunity we can associate together cause and effect through the whole cycle of an individual's ordinary actions. We are then said to know the person. Our knowledge of animals is of the very same nature.

The peculiar susceptibility to the human presence now spoken of may arise out of several different sources. The natural history sense makes all visible imagery impressive, and the human face and form among the rest. The susceptibility to visible movements is a distinct element wherein minds differ, and with it is connected the sense of forms, and particularly the human. The sympathetic disposition as contrasted with the egotistic, or self-engrossed, is in favour of the same turn for noticing other people's ways. The artistic sense finds much of its material in the human subject and is thereby made alive to the manifestations of living men. To all these causes of special attention to the phenomena of humanity, we are to add the strong passions and emotions that have our fellow beings for their subjects, and we shall then see how it comes that the natural, if not 'the proper study of mankind is man.' The interest of external nature viewed by itself is cold in comparison, and hence its sequences make a much smaller part of the acquired ideas of causation in the generality of minds than those relating to living men and women.

In the foregoing view I have purposely omitted the mention of *scientific* causation.

MECHANICAL ACQUISITIONS.

We have now touched on what I consider the chief fundamental classes of associated things under Contiguity. In what remains of this chapter no new case will be introduced. What is now proposed is to carry out the illustration of some of the preceding heads into the principal departments of intellectual acquirement.

63. Under Mechanical Acquisitions we include the whole of handicraft industry and skill, as well as the use of the bodily members in the more obvious and universal actions of daily life. Military training, the exercises of sport, recreation, and amusement, the handling of tools in every kind of manual operation, the care of the person, are all so many acquired or artificial linkings of action with action, or action with sensation, through the operation of the adhesive force of the brain.

I feel no doubt that the first condition of high success in all these acquirements is the existence of a vigorous and various spontaneity of the active organs concerned; the forces of the brain must especially direct themselves into the channels of bodily movement. This makes the active temperament, the natural turn for active display. When such is the primitive arrangement of the machinery of the nervous system, the movements once commenced are speedily fixed into the routine of habit. To this spontaneity we must continually recur as the origin of all voluntary power or active acquirement.

The delicacy of the senses concerned in the effect to be produced must also be taken into account when we would enquire into the sources of bodily acquisition. If the operation is to make a paste, or to bring out a polish, the touch is the testing organ, and must have the requisite delicacy; if the work is judged by colour, the eye must be duly sensitive; if to play on an instrument, the ear must discriminate the shades of sound. However flexible and powerful be the active organ, it can never transcend the effect produced. The most delicate fingers are useless for musical performance when the ear is unsusceptible of a corresponding delicacy of musical perception.

These two conditions being recognised, we may next assume that there is a certain force of adhesiveness belonging to each individual character, in some more and others less. It is difficult to demonstrate that such a difference remains after allowing for all circumstances and conditions; on the other hand, it would be still more difficult to show that it does not exist. In our experience of human beings we are accustomed to every imaginable form of inequality within certain limits; the stature, bulk, complexion, muscularity, digestive and respiratory vigour, circulation,—are constantly varying, and the functions of the brain cannot be proved to be free from the like inequalities among individuals.

Much more modifiable than these three conditions, although still, as I believe, growing out of the natural character, is the tendency to concentrate the energy of the brain upon bodily exercise, through the medium of the fascination that it gives, or the agreeable emotion connected with it. This fascinating and agreeable emotion maintains the cerebral currents in that particular channel in preference to others, and brings on the plastic adhesion in a corresponding degree. For example, when the operation of drawing or sketching has from any cause a peculiar charm and power of satisfying the mind, it draws the entire stream of mental attention upon itself; the individual is never weary of the occupation; the adhesive action is monopolised upon one subject, instead of being distributed over many. This circumstance determines special mechanical gifts and acquirements, even when the natural activity is equally distributed over all the members.

64. We must now advert to the circumstances favouring mechanical acquisition that depend not on the inborn peculiarities, but on the manner of going to work. This is the practical point. The training of recruits in the army may be

taken as a good example of how mechanical discipline should be conducted. As I am informed, the system there pursued is this; the recruits are drilled three times a day, morning, forenoon, and afternoon, for about an hour and a half or two hours each time. They have thus a meal and a period of rest between each drilling. I am not aware of any better general arrangement that could be devised for attaining the greatest results in the least time. For in the first place, the moments of greatest bodily vigour and freshness are to be chosen for the work of discipline. In the next place, the exercise ought not to be continued too long at a time; when the muscles and brain are once thoroughly fatigued, the plasticity is at an end, and nothing is gained by persisting farther. Lastly, the lessons ought not to be too short: that is to say, a certain time is requisite to get the body into the set that the exercises require. Scarcely any exercise of less than half an hour's duration will take a decided hold of the system. To hit the mean between the period of thorough engagement of the organs in the work on hand, and the period of excessive fatigue, constitutes the practical judgment of the drill-master in every department. In the army, where the time of the learners is completely under command, the system of three daily lessons with intervals of rest and refreshment is chosen as the very best arrangement; the mental disgust apt to be generated by occupying the entire strength of the system upon one class of operations is not taken into account. In the discipline of early education in general there is more variety of interest, and it is possible to occupy nearly half the day continuously upon the work. But the army system is the model, in circumstances where it is practicable to bring the pupils together early morning, forenoon, and afternoon.

The rule for the exercises of the learner is very different from the rule for the practised workman at his work. In this last case, long continued and uninterrupted application is best. But in learning a new thing the stress of the attention very soon fatigues the brain; so does the committing of blunders and false steps. Moreover, the organs unhabituated to an operation are less able to sustain it. But when the mechanical routine is perfect, and the parts strengthened by long practice, it is unnecessary to halt at every two hours; it is much better to continue at work for four, five, or six hours, as the case may be.

The apprentice learning his trade keeps the same hours as the workman, and is not treated as an army recruit or a schoolboy. But in this case the plan of proceeding is different. The apprentice, having gained some one single step, before taking another, goes on repeating that process exactly as a productive workman. He gets much more time for his education, and has it largely diluted with routine work. This makes his situation tolerable during the long hours of his working day. It is when the rate of acquisition is pushed to the uttermost, and actual production disregarded, that the system of long intervals of rest is most necessary.*

A learner's progress will be vitally dependent on the absence of any other engrossing passion or pursuit. This makes it of so great consequence to have a certain amount of exclusive liking for the subject, whatever it may be.

VOCAL OR LINGUAL ACQUISITIONS.

Although the acquisitions of the articulating organs in speech and languages follow the very same general laws as other mechanical acquirements, their importance as a branch of human intelligence demands for them a special notice. I shall advert first to the vocal exercise of singing.

65. The acquiring of musical airs and harmonies by the voice depends on the vocal organs, on the ear, and on certain sensibilities that may be supposed to pass beyond the ear.

As regards the vocal organs themselves, they must necessarily be adapted to the production of musical notes through a sufficient register. They must further be so related to the nervous centres, as spontaneously to give birth to these sounds in

* I should remark, however, that it is unnatural, and on various accounts injudicious, to require an apprentice to work the full time of a fully-trained man.

great variety, that is to say, in many shades of difference. It belongs to the natural endowment of the centres, that they shall act in many degrees of energy upon the respective muscles, so as to give at the very outset a large variety of sounds to be caught up, associated, and artificially reproduced. The narrow or wide compass of these primeval and chance utterances—the result of the spontaneous discharge of nerve force from the centres—is the material circumstance in determining the flexibility or natural variety of the voice.

Next comes the ear, the regulator of the effects produced by the spontaneity of the voice. For music, as already noticed, the ear must be discriminatingly sensitive to pitch and the varieties of up and down, and to the harmonies and discords of different pitches. This sensitiveness rules the action of the voice, and reduces its wild utterances into regular modes productive of musical effect. The ear thus discriminative must also be adhesive to trains of sounds, so as to constitute a good memory for what it hears, and thereby to instruct the voice. The adhesiveness is in fact double; it resides partly in the vocal organs themselves, and partly in the ear. A good ear is one both discriminative and adhesive; the first circumstance doubtless favouring the second. The adhesiveness of the frame for mechanical exercises in general will probably show itself in the musical voice, when once it has been put in the proper train. But I can have little doubt that the quality of the ear is the special and ruling circumstance in the acquisitions of the singer.

The inward sense and enjoyment of musical effects causes here as elsewhere a flow of mental attention to the acts of listening and imitating. There is, however, a certain intoxication of excitement caused in some minds that does not answer the ends of acquisition, according to the important distinction already drawn between vague excitement and arrested attention.

The acquisition of instrumental music may be explained by substituting for the voice the action of the hands or the mouth, all other considerations remaining the same.

It would not be difficult to apply a test to the musical adhesiveness of different persons by fixing upon a corresponding stage of progress, and counting the number of repetitions necessary to learn a melody. The most enormous differences in this respect may be constantly observed; two or three repetitions being as good to one person as two or three scores of repetitions to another.

66. In Articulate Speech we have likewise a case of vocal action guided by the ear, but with great differences as respects both the action and the feeling. The power of articulating brings out a new series of movements, those of the mouth; while the nice graduation of the force of the chest and of the tension of the vocal chords required in singing is here dispensed with. The sensitiveness of the ear to articulate sounds has already been noticed as quite distinct from the musical sense. Hence, on both grounds, speaking and singing are exercises so different that the greatest excellence in the one is compatible with the lowest attainments in the other, as experience testifies.

The first stage of speaking is the utterance of simple vowels or of simple consonants with vowels attached, as *wa*, *ma*, *pa*, *hum*. The sound '*ah*' is the easiest exertion of the mouth; the other vowels, *e*, *i*, *o*, *u*, are more difficult positions. The labial consonants, *m*, *p*, *b*, usually, but not always, precede the dental and guttural; the closing of the lips being a very easy effort. I am not aware that the dental letters, *d*, *l*, *t*, *n*, are more easy than the gutturals, *k*, *g*, but the aspirates are perhaps more difficult than either. Of the vibrating sounds, the hissing action of the *s* is readier got at than the *r*. For this last letter *l* and *w* are used, as *lun*, *wun*, for *run*.

A new class of difficulties appears in the attempts to combine two consonants into one utterance; as in syllables that begin and end with a consonant. Some of these are found easier than others; *mam* is easier than *man*, and this than *mug;* for the reason that it is less difficult to combine two labials, than a labial with a dental, or a guttural.

There are two stages in the acquirement of articulate sounds; the first is the stage of spontaneous utterances, and the second the stage of imitation. In both, the natural flexibility or variety of the organs must be coupled with delicacy of the ear for articulate effects in order to make rapid progress.

The joining of syllables and words into continuous speech brings into play a further exercise of the associating principle; but there is also added the element of intonation, or cadence. This is a totally distinct effect at every stage of verbal acquisition. The sense for it is a peculiar feeling in the ear of the musical species, and the action of the voice to produce it is noways the same as the articulate action. The effect of cadence agrees with all the accessories of musical effect, having little regard to what are the principal circumstances in the other, namely, pitch, with its harmonies and time. In cadence the voice rises and falls in pitch, but not with any nice or measured gradation; the degree of stress or emphasis, the change from the abrupt to the long-drawn utterance, the alternate rise and fall of the voice, the descent and gradual subsidence at the close, are among the characteristics of cadence, or the music of speech. It appeals more to the muscular sensibility of the ear than to the auditory sense proper; it is like the effect of curves and beautiful forms on the eye. A great susceptibility to intonation marks some constitutions, and probably goes along with that other sensibility to curve lines, and to muscular effects in general. If the voice be naturally favourable to the changes of intonation, the concurrence of a good ear for it will inevitably render the acquisition easy; and by a reasonable amount of study the highest effects of oratory may be successfully achieved.

The earliest acquisitions of the purely verbal kind, such as prayers, rhymes, and stories, bring to the test the natural force of the verbal memory. The less the appreciation of meaning, the better the criterion afforded of pure verbal adhesiveness. This quality, when strongly manifested, is the basis of lingual scholarship, and of what is called memory by rote. It manifests the presence of a good articulate ear, and probably a high degree of the adhesive association by contiguity. The memory of the ancient bards, which had to retain to the letter long compositions, and the kind of erudition ascribed to the Druids, would exemplify it, although in these cases, natural deficiency could be made up by iteration.

67. In the acquisition of the Mother Tongue, the process is partly a verbal one, and partly an association of names with objects. Here there is a complex effect. For in associating two things of a different nature, as a sound on the ear, with an appearance to the eye,—the name 'sun,' for example, with the visible effect, the adhesiveness depends on the degree of impression produced by each. In fact we remember much sooner the names of things that impress us, than the names of indifferent things. Hence the progress in the use of names depends on the tenacity of the mind for the corresponding things. The acquisition of our mother tongue is something exceedingly vast, seeing that it implies the conception of all the objects named therein; and the use of names proceeds with the experience of things. Doubtless in this case too the force of mere contiguity counts as the prevailing circumstance; for in order that all objects indiscriminately may yield tenacious impressions, this power must be naturally great, and the same circumstance would serve to foster the growth of the adhesive link between name and thing. In the natural history intellect there is much in common with the verbal scholar.

When we come to the case of Written Language, the resemblance just hinted at is still closer; for there the object is not an articulation but a visible sign, and the tenacity of its adherence will depend on the eye and its connexions in the brain. In acquiring language through the medium of writing or print, we may either keep a hold of the visible symbols as pictures in the eye, just as we remember maps and diagrams, or we may pass from these to the vocal pronunciation, and retain it by articulate adhesiveness. It is not necessary to read aloud in order to transfer the work from the eye to the voice, a mere whispered or muttered articulation, a mere *ideal* rehearsal, will take, and become coherent. In fact, I believe we retain written language by the help of both methods, or by a combination of trains of symbols, as seen by the eye, with trains of articulations rehearsed by the voice. This is an example of Compound Associations, to which I shall devote a chapter apart. Notwithstanding this division of the labour of retaining written speech between sight and vocalisation, it is obvious that a good retentive eye for alphabetic forms is an element in the intellect of the scholar. In the adhesion of forms generally, I have classified three different kinds retained by different modes of cerebral force, namely, the artistic, the mathematical, and the arbitrary. These last are the most numerous, and individually the least important; all that needs to be retained in them is some characteristic point wherein each is distinguished from the rest. The recollection of a vast multitude of trains of alphabets and names and compositions demands a strong natural cohesiveness of Contiguity; for they will not afford an intense concentration of the brain, as in the case of the few and important forms of Geometry and the other sciences. On the whole, therefore, as above remarked, there is a common character in the Scholarly and the Natural History intellect.

68. In acquiring Foreign Languages by the usual methods, we have more of the purely verbal than in the mother tongue. We do not usually connect the names of a foreign language with the objects, but with the names already learnt. We may connect sound with sound, as when we are taught orally, articulation with articulation, or mark with mark in the eye. Thus 'domus' and 'house' may be associated as two sounds, two articulations, or two sights; usually we have the help of all three ways of linking. Including the act of writing down words there are no less than four lines of adhesion, involving two senses and two modes of mechanical exertion. What the hand has shaped persists as an idea in the moving circles of the arm, which idea tends to remain coherent, and afterwards to recover itself in full; it may thus act as a help along with the other links in the recollection of names and compositions.

In the absence of a good contiguous cohesiveness for indifferent things, such as arbitrary sounds and symbols, lingual acquisitions are necessarily laborious and difficult, and an unprofitable waste of mind.

69. Oratorical Acquisition introduces the element of

Cadence, the music of speech. This is partly created in ourselves by the spontaneous flow of voice becoming modified to please each person's own ear; in this way we have *originality* of cadence, whether the quality of the creation be high or low. But for the most part it is acquired by hearing others, like vocal melodies. Many forms of cadence prevail in the world. Each nation has characteristic strains of this kind; the foreigner, never so perfect in the pronunciation of the words of another language, is detected by the absence of the national manner in his spoken music. Provinces differ in the same country: English, Irish, and Scotch have their peculiar strains. The orator is a man able to produce a great variety of the richest cadences, just as a singer has the command of many vocal melodies. To fit articulate language into the forms and falls of musical articulation is the elocutionist's art. We have no artificial means of expressing or representing the oratorical rhythm, so as to preserve the manner of a great orator, or to mark the differences between one cadence and another; the notation of the elocution manuals is not carried far enough for this. But we can easily imagine the process of oratorical acquirement, and we are able to specify the points that it turns upon. The abundant and various action of the voice by primitive constitution, the susceptible ear, the opportunity of hearing many and good varieties of the elocutionist's display, and a strong sustaining interest in this particular effect—are the preliminary essentials. A rapid fixing of this class of impressions will be favoured by all those circumstances, and ought to be aided besides by a good general adhesiveness of the brain. When the individual has by his own exertions, following the lead of his ear, and using all his tendencies, natural and acquired, struck out a fine strain of utterance, it is desirable that this should be ready to fix itself permanently for future uses, and for still further acquirements; no art can be carried to perfection in a mind where the finest effects disintegrate as fast as they are produced.

Cadence, although properly a spoken effect, is transparent through written composition. In pronouncing the language of Johnson or Milton, we fall into a distinct strain; this too we can acquire and impress upon compositions of our own. As a rule we drink in the cadences most suitable to the natural march of our own vocal organs, or most fascinating to our senses.

CONTIGUITY OPERATING IN SCIENCE.

70. By Science I here understand the artificial symbolism and machinery requisite for expressing the laws and properties of the world, as distinguished from the actual appearances of things to the common eye, of which I have already spoken under the heads of natural conjunctions, successions, &c. Thus a treatise on Astronomy is a mass of algebraical calculations and numerical tables. Nothing can well be more unlike the aspects of sun, moon, and planets than the algebraical formulæ and numerical tables expressing the scientific relations of these bodies.

The sciences range from the extremely abstract and symbolical, where nature in its obvious garb is utterly excluded, such as Mathematics, to the more concrete subjects of Natural History, wherein some part of the acquisition really consists in storing up the common appearances of animals, plants, and minerals. The laws of contiguous association differ according as any one branch is nearer the one or the other extreme. Thus theoretical Mechanics, Astronomy, and Optics, come under the mathematical class. The experimental parts of Chemistry, Physiology, and Anatomy approach the other end of the scale: in these the adhesiveness of the natural history mind for sensible appearances and properties is of the highest consequence.

To advert to the more abstract sciences,—which represent science as most opposed to our unscientific familiarity with the things about us,—the symbols of Arithmetic and Mathematics generally, the symbols and nomenclature of Chemistry (combining proportions, atoms, &c.), the nomenclature and abstractions of Physiology (cells, corpuscles, ultimate fibres, secreting glands), require a peculiar cast of intellect for their acquisition; and they are so much of a kind that the mental adhesiveness suited for one would not be much at fault in any other. They are a class of uninteresting forms not remarkably numerous, which are to be held in the mind with great tenacity, and to be taken as the sole representatives of all that is interesting in the world. The self-denial that enables us to dwell among algebraical symbols, and to concentrate the whole force of the brain upon these, to the exclusion of all those things that gratify the various senses and emotions,—this abnegation, so to speak, of human interest, is the moral peculiarity of the mathematician. To be able, for the sake of the ends of Science,—the attainment of truth and certainty as to the causes of things,—to force the mind to entertain willingly conceptions so meagre as the diagrams of Geometry or the symbols of Algebra and Chemistry, proves that the cerebral currents go naturally towards the fixing of mere visible forms, such as have no interest in themselves, but serve as the instruments of our practical ends. It is not necessary that the mathematical mind should be destitute of attraction for colour, and beauty, and picturesqueness, and music, but it is necessary, in such a mind, to cast all these out of the view, and to grapple with the artificial symbols that express the most extensively important truths of the world. This interest in attaining the sure and certain laws of the universe, is the motive for immersing the mind in such a cheerless labyrinth of uncouth characters; this motive being once strong in an individual, the only other requisite is strong natural adhesiveness for arbitrary symbols, an adhesiveness resulting from a facility in concentrating the mind upon them. The symbols of a science are few in comparison with the words of a language, but the hold of the one must be much more severe than of the other. A circle, used as a diagram in Euclid, must make a far deeper impression than a circle as an alphabetic letter. With Euclid's circle has to be associated innumerable lines and constructions, which can never be all presented to the eye at one time, but must be firmly held in idea alone, ready to be brought up on the hint being given; to the circle of written language there is no such array of ideal appendages, it is conceived simply as it can be written, and only as regards its visible difference from the other letters of the same alphabet. It is this complication of visible figures, with a multitude of associates not possible to exhibit at once to the eye, and which yet must all be at command, that gives such an intellectual character to scientific reasonings. The Geometrician must retain, in connexion with a circle, all the constructions of Euclid's Third Book, and, if need be, all the constructions that precede and give foundation to these, and likewise the language that represents in words what cannot be presented to the eye; all which puts to a severe test the cerebral adhesiveness for uninteresting forms. Moreover, this adhesion must get firm rapidly at every step, otherwise the earlier steps of a deduction would be lost before the later were fixed. In an algebraical problem, where x is put for one thing, and y for another, the learner must, by the force of a single repetition, remember all through that these letters stand for such and such things. Persons not rapidly impressed with these arbitrary connexions are unqualified for such operations.

In Arithmetic, the ciphers, their additions, subtractions, multiplications, and the decimal system of reckoning, are of the nature of associations of symbolical forms, and require the firm concentration of the mind upon arbitrary signs for the sake of the end they serve. In Algebra, the same operation is carried to a higher complexity, but without any difference in the nature of the machinery. In Geometry, a host of definitions have to be remembered; that is, a line, a space, a square, a circle, must be associated with certain other lines and constructions, with the assistance of language. A circle is a line equally distant from a central point. The association here is between the visible aspect of the circle, with its central point, and a line drawn from the centre to the circumference, which line is a representative line, and may be drawn anywhere round the whole compass of the figure. This principle of representation is a thing of the intellect entirely; for, in addition to the sensible object, there is a fact, or a multitude of facts, that cannot be made apparent to the eye at one and the same moment. With the sensible appearance of a triangle in Euclid, there is a movement of the mind away from this to other triangles, seen or remembered, and we are not allowed to make any affirmation about that triangle, or to take any notice of any point in its appearance, without going over other triangles, to see if the same feature holds in these also. Such is the restraint imposed upon us in dealing with representative objects in general, among which scientific diagrams are to be classed. Instead of occupying ourselves wholly with the sensible present, we must be continually passing to and fro between it and the ideal absent, thus checking our movements by incessant comparison. All this proceeding is contrary to the bent of the natural mind. It shows how the operation of intellect transcends the operation of sense, in this way, namely, that intellect can mix any amount of the past and distant with the consideration of the present, a power extensively drawn upon in the mathematical and other abstract sciences.

71. In the experimental and concrete sciences, as Heat, Electricity, Chemistry, Anatomy, and Natural History in general, the consideration of the actual appearances to the senses mixes largely with the artificial symbols and abstractions, and hence the value of a good adhesiveness for colour and shape, and tact, and even taste and smell, in storing up the objects of those sciences. The Mathematical mind may be quite at fault here, just as the Natural History mind has no chance to be suited for the mathematical group of subjects. In Anatomy, for example, there is a vast detail of bones, ligaments, muscles, blood vessels, nerves, &c., and the visual adhesiveness for mere colour is a very great element in the recollection, as with a map, or a pictorial landscape. The tactual adhesiveness is likewise of value in this class of objects, and in all the objects of the natural history class, minerals, plants, and animals, all which are handled as well as seen. Thus it is that, as regards the intellectual character or the peculiar mode of the contiguous adhesiveness, there are two classes of scientific minds, represented by the extreme terms of Mathematics and Natural History, the abstract or artificial,

and the concrete or real. As regards the modes of human interest or fascination, a greater number of classes could be made out: pure mathematics, as in Algebra and Geometry, would have a different set of votaries from mathematics applied in Mechanics, Astronomy, Optics, &c.; and the natural history group would be both separated from experimental Physics and Chemistry, and broken up into its component members, Mineralogy, Geology, Botany, and Zoology.

72. The sciences of Logic, Grammar, Mind, Political Economy, &c., are noted for being pre-eminently verbal sciences; the artificial element used for expressing their generalities is Language, or general terms. These verbal forms are of the nature of symbolic forms in this, that they are thoroughly uninteresting in themselves, that they express the general, and not the particular or concrete, and must be held intensely by the mind under the stimulus of the end they serve. The subject matter of each is different, and unequally held by different minds, but on the whole their retention is remarkably of a piece with the other abstract sciences.

BUSINESS, OR PRACTICAL LIFE.

73. In the higher departments of industry, or business—handicraft labour being the inferior department,—the forces of the intelligence have a wide scope, the widest next to pure science. In the formalities and machinery of business,—book-keeping, calculation, money reckoning, banking, contracts, deeds, acts of parliament, &c.—we have a number of dry artificial elements, not unlike the machinery of the abstract sciences, but touching more closely and frequently upon things of real interest, and therefore a less severe stretch of intellect than the other. In fact, the superior branches of industry,—in trade, manufactures, government, &c.—seem well adapted for the great majority of the cleverest minds. The interest arising from the human wants and the love of gain is powerful by nature, and independently of deep reflection or any refining process, and is well calculated to stimulate the

mass of mankind, of whom very few can ever be strongly possessed with the interest belonging to science, that is, the desire of getting at truth.

74. The management of human beings, which is a large department of practical life, proceeds upon certain active qualities that give a natural influence and ascendency over others, and upon a knowledge of the ways and tempers of men. This last accomplishment I have already touched upon (see p. 424). Without such knowledge in considerable measure, the master of workmen, the teacher, the legislator, and many other professions besides, can hardly be said to be skilled in their craft. It requires a kind of observation rendered difficult by the very causes that make man interesting to man; for those passionate feelings that arrest our gaze upon our fellows sway the mind from cool judgments. It is not so easy to read accurately a man or woman as it is to read a mineral.

A person engaged in any work should naturally be alive to the effect he is producing, for this it is that guides his hand. The builder sees that his wall is rising plumb and square. But it happens somehow or other, in acting upon men in the various capacities of teaching, ruling, persuading, pleasing, serving, we are not so sensitive to the exact operation of our attempts as in dealing with the material world, nor so easily made to modify the hand so as to suit the end in view.

ACQUISITIONS IN FINE ART.

75. In the Fine Arts there are formed combinations, aggregates, groupings, rhapsodic successions,—such as to produce the species of effect termed beautiful, sublime, picturesque, harmonious, &c.; and the perception of those effects is what we call Taste.

The Artist in any department has to attain the power of producing these combinations. This power is in the first instance a result of creative spontaneity, guided by the sense of the effect produced; it is a mode of the natural forth-putting of the energies of the voice, or the hand, as in the commencement of every kind of active faculty. The first musician gave scope to his vocal powers at random, and gradually corrected the action according to his ear. When this natural outburst took some definite and agreeable shape it became a song, a melody, caught up by imitation and handed down to future ages.

A large part of every artist's power necessarily comes by acquisition, or by the operation of the force of Contiguity. He stores up the combinations produced by previous artists, and fixes in his mind those that he produces in himself, and gradually rises to his highest efforts of execution. In this acquisitive process, the points of character that come to his aid appear to be the following, of which, however, the enunciation is not new to the reader.

(1.) A keen sensibility and adhesiveness for the element or the material that the artist works in. The musician's ear must be sensitive to sounds and successions of sound, and that in the manner best adapted for fixing and retaining them: by which circumstance he is able to acquire a large stock of melodies. The sculptor must have a keen sense of contour and form; the painter, of form and colour; the actor, of dramatic movements; the poet, of language and the usual subjects of poetry.

(2.) In addition to this sensitiveness to the material of the art in general, we must add the special sensibility to the proper effects of the art; the sense of melody and harmony in music, of beautiful curves and proportions in sculpture and architecture, of these and of coloured effects in painting, and so forth. I take for granted that beauty is not arbitrary,—that there are effects that please the generality of mankind when once produced. For these the Artist has a strong preference, and by virtue of this preference he acquires a stronger hold of what exemplifies them than of what does not. It is not every mass of colouring that impresses itself on the painter's recollection. He ought to remember coloured masses in general better than other people, but being specially fascinated by a certain class which he calls harmonious, he is most ready to recal these at after times. So a poet needs a large disinterested adhesiveness for the concretes of nature and the incidents of humanity, but with this alone he would be indistinguishable from a born naturalist: the disinterested adhesiveness must be qualified by a special fascination for things that have a poet's interest, so as to alter the proportions of his impressibility and give the preponderance to one special class of appearances. Not all trees and all mountains and all vegetation and all displays of human feeling should impress alike either a painter or a poet: their character is specially made for their preferences.

(3.) An artist in any art is to a great extent a mechanical workman, and progresses in his art according as mechanical operative skill fixes itself in his framework. The singer, the orator, the actor, owe their improvement to the retentiveness of the voice under vocal practice. The painter and sculptor must be persons that would soon learn any handicraft operation of the artisan's workshop. This muscular adhesiveness belongs to the structure of the muscular system with its nerve centres, and is a very material fact of character; it is the higher quality of the muscular development, mere brute force being the lower. It may be often observed, I think, that both qualities go together,—the plasticity and the physical force,—and with them, as a matter of course, an enjoyment and preference for muscular activity. An abstract thinker may dispense with this muscular element of character, except as a counterpoise to the tendency to keep up a whirl and isolation of the circles of the brain; but to the artist, in common with the artisan, the high physical development of the active organs I should consider an almost indispensable endowment. Its importance fades away only in such a case as the Poet, in whom the artist approaches to the man of pure thought and mere ideal activity.

HISTORY AND NARRATIVE.

76. The successions of events and transactions in human life, remembered and related, make History. A considerable portion of each one's stock of recollections is made up of this kind of matter.

The transactions and events wherein we have been our selves present impress themselves on our mind as pictures of living men and women, their various manifestations, and the appearances and situations of things about them. It is thus that we retain the impression of a public assembly, a military spectacle, a pageant, a play, or any of the daily events of private society or ordinary business. The pictorial mind is fully alive and susceptible to such things, and proves itself by retaining them. The retentiveness is influenced by the natural adhesiveness to surrounding appearances as they succeed one another, by the general interest in human beings, and by the specific or personal interest that belongs to the individual transactions. Of this last influence on the attention, it is easy to fall upon any amount of illustration. The soldierly feeling fixes the mind upon battles, reviews, and military movements; the trader is arrested by markets and trading enterprise; the politician by diplomatic congresses and debates; the sporting mind is alive on the race-course; the family interest excites the attention upon the incidents of the domestic circle.

A single transaction deliberately witnessed is often able to impress itself minutely on the memory for life. There seems to be in the case of human events an exception to the law of repetition, or to the usual necessity for passing a thing before the mind many times in order to make it coherent. But it is not difficult to account for this seeming anomaly. For, in the first place, such transactions are usually slow; that is, they keep the attention awake for a length of time before they are completed; a single race, if we include the preparations, will engage the mind for an hour together; while many transactions occupy days and months, being the subject of frequent attention all through. But what is more; an event past is repeatedly brought up in the recollection, and every such occasion is a mental repetition, and ends in fixing the different parts in the mind. After being present at an exciting spectacle, our thoughts keep themselves engaged upon its details, and in this retrospect we expand our attention upon things that were but hurriedly glanced at as they passed before the actual view. Such rehearsal in the mind after the reality has passed, is a great means of impressing the events of our personal experience. The degree of emotional interest attaching to them displays its efficacy in bringing about their more or less frequent recal. What is indifferent passes by and is never dwelt upon afterwards; what has excited us at the time excites us in the remembrance, and secures a large space in our ideal meditations. Provision is thus made for consolidating in the memory a train of circumstances that do not admit of being repeated in the view. We are thereby enabled to recal in after years all the leading transactions that are now going on around us; we can describe the incidents connected with our family, our village or city, our school, our places of business, recreation, or worship; we can live over again, in minute detail, the scenes that had an intense pleasurable or painful interest at the time.

77. The transactions that we know by hearsay, or the narrative of others, impress themselves somewhat differently. We have no longer the actual scenes presented to our vision. They are represented by words, and the recollection is modified by the circumstances affecting verbal adhesion. If we make the extreme supposition that the hearer of a narrative has his mind carried at once to the scenes and events themselves, and is able to realize them with an almost living reality, the case is not different from the foregoing; the words are made use of to hoist the scenes, and then drop away. But there are few people that have this vivid power of conceiving the realities of narrated transactions. In general, the verbal succession of the narrative is itself a medium of holding together the events contained in it, and the recollection is a mixture of adhesions, pictorial and verbal.

Written history may therefore be retained by a good verbal memory. Where the thread of pictured events has snapped, the thread of verbal succession in the printed page may chance to be adherent; between the two, the power of recollection on the whole is irregularly divided.

OUR PAST LIFE.

78. The train of our past existence is made coherent in the mind through contiguity, and can be recalled with more or less minuteness according to the strength of the adhesion. In any subject that is complicated with a multitude of details, only a few prominent features usually adhere; as, for example, the parts of a landscape, or the incidents of a history; and such is the case with the great complex current of each one's individual existence.

This current is made up of all the elements contained in the foregoing heads of this chapter. It is made up of all our actions, all our sensations, emotions, volitions, in the order of their occurrence. It is the track described by each individual through the world during his sojourn therein; it comprises all that he has done and all that he has been impressed with.

Under the previous head I have spoken of the stream of history, or the current of events passing before the eyes of a spectator supposed to be passive. This spectatorship of what is going on about us does not express the whole current of our remembered existence; there is wanting the series of our own doings and transactions. When what we have *done* is added to what we have *seen* and *felt*, the history of self is complete.

The peculiar feature of the present case, therefore, is the remembrance of our own actions according as they happened. We have to determine the nature of the bond that associates things done by us, and not simply seen.

79. In the first place, a vast number of our movements consist in changing the spectacle about us, or in producing a series of appearances to the eye, or effects on the senses in general. Thus when we walk out, we bring before our eyes a stream of houses, shops, streets, fields, and the impression of the walk, the coherent trace that it leaves in the brain, is in part at least pictorial, just as if we stood still and saw the scenes shifted in the same order. So our work often consists in producing changes seen and remembered as sensible appear-

ances. The ploughman's active day is summed up in the furrowed field that is pictured in his mind in the evening retrospect. The soldier in a field-day remembers less his own exertions than the movements of the collective battalions as they took place before his eyes. Hence it is that remembered actions may be to a great extent remembered appearances, and so far the case now in hand is in noways different from the preceding.

It is evident, however, that there must be a remembrance of actions by themselves as well as of the changes that they bring before the view. We do in fact have a recollection of our own active states as such; we can describe the movements made by us, the feelings of pleasant exercise, laborious exertion, or reposing fatigue, that we have successively gone through in a given day, week, or month.

This takes us back to what was advanced at the commencement of the present chapter on the Ideas of movement and action. I endeavoured to show that these are constituted by re-actuating the circles of movement, but so as to come short of the full stimulus required by the action itself; the remembrance of striking a blow is in reality all but to repeat the act, the restraining of the full display being sometimes a matter of difficulty. Now successive actions cohere both as actions and as ideas; we may either perform the actions outright, or stop short at the mere idea or vestige of the action. Much of our life is spent in going over remembered and ideal actions; and when we recover a work done by us, merely as a matter of history and not for the purpose of doing the work again, the vestige or idea of the different steps is what passes along the mental system. These vestiges of movements executed are as really and truly mental possessions or ideas as the remembered pictures of the external world through the eye. We can revive one or other in the ideal form; in truth our recollections are usually a mixture of the two, inasmuch as our sensations are all unavoidably mixed up with movements.

Now in recalling a series of movements, as for instance a dance, simply for our own gratification, because of the agreeable feelings that they gave in the reality, we do nothing but revive those vestiges or diminished currents that suffice for the purpose of a recollection. This is to live our history over again in idea. But when we have acquired the power of *naming* all the various movements in the succession, the ideas, as they successively repossess the various organs, suggest the names of the different steps, and we can then narrate the whole in language. It is this power of narrating that we usually term the recollection of an event, and that constitutes history. With the power of language that belongs to human beings, it happens that our recollections of what we have gone through do not occur as pure ideas of the actions and scenes themselves, but as ideas mixed up with verbal descriptions, which last are constantly disposed to intrude themselves into our recollections, even when these are not communicated to any one.

The firm adhesion of the ideas or vestiges of our active movements is a case of muscular contiguity, like the adhesion of the actions themselves in acquiring mechanical habits. I cannot find any other law for the association of ideas of movements than for actual movements. I have already endeavoured to discuss the circumstances favourable to the adhesion of muscular trains, and these would, I conceive, hold in the present case also. People that have a facility in acquiring mechanical habits would have an equal facility in remembering the steps of any performance that they had gone through. The greater instance implies the less; the adhesion of the movements in full involves the adhesion of the currents that stop short of movement.

The case is altered, as above remarked, by the intrusion of language or expression; in so far as we rely upon this, our remembrance will be easy or difficult according as our adhesiveness for language is strong or feeble. This is not the only instance of impressions retained by the help of some foreign machinery more adhesive than themselves. We have seen the same thing in the retention of the sensations of the inferior senses.

80. Our past life may, therefore, be conceived as a vast stream of spectacle, action, emotion, volition, desire, inter

mingled and complicated in every way, and rendered adherent by its unbroken continuity. It being impossible to associate all the details, so as to recover them at pleasure, we find in experience that only the more impressive facts remain strung together in recollection. All the larger epochs and stirring incidents readily flow in upon our memory, when we go back to some early starting point; while the minor events fail to appear on the simple thread of sequence in time, and are recalled only by the presence of other circumstances that serve to link them with the present. Our habits of recalling the past generally lead us to associate events in new connexions, as when a person recites the history of his early education, selecting out of the miscellaneous stream the incidents that relate to this one point. Our individual history becomes thus broken up into sections and partial narratives; and to recover the total current, we should find it requisite to collect these into one great combination upon the thread of strict succession in order of time.

81. I have thus presented a series of examples of the working of the adhesive force, termed the principle of Association by Contiguity. As the subject proceeds there will be other opportunities of adding to the illustration. The special branch of Moral acquisitions, or Habits, would best find a place in a Treatise on Volition. There now only remains some general observations on the nature of this great adhesive force.

I would first remark the difficulty there is in obtaining a measure of the absolute force of contiguous adhesiveness in an individual character. The modifying circumstances interfere so as to perplex the question. There are doubtless local and special acquirements, as music, or the verbal memory, both which repose in a great measure on the structure of the organ of hearing, and not exclusively on the general adhesiveness of the brain. The only measure that I can propose for this general adhesiveness is the multitude, variety, and facility of acquisitions in general,—the ease of acquiring any kind of bent, habit, or faculty that may be entered on,—the distinction acquired as a learner, in all departments of knowledge, business, or art. We occasionally meet with characters of this description; the famous 'admirable Crichton,' as usually described, is an example of the highest order of the class.

In the second place, I may advert to the known superiority of early years as regards this force or plasticity. It is impossible to state with any precision the comparative intensity of the adhesive growth at different ages, but there can be no doubt of the fact of its gradual diminution from infancy to old age. Bodily acquisitions are easiest while the organs are still flexible, apart from the plastic adhesiveness of the brain; hence a maximum age is fixed for receiving recruits in the military service. At the present time, I believe the age of twenty-three is the extreme term of admission. Up to this age any bodily habit is easily assumed; the moral discipline of obedience is also comparatively easy. But for both the one and the other the earliest years are the best. We must always take account of the obstruction arising from adverse bents and acquisitions. In matters where the bodily and mental system are not in any way pre-occupied, the age of twenty-five is a very plastic age, as, for example, in learning business forms, languages, or science. On the other hand, the voluntary command of the attention is greatest in mature life, a circumstance very much in favour of acquisition.

I remark finally that there is a temporary adhesiveness as distinguished from what is enduring or permanent. I can convey a lengthy message from one room to another, but am unable to reproduce it next day. The endurance of the first impression, while the mind is wholly occupied with it, is no surety for its being retained for a week or a month to come.

The illustration in this chapter has been mainly directed upon the enduring acquisitions. We have generally understood the retainability of an impression to mean the power of recalling it at any future time, however remote. But it is necessary to take account of the tendency of all acquisitions to decay by time; the rate of decay being dependent on various circumstances, and chiefly on the decay of the brain itself. It is observed that in old age the impressions that survive longest are those of early years.

To keep our acquisitions from decaying it is requisite that they should be occasionally revived. A language acquired in early years may be utterly lost by disuse; if kept up till mature age it will be fixed for life. Sustained practice seems particularly necessary in early education: children's acquisitions are very liable to decompose if not kept up and confirmed by new additions. No precise laws have ever been ascertained in this department of the human mind.

The system of *cramming* is a scheme for making temporary acquisitions, regardless of the endurance of them. Excitable brains, that can command a very great concentration of force upon a subject, will be proportionably impressed for the time being. By drawing upon the strength of the future, we are able to fix temporarily a great variety of impressions during the exaltation of cerebral power that the excitement gives. The occasion past, the brain must lie idle for a corresponding length of time, while a large portion of the excited impressions will gradually perish away. This system is extremely unfavourable to permanent acquisitions; for these, the force of the brain should be carefully husbanded and temperately drawn upon. Every period of undue excitement and feverish susceptibility is a time of great waste of the plastic energy of the mind on the whole.

CHAPTER II.

LAW OF SIMILARITY.

Present Actions, Sensations, Thoughts, or Emotions tend to revive their LIKE among *previous* Impressions.

1. CONTIGUITY joins together things that are naturally juxtaposed, or that are, by any circumstance, presented to the mind at the same time, as when we associate heat with light, a falling body with a concussion. But in addition to this link of reproductive connexion, we find that one thing will, by virtue of similarity, recal another separated from it in time; thus, if I see Lear acted to-day, I am put in mind of a former occasion, when I have seen the same play acted.

This tendency to be reminded of past occurrences and thoughts of every kind, through their resemblance to something present, is here termed the Law or Principle of Similarity. It is styled by Sir William Hamilton the Law of Repetition. He shows it to have been first recognised and enunciated by Aristotle.* But its application to explain particular phenomena has been gradually extended by many successive writers down to the present time.

2. Some preliminary explanation of the kind of relation subsisting between the two principles of Contiguity and Similarity is requisite in order to guard against mistakes, and especially to prevent a too easy misapprehension as to the radical distinctness of the two modes of action in the mental framework. When the cohesive link between any two contiguous actions or images is confirmed by a new occurrence or repetition, it is perfectly obvious that the present impression

* *Dissertations on Reid*, p. 889.

must revive the sum total of the past impressions, or reinstate the whole mental condition left on the occasion immediately preceding. Thus, if I am disciplining myself in the act of drawing a round figure with my hand, any one present effort must recal the state of the muscular and nervous action, or the precise bent acquired at the end of the previous effort, while that effort had to reinstate the condition attained at the end of the one preceding, and so on. It is only in this way that repetition can be of any avail in confirming a physical habit or forming an intellectual aggregate. But this reinstatement of a former condition by a present act of the same kind, is really and truly a case of the operation of the associating principle of similarity, or of like recalling like; and we here plainly see, that without such recal, the adhesion of contiguous things would be impossible. It would appear, therefore, that all through the exposition of Contiguity, the principle of Similarity has been tacitly assumed; we have always taken for granted, that the recurrence of any object to the view recalled the total impression made by all the previous occurrences, and added its own effect to that total. In a word, no one ever doubts the perfect operation of the principle of like recalling like, in any of the numerous instances above adduced as showing the growth of contiguous adhesion.

But by this tacit assumption of the unfailing operation of the force of anything present to reinstate the past impressions of the same thing, we restrict ourselves to those cases where the reinstatement is sure and certain, in fact to cases of absolute identity of the present and past. Such is the nature of the instances dwelt upon in the previous chapter: in all of them the new action, or the new image, was supposed precisely identical with the old, and went simply to reinstate and deepen an impression already made. We must, however, now pass beyond this class of examples and enter upon cases of a new description, where the identity is only partial, and is on that account liable to be missed; where the restoration, instead of being sure, is doubtful; and where, moreover, the reinstatement serves higher purposes than the mere iteration and deepening of an impression already made. In all mental restorations whatsoever, both Contiguity and Similarity are at work; in one class the question is, as to the sufficiency of the contiguous bond, the similarity being sure; in another class the question is, as to the sufficiency of the attractive force of the likeness, the contiguous adhesiveness being believed secure. If I chance to meet with a person I have formerly seen, and endeavour to remember his name, it will depend upon the goodness of a cohesive link whether or not I succeed; there will be no difficulty in my recalling the past impression of his personal appearance through the force of the present impression; but having recalled the full total of the past impressions, I may not be able to recover the accompaniment of the name; the contiguity may be at fault, although the similarity works its perfect work of restoring me to my previous conception of the personal aspect. If, on the other hand, I see a man on the street, and if I have formerly seen a portrait of that man, it is a question whether the living reality shall recal the portrait; the doubt hangs not upon the contiguity, or coherence of the parts of the picture, if it could be recalled, but upon the chance of its being recalled at all. Where things are identical, the operation of similarity in making the present case revive the former ones is so certain, that it is not even mentioned; we talk of the goodness of the cohesive bond between the revived part and its accompaniments, as if contiguity expressed the whole fact of the restoration. To make up for this partiality of view, which was indispensable to a clear exposition, we now embrace with the same partial and prominent consideration the element that was left in a tacit condition, and allow to sink into the same tacit state the one that has hitherto been made exclusively prominent.*

3. In the case of perfect identity between a present and

* To a mathematical student this would be made at once intelligible by saying that in the former chapter the Contiguity is assumed as the *variable* element, and the Similarity the *constant;* in this chapter, Similarity is supposed variable and Contiguity constant.

past impression the past is recovered and fused with the present instantaneously and surely. So quick and unfaltering is the process that we lose sight of it altogether; we are scarcely made aware of the existence of an associating link of similarity in the chain of sequence. When I look at the full moon, I am instantly impressed with the state arising from all my former impressions of her disc added together; so natural and necessary does this restoration seem that we rarely reflect on the principle implied in it, namely, the power of the new stimulus to set a-going the nervous currents with all the energy acquired in the course of many hundred repetitions of the same visual impetus. But when we pass from perfect to imperfect or partial identity, we are more readily made aware of the existence of this link of attraction between similars, for we find that the restoration sometimes does not take place; cases occur where we fail to be struck with a similitude; the spark does not pass between the new currents and the old dormant ones. The failure in reinstating the old condition by virtue of the present stimulus, is in the main ascribable to imperfect identity. When in some new impression of a thing, the original form is muffled, obscured, distorted, disguised, or in any way altered, it is just a chance if we recognised it; the amount of likeness that is left will have a reviving power, or a certain amount of reinstating energy, while the points of difference or unlikeness will act in resisting the supervention of the old state, and will tend to revive objects like themselves. If I hear a musical air that I have been accustomed to, the new impression revives the old as a matter of course; but if the air is played with complex harmonies and accompaniments, it is possible that the effect of these additions may be to check my recognition of the piece; the unlike circumstances may repel the reinstatement of the old experience more powerfully than the remaining likeness attracts it; and I may either find in it no identity whatever with an air previously known, or I may identify it with something altogether different. If my hold of the essential character of the melody is but feeble, and if I am stunned and confounded with the new accompaniments, there is every likelihood that I shall not experience the restoration of my past hearings of the air intended, and consequently I shall not identify the performance.

4. The obstructives that prevent the revival of the past through similitude may be classed under the two heads of Faintness and Diversity. There are cases where a new impression is too feeble to strike into the old-established track of the same impression and make it alive again, as when we are unable to identify the taste of a very weak solution, or to make out an object in twilight dimness. The most numerous and interesting cases come under the other head of Diversity, or mingled likeness and unlikeness; as when we meet an old acquaintance in a new dress, or in circumstances where we have never seen the same person before. The modes of this diversity are countless and incapable of being classified. We might, indeed, include under diversity the other of the two heads, seeing that faintness implies diversity of *degree*, if not of any other circumstance; but I prefer considering the obstruction arising from faintness by itself, after which we shall proceed to the larger field of instances constituted by unlikeness in other respects.

5. The difficulty or facility of resuming a past mental condition at the suggestion of a present similitude will depend upon the hold that the past impression has acquired; it is much easier to revive a familiar image than an unfamiliar by the force of a new presentation. We shall, therefore, have to keep this circumstance in view, among others, in the course of our illustration of the law of similarity.

It has to be seriously considered how far mental character, or intellectual peculiarity, affects the power of reviving similars, or of bringing together like things in spite of the repulsion of unlike accompaniments. There is much to be explained in the preferences shown by different minds in the objects that they most readily recal to the present view; which preferences determine varieties of character, such as the scientific and artistic minds. The explanation of these differences was carried up to a certain point under the Law of Contiguity; but if I am not mistaken there is still a residue referable to the existence of various modes and degrees of susceptibility to the force of Similarity. From all that I have been able to observe, the two energies of contiguous adhesion and of attraction of similars do not rise and fall together in the character; we may have one feeble and the other strong, in all proportions and degrees of adjustment. I believe, moreover, that there is such a thing as an energetic power of recognising similarity in general, and that this is productive of very striking consequences. Whether I shall be able to impress these convictions upon my readers will depend upon the success of my detailed exposition of this second leading peculiarity of our intellectual nature.

FEEBLENESS OF IMPRESSION.

6. We commence with the case of Faintness or Feebleness in the present, or suggesting, impression considered as an obstacle to the revival of the corresponding previous impression. There is in every instance a certain degree of feebleness that will militate against the efficacy of the present image to reinstate the old track worn by the same image in its former advent. When an extremely faint suggestion in the present answers completely the purpose of reviving the old currents, we must consider that the restoring action of similarity is unusually vigorous in that mind, or for that class of impressions. Thus if by a very feeble solution of salt in water, such as occurs in many land springs, the impression on the tongue is sufficient to revive in one person, and not in another, the past state of mind produced by the tasting of salt, we should naturally remark that in the one the attraction of similars in the matter of taste is more vigorous than in the other. Doubtless there is another circumstance that would make a difference without any positive distinction in the character of the intellectual force of similarity, that is the familiarity with the substance tasted combined with a habit of attending to minute differences, in other words a concentration of the mind upon the effect; but where this difference, due to professional habits, does not exist, the only interpretation we can put upon the

circumstance is that now supposed,—an inequality in the power of reinstating a past condition of mind by a similar one present. If without any express education, one person can discern common salt in a solution when present at the rate of eight grains to the gallon, while another person requires twelve grains per gallon to be present, and a third twenty, then these numbers would roughly express the strength of the force of similarity on the matter of Taste in the three persons respectively. We cannot infer from this that in other impressions, as in Smell or Hearing, there would be the same distinction in these three parties, inasmuch as the character of the special organ counts for something. The structure of the tongue may be such as to make a slight taste in one person as impressive in the conscious mind as a stronger taste in another person: while in order to ascribe the difference to an intellectual peculiarity, such as the intensity of the attraction of similars, we should have to suppose the same solution to yield an equal sensation or an equal intensity of the feeling of taste.

7. Such is a general example taken at random to show what is meant by the revival of impressions under the impediment that feebleness puts in the way. I might go systematically through the Sensations of the various Senses to gather illustrations of the same fact. (Movements apart from Sensations do not furnish cases in point). In the various sensations of Organic Life, there occur examples of difficult reinstatement, through feebleness of the suggesting sensation. I may experience a certain uneasy sensation, which I cannot describe or recognise, because of its being too faintly marked to reproduce the old accustomed impression of the same thing. It may be a derangement of the stomach, or the liver, or the brain, such as I have experienced before and possess a durable conception of, but being too little prominent to strike into the old track it reminds me of nothing, and I cannot tell what it is. By and by it increases somewhat, and becomes powerful enough to reinstate some likeness of it in the past, and I then know its character. If on the one hand, the feeling is located in an organic tissue easily inflamed into sensibility by a light

impression, or if on the other, the general power of similarity is comparatively strong, and the recognition of organic pains and pleasures rapid and easy, a very slight manifestation makes me at once aware of what is happening to me. This keen organic sensibility may be noted as a peculiarity of some constitutions, making the individual extremely self-conscious, in the sense of being alive to every passing change of organic state; generating hypochondria and the alternation of fears and hopes regarding one's bodily welfare. The peculiarity will be occasionally found rising to a morbid extreme; as when the individual never passes an hour without solicitude on the matter of health and mortality. Obtuseness of feeling to what is going on within the various bodily parts is a defect fraught with dangerous neglect; while on the other hand a needless amount of distress and a needless waste of precaution may be the result of too much sensibility, whether this have its origin in the sense or in the intellect.

8. I have already cited an example from Taste. There would be no material difference in the circumstances of a case of Smell. When a very faint odour is recognised or identified, this shows that notwithstanding the faintness of the impression the previous sum total of the same smell has been brought back. If two persons be subjected to the same odour, as in walking through a garden, and if one recognises it while the other feels it not, the difference is to be referred to one or more of the three main circumstances involved in such a perception,—namely, greater familiarity with the odorous substance, greater acuteness of the organ, or greater force of the attraction of similars. If both parties are known to be alike familiar with the supposed odour, we must refer the difference to one of the two remaining circumstances; and if by some further test we could find that they had equal delicacy of organ, that is, if it could be shown that the same smell caused a nearly equal force of sensation or consciousness, the explanation would be thrown upon the last of the three considerations, the intellectual force of similarity, which we are now bent upon tracing out. If a person is not remarkable for being excited, agitated, in other words made highly sensitive, by

strong odours, while yet able to identify those that are feeble, we must ascribe to such a person a large development of the power of similarity; for if the discrimination were due to the easy inflammability of the membrane of the nose, we should find that a very great excitement would be produced when the action was strong. The experiment to decide between sense and intellect as the principal agent of the discriminating faculty might be made thus. Expose two persons to a strong repulsive smell, assafœtida for example. Ascertain by their manner of excitement and by their expression of their feelings, whether it affects them equally, or nearly so. We cannot expect to determine this point with very great nicety, but in a rude way the thing is possible. Suppose we find that they are almost equally affected by the odour, or, have a nearly equal degree of repulsive sensation. Let this experiment pass over for some time, and subject the same persons to an extremely faint exhalation of the same substance. Let it be so faint at first as to be imperceptible, and raise it by very slow degrees, until one of the two is struck with the idea that assafœtida is present. If the one notices it a considerable time before the other has been affected to the same point, the two must differ in the general power of reinstating like by like, or in the attraction of similars; that is, we must attribute the superior smelling acuteness of the one to something different from the susceptibility of the sentient surface, for that has been put to the test and found equal in both.

9. The sense of Touch does not appear to furnish any instructive case of the action of reinstatement made difficult by feebleness of impression, for we can usually command any degree of contact that we please. We may, however, derive examples in point from Hearing. It often happens that sounds are so faint as to be barely identifiable, in which case we shall observe one person making them out and another missing them. The difference of acuteness must be referred as before to familiarity, delicacy of ear, or facility of reinstatement, one or other. The influence of familiarity, the first of the three causes, is well exemplified in sounds. Compare the hearing of our mother tongue with the hearing of a foreign

tongue; every one knows how easy it is to catch up an utterance in the one, even when very faintly pronounced, and how utterly we fail in the other under like circumstances. The same contrast is observed between a familiar voice and the voice of a stranger; persons partially deaf identify the speech of those about them, while others to be as easily understood must raise their voice to a much higher pitch. This fact as to the greater readiness of reviving a deeply printed impression obtains all through the field of associations by similarity; the readiness follows the growth of the adhesive bond of contiguity under repeated conjunctions of the associated things. The more thoroughly accustomed the mental system is to an impression, the lighter the touch needed to make it present at any moment.

10. The same line of illustration can be carried out under the Sense of Sight. There is a point of twilight dimness when objects begin to be doubtful; they fail to reinstate the corresponding previous impressions whereby their identity is made apparent. Haziness in the intervening sky, and mere distance, have the same effect. In those circumstances we find that an object can be identified by one person and not by others equally well situated for discerning it. Familiarity may be the main cause of the difference, as when a sailor identifies a speck in the horizon as a ship of particular build. If not attributable to this cause, the superiority of one person over another in discernment must be ascribed to one or other of the remaining causes, namely, the sensitiveness of the eye, or the force of similarity. If by any appropriate test, such as the one above described for smell, we could prove the eyes of two persons to be equally impressible to degrees of light, the difference of discernment would fall to be attributed to a difference in the force of reinstatement of like by like.

11. In the case of very exalted acuteness of sense, such as we witness among the Indians, who can discern the tread of horses at a great distance by applying the ear to the ground, and who have also a great degree of long-sightedness, we are to refer principally to the first of the above-named circumstances for the explanation, that is, to familiarity, or education.

It may be that a hereditary acuteness of sense becomes developed in that state of life, but practice is undoubtedly the main cause of the remarkable difference in this respect between these savage tribes and the generality of mankind. For we are to remark that their education is not simply a frequent repetition of those sensations of the tramp of horses or men on the ear, but the concentration of the brain upon the sense on those occasions, whereby an intense stretch of attention habitually accompanies the act of listening. A sense can always be developed to a high degree by an intent application of the entire force of the brain to its sensations. The degree of voluntary attention given to an observation of sense will at any time make the sensation more acute; a habit of absorbing attention will generate a permanent acuteness at the expense of attention to other things. A painter will be the more impressed with a landscape that he is deaf to the song of birds, the hum of insects, or the murmur of the breeze; the whole soul passing into one sense aggrandizes that sense and starves the rest.

12. The acuteness of the senses in animals may in like manner be accounted for. The scent of the dog resolves itself into the identification of an exceedingly faint impression. An effluvium on the nostrils of a pointer revives the former impression of the smell of a hare, while on the human nose the same effluvium is utterly devoid of effect. Here we must attribute the distinction neither to education nor to the force of the association of similarity, but to the acuteness of the smelling organ. Any given smell will produce a far more intense sensation in a dog than in a man. If we take a scent sufficiently strong to be felt by both, as when the hare is brought close enough to be felt as a smell on the human nose, the man is calm in his manifestations, whereas the dog is excited almost to madness. By this we can see that such is the organization of the smelling organ of the dog that impressions made on it are transmitted to the brain in a highly magnified state; and further, that the brain is specially inflammable to a particular class of sensations of smell, an effect to which nothing corresponding is found in the human

constitution. Even if the smell of a hare were multiplied a thousand times in the human nose, and made equal to the impression made on the brain in the dog, it would not follow that the same maddening excitement would follow; this is an additional circumstance growing out of the emotional nature of the animal, or out of the deep-seated circles of its brain.

The far-sightedness of birds depends in part on the adaptation of their eyes to distant vision. It corresponds with the far-sightedness of persons habituated to remote objects, or to the change that age makes in the lenses of the human eye. We have had occasion to notice the superior development of the adapting muscles of the eye in birds, whereby the organ can go through a greater range of adjustment than is in the power of other animals.

There thus appears to be but few cases where we can decisively attribute acuteness in identifying objects under feeble impressions to the purely intellectual part of the process, the reinstatement of the old by the new through the force of likeness. This intellectual peculiarity is by no means prominently illustrated by this class of examples; still it is proper for us to allude to them as being cases that unquestionably involve the operation of the principle.

SIMILARITY IN DIVERSITY.—SENSATIONS.

13. We now approach the case that contains the greatest amount of interesting applications—the case of similarity disguised by mixture with foreign elements, the like in the midst of the unlike. There is often very great difficulty in recognising an old familiar object owing to alterations that have been made upon it. Coming back after a lapse of years to a place that we had lived in, we find houses and streets and fields and persons so altered that we fail to identify them; the differences that have overgrown the permanent features are in many cases such as to destroy their power of reinstating the ancient impressions. When likeness is thus surrounded with diversity, it is a doubtful point whether the attraction of similars will succeed in reviving the old by means of the new.

In these cases of doubtful and difficult reinstatement, we come to observe great differences in the intellectual reach of individuals; out of a number of persons placed in a similar predicament, some will be struck with the likeness, the flash of identity will come over them, and the past will stand side by side with its muffled likeness in the present; others again will see no identity, the attraction of the new for the old will in them be overborne and quenched by the surrounding diversity.

To trace the workings of the attractive force of similarity in its struggles with the obstruction of unlike accompaniments, I count one of the most interesting problems of the human mind; and I trust that in the course of the illustration that is to occupy the remainder of the present chapter, my readers will grow to be of the same opinion. Although any natural defect in this link of reproduction is perhaps less capable of being made up by artificial means than in the case of contiguity, yet we shall see that here too there are circumstances under our control that have an undoubted efficacy in clearing the way for the reviving stroke of similarity.

14. Before proceeding to the main subject under the present head, namely, the Sensations, I shall advert to the one case of Action or Movement that furnishes interesting examples of the working of the present law, I mean articulate action, or Speech. In the numerous and various trains of articulation entering into our education in language, there are many instances of recurring likeness in the midst of unlikeness, leading to the revival of the past by the present. We are constantly liable to be reminded of past sayings of our own and of other people, and passages of writings that we have read, by hitting on catch-words or identical phrases, at a time when our thoughts are running in some quite different channel. The single word 'phrenzy' uttered with emphasis will recal, in a mind familiar with the passage, 'The poet's eye in a fine phrenzy rolling;' the principal epithet in such a case being enough to reinstate the entire connected train. By the suggestion of common words we can thus leap from one passage to another by the remotest fetches

through an endless succession of recollections. The character of the mind will determine the prevailing character of the revived sayings; in some minds they will be poetical and ornate; in another prose melody will have the preference; in a third, epigram and wit; in a fourth, sententious wisdom and prudential saws. The sayings and passages that have been most impressed upon us in the course of our education will necessarily take a lead in coming over us through the medium of common phrases; and the general power of similarity in the mind, modified by the quality of the articulate circles in particular, will determine the abundance of this class of revivals, in other words, the quantity of speech flowing into the utterance of the individual. The force of Contiguity strings together in the mind words that have been uttered together; the force of similarity brings forward recollections from different times and circumstances and connexions, and makes a new train out of many old ones. I may have learnt at one time a passage from Milton, at another an extract from Pope, on a third occasion a piece from Campbell; mere contiguity would enable me when reminded of the commencing words of any of these passages to repeat the whole; but the energetic working of similarity would enable me to break into any one or all of them while speaking on some remote subject. I chance to fall into two or three words resembling an expression in one of the pieces, and notwithstanding the diversity of the context, the old stream of recollection is re-constituted, and the entire passage brought within my command. The attraction of sameness is here manifested as overcoming the repulsion of diversity. I am uttering a connected series of words, and among these, one, two, or three, have by chance the echo of one of the falls of an old utterance; instantly I feel myself plunged in the entire current of the past, and may avail myself of any portion of it to serve my present end in speaking. Neither the unlikeness of the context nor the totally foreign nature of the subject matter will stifle the reviving action in a mind very much alive to articulate effects, although both have a share in resisting the stroke of resuscitation. I assume that there is in each mind a special degree of the attraction of similarity for articulate utterances, just as there is a special degree of contiguous adhesiveness; and both have their measure, although in different ways. The adhesiveness is measured by the fewness of repetitions necessary to fix a connected speech in the memory; the other is measured by the amount of repulsion and disparity that can be overcome in bringing an old train forward by the force of a new one.

Unlikeness of circumstances and situations is no bar to the revival of past expressions, any more than difference of verbal context and subject matter. A word casually spoken in some present emergency will often revive a stream of recollections and incidents long past, where that word chanced to figure as an important turning point of the history. It is hardly possible to fall into the phrase 'every man to do his duty,' without being put on the track of our recollection of Nelson's last victory. The word 'duty' is liable at any time to bring up the Duke of Wellington. These verbal coincidences are one great link of connexion between us and our past experiences; they bear a full part in putting us ever and anon upon the track of some bygone incident of our history. The more alive we are to the influence of words, the larger is the share of reviving efficacy that belongs to them.

The hold that we have of language not being confined to the articulate organs, but extending over the senses of hearing and sight, and being besides influenced by the emotions, we shall have to recur to the topic on various occasions. The importance of language in the operations of intellect generally also justifies a frequent reference to the subject.

15. To pass to the Sensations. In Organic Life there are many cases of a sensation repeated with new admixtures, serving to disguise its character, and prevent its recalling the former instances of the same impressions. It often happens that the same organic state is produced by very different causes. A shock of grief, a glut of pleasure, a fit of overworking, an accidental loss of two or three nights' rest, may all end in the very same kind of headache, stupor, or feeling of discomfort; but the great difference in the antecedents

may prevent our identifying the occasions. The derangement caused by grief is more likely to recal a previous occasion of a similar grief, than to suggest a time of overdone enjoyment; the sameness in organic state is, in the case of such a parallel, nullified by the repulsion of opposites in the accompanying circumstances; a state of grief does not permit a time of pleasure to be recalled and dwelt upon; the loss of a parent at home is not compatible with the remembrance of a long night of gaiety abroad. Hence we do not identify the supposed state of organic depression with all the previous recurrences of the same state; unless indeed a scientific education has made us aware of the sameness of the physical effects resulting from the most dissimilar causes.

16. We have in the case of Taste examples of a like nature. A taste may be so disguised by mixture as to be undiscernible; the presence of the other ingredients operating to resist the reviving power of the one that we desire to identify. In a solution of Epsom salts we should not be able to discern a small quantity of sugar. The saline bitter of the salts acts upon the tongue and the sense, so as to render it impossible that the sugary taste should have any influence. This is an example of the weak borne down by the powerful. Again, when malt liquor becomes sour, we are unable to discriminate any longer the alcoholic taste, the action of the acid on the palate overwhelms every other sensation. If in such a case, the alcohol is still discernible by any one person, when others fail to perceive it, we should say that the power of reinstatement for alcohol was strong in such a one's mind, either from old familiarity or a great susceptibility to this particular impression, or from the more deep-seated cause of a vigorous attraction of similars of every description.

17. Hitherto I have spoken of sensations identified because of their actual sameness, the difficulty of reinstatement arising from other sensations mixed up with them. A case of greater complicacy and more importance is furnished by the existence of sensations really different, but having something in common. Take as an instance the tastes of the various wines; these are all different, and if similarity acted only in absolute

sameness, port would remind us only of port, claret of claret, madeira of madeira, and so on. But we find that there is so much of a common influence in all wines, that any one of them can remind us of a great many others, we at the same time noting points of difference when they are thus brought into comparison. It is this common influence, with its suggesting power, that has led mankind to constitute what is termed a class, or a genus, 'wine,' comprehending many widely scattered individuals. The identification of likeness in the midst of unlikeness, in other words of a common property, is the essence of this classifying operation. A class differs from a catalogue by virtue of a common resemblance in the midst of diversity. This class, 'wines,' identified through their common organic sensation and taste, is merged in a larger class when spirituous liquors come to be known. There is felt to be an identity between the principal effect of these liquors on the system, and the effect of the various members of the vinous group. The class is now extended; but because of there being some features common to wines that do not attach to spirits, these are still held together in a group by themselves, subordinate to the larger group, or as a species coming under the other as a genus. The addition of malt liquors to the comparison extends the identity still farther, and enlarges the class of substances that suggest one another by virtue of the common quality of causing intoxication. These malt liquors being themselves identical in more points than those common to them with wines and distilled spirits, they also make a small species by themselves contained in the comprehensive genus of intoxicating drinks.

It was not discovered at first that this influence, common to so many substances derived from such various natural sources (the grape, the sugar-cane, barley, oats, rice, &c.), was due to one distinct ingredient occurring in them all under various combinations. The identification had proceeded solely on their common influence on the human system, and not from discerning the recurrence of the common element, alcohol. Had the grouping proceeded on this perception, the case would have been exactly like those above described.

where a taste or smell is identified in its mixtures with other tastes or smells. But the substances were classed together without men knowing whether it was that many different liquids had the same action on the human body, or that there was one substance that pervaded many compounds, to which the influence was solely owing. It was a generalization of a common internal feeling, not of a common external object.

Another example akin to the foregoing is furnished by the pungent odours. The influence of the various kinds of snuff upon the nose is so well marked that we readily identify it notwithstanding differences of aroma or flavour. Upon this similarity we group all the different varieties together, and make a class of bodies, any one of which may be used for any other when the common effect of pungency is desired. The kinds of snuff would doubtless also be identified on the ground of their common origin, the tobacco plant, like wines by the grape. But looking at the subjective sensation of the snuffs, we find that this assimilates itself to a like sensation produced from other bodies; thus the odour of smelling salts may by similarity recal the odour of snuff, and the two different substances will in this way come together in the mind. If we have at any time acquired the impression of hartshorn, this impression also might be recalled in virtue of its resemblance to these others; we should then have three distinct experiences brought up from different times and circumstances of our past history to the present view, these experiences presenting three different substances lying quite remote from one another in nature, but now drawn together in the mind, from exerting on it a common influence. If our acquaintance with pungent odours had been still greater, others would be recalled to join the group already formed, and we should have amassed from far and near a multitude of recollections strung upon one common thread of resemblance, and these recollections would thenceforth be held together as a group in the mind, forming what we term a class, a genus, or a generalization of agreeing objects.

In this instance there is no external element common to all the bodies producing the pungent effect; the classification is purely based on the common sensation of smell. The smelling salts and hartshorn are identical, inasmuch as both yield ammonia; but the effluvium of snuff is not ammonia, although found to bear a resemblance to it in chemical constitution.

These various identifications put to the test the force of similarity in different individuals. While seized by some minds, they are wholly missed by others; and the reason for their being missed usually resolves itself into one or other of the defects already recounted;—the obscuration of the differing ingredients in the combination, the want of good previous impressions, obtuseness of the sense itself, or feebleness in the action of similarity generally. Possibly also the attention may never be turned upon the subject. A distinct effort made to recal some past object resembling a present one has a chance to succeed, when without such effort the identity would never flash on the mind.

The greater the diversity that muffles up a likeness, the greater the intellectual stretch requisite in reinstating the past on the mere force of likeness; the former impressions must be good, the sense delicate, or the recalling stroke of similarity in general vigorous, in order to succeed in a case where the discrepancy is so strong as nearly to overwhelm the agreement.

13. The illustration of similarity in Touch might be very copious. I prefer, however, to reserve the largest share of our space for the two highest senses.

The intellectual sensations of Touch may be said to start from the feeling of a plurality of points; this, combined with movement, gives the sense of surface both as to quality and as to size and shape. On all possible varieties of surface we may have identification at work. Thus if I take in my hand a wooden ball, the turn given to my fingers in handling it reinstates the old engrained impression of the round shape got from the various balls that I have handled in my time. The feeling of the surface may also revive the impression of other surfaces not globular; the impression belonging to the material

—whether fir, oak, beech, mahogany, &c. The shape is not a sufficiently powerful disguise to prevent my identifying the substance with my former recollections of the same timber in many different shapes. A blind person accustomed to discriminate by touch what others discriminate by sight, would not be distracted by altered form; he might be distracted by differences of polish; the remaining similarity in that case being too faint to waken up the former impressions of the same material.

We can generally identify any substance touched as being wood, stone, metal, woollen, silk, cotton, linen, &c. Under very considerable differences of form and fabric, these characteristic kinds of material can still be discerned by the force of similarity. In cases where one sort approaches very closely to another, as in the approximation of cotton to woollen cloth, we have those difficult and testing examples where one person will succeed and another fail in detecting the true resemblance. So in the viscid and powdery substances that come under the hands of the dyer, painter, potter, baker, cook, &c., there are cases of easy, and of difficult identity of touch; variations occasionally happen such as to blind the sense of identity. It is when a very small trace of likeness is sufficient to restore the past impression of the material, and with it the former experience as to its character, that the practised hand and the acute sense manifest their power. Among the qualities of Minerals the feeling to the touch is included.

19. To take next the sense of Hearing. The analysis of sounds has shown us the complexity of the characters attaching to any one individual sound, and to what extent identity in some of these may be disguised by differences in others. For example, the *pitch* of a note may be readily identified when sounded on some voice or instrument familiar to us; but on a strange instrument it is less easy to make out the identity. The change of quality in the note, the greater or less emphasis, the different duration of the sound, as in comparing a piano note with an organ, all tend to disguise the pitch and to render a more delicate or a more cultivated ear necessary for its discernment. Any natural obtuseness of

ensibility to the attribute of pitch will be demonstrated by uch a trial as this; for if the same note be played feebly on he violin and thundered on the organ, the great disparity of mphasis will confound the ear, and destroy the sense of what s common to the two. We have formerly seen that the lelicate appreciation of pitch is the foremost requisite of a nusical ear; being a point of character that a musical educaion tends to improve. When thoroughly cultivated, the ear is able to identify every note on the scale, however sounded; no distracting accompaniment ought to be able to lisguise this, which is the first attribute of a sound as regards musical composition.

The property of *articulateness* of sound is very apt to be disguised beyond the reach of identity by strange accompaniments. Our ear for articulation is formed in the first instance on the voices around us; we identify with ease a letter or a word as pronounced by those; in fact, the casual peculiarities of their manner become as it were fused with our sense of the articulations themselves. A child born in Yorkshire acquires an ear for the vowels and consonants of the alphabet as sounded in Yorkshire. Passing into Middlesex, the articulations correspond without being identical; and it puts a considerable strain upon the force of reinstatement to identify the old words under the new utterance. Such an experiment would show whether the ear is good as respects the essential quality of articulate form, just as the trials above alluded to show the degree of delicacy as regards the pitch of a note. Some ears are but faintly susceptible to the distinctiveness of the articulations, or to the essential difference between one vowel and another, and between one consonant and those closely allied to it. If such ears happen to be acutely sensible to the qualities of different voices, and to differences of emphasis, or stress, they will be more strongly acted on by the disagreements than by the agreements, and the identification will sometimes be a matter of extreme uncertainty.

The illustration takes a wider sweep when we suppose a continuous flow of a sound, as in a musical performance or a consecutive address. The effects on the ear being more varied,

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The illustration takes a wider sweep when we suppose a continuous flow of a sound, as in a musical performance or a consecutive address. The effects on the ear being more varied, there is greater scope for tracing similarities, and more opportunity for the obstruction arising from diversity. We can commonly identify an air that we have once known on all varieties of instruments, and with or without harmonies. But it will repeatedly happen to persons little accomplished in musical matters to be confounded with a known air when played on a full band, while they could readily identify it on a single instrument. Musicians can also identify the key on which a piece is composed, although this point of identity must be enveloped in the widest differences as regards everything else. We are accustomed to find a common emotion in many compositions; we classify airs as martial, gay, solemn, sacred, melancholy, &c. In so far as there is any reality in these distinctions, they are made out by the force of similarity recalling the past, and scattered examples of an effect felt at the present moment. A more substantial agreement is that commonly found in the compositions of the same master. Let a composer vary his works as he may, there is a manner that usually sits upon every one of them; this manner the hearers get accustomed to, and identify on almost any occasion. The identification in the midst of difference is not difficult with the more original composers,—Handel, Beethoven, Mozart, Mendelssohn, &c.; there are others less characteristic than these, and giving scope to a nicer and more practised sense.

I have repeatedly remarked a contrast as subsisting between the ear for Music and the ear for Speech. These two modes of addressing the same sense affect for the most part different susceptibilities of the organ. Pitch is the leading quality in music, articulation the main peculiarity of speech; and a good ear for the one may be a very indifferent ear for the other. In listening to speech, therefore, the effects identified by the ear are considerably different from those above mentioned as belonging to music, although agreeing in one or two particulars. The foremost quality is articulateness, upon which hangs all our perception of meaning; to this succeed pronunciation, accent, cadence, and the accompaniments of manner and gesticulation. (The difference between one voice and another should also be taken into account among the diversifying circumstances.) By 'pronunciation' I here mean simply the manner of articulating the vowels and consonants and separate vocables of the language, as treated of in our pronouncing dictionaries. By 'accent' I understand that indescribable accompaniment with the voice, termed also 'twang' or 'brogue,' and which constitutes the indelible distinction between English, Irish, Scotch, Americans, French, &c., and may subsist along with a perfect sameness of articulate pronunciation. 'Cadence,' I take to mean something more than accent, being the modulation of the voice in consecutive utterance; the peculiar form of elocution fallen upon with the view of making speech agreeable to the ear of the listener; it is in fact the melody of music or speech. This too is natural to some extent, but differing far more among the different inhabitants of the same province, than accent does. Vocal organization, mental character, and education modify the cadence of the voice to very different tunes. Moreover there is one cadence for conversation, another for reading, a third for public address; oratory consists of the most highly wrought, the most rich and various cadences that the speaker can command. The 'accompaniments of manner and gesticulation' which come to be looked upon as a part of speech, being interpreted by the hearer just as much as the articulate syllables themselves, are likewise a source of diversity, inasmuch as they are conventionally different while having a certain community of character founded on the natural expression of feeling. If we are accustomed to the very slight degree of gesticulation practised in this country, the action of a foreigner is perplexing, and distracts instead of aiding us in comprehending his meaning.

Taking all these sources of diversity in connexion with the one main feature of articulate utterance, we may derive an unlimited fund of examples of reinstatement made difficult by unlike accompaniments. Voice, pronunciation, accent, cadence, and gesticulation, are inseparable from articulation; and we become accustomed to the sound of words as beset with a particular mode of each of these effects. Often indeed we take up a meaning from manner alone. Accordingly, when we come to listen to strangers, to the people of another province, to foreigners, we experience the difficulty of identifying the articulation in the midst of unusual combinations. The goodness of the ear for articulation proper is submitted to a trying ordeal, as the ear for pitch is tested by the sound of a strange instrument. The trial is greatest of all when we are endeavouring to catch up a foreign language, the ear being as yet unfamiliarized with the new articulations. Here the one fact of the articulation of vowels and consonants needs to make itself felt amid the distraction of a manifold variety of other effects. I know nothing that proves so decisively the goodness of the articulate sensibility of the ear as the rapidity of understanding a foreigner speaking his own language. The power of identifying the essentials of the articulation in the diversity of all else, is in such circumstances conspicuously manifested. It will happen, however, that a person is more than usually sensitive to some of the accompaniments that do not concern the conveyance of the meaning; an ear strongly impressed with the accent and cadence, and permitting itself to be very much engrossed with the different turns of the emphasis and modulation, is by that circumstance rendered more obtuse to the articulate character or to the meaning of the words. The thunder of a diverse and unaccustomed cadence drowns the still small voice of expressive utterance. An acute ear for oratory is thus a great obstruction to the acquirement of languages; an eye unduly oppressed with gesticulate display is an evil in the same way. In listening to our own language spoken in the style that we are accustomed to, the sensitiveness to those accompaniments is in our favour, and brings home the meaning all the more powerfully; but when they are totally changed in character, as when we listen to a Frenchman or an Italian, we are just as much put out in identifying the articulation as in the other case we were assisted. The reinstatement thus depends in part upon the power of attraction we have for the point of sameness, and in part on our not being too sensitive and too easily laid hold of by the points of difference. We shall everywhere observe the influence of both these conditions in bringing on the reviving stroke of identity.

20. The ear, along with the articulate organs, is, as already remarked, a matrix for holding together our recollections of language. A speech heard is in part remembered as a connected series of auditory impressions. Our recollections of this class are likewise liable to be recalled by similarity, even under circumstances of considerable diversity. We can scarcely listen to any address without being reminded of many past addresses, through the occurrence of phrases, tones, and peculiarities that lead us into some formerly experienced track of impressions on our ear. The greater our susceptibility to the articulate quality that governs distinctness of meaning, the more readily shall we fall upon previous addresses that correspond in phraseology; if we are more alive to tone, accent, and cadence, these qualities will preside over the recal of the former occasions when we were in the position of listeners. In this way we are led to detect similarities of manner and phrase in different speakers; we hunt out imitation and plagiarism, and bring on comparisons among various styles of address. When similarity has brought up the remembrance of a past speaker, we have the further opportunity of noting differences; but this last operation always supposes that similarity has done its work in confronting the past with what is now before us. As regards the diversities that may obstruct the reviving impetus of likeness, they may lie in the context of the agreeing phrases, in the other peculiarities not connected with meaning, or in the subject matter and sentiment of the address. As in former cases, we pronounce the attraction of similarity powerful when it breaks through a great discordance, and the discordance great that arrests the reviving stroke of similarity; in fact, we must measure each force by the opposition that it conquers. If a verbal likeness has the effect of interpolating some old recollection in a subject most discordant with it, we pronounce either the verbal action powerful, or the bent of the mind upon the subject feeble, or both.

As regards the workings of similarity among the sensations of hearing, we have confined ourselves, in accounting for easy or difficult reinstatement, to the character of the ear; we have not in this case brought in as a possible explanation the general force of similarity in the mind, that force, namely, that would tell equally upon all classes of sensations and thoughts, and make the individual good or bad on the whole in the matter of tracing out sameness in diversity. I am induced, from the facts that have come under my observation, to admit the existence of such a pervading characteristic of the brain; and the reader will observe that it has been already invoked as one of the possible explanations of difference of character in reviving sensations of Taste and Smell; but in the special case of the ear, I am strongly impressed with the view that the nature of the organ itself has much more to do with our powers of acute hearing and the acquisitions connected therewith, than the pervading characters of the brain or mind in general. As regards music, I think this view very strongly supported by facts; as regards articulation, it probably holds to a less degree.

21. Among Sensations of Sight, the occasions for identifying sameness in diversity are innumerable. We can identify *colours* in spite of difference of shade; thus we have a whole class of blues, of reds, of yellows. The existence of such classes implies both sameness and difference; the class name being derived from the sameness or the effect common to all the individuals. When a colour is intermediate between two principal colours, as between yellow and red, we may fail to class it with either, not being struck with any feeling of identity in the case; whereupon we constitute a new colour, as orange. It may also happen that to one mind the colour may appear as red, and to another yellow, according to the previous impression that it most readily revives. The peculiar effect induced when colour shines through a transparent surface may be quoted to exemplify the operation of similarity in vision; for we do not readily identify this effect in all colours and in all varieties of the transparent covering; that is to say, such is the diversity, that the perception of sameness is attended with difficulty, and reveals itself

to some minds and not to all. A varnished substance, a glossy fabric, a polished surface in metal or stone, a film of wet, a clear brook, a covering of glass, all strike the mind with a common effect of brilliancy, and if the power of similarity is in effective operation, each one of these effects may recal a great many of the others, so as to muster in the present view a whole class of things very different in general appearance, but all agreeing in a particular impression. According to the reach of mind possessed by the individual, that is, according to the vigour of the identifying stroke, will be the range of objects brought up from the past at the instance of some one present. Looking at a brilliantly polished marble chimney-piece, one man may be reminded only of polished stones of various kinds; another, breaking through a greater shroud of diversity, compares the effect with metallic polish. Speculating still more deeply on the kind of influence exerted on the mind by such effects, a third person brings up a still more remote subject, varnished surfaces; from these he may proceed to glossy silks and polished leather; and by a stretch still more remote, one may bring the effect of a pebbly bottom through a clear running rivulet into the comparison. But in order to carry an identity so far as would be implied in this series of objects, it would be necessary that we should have not merely a keen feeling of the common effect of lustrous brilliancy, but also a notion of its depending on a transparent covering over a mass of colour. This notion, added to the feeling of effect, might enable us without a great stretch of mind to break through the enormous difference between a marble chimney-piece and a pool of water; whereas the feeling of effect, if alone able for such a stroke of identity, would show itself to be intensely acute, or the general force of similarity would need to be very powerful. The case would then be more of the nature of a poetic fetch, a Shakesperian instance; two objects totally diverse in their appearance to the common eye recalling one another through the medium of a common emotion. On the other hand, the case of identifying the series through the *idea* that the transparent surface overlying the colour was the main circumstance of the brilliancy, would be an example of a more intellectual kind of identification, such as a scientific mind is accustomed to bring about.

In the combinations of colour with form and size,—the optical with the muscular impressions of sight,—we have the widest possible scope for tracing likeness amidst diversity. We identify a common colour through all varieties of objects, large, small, round, square, straight, crooked, here and there and everywhere. Thus it is that we have in our minds a class notion for every colour, a common impression of white, red, and blue, derived from every imaginable species of objects. The more susceptible we are to colour, the more deep and permanent and various are these common impressions, and the more easily do we identify a new case with the total of the previous instances of the same colour,—of green, violet, purple, claret, &c.; and the less liable are we to be put out by diversifying circumstances, as by differences of shade, of richness, the addition of lustre, the presence of other colours, the total difference in the material, shape, and size of the objects. When one's hold of colour is but feeble, one is very readily confused by all these circumstances of variety; the sense of difference between scarlets, crimsons, and purples, becomes practically obliterated; in the language of our general doctrine, a scarlet does not revive the previous impressions of scarlet, so as to retain them firmly and interpret the new case by their means, thereby settling the identity between it and them.

The identification and generalization of *forms* in the midst of every possible difference in colour and dimensions, opens up another field of illustration. We identify the circular outline of round bodies; the oval shape of others; there is an infinity of classes determined by form, including not merely the regular figures of Geometry, but all the recurring shapes in nature and art—egg-shaped, heart-shaped, pear-shaped, vase-shaped, cup-shaped, lanceolate, &c. &c. These comparisons arise out of identity in the attribute of form, seen through diversity in all other respects. Most of the identifi-
are sufficiently easy to strike any observer; while

instances occasionally arise where only a limited number of minds are struck with the likeness, or experience the revival of the old upon the new. Thus, in the descriptions of botany, the shapes of leaf and flower are often represented by comparisons that are far from obvious to an ordinary observer. In anatomical descriptions there is not unfrequently an analogous want of obvious resemblance.

The case of mathematical forms and artificial diagrams is both peculiar and interesting; but the important strokes of likeness in diversity that occur in science are rather more complicated than the examples falling properly under our present head. The generalization of the forms themselves—of triangle, square, parallelogram, ellipse, &c.—through all possible differences of subject, is all that we can quote on the subject of tracing similarity among our sensations of sight. And we may remark here, as on a former occasion, that a strong sensitiveness to the other properties of things, that is, to their colours, dimensions, material, uses, influences on the feelings, &c., is an obstruction to the process of identifying the mathematical form. A burning volcano suggests comparisons not with the diagrams of the cone in a book of Geometry, but with images of conflagration and explosive energy.

Of forms not mathematical we have the alphabetical and other artificial signs and symbols, used both in business operations and in science. In deciphering bad hand-writing there is scope for identifying sameness in diversity. This is like the case of obscure articulation discussed under hearing. A strong sense of the points that make the characteristic difference of each letter, and an obtuseness to all the unmeaning flourishes, are the qualities of a good deciphering head. In proportion as a reader is carried away by ornamental shapes, his power of making out the meaning is impaired. This is the exact parallel of what was said above respecting the effects of over-sensibility to oratorical cadence.

The important case of the revival of language, already brought in under both articulate action and the sense of hearing, comes in here also, inasmuch as written language appeals to the eye, and is made coherent in the mind in the shape of impressions of sight. What was said above on the resuscitation of past addresses and sayings, through listening to some one speaking, applies to the reader of books. Forms of language and phrases affecting the eye, recal their similars from the past, and break through a greater or less amount of unlikeness, so as to make present at the same time matters written in different places and occasions. An eye very much arrested and impressed with language is to that degree prone to such revivals; but according as the written symbols are regarded purely as a medium for conveying pictures or information, the tendency to mere symbolical identification is restrained. We have here, as before, occasion to note the verbal aptitude of the mind in contrast to the hold taken of the things that make the subject matter of language, whatever those may happen to be,—whether science, history, poetry, business transactions, or any other. In the verbal mind we can remark the following peculiarities,—1st. The physical power of articulation well developed; this is shown in the easy acquirement of all the positions of the voice and mouth requisite for speech. 2nd. The contiguous adhesiveness of trains of articulate actions, or of the letters, syllables, and words that make up the stream of utterance. 3rd. A good articulate ear, both as respects discrimination and cohesiveness of impressions. 4th. A corresponding eye for alphabetical or written composition. 5th. A certain pleasure or enjoyment in the exertions of speaking, hearing, and reading, apart from the further ends served by these; this circumstance inspires and sustains the exercise of those lingual functions. 6th. The restoring power of similarity for verbal states in the articulate organs, ear and eye respectively, should be vigorous, either in consequence of this force being largely developed over all kinds of material, or from the special susceptibility in those speech-embodying parts of the system. To these six positive peculiarities may be added a negative aid, namely, comparative indifference or insensibility to subject matter. This is the only thing wanted to enable the faculty of language to run riot, as we occasionally find it in our experience of men and women.

Artistic forms make a class distinct from both the mathematical and the symbolical. In them the identity is partly in the literal outline, as traced upon the eye, and partly in the effect of it on the mind, as an object of beauty or grace. This last requisite, being the essential feature, must rule the mind in recalling the various examples of some effect present to the eye. Thus, in the drapery of a statue, we identify some effect that we have formerly been impressed with, and the stroke of similarity brings up the former objects to the recollection, on which we find that there is by no means a literal coincidence of lines, and curves, and folds; but the æsthetic similarity has broken through these and other differences, and brought before the mind an instructive array of artistic parallels. A deep feeling of literal or mathematical form would be repugnant to an identification of this kind, unless we had the power of entirely sinking the one susceptibility in the presence of the other; for this is the only means of maintaining such contradictory tastes in the same mind.

The identification of one scene of nature with another may present all degrees of difficulty, according to the predominance of agreement or of difference, and according to the tendercy of the mind to be impressed with the one or the other. If the sameness is in form and outline, in the arrangement of mountain, valley, and river, the reviving stroke of similarity turns on the attraction of the mind for unsymmetrical shapes and groupings, one of the features of the catholic susceptibility of the naturalist's mind. If the resemblance to certain other scenes lies in richness, massiveness of colouring, and strength of contrasts, the chord to be struck is of a different kind, and such scenes will be revived in a mind alive to these effects, notwithstanding perhaps very great differences in the groupings or formal arrangements of the component parts.

The same observations are applicable to any other mixed objects of sight or spectacle. When one dress or uniform recals others; when the *mise en scène* of a dramatic representation suggests parallels from our former experience in those things; when one face recals another by similarity: or even when a picture revives the original;—in all such cases, the interest, in a scientific point of view, lies in remarking what is the nature of the agreeing particulars, and what are the points of discord. These will determine the sort of mind that would experience the stroke of recal, and the facilities and difficulties belonging to the case for each different variety of mental constitution.

The general power of Similarity would operate alike on all kinds of forms and on all varieties of objects, reviving with equal readiness the similar in colour and in shape. But this general power is always modified by the acuteness of the sense, as well as by special education, which deepens the hold that we have of some one class of impressions, and makes us all the more ready to fall into that particular net. Hence it never happens that any individual is equally prone to restore likeness in colour, in geometrical form, in cypher and symbol, and in æsthetic effect.

The last class of objects coming under sensations of Light are Visible Movements. These are of the greatest possible variety. Among those that agree in some point or other, classes are formed, and names given indicating the agreement. For example, the class of projectiles agree in the form of the curve that they take; in like manner, we have circular movements, elliptic movements as in the planets, rectilineal movements, uniform movements, accelerated movements, rotation on an axle, pendulums, waves, zig-zag movements, waterfalls, explosions, &c. Under all these we may have any amount of diversity in the range and speed, as well as in the thing moved. The movements of animals originate many other varieties; we have all the varieties of movement on all-fours, the walk, trot, canter, gallop, shamble, &c.; the flight of birds, besides having a common character, is marked by great diversity in the different species; the darting to and fro of the bat, the frog-leap, the crawl of creeping things, the sluggish pace of the snail, the dartings of the infusoria, are all distinct types of moving spectacle. By identifications through the stroke of similarity we bring together into classes a great many instances isolated in their occurrence, and keep hold of them by class names. We thus generalize the grand varieties of swimming, flying, two-footed locomotion, &c.; and within each of these we have a number of minor classes formed in still closer likenesses. In the flexible and various action of a human being we have many characteristic types of movement and display. The gait in walking, the action in speaking, the mode of performing any work or operation, the movements of the stage, are so many objects that excite our notice and sink into our minds as permanent recollections. The collective movements of multitudes either in orderly array and disciplined precision, or in inorganic tumult and confusion, impress themselves upon the view, and spring up as memories in after times. The moving life over the face of the globe and in the habitations of men is more interesting to us than the still life; it contains more matter of emotion and excitement, and is consequently ore dwelt upon both in present reality and in idea.

Here, therefore, the force of similarity has a wide arena to in. The recurrence of sameness in the midst of more or ess diversity in all these various movements leads to identifi-tion more or less easy. We identify a style of acting on e stage, a dance, a gait, although the circumstances of the resent are very different from the examples lying in the emory. If the agreement is not literal, but in a certain general spirit and effect, a strong sense of the literal will be a bar to the revival of the resembling cases in the past. If we are very sensitive to the stirring effects of movement in general, we are not so likely to identify special curves and patterns as being similar to others previously known. Easy inflammation to a striking effect blinds us to the accompanying details, according to a principle already adverted to. Movements may be divided and classed in a manner exactly parallel to the threefold division of forms; *mathematical* or regular movements, as rectilinear, circular, elliptical, &c., comprising all the continuous movements of machinery, and all movements that can be numerically calculated or geometrically traced; *symbolical* movements, or all those used as arbitrary signs, such as the gesticulation accompanying directions, commands, instruction, and the like, telegraphic signals, the alphabet of the deaf and dumb, the characteristic gait and movements whereby we discriminate persons and animals; lastly, *æsthetic* movements, or all those that touch the sense of beauty and the interesting emotions. Different minds are variously susceptible to these three kinds, and identify one sort by preference over the others. The æsthetic sense leads to a revival on that point of resemblance, and obstructs the disposition to classify movements according to their mathematical character or arbitrary meaning. The most literal and disinterested susceptibility is to the arbitrary, where neither calculable regularity nor artistic beauty imparts any attractions. The signals of a telegraph, the motions of a fugleman, the signs used in converse with the deaf, are like cyphers and alphabetic letters; they give scope for pure intellectual identity and discrimination; they require to be closely observed and literally compared with those previously known; the differences are arbitrary and so are the agreements. A cold intellect, with good adhesion and good reinstatement for numerous uninteresting and conventional movements, is the basis of their easy recognition. This would pretty accurately describe the business mind.

22. A somewhat interesting class of identities is that presented by the properties common to Sensations of different senses. Impressions reaching the mind through different avenues of sense are yet found to have a sameness in the mental feeling or the emotion, this sameness being necessarily accompanied with the difference due to the diverse entries whereby they reach the brain. For example, many tastes and smells have the character that we call sweet; but there are also effects on the ear and on the eye with so much of the same character that we apply to them the same epithet. In like manner, the character of 'pungency' is common to sensations of all the senses; we have it under taste, in peppered meats; in smell, we have sal volatile; in touch, a scalding warmth; in hearing, drum and fife music; in sight, intense illumination.

The amount of sameness in these various sensations is such as often to cause one to recal the others, especially when we are anxious to make known the effect of some one of them upon our minds. The identity has been long since made out in many such classes, and once struck is clenched and handed down by the use of a common term, as in the above case of 'sweetness.' The opposite quality, 'bitter,' originally referring to taste, has been recognised as occurring in various emotions, as when we speak of the bitterness of disappointment or remorse. The quality that we call 'delicate' has original reference to Touch, but by the feeling of sameness it is looked upon as a mode of sensation in all the other senses. Comparisons are instituted between sights and sounds, and the phraseology of the two arts of music and painting is in this way made interchangeable. A picture is said to have a certain *tone;* and a piece of music is by a less common figure spoken of as richly *coloured.* The feeling of 'warmth' is identified as belonging to effects that have no connexion with heat; we hear of warm colours, and warm affections. Notwithstanding the great disparity there is between an actual sensation of heat, and a colour or a natural affection, there is a degree of sameness sufficient to break through the discordance in other respects, and bring on the stroke of identification. The designation of one class of sensations as pains and of another as pleasures is also an identifying of a common character in the midst of great diversity; but these qualities are usually so well marked in the mind, being, in fact, the prime movers of our actions, that no amount of diversity can prevent us from recognising either the one or the other; indeed a pain not identified as such, that is, not recalling our general notion of pain gathered from the sum of all our painful experiences, would really be no pain.

These generalizations among the feelings of our different senses serve interesting uses. They teach us the existence of common mental effects arising out of very different outward causes, and are in fact so many discoveries regarding our mental nature. They also serve as illustrations the one of the other, in our descriptions of feelings, whether in the common conversation of society, in the higher sphere of poetic delineation, or for the purposes of science, as in the delineations of the Senses attempted to be given in this work. If we are endeavouring to convey to others some state of feeling that they have not experienced, we must endeavour to bring before their view some identical or parallel state that they have experienced, and therefore we require to possess through the identifying action of similarity, a store of such likenesses. This is one of the most frequently recurring attempts of poetry, one of whose objects is to produce new emotions in the minds of men. The illustration of the feeling roused in the mind of Antonio by music brings in a complicated reference to the other senses.

> Oh, it came over me
> Like the sweet south upon a bank of violets,
> Stealing and giving odour.

CONTIGUOUS AGGREGATES.—CONJUNCTIONS.

23. Under Contiguity we had to notice the aggregation of impressions derived from many different sources, through the circumstance of their proximity or their striking the mind at the same time. We pointed to the association of feelings of movement and sensations with one another in the notions that external objects create within us, as in the complex idea of an apple, or a piece of gold. We remarked further that in many objects the mental impression overflowed or surpassed the sensible impression, as in the whole class of tools, with which are associated uses, that is, actions and reactions upon other bodies. In the more profound knowledge of natural things that experimental science yields us, there is a similar addition of associated impressions to the actual feelings of the senses; the chemical notion we have of sulphur, for example, is a complication of this kind.

Now wherever there is much variety or complicacy in the impressions of outward things, there is scope for the detection of likenesses in the midst of diversity. An object acts upon four different senses; the effect on one sense is identical with an effect formerly felt, but the collateral effects on the three other senses are totally different from the collaterals in the other case. Thus I take in my hand a ball of glass; to the touch it is the same as a ball of polished marble, and might recal the remembrance of such a ball if I had chanced to have been previously cognizant of one; but looking at it, hearing the ring that it makes on being struck, the disparity is notable in both points, and would probably prevent my getting upon the old track of the marble specimen. The most impressive feature of the object being its brilliant effect on the eye, this would have every chance to rule the identifying operation, and prevent me from recalling an object entirely destitute of this peculiarity. There might, however, be circumstances that carried my attention off from this effect, in which case the round smooth touch might start forth to the dignity of striking the recal.

In the popular classifications made among familiar objects, the identifying process is seen habitually at work. On the landscape we observe an elevation of the ground, an ascent from the ordinary level to a high point or peak; we note this appearance repeated under a great variety of shapes and in different situations; we are not prevented by the disparity from feeling the sameness, and the sight of every new individual recals to the view those that we have formerly seen. We retain in our minds one vast array of objects widely scattered in nature; we give them a common name, we predicate of each new example the peculiarities that we have found attaching to the previous ones; we know without a trial that if we were to ascend any one of them we should experience a wide prospect, a diminishing temperature, and an altered vegetation. We thus group in the mind a number of things not grouped in nature; we also assemble together into one recollection many widely scattered periods of our past history, being the epochs when we encountered all the different mountains and mountain ranges that make up our catalogue; and lastly, we accumulate a body of information that enables us to infer beforehand or divine the characters that we should find on a close inspection to belong to every new-discovered member of the class.

In the same way, and with similar consequences, do we classify numerous other groups of natural objects;—rivers, forests, cultivated fields, lakes, seas, cities, quadrupeds, birds, fishes, &c. Natural History makes a more express business of the classifying operation; it searches all creation in order to exhaust the materials and forms that it contains, and takes precautions to arrive at real and fundamental identities. The progress of Natural History knowledge has been partly in the increase of objects discovered, and partly in the transition from superficial to deep identities. In the time of Aristotle animals were classified according to the element they inhabited; one class dwelling on the land, another on the sea, a third in the air: this point of identity being so prominent and forcible that it arrested every one's attention. Each of these classes could be subdivided by forming minor groups on still closer resemblances; thus we should have on the earth, bipeds, quadrupeds, reptiles, &c., each of these groups being the assemblage of a number of individuals recalled to the view by special identities. So in the air, the insect multitude would be readily marked off from the feathered tribes. It was not difficult for observing men to draw together classes such as these. But a more profound examination has developed features of identification that carry with them a greater amount of agreement, and on points of more value as knowledge, than in those ancient groupings. Birds are now identified not by the circumstance of their flying in the air, but on the fact of their bringing forth their young in the egg, by their feathered structure, their warm-blooded circulation, &c. Instead of the old group of quadrupeds or animals walking on all fours, we have the class *mammalia* (which suckle their young), including both man and quadrupeds, and certain animals of the sea and the air; this class therefore goes completely athwart the classification according to the element the creature lives in.

24. The operation of Similarity in such classifyings and re-classifyings as the above, has a very high interest; it sets forth the workings of genius, and the history of science and of the human mind. The reader has not as yet been quite

prepared for carrying a full explanation over this field of intellectual labour. It is necessary first to dwell for some little time upon less complicated instances. I might follow the order adopted in developing the Law of Contiguity, and specify instances of the aggregation of impressions of the various senses, the Organic sensibility with Taste, Smell, Touch, Hearing, or Sight; and it would be easy to lay hold of many cases of identity in diversity among such aggregates. Things affecting the palate alike may yet be very different to the touch and sight, as in the different varieties of the same alimentary substances,—bread, butter, flesh, &c. Objects that are identical to the eye may yet be utterly different to the taste and smell, as in the case of transparent liquids, such as water, alcohol, nitric acid, and many others. We here make a class founded on the common peculiarities, and give a designation implying these and no more. If, however, the taste or smell is the point we are bent on studying, we do not pass from nitric acid to alcohol and water, but to other substances that we have known with analogous actions on the nose, as the other strong acids and the biting gases; these are recalled to mind in spite of differences in all the other sensible properties distinguishing one kind of matter from another. In such cases, it is to be noted that the diversity is often but very slightly obstructive of the process of reviving the parallel instances, and for this reason, that the mind may be entirely engrossed with the one property, and inattentive to all the others; the acid and biting odour may be the one property of nitric acid that occupies the regards, and the substance is to all intents and purposes a substance known by one sense, and recalling former substances identical in their action upon that one sense. This remark is often applicable in the workings of Similarity. Things may have a multiple action on the senses, but if the currents of mental occupation are exclusively occupied with one of the effects, the others are for the time being as good as null; they neither aid nor obstruct the operations of the intellect stimulated by the one effect of taste, or sound, or sight that is the engrossing influence at the moment. We have had occasion previously to notice the circumstance that a diverse feature is obstructive of the reviving tendency of an agreeing feature, in proportion as it has power to seize and occupy the mind; as when great difference in artistic effect prevents an artist from identifying objects that have a likeness in their material or in mathematical form,—a burning volcano with a truncated cone in Geometry. The observation is an extremely general one; for when by obtuseness of sense or voluntary power of resistance, we shut our attention to a circumstance of disparity, it ceases to count as an obstruction to the effect of similarity in other particulars. The overwhelming attractions of the agreeing feature will often of themselves suffice to reduce disagreement to a nullity, even supposing that there is no natural obtuseness, and no effort of volition to withdraw attention from the disagreeing circumstances. Absorbed in listening to a full band, our intellectual trains of identity and comparison turn upon airs, melodies, and harmonies, and not upon the persons, instruments, and incidentals of the performance.

25. I shall not pursue farther the instances of aggregate impressions on plurality of senses. Passing on one stage farther, we will now advert to objects viewed as compounds of sense and association. Tools, implements, machinery, and all objects of practical utility, make a class that may stand first in exemplifying this aggregation. A knife, for example, is not simply an object of the senses; it is this and something more. Along with the sensation that it produces in the touch and the sight, there is an associated impression of its use or of the cutting operation: and we are almost unable to regard it apart from this other circumstance. The appearance of a knife lying on the table is not the whole knife, the appearance of it in the hand while we feel its form and dimensions, coupling sight and touch, is not the whole knife; they are at best but signs or suggestive particulars that revive in the mind by association the full notion of the object. Here, therefore, we have a complication of sense and intellect, of impressions made by an actual object, with ideal or associated impressions arising from former occasions when we have seen it in its full operation. In this association of sensible

appearance with use,—the last being only occasionally seen in the reality, and therefore for the most part an idea or a potentiality,—we have abundant room for the exercise of tracing likeness yoked with unlikeness. We may have similarity in form with diversity of use, and similarity of use with diversity of form. A rope suggests other ropes and cords, if we look to the appearance; but looking to the use, it may suggest an iron cable, a wooden prop, an iron girding, a leather band, or bevelled gear. In spite of diversity of appearance, we are led to bring up what answers a common end. If we are very much attracted by sensible appearances, there will be the more difficulty in recalling things that agree only in the use; if on the other hand we are profoundly sensitive to the one point of practical efficiency as a tool, the peculiarities not essential to this will be little noticed, and we shall be ever ready to revive past objects corresponding in use to some one present, although never so diverse in all other circumstances. We become oblivious to the difference between a horse, a steam-engine, and a waterfall, when our minds are engrossed with the one circumstance of moving power. The diversity in these had no doubt for a long time the effect of keeping down their first identification; and in many classes of minds this identification would have been for ever impossible. The regarding of these three things as one and alike implies a remarkable sense of sameness in diversity: the attractive force of similarity behoves to be very energetic, and the aiding circumstances must likewise be very efficient. A strong concentration of mind upon the single peculiarity of mechanical force, and a degree of indifference to the general aspect of the things themselves, must conspire with the intellectual energy of resuscitation by similars, in order to summon together in the view three structures so different. We can see by an instance like this how new adaptations of existing machinery might arise in the mind of a mechanical inventor. All new identifications lead to the multiplication of things serving a common end. When it first occurred to a reflecting mind that moving water had a property identical with human or brute force, namely, the property of setting other masses in motion, overcoming inertia and resistance,—when the sight of the stream suggested through this point of likeness the power of the animal,—a new addition was made to the class of prime movers, and when circumstances permitted, this power would be put to use instead of the others. Here would be in fact a discovery of a new property of water, and a new invention in the mechanical arts. It may seem to the modern understanding, familiar with water wheels and drifting rafts, that the similarity here was an extremely obvious one. But if we could put ourselves back into an early state of mind, when running water affected the mind by its brilliancy, its roar, and irregular devastation, we might perhaps feel that to identify this with a man's muscular energy for practical purposes, was by no means an obvious effect. Doubtless when a mind arose, insensible by natural constitution to the poetic aspects of things, and devoted to the working out of practical ends, having withal a great stretch of identifying intellect, such a comparison would readily take place; and I am disposed to attribute to great discoverers generally the concurrence of all these three circumstances,—strong attraction for the properties whereon the identification is to turn, comparative indifference to the discrepant accompaniments, and good reach of mind in general. We may pursue the same example one stage further, and come to the discovery of steam power, or the identification of expanding vapour with the previously known sources of mechanical force. To the common eye, for ages, the vapour presented itself as clouds in the sky, as a hissing noise at the spout of a kettle, with the formation of a foggy curling vapour at a few inches' distance. The forcing up of the lid of the kettle may also have been occasionally observed. But how long was it ere any one had suggested to their mind the parallelism of this appearance with a blast of wind, a rush of water, or an exertion of animal muscle? The discordance was too great to be broken through by such a faint and limited amount of likeness. In one mind, however, the identification did take place, and was followed out into all its consequences. The likeness had occurred to other minds previously, but not with the same results. These minds must have been in some way or other distinguished from the millions of mankind, and the above is the explanation of this difference that I should be disposed to assign, as deduced from the theory of the human intellect adopted in the present exposition. The intellectual character of Watt is well known to us; and we can have no hesitation in attributing to him a very great susceptibility to the mechanical properties of bodies, or the uses of things as tools and machinery, and a concentration of mind upon this one feature, which would be a practical indifference to all other aspects, together with great reach of the identifying intellect: and I may add, what would be almost implied in these three characteristics, a previous knowledge of the matters likely to rise up to the view under the identifying impulse; for the previous storing of the mind must necessarily determine what things will be recalled by the promptings of things present. He that had best studied the existing prime movers would be the person to detect a new one; a far less salient manifestation of the property would awaken in his mind the notion of the others, and lead to the enrolling of the new object in their company. But I am nevertheless persuaded that equal acquaintance with the known does not make an equal power of forcing a way into the unknown by means of the attraction of like for like through an interval of separation and a repulsion of unlikeness. It is always difficult to assign the proportions due to different causes in such a recondite region of nature as the one we are now labouring to elucidate; but the recorded instances of extraordinary genius put out of the question the sufficiency of any explanation limited to the amount of study or attention bestowed on the subject matter of the discoveries.

26. The foregoing will suffice as an example of the workings of our present law in one very wide region of objects. We might under this head have gone a great way into the illustration of practical genius in all departments of life, from mechanical industry up to those high walks of action where human beings are the tools, as in military and civic command. But I defer for the present any remarks on these departments.

Let us next view natural objects, as seen by the eye of the naturalist with a view to catalogue and exhaust all their properties and relations, whether practical or otherwise. The mineral, vegetable, and animal kingdoms, as objects of intellectual curiosity and rational explanation, present in each of their individual specimens that mixture of the sensible present with the associated absent above exemplified in the class of tools or machinery. Each mineral, plant, or animal, is a bundle of impressions, of which the whole cannot be made present to the sense at one time, there being a series of actions upon other individuals to be included in the conception, and these usually held together with the assistance of language. The complication thus presented is a degree beyond the preceding group. In the class of Mineral bodies for example, we have the concurrence of many attributes in each individual, some sensible, others experimental; and it is under the estranging influence of much diversity that all the classes have been formed. Thus, to take the group of metals. Some of these have a very large extent of sameness, as tin, zinc, silver, and lead; gold and copper are not very different to the common eye. Iron and manganese show a very close resemblance. But when we come to mercury, a striking point of diversity starts forth; the property of liquidity marks even a contrast with every one of the others. The influence of this diversity, leading the mind away to water and liquids of every kind, would prevent the rise of metals to the view, but for the strong effect of the two qualities of lustre and weight or specific gravity, which acting by themselves could suggest by similarity only such substances as silver, lead, tin, &c. This concurrence of two striking points of sameness overpowers the diverting influence of the liquid state, and brings mercury to the mind's eye side by side with the metals. But these bodies have been identified with others in the midst of still greater discordance. When Sir Humphrey Davy suggested that metallic substances were locked up in soda, potash, and lime, the identification in his mind proceeded upon resemblances purely intellectual, that is to say, having no direct appearance to the senses, but made out through indirect means, and represented to the mind by technical symbols. He found a class of bodies that had a close agreement with one another, and were termed salts; he saw that some of these consisted of an acid and the oxide of a metal, as sulphate of iron, nitrate of silver; others consisted of an acid and a substance called an alkali, as sulphate of soda, nitrate of potash. Here there were a number of bodies brought together in the mind by general agreement; an oxide of a metal in these bodies suggested by similarity of *function* an alkaline substance, both having the property of neutralizing an acid and forming a salt; it was impossible therefore not to class together in one group all substances having this property, which was done before the time of Davy, under the name *bases.* He by a bold venture asserted that this common property of neutralizing acids and making salts grows out of a still closer identity of character, namely, a common composition; that is to say, that the alkalies were oxides of metals too, and that therefore all the bases contained a metal and oxygen. On putting the suggestion to the proof it was found to hold good; lustrous metallic substances were actually separated from soda, potash, &c., and the identity made good to the sense as well as to the reason. But to trace identities of this nature a highly intellectual medium of conception is necessary; salts had to be considered, not as appealing to the touch, taste, and sight, but as compounded of ingredients represented to the mind by names, figures, and symbols. Had copperas been known only as it appears in a drysalter's store, no such identifications could have grown out of its comparison with other salts. It behoved to be known as sulphuric acid combined with oxide of iron, or symbolically as $S\,O^3 + Fe\,O$, in order to see an analogy between it and Glauber's salts, similarly represented, $S\,O^3$ + Soda. The scientific identities proceed on scientific conceptions, that is to say, on artificial ways of expressing by names, numbers, and symbols, the facts that experiment brings to light. The same train of proceeding led to an identification that would have been utterly impossible to the common eye, namely, hydrogen gas with the metals,—a gas with a solid,—the lightest substance in nature with the heaviest.

For hydrogen occurs in connexions that inevitably suggest a metal by the force of similarity, as by its combining with oxygen, and entering into still higher compounds exactly as the metals do. The repugnance of the physical or more sensible properties of hydrogen (gaseous form and lightness) to the properties of the metals kept back for a time, but did not in the end prevent, an identification on the property of combining chemically in the same manner as these. And in the artificial representations of chemical formulæ the identity is such as to strike the eye at once, although this representation was consequent on the recognition of similarity of function in the two cases. An acid is now represented chemically in the same form as a salt, hydrogen standing in the acid for the metal in the salt. Sulphuric acid is $H\,O, S\,O^3$, the sulphate of iron $Fe\,O, S\,O^3$.

27. To pass from the mineral world to the vegetable. Plants may be identified on many different points, and the same plant fall into many groups of associates according to the feature that predominates in the mind, and strikes the stroke of recal. What in the end has turned out a most valuable classification, was repelled at the outset by obtrusive dissimilarities. In the first classifications of plants, the trees of the forest would be grouped together, owing to their easy identification through their prominent and imposing points of likeness. The shrubs would make another class identified by the same superficial likeness. The apparently insignificant and artificial identification of Linnæus would be repulsive to a common eye, and could only result from minute dissection of the structure, which brought out features of identity hidden in the heart of the efflorescence. The Linnæan classification was properly a fetch of identity in the midst of the widest discordance; and the mental preparation for gaining this triumph of identification in the midst of difficulties was a shutting of the eye to the bold features that held all other minds captive, and a devoted study of the minute and concealed structure. The identifying reach of similarity in such a mind must have been of a high order to produce so great a change in the mode of looking at the whole vegetable world, to break down all the

old classifications, and compel the adoption of others entirely at variance with them.

The vegetable world presents us with another example of the attraction of Similarity in a very pure form. The analogy of the flower to the whole plant first struck the mind of the poet Goethe, and was considered by botanists a luminous suggestion. He saw in the arrangement of the leaves round a stem the analogue of the circular arrangement of the petals of the flower, notwithstanding very great diversity of general appearance. So in the leaf, Oken identified the plant. The branchings of the veins of the leaf are in fact a miniature of the entire vegetable, with its parent stem branches and ramifications. In the first suggestion of these identities we have notable cases of the stroke of similarity through a dense medium of diversity. Such identifications as these (when proved to be genuine and not merely apparent or fanciful), cast new lights over a subject; they simplify what is before complex, and give a clue to what seemed a labyrinth.

28. Our next examples are from the Animal Kingdom. We have here cases exactly similar to the foregoing. In the classifications of animals we find the stroke of identity falling first upon one class of features, as in the divisions into quadrupeds, birds, and fishes; this is superseded by a deeper resemblance resting on more minute examination, whereby certain animals that inhabit the sea are excluded from the class of fishes, as the whale, seal, and porpoise, and certain others that fly in the air (the bats for example), are excluded from the class of birds. This new classification, like the reform of Linnæus in the Vegetable world, proceeded on an investigation of structure, and a disregard of the startling differences that arrest the common eye. It was accomplished by the comparative anatomists of the last century, and is now fixed for ever in the minds of men by the language expressing the divisions and subdivisions of the Animal Kingdom.

The science of Zoology furnishes likewise a number of interesting comparisons within the individual animal. These are termed *homologies*. The first suggestion of one of these homologies is attributed to the fertile analogical brain of Oken.

Walking one day in a forest, he came upon the bleached skull of a deer. He took it up, and was examining its Anatomical arrangement, when there flashed upon his mind an identity that had never struck any one. The skull he said was four vertebræ; in fact, the head was merely a continuation of the back bone, but so expanded and distorted as to throw a deep disguise over the fundamental sameness of structure. That disguise was now shot through by a powerful fetch of similarity in a mind prepared by previous knowledge for discovering that class of likenesses. Oken was evidently a man that sat loose to the existing identifications of things, and suffered less obstruction than usual from the prepossessions that these fasten on the mind. He had, moreover, a great natural force of the attractive power of like for like, and could make out identities on a small hint. It is further apparent that he had a strong belief in the simplicity of nature, that is to say, in the recurrence, or repetition, of the same structure and the same plan of working in many various forms and in the most widely separated regions. His conviction on this point went far beyond the reality, as we may see from his writings; for of the many hundreds of analogies that he sets forth in his one work 'Physiophilosophy,'* there are probably not twenty that are sound. The intellectual force of similarity in him was under no check or control. He never took any steps to prove the reality of a supposed identification; he left that to others. It so happened that in the matter of the skeleton he was right; but it is only in our own day, that is half a century after the discovery, that the similarity of the bones of the head and the back is considered established.† The identifying stroke of similarity bringing together for the first time things that had previously been looked at in totally different connexions, is the first step in a discovery, and only the first step. It has to be followed up by the labour of comparing all the different things whose resemblance is implied in the identification, and it is only when this examination is complete and the result

* Translated by the Ray Society.
† See OWEN *on the Vertebrate Skeleton.*

satisfactory that the discovery is realized. Hence the remark, 'he discovers that proves.' Honour belongs to the first suggestion of a discovery, if that suggestion was the means of setting some one to work to verify it, but the world must ever look upon this last operation as the crowning exploit.

The homologies of the skeleton imply a wide range of similarities hunted out through the thickest concealment of diversity. The identity of structure of all animals of the vertebrate class,—mammalia, birds, reptiles, and fishes; the correspondence of the upper arm of the man, the foreleg of the quadruped, the wing of the bird, and the anterior fin of the fish,—implies a very great insight into structure, and a power of setting aside first appearances. The similarity of the segments of the same skeleton, from the crown of the head to the tip of the tail, constitutes the serial homology, which is the working out of Oken's discovery on the skull of the deer. The discovery of these homologies represents the struggles of the human intellect with the perplexity of the world. In the explanation of nature, first thoughts are scarcely ever correct. The superficial resemblances bring together things that have no deep community of structure, and hence no knowledge is derived from one to another. The comparison of a salmon with a seal can only mislead; the comparison of a seal with a whale may improve our knowledge of both. When a superficial likeness in two objects,—a sameness in some one prominent feature,—is the sign of a deep likeness, or a sameness in many other features all of great importance, we can apply the whole of the knowledge we have obtained of the first to the second; that is, by studying one we are master of the two, and thus economize our labour. If I find out that a bat is not a bird, but one of the mammalia, I instantly transfer to it all that I know of the common characters of the mammalia: but if I identify a bat with an owl I gain nothing, for the likeness between the two is superficial or isolated, it does not imply a number of other likenesses, and the comparison is therefore unprofitable. The progress of real discovery consists in seizing these pervading resemblances, and passing by the others. It is a singular fact that where there is the greatest amount of real sameness, there is often the least apparent sameness; which doubtless only shows that the vulgar eye is satisfied with a very narrow and limited glance at things. The kindred features of a family may not be what gives the individual its popular interest.

PHENOMENA OF SUCCESSION.

29. The successions that make up the flow of changes and events in the world are a subject of study rising above the still life aggregates that we have been just considering. Even in those aggregates we have not absolutely refrained from implying phenomena of succession, as, for example, when we spoke of the experimental properties of bodies; whence it will be apparent that to deal with the world as we find it, aggregation and succession must both enter into our field of observation.

Under Contiguity we have classified and illustrated the different kinds of succession prevailing around us. Some are Cyclic or periodic, as day and night, the seasons, the heavenly appearances generally; the tides, the winds, the revolution of machinery, the routine of life. Others are successions of Evolution, as in the growth of living beings, and the constructions of human industry. Some are characterized by *effect*, or the production of some telling sensation, or sudden change, as in a blow, an explosion, a burst of music, a dramatic scene. Apart from these popular and salient effects, we have the links of succession laid hold of in the Scientific view of cause and effect. Lastly, Human History at large is a grand *ensemble* of succession, which no one mind can totally comprehend, and which consequently presents itself in innumerable aspects to the intellects of men.

Among all these various kinds of succession, identifications are struck through the medium of similarity. Hence arises classes of succession that may substitute another in practice, and that throw light upon one another as regards our knowledge. To take a familiar example from the group of Evolutions. Each person has a familiar knowledge of the growth of their own frame, and, by identifying self with other beings, can transfer all this knowledge to them, thereby inheriting an insight far beyond the field of actual inspection.

The identifications that have been traced among these innumerable varieties of sequence, and which remain held together, by the use of language, as the common estate of civilized men, have vastly enlarged the sum of human knowledge and the compass of human power, besides yielding much refined gratification. To do them full justice, however, we must specify two great divisions that they fall under, namely, the Real and the Illustrative; the one implying an identity in the actual subject or intrinsic quality of the sequence, the other implying a sameness in some mode or aspect of it. Of the first class are the scientific and practical identities; the second are those that serve as a medium of intellectual comprehension or of artistic adornment. When we term certain atmospheric movements aerial tides, thereby identifying them with the tides of the ocean, the comparison is strict and scientific, for both phenomena are caused by one and the same natural power, namely, gravitation; but when we speak of 'a tide in the affairs of men,' the identity is not real, but merely illustrative through a certain similarity of phase or aspect; the ebb and flow of human prosperity has no dependence upon gravitation, it grows out of quite another class of natural impulses. Owing to the fact that the same effect may be produced by a plurality of causes, there are practical identifications among forces in themselves distinct, as when in quarrying we substitute the expansive action of moisture on dry chips of wood for the explosion of gunpowder. The sources of power in these two effects are not the same; they do not fall under a common natural cause. Nevertheless, this, too, would be called a real, and not an illustrative identity; it would be *fructifera*, and not *lucifera*, or *poetica*.

30. The illustrative comparisons, however, are not confined to phenomena of succession; they occur equally among the objects brought in under the previous head, namely,

aggregates, conjunctions, or appearances of still life. On this account I prefer to treat 'illustration' as a separate subject, and under the present head, 'successions,' I shall merely cite a few examples of the identification of likenesses considered as real, or believed to be real. And to commence with sequences that are periodic or cyclic:—the revolutions of the year are too much alike to present a case of difficult identification, on which alone any interest hinges. In the rising and setting of the stars there is one point of similarity that might for a long time escape observation, in consequence of accompanying dissimilarities, namely, that in the same place the stars all rise constantly at the same angle, the angle being the co-latitude of the place; at latitude 60° the angle is 30°, at latitude 50° it is 40°. Now there are two disguising differences in the rising and setting of the various stars; one relating to the height they reach when at their highest, and the other relating to their time of rising, which last element differs for the same star throughout the year. It takes a steady glance, a ready appreciation of mathematical elements (such as this of the angle of rising), and a considerable reach of the identifying faculty to make out for the first time a common feature of this description in the midst of a dazzling and variegated scene. An absence of poetic feeling would be almost an indispensable requisite.

In the vegetable kingdom, as seen in temperate and cold countries, men soon attain to the generalization of alternating life and death, in the cycle of the year. Notwithstanding the boundless variety and diversity of vegetable nature, this fact, of summer growth and autumnal fading, is too prominent to be disguised by the distinctions between a garden flower and a forest oak. It would consequently be one of the earliest generalizations of the human race living out of the tropics. The same remark would apply to the alternation of waking and sleeping, as a fact of animal life in general. The identification of the daily repose of men and animals with the hybernation of reptiles and some other classes, would be somewhat less obvious, but by no means difficult to observant men; unless indeed an artificial obstruction were created by a comparison with death, or with the winter of vegetation, having already got possession of men's minds. We have repeatedly had occasion for this remark, as to the influence of prepossessions in stifling a stroke of identity, and the present is only a fair supposition of that nature.

The steps of the generalization of the planets, or the tracing of a common character in spite of accompanying dissimilarity among these wandering bodies, would be interesting to follow if we could now recover them. The discovery of the common fact of their circling round the entire heavens was by no means easy in the case of the inferior planets, Mercury and Venus, seeing that men's minds would in their case be carried away with the more limited circumstances of their attending on the sun, and appearing as morning and evening stars.

The successions of evolution are typified and principally constituted by the growth of living beings. Each plant and animal, in the course of its existence, presents a series of phases, and these we may watch more or less closely, so as the better to know the course of the evolution. With the fact of birth and death, as a property of all living beings, we become acquainted through the identifying operation which seizes hold of this common feature in the midst of never so much variety in all else that can constitute a living being. But identities of the special mode of growth can be traced among limited groups, which are thereupon formed into classes; as in animals, the oviparous and viviparous. The successions of insect life are peculiar and interesting, and, as regards the distinct stages and states of existence, the identifications through the animal tribes are curious and instructive. Close observation of individuals is necessary to put the mind in a position to strike out such identities; the absence of vulgar wonderment, poetic illusion, and strong prepossessions in favour of some mistaken comparison is also very helpful. The physiological department called Embryology, includes the knowledge of the early evolution of animals, and it is very much dependent upon identifying the modes of growth of creatures considerably different from one another, as the chicken with the infant. Here, however, there was no great reach of mind needed to suggest the identity of these two; the difficulty in such a case is to prove that an obvious and apparent identity is real and deep, or so close that what is known of the one member of the comparison may, with absolute certainty, be believed of the other. Whereas in other instances the discovery is difficult, but the proof easy, in this the discovery is easy, and the proof difficult. With the intellectual operations required to ascertain the reality of an identity seen by the intellectual glance of similarity, the logic of the case, we are not at present concerning ourselves.

31. The Successions that make Human History, present a choice field of illustration of the mental force of Similarity. Nowhere are comparisons, good and bad, more abundantly struck. Plutarch is not the only writer that has set to work expressly to construct historical parallels.* In the situations that arise in public affairs, in the problems that have to be solved, in the issues of critical periods, and in the catastrophes that have overwhelmed empires, the intellect of enquiring and observing men finds numerous identities. Sometimes we compare the past with the present, sometimes one past epoch with another. And such comparisons are seldom barren efforts of the identifying faculty; they are usually employed for some end of mutual illustration, or in order to infer in the one all the good or bad features belonging to the other. The rise of the British empire is compared by one class of minds to the history of the great empires of antiquity, the object of the comparison being to carry out the analogy to the full length of anticipating for Britain a similar course of decay. The parallelisms that set forth popular government as conducting to anarchy and ending in military despotism have been sufficient to satiate the reading mind of modern times. It is not these very large comparisons that illustrate happily the operation of the principle now under discussion, or that show the results of identification in enlarging the grasp of the human intellect. For these ends I should choose rather to

* See the interesting volumes under this title, published by Charles Knight.

point to comparisons made in very limited chains of historic succession. The narrower the field of view contemplated, the more chance there is of hitting upon a real and instructive comparison. Take the following from GROTE'S *History of Greece*. In discussing the changes made in Sparta by the institutions of Lycurgus, the historian calls in question the alleged re-partition of the lands of the state among the citizens. He shows that this is not stated by the earliest authorities, and that it appears to have gained credence only after the revolutionary proceedings of Agis and Kleomenês in the third century, B.C.; at which time he thinks the idea grew up in consequence of its being strongly suggested by the present desire for a similar re-division. 'It was under the state of public feeling which gave birth to these projects of Agis and Kleomenês at Sparta, that the historic fancy, unknown to Aristotle and his predecessors, first gained ground, of the absolute equality of property as a primitive institution of Lycurgus. How much such a belief would favour the schemes of innovation is too obvious to require notice; and without supposing any deliberate imposture, we cannot be astonished that the predispositions of enthusiastic patriots interpreted according to their own partialities an old unrecorded legislation from which they were separated by more than five centuries. The Lycurgean discipline tended forcibly to suggest to men's minds the *idea* of equality among the citizens,—that, is the negation of all inequality not founded on some personal attribute—inasmuch as it assimilated the habits, enjoyments, and capacities of the rich to those of the poor; and the equality thus existing in idea and tendency, which seemed to proclaim the wish of the founder, was strained by the later reformers into a positive institution which he had at first realized, but from which his degenerate followers had receded. It was thus that the fancies, longings, and indirect suggestions of the present assumed the character of recollections out of the early, obscure, and extinct historical past. Perhaps the philosopher Sphœrus of Borysthenês (friend and companion of Kleomenês, disciple of Zeno the Stoic, and author of works now lost both on Lycurgus and Socrates and on the constitution of Sparta) may have been one of those who gave currency to such an hypothesis. And we shall readily believe that if advanced, it would find easy and sincere credence, when we recollect how many similar delusions have obtained vogue in modern times far more favourable to historical accuracy — how much false colouring has been attached by the political feeling of recent days to matters of ancient history, such as the Saxon Witenageomote, the Great Charter, the rise and growth of the English House of Commons, or even the Poor Law of Elizabeth.'* The comparisons contained in this last sentence are such as both to suggest the explanation above given of the rise of the belief in question, and to give probability to it when suggested. The same historian has effectively illustrated the general body of Grecian legends by a comparison with the middle age legends of the Roman Catholic Church. The range of knowledge possessed by an historical enquirer on the one hand, and the force of his identifying intellect on the other, are the sources of his fertility in those comparisons that illuminate the darker specks of the ill-recorded past. Whether those comparisons are strictly applicable and good, depends on a quite different mental peculiarity, already more than once touched upon, his sense of accuracy and precision, or what is sometimes called the logical faculty. We find in history no less than in zoology, the characteristics of the *Oken* mind; a fulness of analogical suggestiveness with an absence of the logical discrimination of soundness.

32. It is not stepping far out of the class of instances typified in the foregoing paragraph to advert to Institutional comparisons, whether of different ages or of the same age. The social and political institutions of nations and races have often points of agreement in the midst of great diversity; and a penetrating mind, in other words a strong identifying faculty, can bring together the like out of the enveloping clouds of unlikeness. It is easy, for example, to identify the fact of government as belonging to every tribe of men that act together; it is not difficult further for one absolutism to

* Vol. ii., pp. 538–40.

bring up into the view all the other instances of absolutism that have at different times been impressed on one's mind; and so with the consideration of free or responsible governments. By this operation we gather up various classifications of agreeing institutions, the one throwing light upon the other, and the whole concurring to make one broad luminous effect, which we call the general impression of government; of absolutism, of constitutionalism, &c. The vast complexity and seemingly endless variety of human institutions is thus simplified in a remarkable degree; out of chaos order arises, as soon as similarity begins to draw together the agreeing elements of the discordant heap. Our great writers on Society, Aristotle, Vico, Montesquieu, Condorcet, Millar, James Mill, have shown admirable tact in this kind of Comparative Anatomy, and with all the effects of intellectual illumination and expansion that flow from the bringing together of remote samenesses. What the historian does incidentally the writer on Society does upon system; he searches the whole world for analogies, and finds if possible a class for every variety that presents itself. Forms of Government, of Legislation and Justice, Modes of Industry, Distribution of Wealth and Arrangement of Rank, Domestic Institutions, Religion, Recreative amusements, &c., are identified and classified so far as they agree with notification of difference, and out of the *particulars* drawn together in a powerful identifying mind there crystallizes one after another the corresponding *generals*, and the human reason has made one great step in its endeavours to comprehend this wide subject.*

33. To return to successions. There remains one other class to be cited in illustration of our general theme, namely, Cause and Effect, or those successions where the consequent depends on its antecedent, and is always produced by it. Here we have to remark that often the same link of causation occurs in circumstances so widely apart, that the sameness is veiled from the perception of the general mass of mind;

* See MILLAR *on Ranks*, and the examination of the Hindu Institutions in MILL's *History of British India*.

indeed it not seldom happens that until some preparatory operation has had the effect of drawing aside the veil, the identity does not disclose itself to the most piercing intellect. Thus to take the two phenomena of combustion and the rusting of iron, it was not possible for any mind to see a common feature in these two effects as they appear to the common eye. A long series of investigations to ascertain more particularly the import of each of the two actions apart had first to be gone through. Other phenomena had to be interposed having relations to both, in order that actions so unlike should be seen as like. The experiments of Priestley upon the red oxide of mercury were a turning point in the *rapprochement.* These experiments showed that when mercury was burned it became heavier by taking in some substance from the air, which substance could again be driven off, and the metallic mercury reproduced. The act of combustion of the mercury was to all appearance identical with the burning of coal in a fire, while the resulting change on the substance, the conversion of the metal into a red powder, might suggest the process of the rusting of iron, the chief point of diversity being the time occupied in the two different operations. Through an intermediate phenomenon like this, the two others might come together in the mind as identical, and they are now known to be the results of the same operation, or effects of the same cause, namely the combination of the solid material with the gaseous oxygen of the atmosphere.

In the great problem of Inductive science, stated to be the discovery of the effects of all causes, and of the causes of all effects, there are many intellectual operations gone through; —the problem puts on many different aspects. But the importance of a powerful reach of the identifying intellect is constantly made manifest. Some discoveries turn upon this exclusively; and no succession of discoveries can proceed without it. In truth the very essence of generalization being the bringing together of remote things through the attraction of sameness, this attractive energy is the right hand of a scientific inquirer. To cite the greatest example that the history of science contains, the discovery of universal gravitation, or the identifying the fall of heavy bodies on the earth with the attraction between the sun and the planets; this was a pure stroke of similarity, prepared by previous contemplation of the two facts apart. Newton had for years been studying the planetary motions: by the application of the doctrines of the composition and resolution of forces to the planetary movements he had found that there were two actions at work in the case of each planet, that one of these actions was in the direction of the sun, and the other in the direction of the planet's movement at each instant—that the effect of the first, acting alone, would be to draw the body to the sun, and the effect of the second, acting alone, would be to make it fly off at a tangent, or in a straight line through space. By this process of decomposition he had reduced the question to a much simpler state; he had in fact prepared the phenomenon of planetary motion for comparison with other movements already understood. This operation of analysis was itself a remarkable effort of intellect; no other man of that time showed the capability of handling the heavenly motions with such a daring familiarity—of intruding into their spheres the calculations of a terrestrial mechanics. This preparatory operation was perhaps a greater feat of intellect than the flash that followed it; indeed the perception of identity could not be long delayed after such a clearing of the way. He had familiarized himself, as the result of this mechanical resolution of the forces at work, with the existence of an attractive force in the sun, which acted on all the bodies of the system, and he had discovered by a further effort of calculation that this force varied inversely as the square of the distance. As yet the phenomenon of solar attraction stood solitary in his mind, but it stood out as a remarkably clear and definite conception, so definite and clear that if ever he came to encounter any other phenomenon of the same nature, the two would in all probability flash together on his mind. Such was the preparation on the one side, the shaping of one of the two individual phenomena destined to become one. Then as to the other member. He had been familiarized with the falling of bodies from his infancy, like everybody else; and the impression that it had made for a length of time was as superficial as it had been in the minds of his brethren of mankind. It was to him as to them a phenomenon of sensible weight, hurts, breakage; it rendered necessary supports and resistance. This was the view naturally impressed upon his mind, and in this encumbered condition an identity with the pure and grand approach of the distant planets towards the sun, while yet held at distance from him, was not to be looked for even in the mind of Newton, whose identifying reach was doubtless of the first order. He had been for a length of time in possession of the prepared idea of solar force, without its ever bringing to his mind for comparison the familiar fact of a body falling to the earth. It was obviously necessary that some preparatory operation should take place upon this notion likewise; some contemplation that would partially clear it of the accompaniments of mere smash, breakage, weight, support, &c., and hold it up in its purest form of a general movement of all free bodies towards the earth's surface, or rather in the direction of the earth's centre. Here too there was need of an analytic or disentangling procedure, an operation very distasteful and repulsive to the common mind, and stamping the scientific character upon any intellect that is at home in it. At what time Newton laid his analytic grasp upon this ancient experience of our race we may not now be able precisely to determine; it may have been the commonly recounted incident of the fall of the apple that set his mind to work, or it may have come round in the course of his studies of terrestrial phenomena. But I cannot help supposing that when the phenomenon was once taken to task in the way he had already been accustomed to deal with such things, he would very soon identify and eliminate the main fact from all the confusing circumstantials, and see in it an instance of the motion of one body towards another by virtue of some inherent power in the attracting over the attracted mass. This eliminating generalization would present the case pure and prepared to his mind, as the other had already been by a previous operation; and then came the flash of identification, and with it the sublime discovery that brought heaven down to earth, and made a common force prevail throughout the solar system. Not less to his honour than the discovery itself was his reserving the announcement until such time as the proof was rendered complete by the arrival of an accurate estimate of the magnitude of the earth, which was a necessary datum in the verifying operation.

This great stretch of identification, perhaps the widest leap that the intellect of man has had the opportunity of achieving, not only illustrates the mental attraction of similarity, it also presents in relief the preparation of the mind for bringing on the flash. We see the necessity there was for a powerful mathematical faculty to seize the laws of the composition and resolution of forces, and apply them to the complicated case of elliptic motion; in this application Newton already made a step beyond any mathematician of the age. We observe in the next place the intense hold that the mathematical aspect of the phenomena took on his mind, how he could set aside or conquer all the other aspects so much more imposing in the popular eye, and which had led to quite different hypotheses of the cause of the celestial movements. This characteristic shines remarkable through all the scientific writings of Newton; however fascinating a phenomenon may be, he has always his mind ready to seize it with the mathematical pincers, and regard it in that view alone. His mode of dealing with the subject of Light is an instance no less striking than the one we have been now setting forth. There was in him either an absolute indifference to all the popular and poetic aspects of an appearance, or a preference for the scientific side strong enough to set all these aside. The example he set of uncompromising adherence to the relations of number and measured force was probably the most influential result of his genius at a time when physical science was as yet unemancipated from the trammels of a half-poetic style of theorising. The purification and regeneration of the scientific method was quite as much owing to the example of Newton as to the rhetorical enforcements of Bacon. The human intellect was braced by dwelling in his atmosphere, and his avatar was the foremost circumstance in giving a superior stamp to the career of thought in the eighteenth century.

To these two peculiarities of the Newtonian mind,—mathematical power, and exclusive regard to the mathematical and mechanical, in other words, the strictly scientific aspect of the phenomena to be studied,—I have added a third, which although not radically distinct from these, deserves separate notice; I mean analytic force, or the tendency to separate the effects that an object has on the mind or senses, and to concentrate the regard on one particular at a time. Thus we have seen that a falling body produces a very complex impression,—a gross and multifarious effect,—and this total mass of sensation and feeling is the popular notion of the phenomenon. No accurate knowledge can grow out of such aggregates; they are the soil of poetry, not science. I shall illustrate afterwards the nature of this force or impulse of mind that resists the totalizing influence of a complex object, and isolates for study and comparison its individual effects; I remark it here as the volitional, or what may be loosely styled the moral, element of the scientific intellect; it stood forth in singular grandeur in the mind of Newton. All the three peculiarities now stated came in aid of the identifying stretch of similarity, but could not dispense with the presence of this also in a high degree of tenseness in his mind.

REASONING AND SCIENCE IN GENERAL.

34. Not to mention the examples that we have just parted from, many of the instances of similarity already adduced in the course of our exposition are strictly of a scientific nature. I think it right, notwithstanding, to devote a separate head to the operation of the law in the various scientific processes, with a view to elucidating farther both it and them. I shall therefore make the illustration fall under the four divisions of Abstraction, Induction, Deduction, and Analogy.

Classification, Abstraction, Generalization of Notions, General Names, Definitions.—These designations all express substantially the same operation, that of identifying a number of different objects on some one common feature, and of seizing and marking that feature as a distinct subject of consideration; the identification being a pure effort of similarity. Thus we identify the different running streams that have come under our observation, in consequence of the sameness that stands prominent in the midst of much diversity; any new one will recal the previous ones, and they are assembled together in the mind not as a miscellaneous aggregate, but as a class strung together on a common thread. In this connexion they serve to improve our comprehension one of the other; some we know chiefly at the sources, others at the mouth, some in the mountains, others in the plains; accordingly we supply gaps in our knowledge of one by means of the rest. We may go the length of deriving out of the fragmentary views some one unbroken whole, an ideal river, that shall include all the features of a perfect river in goodly proportions; or we may simply choose one that we know better than the rest as our representative instance, and from it supply blanks in our view of those that we have less perfectly examined. This mutual supply of defects in the view is one of the advantages of assembling objects in a class; a second advantage is the substitution of one for another in any practical end; we know, for example, by the experience of one case that a river bank is a convenient site for a town or village, and in consequence of the discovery of identity we can choose any one of all the rivers in our knowledge for the same object. Here, then, we have first a *classification*, assembled by the attraction of similarity; secondly a generalization, or general notion, or *abstract idea*, being some typical river that fairly represents the group, and in which we include only what they all have in common; this typical river may be one of the number, or it may be a composition out of several. Thirdly, we have the application of a *general name* to the class, the name 'river,' which shall express both the whole, and what each has in common with every other. A fourth operation is all that is necessary to complete the work, namely, to furnish a *definition* or an expression in language of the class features or common properties* of the class. This exhausts the line of operations connected with the generalization of an object taken as a total or a unity; of these the first alone grows out of pure Similarity, the others suppose a somewhat more complicated action, to be afterwards described.

Take again the genus of round bodies. As before, these are mustered in a class by the attraction of sameness; their classification has the effects already specified of mutual enlightenment and mutual exchangeability. To clench the operation we seize upon some one instance as a representative or typical instance, and our idea of this we call the abstract, or general, idea. We can here adopt a very refined method; we can draw an outline circle, omitting all the solid substance, and presenting only naked form to the eye; this is an abstraction of a higher order than we could gain by choosing a specimen circular object, as a wheel, for it leaves out all the features wherein circular bodies differ, and gives the point of agreement in a state of isolation. The mathematical diagram is thus a more perfect abstract idea than the idea of a river or a mountain, derived from a fair average specimen, or a composed river or mountain; these last scarcely come up to the meaning of an abstraction, although when properly managed they serve all the ends of such. But we may pass in the present case also from an abstract conception, or a diagram, to a Definition by descriptive words, and we may adopt this as our general conception, and use it in all our operations instead of or along with the other.† The definition is in fact the highest form of the abstract idea, the form that we constantly fall back upon as the test or standard for trying any new claim of admission into the class, or for revising the list of those already admitted.

35. *Induction, Inductive Generalization, Conjoined Properties, Affirmations, Propositions, Laws of Nature.*—The contrast between Abstraction and Induction as here understood may be expressed thus: in the one a single isolated

* A river may be defined 'a natural current of water flowing in an open channel towards the sea,' or to that effect.

† A circle is defined to be a line everywhere at an equal distance from a point which is the centre.

property, or a collection of properties treated as a unity, is identified and generalized; in the other a conjunction, union, or concurrence of two distinct properties is identified. When we bring all rivers into one class, and define the property common to all, we exemplify the first process; the second process, Induction, is exemplified when we note the fact that rivers wear away their beds, or the fact that they deposit deltas at their mouths. In this case two different things are conjoined; the flow of water over a country to the sea in an open channel, which makes the idea of a river, is associated with the circumstance of depositing or forming land in a particular situation. This conjunction makes an Affirmation, or a Proposition; the idea of a river by itself, or anything expressed by a noun substantive, is not an affirmation. When we affirm the uniform co-existence of two distinct facts, we have a Law of Nature, an intellectual possession respecting the world, an extension of our knowledge, a shortening of labour. Of the two conjoined things the presence of one is at any time sufficient to assure us of the presence of the other, without farther examination. As surely as we meet with a river, so surely shall we find the carrying down of mud to be deposited at the mouth, if the two facts be really connected as we suppose. An abstraction or definition gives us a general idea, it assembles a class of things marked by the presence of this common feature,—the class river, the class circle, the class red, the class planet, the class just,—but does not convey a proposition, a law of nature, a truth.

In forming these inductive generalizations we need the identifying impetus pretty much as in abstractive generalizations. The case is distinguished only by being more complex; it is properly a stage beyond the other in the order of discovery, although the two are very apt to be mixed up and determined by one and the same effort of the sense and understanding. Still in order to possess the law that rivers form bars and deltas, we require to have observed the peculiarities of rivers, and to have been struck at some moment with their identity on this point; standing at the mouth of one and observing the island which parts its by a stroke of reinstating similarity of the mouth of some other where a similar formation occurs, with perhaps many points of diversity of circumstances. These two coming together will bring up others, until we have assembled in the mind's eye the whole array that our memory contains. This is the first stage of an inductive discovery; it is the suggestion of a law of nature, which we are next to express and verify. The conflux of all the separate examples in one view indicates to the mind the common conjunction, and out of this we make a general affirmation, as in the other process we make a general notion or idea. But a general affirmation by language makes in this case a proposition, not a definition; it requires a verb for its expression, and carries a law or a truth, something to be believed and acted on.

In like manner, it is by an identification of the separate instances falling under our notice, that we are struck with the conjunction in an animal of cloven hoofs with the act of ruminating and with herbaceous food. So, to take a more abstruse example, we identify the conjunction of transparent bodies with the bending of the rays of light; these transparent bodies are of very various nature,—air, water, glass, crystalline minerals; but after a certain length of observation the identity makes itself felt through them all. By an abstractive process, we gain the general idea of transparency; by looking not simply at the fact of the luminous transmission but at the *direction* of the light, we generalize an induction, a proposition, conjoining two properties instead of isolating one. The operation of induction is thus of the same nature, but more arduous and implying more labour, than the operation of abstraction, being, however, much more pregnant with results. The same cast of mind favours both; the same obstructions block the way. To make a scientific induction, the mind must have the power of regarding the scientific properties and disregarding the unscientific aspects; in discovering the refraction of light, the attention must fasten on the circumstance of mathematical direction, and must not be carried away with vulgar wonderment at the distorting effect upon objects seen through water or glass. To take in the more abstruse and dissimilar instances, as the refractive influence of the air, there is needed a preparation similar to that already exemplified in the identification of burning and rusting. A powerful reach of the identifying faculty must always be implied in great scientific discoverers.

Sometimes an induction from a few identified particulars can be fitted in to a previously established formula or generalization. The above instance of the refraction of light furnishes a case in point; and I quote it as a further example of the identifying operation. The bending of the light on entering or leaving a surface of glass, water, or other transparent material, varies with the inclination of the ray to the surface; at a right angle there is no bending, at all other angles refraction occurs, and it is greater as the course is farther from the right angle, being greatest of all when the ray lays over so much as almost to run along the surface. Now an important identification was here discovered by Snell, namely, the identity of the rate of refraction at different angles with the trigonometrical relation of the sines of the angles, expressed thus:—the sines of the angles of incidence and refraction bear a constant proportion within the same medium, or the same kind of material. Here the observed amount of the bending at different angles was found to accord with a foregone relation of the mathematical lines connected with the circle. This too may be looked upon as a discovery of identification, demanding in the discoverer not only reach of the faculty similarity, but antecedent acquirements in the geometry of the circle, ready to be started by such a case of parallelism as the above. Inductions falling into numerical and geometrical relations previously excogitated occur very frequently in the progress of discovery. All Kepler's laws are identifications of this nature; the third law, which connects the distances of the planets from the sun with their periodic times, is a remarkable case. He had before him two parallel columns of numbers, six in the column, corresponding to the six known planets; one column contained the distances, another the times of revolution; and he set himself to ascertain whether the relations of these numbers could come under any one rule of known proportions:—they were not in a simple proportion, direct or inverse, and they were not as the squares, nor as the cubes; they turned out at last to be a complication of square and cube. The law of areas is perhaps an equally remarkable example of a series of particulars embraced in an all-comprehending formula got out of the existing stores of mathematical knowledge; but in all these discoveries of Kepler, we are perhaps to admire the aims and determination and perseverance of his mind still more than the grasp of his intellect. We have before remarked that for a man to extricate himself from the prevailing modes of viewing natural appearances, and to become attached to a totally different aspect, is itself the proof of a superior nature, and often the principal turning point of original discovery. The identifying faculty in Kepler showed itself less prominently in the strokes of detail, than in the mode of taking up the entire problem, the detection of a common character in the motions of the planets and the relations of numbers and curves. To make that a pure mathematical problem, which really is one, but has not hitherto been sufficiently regarded as such, is itself a great stroke of the scientific intellect; it was the glory alike of Kepler and of Newton. A previously equipped mathematical mind, an indifference or superiority to poetical and fanciful aspects, and a high reach of identifying force, concur in all the authors of discoveries that bind the conjunctions of nature in mathematical laws. The great revolution in Chemistry made by the introduction of definite combining numbers has been even more rapidly prolific of great consequences than the discoveries that gave Mechanics, Astronomy, and Optics the character of mathematical sciences. The introduction of vigorous numerical conceptions into the subtle phenomena of Heat, through Black's doctrine of latent heat, exhibits a stroke of high intellect not inferior to any of those now adduced. The difficulty of seizing the phenomena of freezing, melting, boiling, and condensing, in a bald, numerical estimate, is attested by the lateness of the discovery, if not sufficiently apparent to one that considers how very different from this is the impression that these effects have on the common mind. The engrossing sensations of warmth and cold, the providing of fuel and clothing, the prevention of draughts, or the admission of cool air, are the trains of thought usually suggested by the various facts of congelation, liquefaction, &c.; to enter upon the other trains is the result of a special training and endowment, the explanation of which according to general laws of mind has been one of the aims of our protracted examination of the human intellect.

36. *Inference, Deduction, Ratiocination, Syllogism, Application* or *Extension of Inductions.*—I have repeatedly urged the value of the identifying process in extending our knowledge, by transferring all that has been ascertained in some one case to every other case of the same description. This operation is described under all the above titles. It is an Inference, a Deduction, a step of Reasoning, the Extension of an Affirmation from the known to the unknown. The discovery of a true identity* between the new cases and the old is a justification of this transference of properties. Having, for example, observed in innumerable cases that human beings go through a course of birth, maturity, decay, and death, we transfer their fate to those now alive, and we declare beforehand that each and all of these will go through the same course; this is to make an inference, to reason, to apply our knowledge to new cases, to know the future from the past, the absent from the present. So, when we land on the banks of a strange river, we instantly proceed on the assumption that this river has its origin in high lands, its destination in the sea, and has at its mouth a deposit of mud of larger or smaller dimensions. The little that we see of the river, by walking a few miles along its bank is enough to identify it with the rivers already known to us, or with our general notion, or abstract idea, or definition of a river, and on this identity we forthwith transfer all our experience connected with rivers in general, and all their conjoined phenomena, to the newly

* It is not within the scope of this treatise to explain fully the nature of the evidence which the scientific man requires in order to be satisfied that a supposed identity is real, true, or genuine, or a sufficient basis for deductive inference. Such an explanation is most amply supplied in the work mentioned in the next paragraph.

occurring individual case. When our knowledge comes thus to transcend our actual experience, an inference or act of Deduction or ratiocination is performed.

Mr. John Stuart Mill, in his *System of Logic*, has shown, I think, conclusively, that the basis of all inference is a transition from particulars to particulars, and not, as usually supposed, the application of a general affirmation to the special affirmations included in it. In fact he maintains that when we say all men are mortal, we have already inferred the utmost that it is possible to infer; for out of our experience of the men that have lived and died, we have constructed an assertion applying to all men now living and all that are yet to be born, so that no further deduction remains to be made; the applying of this affirmation to a particular individual or tribe, as to the present inhabitants of London, or the present Emperor of China, is not an inference, it is but to enunciate in detail what has been already enunciated in the gross or total—it is not to make any new step, or to take up with any new piece of information, any new belief. Hence to syllogise is only to go through a form of reasoning; it is to take precaution against one particular source of mistake, namely, the mistake of wrongfully including an individual in a general class. If we say all men are mortal, therefore the angel Gabriel will die, the badness of the reasoning will be exposed by giving it the syllogistic form, thus: all men are mortal, the angel Gabriel is a man, Gabriel will die. Here, by completing the form, we see what assertions we make previously to drawing the conclusion, and that while the major or principal proposition, all men are mortal, is true, the second, or minor proposition, that Gabriel belongs to the class of men, must also be verified. The stress of the syllogism lies not in extending our knowledge to new cases, for this extension is complete when a general proposition is risked, but in making sure of the *relevancy*, the applicability to the case in hand; it requires a solemn, deliberate, overt assertion of the identity of the specific case with the cases contemplated in the already generalized affirmation; and we presume that a person in making this assertion feels that he ought to be quite certain of its accuracy before committing himself to such a broad avowal as this formality brings him to.

This process of inference or extension of properties, therefore, evidently comes of the identifying faculty, by which the new cases and the old are brought together in the view. If the question be, given a certain number of particulars, where a natural law is repeated, to discover other particulars whereto we may extend or apply the law and so reveal new characters in those particulars, these new cases must be summoned to the view by a stroke of similarity. For example, Newton observed in various cases that when a transparent body is largely made up of combustible matter, as an oil or a resin, that it bends light to an unusual degree; in other words, he made an induction of particulars where combustibility of substance and excessive bending of light were conjoined properties. He next bethought himself of any other substances, besides those in the immediate view that possessed one of these properties, and his recollection of the refracting power of the diamond responded to his call by a stroke of similarity; he thereupon extended to the diamond the other property, namely, combustibility of material, or *inferred* what no one had ever experienced, that the diamond is a combustible substance, a singular exception to the class of precious stones. This active obtrusion of observed coincidences upon all parallel cases, this laying out the mind for the suggestion of new particulars to have the observed properties thrust upon them, is one of the ways of extending the domain of knowledge. The enquirer has got in his hand a clue, and makes a business of following it out wherever he can find an opening; he has made his induction, and lies in wait for occasions of pushing it out into deductions. In this endeavour his identifying faculty will avail him much; it will make him as it were keen-scented for everything in the memory of the past that bears a shadow of resemblance to his case; the recollections that in an obtuse mind would lie unawakened by the magnetism of similarity, in the mind of the other start out one by one for examination and choice; and in this lies the harvest home of the man of intellect.

We can next suppose the opposite case; given a dark spot, an obscure phenomenon, to illuminate it by bringing forward parallels or identities among phenomena that are clear and intelligible, supposing such to have actually occurred at some time or other, but in a connexion altogether remote from the present difficulty, so that only the force of similarity can bring them up. The position of the enquirer is now altered; nevertheless the intellectual operation is the same; to summon the clear to illuminate the dark, or to summon the dark to be illuminated by the clear, must alike proceed on a felt identity, which identity is both the mental link of attraction and the circumstance that justifies the transference of information from the one to the other. Of the instances already brought forward several would correspond to this supposition; but instead of recurring to these we will cite the great identity struck out by Franklin, between the thunder and lightning of the sky, and electricity as shown on the common electrical machine. Next to the discovery of gravitation, this is perhaps the most remarkable fetch of remote identification that the history of science presents. The phenomenon of the thundery discharge was an exceedingly obscure and mysterious action; the natural obscurity of the case was farther increased by the emotions that it habitually inspired in men's minds, for nothing is more difficult than to identify, on a mere intellectual similarity, what excites deep emotions (especially fear) with what excites no emotion at all. Only a cool intellectual nature such as distinguished Franklin was a match for a case like this. He could face the evolution of a thunder-storm, and watch it with all the calmness that he would have shown in an ordinary philosophical experiment, deliberately bethinking himself the while of any parallel phenomenon wherewith he could identify and illustrate it. Had he taken up the inquiry a century earlier his attempt would have been in vain; for among all the scientific facts that could have crossed his view in the middle of the seventeenth century, no degree of identifying energy would have been able to summon up a single one to compare with the case in hand. In the eighteenth century his position was different; the electrical machine was a familiar instrument, and an intelligible account of its phenomena had been rendered; and these phenomena had been studied by Franklin, and were vividly impressed on his mind. To his cool eye gazing on the storm, the forked lightning identified itself (in the midst of a diversity that few other minds could have broken through) with the spark of an electrical discharge. This was indeed the only feature of resemblance, unless a favourable accident had revealed some other coincidence, such as the existence of an electrical charge in the clouds before a storm; and I consider the identification to have been a stroke of similarity of the very first order. It took all the preparation of an accurate study of the parallel subject of common electricity, with the passionless temperament and the strong intellect of Franklin, to achieve such a conquest over the obscurity that shrouds the atmospheric agencies. The identity once struck was duly verified, and proved to be a real and not a superficial or apparent sameness; being, in fact, the same natural power showing itself in widely different situations. Then came all the deductive applications; the circumstances known to accompany and precede the discharge of a Leyden jar could be transferred to the electrical storm;—the charging of the clouds with one electricity and the earth with an opposite, the increase of electrical tension to the pitch that an intervening insulator could no longer restrain, the shock of discharge,—were seen through the medium of the familiar parallel to be the history of the lightning and thunder of the sky. Every new fact ascertained in the machine could thenceforth be extended to the atmosphere; what could not be discovered there at first hand could still be known through the medium of deductive inference.

The subject of electricity could furnish me with many other examples of scientific identification on a great scale, but my limits forbid me to dwell upon them.

37. Reasoning by *Analogy.* The three foregoing sections comprehend the leading processes of scientific discovery; every great step in science is either an Abstraction, an Induction, or a Deduction. But resort is occasionally had to Analogy, as a

substitute for identity, as a basis of Deduction or Inference; and for our purpose of illustrating similarity, the striking out of analogies is very much in point. As an example of analogical reasoning or inference, I may take the comparison of human society to a family, with the transfer of the duties and powers of the head of the family to the sovereign of the state; this transfer is an inference or deduction, and is often tendered as a reason for the tutelary and despotical character of the sovereign. The two cases are not identical; they have an analogy, and a good reasoner remarks how far the analogy holds, and confines his inferences within those limits. In like manner, human society has suggested the analogy of herds and hives, an analogy much insisted on by Aristotle. A mind well stored with numerous conceptions, the fruit of various studies, and having at the same time a good reach of the identifying faculty, can strike out analogies when identities fail; and by means of these a certain amount of insight is sometimes obtainable. We have had occasion to advert to one remarkable scientific analogy, namely, that between nerve force and common electricity, from which we have not hesitated to draw inferences in order to support the view taken of the manner of working of the nervous system. Sometimes a farther investigation will convert an analogy into an identity, as was the case with gravitation, if it be true that Hooke went so far as to quote terrestrial gravity as an illustration of solar attraction. But analogies in the proper sense of the word are similarities of relation in diversity of subject, as in the case of society above quoted, where the analogical character is the permanent fact. The circumstance of evolution attaching to the vegetable and animal kingdoms, the successive stages of birth, growth and decay, is but an analogy as between a plant and an animal; to a still greater degree is this the case when we are comparing the mental development of a human being with the growth of a tree, not to speak of the much more remote comparison between the growth of humanity, as a whole, and the progress of an individual plant, or animal. This last analogy is, indeed, too faint to be of any value, and is misleading if deductions are made from it. The logical caution that must accompany discoveries of supposed identity is still more requisite in the slippery regions of analogy.

BUSINESS AND PRACTICE.

38. In Business and Industry, in the power of intelligence applied to the affairs of life, in practical genius, we find exemplified the discovery of deep identities amid superficial differences. In the inventions of practical art, no less than in the discoveries of science, the identifying faculty is called into play.

The labours of Watt, in the steam engine, might with great propriety be cited, to correspond with the greatest strokes of scientific identification. Perhaps his 'governor balls' is the most illustrative example for our present purpose. Here he had to hit upon a method of opening and closing a valve, in connexion with the diminution or increase of the speed of a very rapid wheel movement; and no device in the range of existing machinery would answer this object. He had therefore to venture out into the region of mechanical possibility, to seek among mechanical laws in general, or among very remote natural phenomena, for a parallel situation; and he found the only case that has yet been hit upon, namely, the action of a centrifugal force, where two revolving bodies separate, or come together, according as the rate of revolution is accelerated or retarded. I am not aware of any stroke of remote identification in the history of mechanical invention, surpassing this in intellectual reach; if such a power of bringing together the like out of the unlike were of usual occurrence, the progress of discovery would be incalculably more rapid. Another instance of Watt's power of identifying a practical situation with some other case where the requisite construction is given, was the suggestion of a lobster-jointed pipe, for conveying water across the bottom of the river Clyde, and which answered perfectly. The inventive genius is ever ready with a suggestion derived from some already existing device disguised by considerable disparity, either in the arrangements of nature or in the constructions of art. Identifying power, although not expressing everything that constitutes an inventor, will always be found a prominent feature in the character. As in all other departments, the identifying power must ply its energy in the proper region, and this is determined by the nature of the previous acquisitions, and the attraction of the mind for the specific class of objects wherein the invention shows itself.

An isolated discovery may prove but little as to the intellect of the discoverer, but a career of invention implies a large reach of the identifying faculty. The fertility of new suggestions displayed by some minds is a distinction founded on the power of piercing through disguises and bringing past and present together through an energetic force of reinstatement. Great inventors in all regions of practice,—whether in mechanical industry, government, laws, military affairs, medicine, education,—could be proved to abound in these strokes of similarity; and it would be seen that whatever other circumstances might contribute to their sagacity, this is the most indispensable.

39. In the able administration of private business and public affairs, we shall be able to detect the same force at work, although it may not in this case be called invention or genius. Either in meeting new cases, or in bringing superior methods to bear upon old, there is a march of mind, an advance over routine, which marks the able administrator; and here too the link of power consists in a more than ordinary force of identification. When a present emergency is exactly like a previous one, it recals that one without difficulty, and is treated as that was treated; when it corresponds exactly to no one previous, a subtler mind is wanted; a parallel must be sought for away from the routine of cases. Into quite remote regions of affairs the man of penetration is carried, and finds something in point where perhaps no parallel was ever drawn before. The application of the Syllogism to Law pleadings was a great legal improvement, which has persisted while scholastic forms have gone generally into decay. No routine

lawyer was capable of such an innovation. If for illustration's sake we suppose it to have been the work of one person, it implies a mind that came to the study of law previously prepared with the scholastic training, and detecting in the pleadings before the courts a real identity in form with the discussions of the schools, although hitherto conducted with no such method or precision. The transference of the syllogism to the legal reasonings would be the consequence of this feeling of identity; and hence would arise that capital requirement of making parties plead to the law and to the facts of the case separately, instead of huddling up both in one argument as is usually done in the controversies of every-day life. An innovation of this nature would be not unlikely to be introduced when cases arose of more than usual perplexity, such as make manifest the inadequacy of existing methods.

It is a usual circumstance for practical devices to be first hit upon in obvious cases, and thence transferred to other cases of a like nature but of more complexity. Thus in the great institution of the Division of Labour now so widely ramified over all departments of industry, a progressive application could be traced; we should find it commencing in manual industry, in the separation of the primitive classes of agriculturist, artisan, trader, soldier, and priest, and, in later times especially, extended into the large manufactory, into public business, and scientific research. In every new step there would arise in the mind of some one person or other a feeling of similarity between the exigencies of a business in hand and the cases where the method of divided labour was already in operation, and this identification would suggest the further extension of the practice. I do not at present speak of the faculty required for overcoming the difficulties of detail in all new applications of old machinery, (although here too it would be found that a fertile power of recalling identities in diversity would be the principal instrument of success in so far as the intellect was concerned,) I confine myself to the broad suggestion of a device through derivation from some existing parallel case.

In the progress of free governments there has been gradually diffused from the lower to the higher and more difficult posts the principle of responsibility as a check upon the abuse of power. This practice grew up by a process of extension, until in the constitutional governments of Great Britain and the United States it came to include every executive officer in all departments of state. The experience had of the practice in the more humble functionaries suggested its application to the exactly parallel case of superior officers, and after much struggle, not of an intellectual kind, it got to be introduced into modern free communities, as it had been in the constitution of ancient Athens.

The principle of non-interference with individual tastes and sentiments, except in so far as these affect the legitimate happiness of others, is recognised in certain cases, and has had a tendency to expand itself by assimilation into cases encumbered with obstructive circumstances. Hence has sprung up what amount of toleration in belief and conduct we now enjoy; but the difficulty in proceeding far with this extension shows how powerfully such sentiments as the love of domination and of uniformity may stifle the assimilating action of the intellect.

In the suggestions of a practical mind, the identification must always turn upon the relevant circumstances, and overcome other attractions of sameness on irrelevant points. To attain to this characteristic is the end of a practical education, which makes the person familiar with the aspects that serve the ends contemplated. Thus a lawyer in recovering from his past experience the precedents and analogies suitable to a case in hand is impelled by the force of similarity working in his mind; but, of the many peculiarities of the case, he excludes the assimilating action of all except the one that would govern its decision before a judge. His education must serve him in making this discrimination; and if (as will happen) he is by natural temperament keenly alive to this one feature that constitutes legal relevancy, and indifferent to all other points of interest in the case, he is a born lawyer, just as Newton with his natural avidity for mathematical relations and indifference to sensuous and poetic effects was a born natural philosopher, or Milton by the opposite character was a born poet. That nature should chance to turn out a legal mind is not singular or surprising, for it is only a variety of the scientific or logical intellect using verbal forms as the instrument, and implying an obtuseness to all the more popular and interesting features of human life. To secure a vigorous uniformity of dealing with disputes, scientific definitions must be made and equally applied in spite of the widest diversity in the cases; even though the consequence sometimes be that a wrongdoer is set free and an innocent man punished.

The same remark would apply to the discrimination of disease by the medical practitioner. To identify a set of symptoms with former cases on the real circumstance that determines the disease and the treatment, and not on a circumstance pointing to some other disease, is the essence of professional skill. No incidental accompaniments must blind him to the true features of identity; his sense of the essential symptoms needs to be keen and unwavering in the midst of a variety of confusing elements. If the natural impressibility of his eye, or his hand, be for appearances or effects not relevant in the discrimination of disease, he lodges an enemy in his own frame, and would better have sought some other occupation. In such a mind the greater the force of similarity the more misleading its workings, until a laborious education has made the faint but true perceptions victorious over the vivid and false.

40. The last form of practical ability that I shall here advert to is *Persuasion*. This implies that some course of conduct shall be so described or expressed as to coincide, or be identified, with the active impulses of the individuals addressed, and thereby command their adoption of it by the force of their own natural dispositions. A leader of banditti has to deal with a class of persons whose ruling impulse is plunder; and it becomes his business to show them that any scheme of his proposing will lead to this end. A people with an intense overpowering patriotism, as the old Romans, can be acted on by showing them that the interests of country are at

stake. The fertile oratorical mind is one that can identify a case in hand with a great number of the strongest beliefs of an audience; and more especially with those that seem at first sight to have no connexion with the point to be carried. The discovery of identity in diversity is never more called for than in the attempts to move men to adopt some new and unwonted course of proceeding. When some new reform is introduced in the state, it is usually thought necessary to reconcile and identify it in many ways with the ancient venerated constitution, or with the prevailing maxims and modes of feeling with which it would seem at variance. To be a persuasive speaker it is necessary to have vividly present to the view all the leading impulses and convictions of the persons addressed, and to be ready to catch at every point of identity between these and the propositions or projects presented for their adoption. The first of these qualifications grows out of the experience and study of character; the other is the natural force of similarity, which has often been exemplified in its highest range in oratorical minds. In the speeches of Burke we see it working with remarkable vigour. Perhaps the most striking instance of this fertility of identification for persuasive ends is exhibited in Milton's *Defence of Unlicensed Printing.* Of the class of preachers, Barrow is among the most abundant in his command of topics of persuasion and inducement towards the performance of religious and moral duties; in him no less than in Milton we have everywhere the tokens of an identifying mind of the highest order.

ILLUSTRATIVE COMPARISONS AND LITERARY ART.

41. When two remote phenomena are brought into comparison by a flash of the identifying intellect, they may turn out to be repetitions of the same natural power working in different situations, as in the cases of lightning and the electrical discharge, the fall of a stone and the moon's gravitation to the earth. The comparison in these cases is real or substantial. It is illustrative and instructive in no ordinary

degree, but it is more than an illustration, it is a scientific discovery. The two things identified are so thoroughly of a piece that we can go all lengths in reasoning from the one to the other. But there is also a useful class of comparisons where real identity is wanting; the likeness being yet sufficient to aid us in comprehending the more obscure and remote by the more intelligible and familiar of the two; as when in speaking of the action of supply and demand in commerce we say that these are constantly finding their level. Here the subjects compared are of quite different nature, the one belonging to the province of mind, and somewhat obscure, while the other is a physical phenomenon of a very palpable and intelligible sort. Illustration after this fashion is one of our devices for representing to the mind what is either naturally obscure or accidentally concealed from the view. If we can only see enough of the object to suggest an appropriate comparison, we make use of this to supply the rest. The force of similarity finds extensive scope in this department of invention.

Illustration is particularly wanted to convey scientific notions and abstractions. These are often so artificial and abstruse that an ordinary mind has great difficulty in seizing them. The propagation of the pulses of sound, the phenomena of latent heat, polarity, chemical affinity,—all admit of elucidation by illustrative similes. Human actions, feelings, and thoughts, are often so concealed in their workings, that they cannot be represented without the assistance of material objects used as comparisons; hence the great abundance of the resemblances struck between matter and mind. We speak of a clear head, a warm heart, a torrent of passion, a poet's fire. The comparisons brought to bear upon the complexities of social life are likewise very numerous; in fact there are many social phenomena that we never conceive otherwise than in some matrix of material analogy. If we take for example the different ideas connected with social order and disorder, we find the language almost wholly derived from other things; scarcely a phrase is literal, all is metaphorical. 'The vessel of the state weathers the storm, or is in danger of wreck;' anarchy is described 'chaos,' 'confusion;' the government is said to be 'shaken,' or 'stable,' or 'tottering;' law is 'erected,' 'overthrown.' We speak of the 'life' and 'growth' of society; when we conceive of progress it is generally in a figure; we call it 'movement,' 'development,' 'enlightenment,' and so forth.

Of all existing compositions, the writings of Lord Bacon are perhaps the richest in illustrative comparisons of the kind now under discussion; not being scientific identities, and yet serving in an eminent degree the purpose of assisting the popular intellect to embrace difficult notions. In virtue of this surprising power, Bacon's doctrines became clothed in 'winged words.' According to him, science is the 'interpretation' of nature; a comparison that transfixes the mind with the idea of observing, recording, and explaining the facts of the world. Final causes, he says, are 'vestal virgins;' they bear no fruit. But for the simile, it is doubtful if this notion would have stuck in men's minds and been the subject of keen controversy in the way that we have seen. His classification of 'Instances' or forms of experiment and proof, is wholly embedded in strong metaphors; the 'experimentum crucis,' the leading post between two ways, has been adopted in every civilized tongue. Fallacies or modes of mental bias are with him 'idols;' idols of the 'tribe,' idols of the 'den,' idols of the 'market-place,' idols of the 'theatre.'

A remarkably powerful identifying intellect, working upon the concrete facts of nature and human life and the history and literature of the past, is implied in this mode of genius, of which Bacon is the highest instance. The susceptibility to certain classes of objects and impressions determines the particular element that the resuscitating faculty must work in; and in some men this susceptibility is to the concrete in general, rather than to the select and narrow class of the artistic or poetic concrete. Thus although Bacon's imagery sometimes rises to poetry, this is not its general character; his was not a poetic sense of nature, but a broad general susceptibility, partaking more of the natural historian than of the poet; by which all the objects coming before his view or presented to his imagination took a deep hold, and by the help of his intense attraction of similarity were recalled on the slightest similitude. Many great writers in English literature have had this strong susceptibility to the sensible world at large, without a special poetic sense; while some have had the poetic feeling superadded; these last are our greatest poets, Chaucer, Milton, Shakespeare.

42. This leads me to notice the second class of illustrative comparisons, those serving not for intellectual comprehension, but for ornament, effect, or emotion. I have said that Bacon's comparisons rarely grew out of a poetic choice, though from their reach, their aptness, and their occasional picturesqueness, they might sometimes be quoted as a kind of poetry. His purpose was to enlighten, not to adorn. But similarity is the instrument of adding ornament and force to compositions; when an idea or picture is intended to kindle emotion of any kind, the effect can always be heightened by adducing illustrative comparisons more impressive than the original. When Sir Philip Sydney, to describe the moving effect of the ballad of *Chevy Chase*, says that it stirs the heart 'like the sound of a trumpet,' he enforces a weaker impression by one much stronger as well as more familiar. The following lines of Chaucer contain two exquisite comparisons for enriching the emotional effect of the subject; it is part of his description of the youthful Squire.

> Embroided was he, *as it were a mead,*
> *All full of freshē floures white and rede;*
> He sung and fluted gayly all the day,
> *He was as fresh as is the month of May.*

To find powerful and touching comparisons in keeping with the original subject of the description is one of the constant endeavours of the poet, and puts his genius to the severest test. But the same demand is made upon the orator, who has also to stir up the emotions of his audience, to kindle their likings and dislikings with a view of moving them in some one direction. Hence in oratory of every kind we find abundant use of the figures of speech growing out of comparison. In panegyric, elevating similitudes are employed, in denunciation such as degrade. Derision and merriment grow out of low, grovelling comparisons applied to things pretending to be dignified and venerable. Burke's *French Revolution* teems with all the varieties of eloquent comparison. His 'trampling law and order 'under the hoofs of the swinish multitude,'' will be ever memorable among the figures of oratory.

Although Shakespeare often displays the Baconian power of illuminative comparison, especially in moral maxims and commonplaces, he shines chiefly in the other class, those that heighten the emotional effect (while the genius of both the one and the other abounds in such as have no effect whatever but intellectual profusion). With all his susceptibility to the sensible and concrete of the world, to the full face of nature and life, he had the poetic eclecticism, and dwelt by preference upon the objects that inspired emotions such as an artist is wont to kindle up. Having perhaps the greatest intellectual reach of similarity that the mind of man ever attained to, his power of adducing illustrative similitudes, through chasms of remoteness and the thickest disguise, will be a wonder and an astonishment to the latest posterity.

43. Of the Tropes and Figures described in Rhetoric, the largest half turn upon comparison. The metaphor, the simile, the allegory—are all forms of illustration by similitude, sometimes serving for clearness, or intellectual comprehension, at other times producing animation and effect. Their invention is due to the identifying intellect, which breaks through the partition caused by difference of subject to bring together what is similar in some one striking aspect or form. The literary and poetic genius of ages has accumulated a store of such comparisons; many of them have passed into common speech to enrich the dialects of everyday life. No man has ever attained rank in literature, without possessing in some degree the power of original illustration; and the reach or interval of disparity through which new similes are brought, makes a fair measure of the intellectual force of the individual mind in one of the leading characteristics of genius. The original fetches of Homer, of Æschylus, of Milton, and above all of Shakespeare (I do not pretend to exhaust the list even of the first-rate minds), are prodigious. How remote and yet

how grand the simile describing the descent of Apollo from Olympus: 'he came like night.' The identifying faculty, be it never so strong, would hardly suffice to bring together things so widely different, but for some previous preparation serving to approximate the nature of the two things in the first instance, as we have already had occasion to remark of some of the scientific discoveries. Night itself must have been first personified in the mind to some extent, thereby reducing the immense disparity between the closing day and the march of a living personage down the mountain slopes. But with all due allowance for the highest susceptibility of mind to the poetic aspects of things, the power of adducing comparisons from remote regions, such as we find it in the greatest literary compositions, is stupendous and sublime.

FINE ART IN GENERAL.

44. The spirit of the observations made above respecting Poetry applies to Fine Art in general. In the Arts we may trace out a scale or arrangement, beginning at the most intellectual and ending with those that have this quality in the lowest degree. At one end of the scale we find distinct examples of the purely intellectual law of similarity, at the other end scarcely a trace of this operation appears in the manner that we have been accustomed to recognise it. Poetry, Painting, Sculpture, Architecture, Decoration, and Design, are all conversant with some of the higher intellectual elements: Poetry with speech and the pictorial as represented by speech, the others with visual forms and appearances of various kinds. In stirring up and reproducing on fit occasions the materials of those arts, the associating forces of Contiguity and Similarity are extensively brought into play. As to Contiguity this is obvious enough; as regards Similarity it may be easily shown. A painter in composing a picture must in the last resort choose the component parts according to their artistic keeping with one another: but in recalling from the past a number of objects in order to try their effect, he will be greatly assisted by a powerful identifying faculty. For we may suppose him to

have in his view some one plan of a background, which background, however, although containing the main features, does not satisfy his artistic sense. By the attraction of likeness, this part, unsuitable in itself, may recal others resembling and yet greatly differing, and in the array brought up by a powerful intellect working upon a large foregone experience, one may be presented exactly fitting the picture. There may be nothing artistic in the suggestion of the different views; nevertheless, it is only an artist that can make the proper choice. As in poetry, so in painting, in sculpture, in architecture, decoration, and design, there may be a rich intellectual storage and reproduction of the material, apart from the æsthetic feeling, but by this feeling the artist must be guided in the use that he makes of the suggestions of the intellect. In all the Arts, examples may be found of rich profusion of unselected matter; the authors mistaking a strong recollection and revival of natural scenery and pictorial elements in general, for the artistic harmonizing of the material; still an Artist in the class we are now discussing cannot attain the highest greatness without some intellectual source of suggestions over and above his artistic faculty. The intervention of high intellect in Art seems to have reached a climax in Michael Angelo; and the limits of human nature forbid us to suppose that he could at the same time put forth the power of delicately adjusting the parts of his compositions so as to yield the graces and charms that constitute the true distinction, the essence of Art.

45. When we pass to the second class of Arts, we find intellect dying away and giving place to the genuine artistic stimulus in its purity. Music is the most conspicuous member of the group, and might be taken as representing the whole: the others are, spoken music or Eloquence, Dramatic action and pantomime, the graces of personal Demeanour and display, and the Dance. In these Arts the suggestions of intellectual similarity can hardly be said to occur. Undoubtedly, we may by similarity, as already said, identify a common character in different airs and harmonies; and, through the presence of any one, others may be recalled to the mind of a composer, and may serve him as hints and aids in a new com-

position. In such circumstances, I can conceive the operation of a vigorous identifying faculty as enlarging a musician's resources, or making more readily available to him the examples that have previously impressed themselves on his mind. But this process of imitating and compiling does not fairly exemplify the workings of artistic creativeness. The author of a truly original melody relies upon no such intellectual assistance. By the spontaneous gushings of his mind he flows out into song, and by the guidance of a delicate sense he tunes himself to melody. Other men may imitate and combine such primitive originals in a variety of compositions, but the knowing ear can always detect the work of compilation. Intellect may originate Science, but not Art. It might be shown, I believe, that the fountain of artistic originality in such instances as music and dramatic action is to be sought in the emotional and spontaneous workings of the organs; while in the compositions of the former class these workings conspire with the sensuous intellect; and in all alike a keen æsthetic sensibility is indispensable.

I may here refer to what is a common subject of remark, that great musicians and actors, not to speak of opera dancers, have often a very low order of intellect, as measured by the ordinary tests. So in the charms and graces of society, which is a species of fine art, intellect may contribute nothing. In assisting the less gifted temperaments to take on the charm native to the others, it may operate with good effect; for this is done by acquisition and compilation, where the intellectual forces always work to advantage. Moreover, in Art, effects can often be reduced to rule, and the comprehending and following out of rules is an affair of the intelligence. In musical compositions there are rules as to harmony, which any one might act upon; in elocution much can be done by merely understanding the directions of an instructor, but to stupidity all such directions are nugatory. Thus it is that in the diffusion and extension of the least intellectual of the fine arts, recourse may be had to an instrumentality that would never suffice for their creation. It is a remarkable fact in history, that the most highly gifted people of antiquity, in all that regarded pure intelligence, had no apparent originality in music; but in their appreciation of its effects they made copious use of the Lydian and Phrygian melodies, and pushed them forward into alliance with meaning in their lyric and dramatic poetry.

SIMILARITY IN ACQUISITION AND MEMORY.

46. It now remains to show how the force of reinstatement by similarity can operate in carrying forward the work of Acquisition. We have seen that the associating principle of Contiguity must needs be the groundwork of Acquisition in general; but when any new train can bring up from the past some nearly similar train, the labour of a separate acquirement is thereby saved, the points of difference between the new and the old are all that is left for Contiguity to build up in the mental system. When a workman is to be taught a new operation in his art, there will necessarily be, along with certain matters of novelty, a large amount of identity with his already acquired habits; hence in order to master the operation, he will require to repeat it just as often as will suffice for fixing all those new steps and combinations by the plastic adhesiveness of Contiguity. A professed dancer learning a new dance, is in a very different predicament from a beginner in the art. A musician learning a new piece, actually finds that nineteen-twentieths of all the sequences to be acquired have been already formed through his previous education. A naturalist reads the description of a newly discovered animal; he possesses already, in his mind, the characters of the known animals most nearly approaching to it; and, if he merely give sufficient time and attention for fastening the features that are absolutely new to him, he carries away and retains the whole. The judge in listening to a law-pleading hears little that is absolutely new; if he keeps that little in his memory, he stores up the whole case. When we read a book, on a subject already familiar to us, we can reproduce the entire work, at the expense of labour requisite to remember the additions it makes to our previous stock of knowledge. So in Fine Art; an architect, a painter, or a poet, can easily carry

away with them the total impression of a building, a picture, or a poem; for instead of being acquisitions *de novo*, they are merely variations of effects already engrained on the artist's recollection.

To whatever extent one thing is the repetition of another, the cost of contiguous acquisition is saved. But it is necessary that the repetition or identity should be perceived; in other words, the new lesson must reinstate, by the force of similarity, all the previous trains that in any way correspond with it. An old acquirement containing many steps in common with a lesson in hand, will be of no use unless it is recalled; should the disagreeing points be so marked as to cloud the resemblance and stifle the identifying action, nothing is gained by the agreement. It consequently happens that a mind feeble as regards the restoring force of similarity, misses the help that past acquirements could often bring to bear upon present effects; whereas a remarkable energy of recal will make everything available that contains the smallest trace of common matter.

47. To take a few examples from Science. The subject matter of Geometry embodies a few fundamental notions and processes. A definition, an axiom, a postulate, a proposition, whether theorem or problem, a chain of demonstration, are to the beginner things absolutely new. They must be fixed by the plastic power of Contiguity, and time and concentration must be allowed for the purpose. But in a good head, one or two examples of each strongly imprinted will make all the rest easy; the method or character of the devices will be seen through and acquired, and in every new case the mind will fall back upon the old ones for the common element, and concentrate attention on the points of difference solely. When, after going over a few definitions, the mind gets impressed with the form and peculiarity of a definition, there is little to acquire in the rest; a slight substitution serves to make a new one out of an old; the definition of a square is easily changed to suit a rectangle. So with an axiom: the first is the most laborious to acquire; every subsequent one is easier than the preceding. When we come to the propositions, there is a

very great deal of novelty at first; the whole scheme and management of a theorem or problem—the formality in the statement, and in the order of the proof—are things utterly strange to the young beginner; to acquire a simple proposition is a heavy strain upon his adhesiveness for abstract and representative forms. When this first acquisition is made, it can be turned to account in every succeeding proposition, provided the operation of similarity is not obstructed by the differences that encumber the new cases. Indeed, if each step in the machinery of Geometry were, without much waste of time, firmly learned on the first encounter, and if the reviving power of similarity for this class of things were unfailing, one's progress through Euclid would be a race, such as is recorded of Pascal and Newton. But to the generality of minds identities in geometrical reasoning are hard to perceive; a difference in collaterals utterly extinguishes the sense of a similarity in substance, and every new proposition is a fresh labour, as if nothing like it had been gone through before.

What is true of Geometry holds in all the sciences. There is in each one a vast deal of repetition both of the facts, or subject-matter, and of the formal machinery, although with great differences of mode and circumstance. The law of gravitation runs through all Astronomy; and in the deepest calculations of the celestial movements the same mathematical devices are constantly reproduced in new complications. A mind that can seize a calculation once for all, and trace it out in the thickest envelope of diversity, will speedily pass through the intricacies of this vast subject, or of any other abstract science. Along with the grasp of similarity that can suffice to trace out identities hitherto passed over by all former minds working in the same sphere, it is to be presumed that the more ordinary resemblances will be easy to strike; hence an original mind in science is also distinguished for the rapidity of its course along the track of the already known. Much of the acquisitions of a strong intellect is in reality the re-discovery of what is already known; such an intellect catches the identities of abstraction, classification, induction, deductive application, and demonstrative reasoning, even before they are pointed out by the master. He will make but a poor mathematician that needs to refer to his book for the demonstration of every successive theorem. With all branches of Physics, with Chemistry and Physiology, the very same remarks will apply. It is the nature of an advanced science to contain innumerable identifications summed up in its definitions and general laws; it was by a vigorous similarity that these were first formed; by the same power they are rapidly acquired.

So in the more concrete sciences of the Natural History group. In Zoology, Botany, Mineralogy, Geology, there has been accumulated a fund of identities in the classifications made of the objects of each. To acquire these classifications the learner must himself feel the similarity among the individuals; and if his mind is of that powerful kind that can trace many of the likenesses by its own unassisted force, he will speedily string together all the groups that have been formed by others. It is of consequence to a botanist looking to a new plant that he shall be able to recal at once whatever other plants he had known that in any way resemble it; he will in this way both determine its true class, and stamp it with ease, upon his memory.

48. In all the acquisitions of Business, no less than of Science, similarity will likewise bear an important part. If an apprentice at the Law has that deep and subtle identifying power that sees in every new case whatever similarity there is in it to some previous one, he saves half his labour; his mind breaks in upon the old track, and on that builds up the new recollection to the extent of the likeness. It is possible to lay under contribution in this way matters quite different from the subject in hand; to clench the technicalities of the law we may go back upon recollections out of all sciences and arts, illustrating the subject as it were to one's self. The mind of Lord Bacon could see in anything that presented itself multifarious analogies to things the most remote; these analogies he could produce to his readers to facilitate their conception of his meaning, and by the same power he could shorten his own labour and study. When a clever person surprises us by instantaneously comprehending and firmly retaining some new

method of procedure, we may be quite sure that it has taken hold of him by resuscitating something analogous out of the storehouses of his past experience; whenever this easy comprehension and this permanent retention form part of the mental character, and show themselves in a wide range of subjects, a vigorous identifying faculty certainly lies at the bottom.

49. The case of the Artistic mind presents no essential difference. The storing up of impressions of objects of art is easiest when the identifying power is so strong as to bring up on every occasion whatever resembles the object before the view. That a likeness should exist between something we are at present looking at or listening to, and some past impressions of the eye or the ear, and that that likeness should not be felt, is a misfortune, a loss in every way, and for this reason among others, that to impress the new object on the memory we require as much repetition and pains as if nothing of the kind had ever been experienced before. In reading a poem the memory is assisted to remember it by all the similarities of thought, of imagery, of language, of metre and rhythm, that it is able to evoke from the traces of former readings and recollections. In a mind very keen and susceptible on all these poetic elements, and having the power of similarity highly manifested, almost every touch will rouse up something from the past that has a certain degree of resemblance, and that something will be an already formed recollection to eke out the retentiveness of the new strain. The more one's acquisitions advance, the greater the scope of this work of fitting old cloth into new garments; but previous acquisition is only of avail according as the stroke of resuscitation is good, and able to pierce the disguises of diversity and altered form that may attach to the most resembling of all our past examples.

The contiguous retentiveness of the mind is put to the fullest test only by entire and absolute novelty, a thing that is more and more rare as one grows older. In learning languages, for example, we have less to acquire with every new individual language. Latin prepares for French, Italian, Spanish, &c.; German for Dutch; Sanscrit for Hindostanee.

The generalizations of philologists in tracing common roots through all the Indo-European tongues, greatly diminish the number of original ties that contiguity has to fix. All discoveries of generalization have this effect; and if an individual learner can see likenesses in addition to what have been generally promulgated, his labour is shortened by strokes of power peculiar to himself.

50. The Historical Memory might furnish good examples of the intervention of Similarity in making up the coherent tissue of recollected events. In the transactions of the world, great and small, there is so much of repetition, that a new history is in reality a various reading of some old one; not to mention how much each nation repeats itself through its successive epochs. To a dull mind a great deal of this repetition is lost for all purposes, the aid to memory among the rest; but a keen-sighted attraction for every vestige of recurring likeness enables another person to retain large masses of narrative at a small expense of adhesive acquisition. Campaign suggests campaign, and one battle another; an intrigue, a negociation, a career of ambition, a conquest, a revolution, are no new things to the student gone some way in history; certain minor features, some of the proportions and circumstantials, are special to the case in hand, and these must be fixed in the memory by pure contiguity. No man could recite a narrative of any sort from a single reading or hearing, if it were all new to him; to tell a story an hour after getting it from another party would be impossible but for our possessing already among our stored recollections more than nineteen-twentieths of all the adhesions that enter into it.

CHAPTER III.

COMPOUND ASSOCIATION.

1. HITHERTO we have restricted our attention to single threads or invisible links of association, whether of contiguity or similarity. It remains for us yet to consider the case where several threads, or a plurality of links or bonds of connexion, concur in reviving some previous thought or mental state. No new principle is introduced here; we have merely to note, what seems an almost unavoidable effect of the combined action, that the reinstatement is thereby made more easy and certain. Associations that are individually too weak to operate the revival of a past idea may succeed by acting together; and there is thus opened up to our view a means of aiding our recollection or invention when the one thread in hand is too feeble to effect a desired recal. It happens, in fact, that in a very large number of our mental transitions a multiple bond of association is at work, and our subject therefore demands that we should follow out the exposition under this new view.

The combinations may be made up of contiguities alone, of similarities alone, or of contiguity and similarity mixed. Moreover, we shall find that there is a suggesting power in Emotion and in Volition, and that this may conspire with the proper intellectual forces, and may either assist or obstruct their operation. In the reviving of a past image or idea, it is never an unimportant circumstance that the revival gratifies a favourite emotion or is strongly willed in the pursuit of an end. We must endeavour to appreciate as far as we are able the influence of these extra-intellectual energies within the sphere of intellect; but as they would rarely suffice for the reproduction of thought if acting apart and alone, we are led to look at them chiefly as modifying the effects of the proper intellectual forces, or as combining elements in the composition of associations.

The general law may be stated as follows :—

> Past actions, sensations, thoughts, or emotions are recalled more easily, when associated either through contiguity or similarity, with more than one present object or impression.

COMPOSITION OF CONTIGUITIES.

2. Commencing with the case where a plurality of links of contiguous association is concerned in the revival, there is a wide scope for illustration. Instances might be cited under all the heads of the first chapter of the present Book ; but a less profuse selection will suffice. There will, however, be a gain in clearness by taking Conjunctions and Successions separately.

Conjunctions.—For a simple example of a compound conjunction, we may suppose a person smelling a liquid and identifying the smell as something felt before, but unable to recal to mind the material causing it. Here the bond between an odour and the odorous substance is too feeble for reproducing the idea and name of the substance. Suppose farther that the person could taste the liquid without feeling the odour, and that in the taste he could recognise a former taste, but could not remember the thing. If in these circumstances the concurrence of the two present sensations of taste and smell brought the substance to the recollection, we should have a true instance of composite association. If one of the two links is fully equal to the restoring effect, there is no clear case under the present law ; in order to constitute a proper example each should be insufficient when acting singly.* There

* If, by the assistance of the second bond, the revived idea were more vividly or forcibly brought forward, we should have a true example of compound association, although a restoration was possible through the first bond acting alone.

can I think be little doubt as to the fact that such revivals occur, although we might conceive it otherwise. It would be nothing intrinsically improbable that two links of connexion inadequate separately, should be inadequate jointly; just as no amount of water at the temperature of 40° is able to yield one spoonful at 45°. Combination does not in all cases make strength. Ten thousand commonplace intellects would not make one genius, under any system of co-operation. The multiplication of unaided eyes could never equal the vision of one person with a telescope or microscope.

We have seen that the *complex wholes* that surround us in the world are held together in the recollection by the adhesive force of Contiguity; such objects as a tree, a human figure, a scene in nature, cannot continue in the mind or be revived as ideas until frequent repetition has made all the parts coherent. After the requisite iteration a complex object, such as a rural village, may be revived by the presence of a single portion of it, as some street, or building, or marked locality. But if the village is one not well known to a person, that is, if the notion of it is not very firmly aggregated in the mind, the traveller just entering may not be liable to identify it by the first thing that strikes him; he may require to go on till several other objects come in view, when probably their joint impression will be able to bring up the whole, in other words, will remind him what village he is now entering, so that he can tell the name and all the particulars that enter into his recollection of it.

So in regarding objects as *concretes*, or combinations of many distinct qualities,—an orange, for example, affects all the senses,—there is a fixing process which makes the different sensations hold together in one complex idea. Here too there is room for the joint action of associating links in recalling an image to the mind. I have already imagined a case of this description, where the united action of smell and taste was supposed to revive the idea of the concrete object causing them, either being of itself insufficient for the purpose.

3. It is, however, when we go beyond the case of isolated objects to the still greater aggregations made up by the rela-

tions of things to one another, that we can reap examples of multiple association in the greatest abundance. In the connexions of objects with places or locality, with persons, with uses, and with all the properties that may belong to them, we see numberless occasions for the working of the composite link in effecting the recal.

When things have a fixed *locality*, they become associated in the mind with that locality, or with a number of companion objects or appearances. This is one of the means of their restoration to the mind in idea. The sight or remembrance of a harbour recals the shipping; the recollection of a building brings up the things that we know it to contain. Conversely, an object that has a fixed place recals the place, as when St. Paul's reminds us of the neighbourhood where it stands. Now it not seldom happens that we desire to recal a place or an object by this link of connexion but are unable to do so; a second connexion of this or some other kind may then come to the rescue.

Thus, to take the case of searching for things lost. When we do not know where to find a thing, although we ourselves have put it in its place or seen it there, the adhesion of place is by that circumstance declared to be feeble. We then run over other links of association; we get upon the time when we last saw it, the work we were engaged in, or any fact that would along with the lost object have an association with the forgotten place, and we may thus through a multiplicity of feeble connexions attain a force of recal equal to one strong adhesion.

The connexions with *persons* frequently yield an assisting link in difficult recollection. Objects become associated with their owners, their makers, inventors, all persons concerned in their use, or frequenting their locality. When we are unable to recover a thing by the adhesion between it and other inanimate accompaniments, the suggestion of a personal connexion will often make up what is wanting in reviving efficacy. Thus in my endeavour to recollect an array of objects in some museum, there are some that have completely escaped me; the association of these with their place in the building and with the adjoining objects which are present to my mind is not enough; but when I chance to recal the donor, the collector, or maker, along with these other adjuncts, the vanished individuals will probably reappear.

It occurs likewise that things are recalled by plurality of association with persons, each link being too weak alone, but made powerful by union. I meet some one in the street, and make an ineffectual attempt to remember where I last saw the same person: by and by some one else occurs to me, who was present in the same place. Perhaps, if I had merely this last person in my view, I should have been as little able to revive the place as with the first alone; whereas with the two I have no longer any difficulty.

The converse operation of remembering a person by two or more different connexions is still more frequently exemplified. A human being standing alone is a sufficiently many-sided object to be open to revival through a multiplex bond. Looking upon it, either as an aggregate of many parts, or as a concrete of many qualities, the remark holds to a very great degree. The particulars of a personal description are very numerous, and it often requires many of them to be cited, in order to bring to mind an individual very well known to us. Moreover, the external relations of human beings surpass in variety those of other objects. A person is associated with a name; with locality, habitation, and places of resort; with blood and lineage, a very powerful mental tie in consequence of the strength of the family feelings; with associates and friends ; with occupation, pursuits, amusements; with property and possessions; with rank and position; with the many attributes that make up character and reputation; with a particular age; with the time they have lived in; with the vicissitudes and incidents that mark the course of their life. Now, in recalling a person previously known, any one or more of these connexions may serve us; and when a present link is insufficient, others require to be added. If we were endeavouring to recover the historical personages of a given time, the age of Pericles, for example, there would be a certain strength of bond between each of them and the idea of the time, namely, the fifth century before Christ. In the case of some, this link might be strong enough of itself; with others a second link might be requisite, as for example, their profession. With the idea of a sculptor entering into the composition, we should recal Phidias, with a painter Praxiteles, with a philosopher Anaxagoras. Our historical memory is very often helped after this fashion.

Persons are brought more or less frequently before our view, and are made links in our trains of thought, according as we are liable to encounter the various accompaniments of their life. If we pass every day by a particular dwelling the tenant comes readily to mind; if in addition we have to think frequently of the same individual's calling, as the chief of some business department which we have many dealings with, such an one will engross a large share of our thinking currents and permanent regards.

4. The connexion of things with *uses* is a source of multiple bonds. A tool, a building, the materials of food, clothing, &c., everything that comes into the market as a useful commodity, an army, or a fleet,—all such things have besides their appearance, locality, ownership, &c., a distinct end to serve, whence arises a powerful bond of association. I am unable to remember the objects that I have seen in a certain shop, by virtue solely of their association with the shop, and with contiguous things that I do remember, one course open to me would be to run over in my mind a list of utilities to be answered, in which list I should bring up one or more uses of the forgotten things, and this new bond co-operating would be sure to recover some of those from their oblivious condition. To carry away a full recollection of the contents of a manufactory that I have visited, I should find it necessary to aid the association of contiguity of place and succession, with the various ends or utilities that were to be supplied. In recalling the details of a printing-office that I have been seeing, I forget the operation of wetting the paper; I chance, however, to get into my hand a newly printed sheet, and the

wetness adds its suggesting power to the other contiguities, and I bring to mind the manual operation for imparting the effect.

In the natural sciences, the material objects of the world are looked upon as having many *properties*, useful or not; these are ascertained by observation and experiment, and are recorded as part of the description of the several substances. In this way everything suffers an ideal expansion or aggrandisement in the mind; the connexions of things, or the threads that give us our hold of them, are multiplied. The substance, silica, in the mind of a naturalist, has a vast range of associations in consequence of the many properties entering into his notion of it. These various links tend to bring the substance repeatedly before the mind; sometimes one link is sufficiently powerful, for example, the recollection of a given degree of hardness; at other times the material is recovered by double or triple connexions, as the ideas of an oxide, of insolubility, and of a six-sided crystallization. The scientific man's memory is constantly liable to be aided by the multiplication of bonds individually too feeble to bring about the recollection of a forgotten object. In invention, as in the search for a device to answer some new end, the mind must go over catalogues of objects according to many kinds of contiguity, including the most casual connexions, in order to bring forward a large field for selection.

5. *Successions.* I have dwelt at length, in a previous chapter, on the contiguous association of successions of various kinds. Here, too, in the case of imperfect adhesion, the recovery may be due to a composite action. I have witnessed a series of events, and these are in consequence associated in my mind. In endeavouring to recal the series from the commencement, a link fails, and the recovery is arrested until some other association, such as place, or person, contribute a thread in aid of the defective link. Very often, indeed, the auxiliary bond is of itself strong enough to effect a revival single-handed; this would not be an instance of the principle now under consideration.

There is one succession that contains the whole of our past experience, that is the Order of Time, or the sequence of events in each one's own history. If all the minutiæ of this succession were to cohere perfectly in the mind, everything that we have ever done, seen, or been cognizant of, could be recovered by means of it. But, although all the larger transactions and the more impressive scenes of our personal history are linked in this order with a sufficient firmness, yet for smaller incidents the bond is too weak. I cannot remember fully my yesterday's train of thoughts; nor repeat verbatim an address of five minutes' length, whether spoken or heard. Things related in the order of time are strictly speaking experienced only once, and we almost always require repetition to fix any mental train. It constantly happens therefore that we are in search of some reinforcing connexion to help us in recovering the stream of events as they occurred in the order of time. We seek for other conjunctions and successions to enable us to recommence after every break.

Experience teaches us that the only way of making up a defective adhesion is to compass in our minds some other connexion, or to get at the missing object through a different door. The inability to recollect the next occurring particular of a train that we are in want of stimulates a great effort of volition, and the true course for the mind to take is to get upon some other chain or stream that is likely to cross the line of the first near the break. We are probably unable to say which succession will answer best for this end, and we therefore try several, one after the other. Sometimes by sticking with energy upon the last link remembered, the mental force may be exalted by excitement, and by this means the recovery may take place. It is, however, difficult to say whether this exalting effect of excitement can ever count for much. The other method, though slow and protracted, is the more likely. If I wish to remember all the incidents of a long and eventful day, I must be indebted in a very great degree to composite connexions.

At every moment of life each person stands immersed in a complicated scene, and each object of this scene may become a starting point for a train of recollections. All the internal feelings of the body; everything that surrounds us and strikes the eye, ear, touch, taste, or smell; all the ideas, emotions, and purposes occupying the mind;—these form so many beginnings of trains of association passing far away in the remotest regions of recollection and thought; and we have it in our power to stop and change the direction as often as we please. From some one of these present things we must commence our outgoings towards the absent and the distant, whether treading in single routes, or using the aid that composite action can bestow.

6. *Language.*—The recal of names by things and of things by names give in both cases occasion for bringing in additional links to aid a feeble tie. When we have forgotten the name of a person or of an object, we are under the necessity of referring back to the situation and circumstances where we have heard the name to see if any other bond of connexion will spring up. Very often we are unable at the time to recover the lost sound by any means; but a short time afterwards an auxiliary circumstance crosses the view, and the recollection strikes us of its own accord.

Many of our recollections, thoughts, conceptions and imaginings are an inextricable mixture of language and visible pictures. The notions that we acquire through oral instruction or from books are made up in part by the subject matter purely, and in part by the phraseology that conveyed it. Thus my recollection of a portion of history is made up of the train of words and the train of historical facts and scenes as I might have seen them with my own eyes. So in many sciences, there is a combination of visible or tangible notions with terms or language. Geometry is a compound of visible diagrams with the language of definitions, axioms, and demonstrations. Now in all these cases recollection may turn either on the associations of words, or on those of visible and other conceptions, or on a compound of both. If I listen to a geographical description, there is in the first place a train of words dropping on my ear; and by virtue of a perfect verbal cohesion I might recal the whole description and recite it to another party. In the second place, there is a series of views of objects, of mountain, river, plain, and forest, which I picture in my mind and retain independently of the language used to suggest them. Were my pictorial adhesion strong enough I could recal the whole of the features in the order that I was made to conceive them and leave aside the language. The common case, however, is that the recollection is made out of a union of both the threads of cohesion; the pictorial train is assisted by the verbal, and the verbal by the pictorial as may be required.

COMPOSITION OF SIMILARITIES.

7. The effect of the multiplication of points of likeness in securing the revival of a past object is liable to no uncertainty. It is only an extension of the principle maintained all through the discussion of the law of similarity, that the greater the similitude and the more numerous the points of resemblance, the surer is the stroke of recal. If I meet a person very like some one else I have formerly known, the probability of my recalling this last person to view is increased, if the likeness in face and feature is combined with similarity of dress, of speech, of gait, or of any still more extraneous points, such as occupation, or history. Increase of resemblance *extensively*, that is by outward connexions, has the same power as increase of resemblance *intensively*, in rendering the restoration of the past more certain. It might admit of a doubt whether four faint links of contiguous adhesion would be equal to one strong, but it would be against our whole experience of the workings of similarity to doubt the utility of multiplying faint resemblances when there was no one sufficiently powerful to effect the revival. At the same time we must admit that much more is contributed to the chances of reinstatement by intensifying one point of likeness than by adding new ones of a faint character. By raising some single feature almost up to the point of identity we should do more good than could be done by scattering faint and detached likenesses over the picture. This, however, is not always in our power; and we are fain to acknowledge that when the similarity in any one particular is too feeble to suggest the resembling past, the

existence of a plurality of weak resemblances will be the equivalent of a single stronger one.

On this view, I might exemplify the workings of composite similarities from the various classes of examples gone over in the preceding chapter. In all very complicated conjunctions, as, for example, a landscape, there may be a multiplication of likenesses unable to strike singly, but by their concurrence suggesting a parallel scene. Hence, in endeavouring to gain from the past a scene resembling some one present, we may proceed, as in Contiguity, by hunting out new collaterals for the chance of increasing the amount of similitude and with that the attractive power of the present for the absent. If I am endeavouring to recal to mind some historic parallel to a present political situation, supposing one to exist and to have been at some former time impressed on my mind, there may be a want of any single salient likeness, such as we admit to be the most effective medium of reinstatement, and I must therefore go over in my mind all the minute features of the present to enhance in this way the force of the attraction of similitude for the forgotten parallel.

8. The case noticed at the conclusion of the preceding head, namely, the combination of language with subject-matter in a mixed recollection, is favourable to the occurrence of compound similarity. If an orator has before his mind a certain subject, the conduct of an individual, for example, which he wishes to denounce by a cutting simile, his invention may be aided by some similarity in the phrases descriptive of the case as well as in the features of the case itself. If one who has at a former time read the play of Œdipus, now commences to read Lear, the similarity is not at first apparent, but long before the conclusion there will be a sufficient accumulation of features of similitude, in dramatic situation and in language, to bring Œdipus to mind without any very powerful stretch of intellectual force. So in scientific invention; a fact described in language has a double power of suggestion; and if, by good luck, both the fact and the description have a resemblance

to some other fact, and to the language that accompanied this other when formerly present to the mind, there is so much the more chance of the revival taking place.

MIXED CONTIGUITY AND SIMILARITY.

9. Under this head several important groups of instances might be noted.

If any one in describing a storm bring in the phrase 'a war of elements,' the metaphor has been brought to mind partly by similitude, but partly also by contiguity, seeing that the comparison has already been used in conjunction with the picture of a storm. The person that first used the phrase came upon it by similarity; he that used it next had contiguity to assist him; and after frequent usage the bond of contiguity might come to be so well confirmed, that the force of similarity is at last entirely superseded. In this way many things that were originally strokes of genius end in being efforts of mere adhesive recollection; while, for a time previous to this final consummation, a mixed effort of the two suggesting forces is displayed. Hence Johnson's remark on the poet Ogilvie, that his poem contained what was once imagination, but in him had come to be memory.*

In all regions of intellectual exertion, in industry, science, art, literature, there is a kind of ability displayed in taking up great and original ideas and combinations, before they have been made easy by iteration. Minds unable for the highest efforts of origination may yet be equal to this second degree of genius, wherein a considerable force of similarity

* 'On Tuesday the 5th July (1763), I again visited Johnson. He told me he had now looked into the poems of a pretty voluminous writer, Mr. (now Dr.) John Ogilvie, one of the Presbyterian ministers of Scotland, which had lately come out, but could find nothing in them.

'BOSWELL. 'Is there not imagination in them, Sir?'

'JOHNSON. 'Why, Sir, there is in them, what *was* imagination, but it is no more imagination in *him*, than sound is sound in the echo. And his diction, too, is not his own. We have long ago seen *white-robed innocence*, and *flower-bespangled meads*.''

is assisted by a small thread of contiguity. To master a large multitude of the discoveries of identification, a power of similarity somewhat short of the original force that gave birth to them is aided by the contiguous bond that has grown up during the few repetitions of each that there has been opportunity for making.

10. A second case is furnished when a similarity is struck for the first time in circumstances that brought the absent object into near proximity in some contiguous train. Thus a poet falls upon a beautiful metaphor while dwelling in the region or neighbourhood where the material of the simile occurs. In the country, rural comparisons are most easily made, on ship-board nautical metaphors are naturally abundant. There is a real effort of similarity in giving birth to new comparisons, but the things compared may chance to stand so near that notwithstanding the faintness or disguise the embrace of identity comes on.

If we chance to be studying by turns two different sciences that throw much light on each other, we are in a good way for easily deriving the benefit of the comparison. Should we know the most likely source of fertile similitudes for some difficult problem, we naturally keep near that source in order that we may be struck with the faintest gleam of likeness through the help of proximity. A historian of the ancient republics keeps his mind familiar with all the living instances of the republican system, as well as with those of the middle ages that have been fully recorded. At a time when physical science is largely indebted to mathematical handling as during the age of Newton, the scientific man spends half his time in mathematical studies. In such cases, it is not safe to trust to an acquisition of old date, however pertinacious the mind may be in retaining the subject in question. The great discoveries of identification that astonish the world and open up new vistas of knowledge, may have often required a help from the accidental proximity of the things made to flash together. For illustration's sake, we might suppose Newton in the act of meditating upon the planetary attraction, at the time that the celebrated apple fell to the ground before his eyes; a proximity so very close would powerfully aid in bringing on the stroke of identification.

THE ELEMENT OF EMOTION.

11. We have already seen under Contiguity that associations grow up between objects and emotional states, whereby the one can recal the other,—the object reviving the emotion, and the emotion the object. Anything, for example, that has been strongly associated with a disgust, is apt to recal the feeling at a future time.

This link may now be noted as entering into composite associations. In remembering some past object that has been linked in the mind with a certain emotion, the presence of the emotion will contribute to the recal. Although perhaps insufficient of itself this bond will often be found co-operating with others to effect the revival of an old recollection. While luxuriating in a state of agreeable warmth, we are very easily reminded of former situations and circumstances that have had this accompaniment.

When the mind is immersed in any of the special emotions, as Terror, Anger, Tenderness, Beauty, objects connected with the emotion are favoured, while all others are repelled. In moods of tenderness objects of affection rise by preference; this link co-operating with any other that may be present makes the restoration of such objects more certain. If the mind is disposed to indulge in the irascible emotion, objects of anger and hatred find an easy opening, while others are repelled even although strongly suggested by other links of association. Something occurs to remind a person of a good deed performed to him by the object of his wrath; but the recollection is refused admittance. When an emotion possesses the mind in anything like fury, nothing that discords with it can find a place though ever so powerfully suggested, while the feeblest link of connexion is sufficient to recal circumstances in harmony with the dominant state.

12. Hence in minds very susceptible to emotion, the more purely intellectual bonds of association are continually combined and modified by connexions with feeling. The entire current of thought and recollection is thus impressed with a character derived from emotion. Where tender affection is indulged as a dominant feeling, the objects that rise from the past, no less than those engaging the attention in the present, are for the most part tinged with this feeling. A joyous temperament has its genial recollections; melancholy opens the door to a totally different class. The egotist is eager for any suggestions that connect themselves with self, and a slight bond of adhesion otherwise will suffice to make these present. Poetic emotion gaining possession of the mind gives a select character to the images that recur from the past. A strong natural feeling of reverence accumulates a store of ideas of things venerable, and gives them precedence in the resurrections of thought.

This peculiarity has often arrested attention, and has been adopted as a theme both by poets and by philosophers. It is the character of an intellectual and cultivated nature to maintain the ascendancy of the intellectual associations over the suggestions of emotion. This is one of the forms of the dominion of reason in the mind.

When a particular emotion is excessive in the character, not only can we readily predict the actions, we can almost read the thoughts of the individual. The anecdote of Burke's divination of the thoughts of Goldsmith, when passing a crowd collected by the feats of a mountebank, can scarcely be called extravagant as an illustration of this point.

INFLUENCE OF VOLITION.

13. In many cases our recollection of the past is promoted by Volition; that is, we have some purpose or end in view, which stimulates the activity of the system to bring about the recovery. I want to recal the name of an object before me, to remember where I last saw a given person, to find a principle applicable to a case in hand. For a time I fail in my

endeavour, but by prolonged effort I at last effect the desired recovery.

It is interesting to ascertain in what precise form the power of the will makes itself felt in aiding the intellectual forces of reproduction. At what point does this influence operate? Can it simply augment a contiguous adhesiveness too feeble, or the attraction of a similarity too little marked?

To the best of my judgment, the influence is indirect; that is to say, there is no power of increasing the energy of the associating bond, either of contiguity or of similarity, by a voluntary effort. The movement of the intellect is withdrawn from the control of volition. I know no fact that would tend to show that one thought can be made to succeed another by mere will as one movement of a limb may be made to succeed another. The modes of interference of a volition I conceive to be as follows:

(1.) In exciting the nervous system so as to exalt the intensity of the mental processes. It is the nature of an end strongly felt to stimulate and excite the whole frame of body and mind. Difficulty adds fuel to the flame. In such a state of things everything we do is done with more vigour. The bodily efforts are stronger, the senses are more alive, the volitions are more intense, the intellect is sharpened. Not that excitement always produces these effects unmixed. It occasionally happens that the system is incapacitated for a pressing emergency by the unusual fervour communicated to the bodily and mental movements. Some constitutions are rendered more alert and active by excitement, others are unhinged. Nevertheless I am disposed to recognise it as a property of the human mind, that we can bring about a temporary exaltation of all the powers belonging to it, the forces of intellectual reproduction being included. This exaltation may be effected at the instance of a strong desire, purpose, or voluntary effort.

(2.) Volition may govern intellectual attention in the same manner as observation is influenced by our will. When many things are before the eye, some are observed and the rest passed by. A strong liking for one object of the scene stimulates the movements that direct the gaze in that direction: as an infant turns its eyes to the flame of a candle or a familiar face. Now, I have already maintained a lengthened argument to show that in the recovery of objects as ideas, when they are no longer present as realities, the same nervous circles and the same organs of sense and movement are occupied as in the original perception during the actual presence. The ideal picture of a building is a series of impressions sustained in the optic and moving apparatus of the eye and in the circles of the brain that were affected at the time when we were gazing on the actual building. Now as we have the power to prolong our gaze at pleasure upon the real object, to turn from one part to another, to examine some points minutely and pass the rest over, so when this building becomes a recollection, the same power of varying the inward gaze remains to us. We can dwell upon the outline, to the exclusion of the details, we can concentrate the attention upon a column or a cornice, we can indulge our recollection of the appearance of the material; in a word, we can deal with the idea, notion, or recollection, as we could with the reality. Volition is not crippled by the transition from the actual to the ideal: all because, as I conceive, the same organs are concerned in both. If the objects of observation were made to pass into a separate chamber of the mind when they existed as ideas, I should have a difficulty in comprehending how they could be reached by this voluntary control; because I look upon volition as existing only in connexion with the active organs, that is with the muscular system. Even in the sphere of thought, this limitation holds; at least such is my view. The same volition that rules the bodily eye, can rule the mental, because that mental eye is still the bodily one.

Thus, then, volition operates in aiding the recovery of the past through the power of directing and fixing the attention on any of the objects present to the mind at the time, to the exclusion of others. I remember one link of an otherwise forgotten chain: I dwell upon this link till it become more vivid itself, and thus acquire the power of calling up the rest.

The object thus selected is the one made vividly present, and thereby becomes the starting point of association. The idea that next comes up in the movement of reproduction will be some associate or similar of this one thus rendered prominent in the view; just as the thing that we select for special observation out of a various array, seen by the eye, will be the thing that will suggest the next idea that rises before the mind. We can, therefore, always give a preference of attention to one of the many objects that come up to our recollection, and whichever is thus preferred will be constituted the suggestive object; and so it will happen that the resuscitated trains will be those in accordance with the purposes or ends of the moment.

In difficult or laboured recollection we have already seen that the chief hope lies in attaining additional bonds of association. An effort of volition puts us in the way of commanding these. The effort consists in fastening the attention on various things within the view till these, one after another, are rendered suggestive of trains of ideas, some one of which perchance may have a connexion with the thing sought, and may supplement the deficient bond up to the full power of recal. In searching for a historic parallel, for example, we may suppose the power of similarity unequal to the task of evoking a proper instance. The mind then starts off in a train of contiguity over the field of history; which proceeds not by any voluntary power of commanding one fact to succeed another, but by directing the view on a starting point, the age of Alexander the Great, for instance; with the attention fixed on him, the associated particulars of his time, so far as they have been made coherent, flow in of their own accord. This power of concentrating the attention on any part of a circle of notions present to the mind, like the power of directing the observation on some one aspect of a real scene, is, in my view, the main function of volition in the restorations due to intellect.

THE SINGLING OUT OF ONE AMONG MANY TRAINS.

14. If I look at a mountain, there are many trains that I may be led into by taking this as a point to start from. By contiguity, I may pass to the other mountains of the chain, to the valleys and villages beyond, to the mineral composition of the mass, to the botany, to the geological structure, to the historical events happening there. By similarity, I may be led away to mountains that I have seen in other lands, or in the representations of the painter and poet, to the analogous geometrical forms, to equivalent artistic effects. All these vents may be open to me, but it will happen that I go on some one track by preference, and there will be a reason for this preference. Perhaps one of the associations may have come by repetition to have greater force than any other; I may have been so accustomed to associate together the mountain and the neighbouring village that I am led at once upon this one special transition. Another cause may be the presence of a second associating bond. If I see the adjoining mountain I am then liable to be led along the chain; if I catch the glancings of the cascades there is a double link of contiguity tending to carry my mind to the river flowing from the sides of the mountain. If historical events have been recently in my mind, the events referable to this locality are suggested. If botany or geology is my study, a bent corresponding to these is impresssed on the current of thought. If a geometer, the forms suggested to me by preference are the figures of geometry, if an artist, the forms of art spring up instead.

A case like this almost demands a compound attraction to make the mind move at all. We might imagine an intellectual situation so equally balanced that no restoration took place in any direction, just as in a conflict of equal volitions. Some inequality of restorative power in the various trains, or some second association coming in aid of one to give that one a preponderance, is the condition of an effective recollection in any direction. The case of an intellectual stand-still between opposing suggestions is neither chimerical nor unexampled.

I will suppose another instance. A violent storm has flooded the rivers, blown down trees and buildings, and inspired general terror. The trains of thought suggested by such an incident are extremely various, and will depend on the mental condition of the observer in other respects, or on the special ideas that concur with the aspect common to all. The sailor's wife thinks of her husband at sea. The merchant and underwriter have their thoughts on the same element. The farmer calculates the losses to his fields. The millowner sees a prospect of abundant water power. The meteorologist studies the direction, duration, and force of the hurricane, and compares it with previous cases. The poet sees grand and imposing effects. The religious man has his mind carried upwards to the Deity.

These instances imply some habitual attitude of the mind, or an emotion, occupation, or pursuit, ever ready as a starting-point to the intellectual movement, and combining itself with every casual impetus given to the mental trains, so as to constitute an element of the composite effect. The principle is exactly the same in cases where the second association is present merely by accident.

15. We have more than once adverted to the mental aggregates formed by the cluster of properties attaching to natural objects, especially as viewed by the scientific mind. Thus the idea of the mineral quartz is a vast assemblage of facts, properties, and influences, all which are liable to come before the view, when the mineral is seen or named. So even a naked circle is rich in associations to the geometrical mind. It does not therefore follow that every time a mineralogist looks upon a piece of quartz all its many qualities shall rise and pass before his view, or that every circle shall hurry the mind of a Geometer all through the Third Book of Euclid. The associating links in both cases are good and sound; but some motive additional to the force of the acquired adhesions is needed actually to recover the train. Not only must the mind be disengaged from other trains, there must also be a positive stimulus, a second starting point, to individualize and determine the bent of the suggesting power to one or other of

the many associated ideas. If I am handling a piece of quartz and trying a knife-edge upon it, the degree of hardness of the mineral is the quality suggested; if an acid is at hand the chemical action of quartz is brought up to the view, and so on. When one of the many properties of the circle strung together in the mind of a mathematician is resuscitated by preference, it is by the agency of some specializing notion pointing to that individual. The most highly cultivated mind has moments of perfect quiescence, and yet how numerous the possible outlets of thought at every moment!

OBSTRUCTIVE ASSOCIATIONS.

16. It will have occurred to the reader that thoughts may be prevented from rising in the mind, notwithstanding an adequate force of association with something already present. I have shown how a strong emotion will forbid objects discordant with it to make their appearance; and it has just been seen that one object is brought forward and others kept in the background in consequence solely of the excess of force in the favoured direction.

This is not all. A recollection is sometimes made impossible through the mind's being inextricably seized with something very near what is sought, but yet different. We are often in this state of embarrassment in remembering names. Falling accidentally into a wrong articulation we are unable to get free of the coil; and it is not till some time afterwards that we are even in a position to give a fair trial to the recollective adhesion actually existing in the case. So a stroke of similarity may be effectually resisted by the presence of a second idea repugnant to the reinstatement. The principle of compound association necessarily implies this power of obstruction. If two ideas, by both pointing to a third, constitute a prevailing bond of restoration, it must likewise happen that if these two present ideas point in opposite directions, they will be liable to neutralize one another's efficacy. The power of assisting implies the power of resisting.

Both in the subject of the present chapter and in speaking of constructive associations in the following chapter, we have room for exemplifying the distracting influence of too many ideas. Promptitude of action is exceedingly favoured by the fewness of the considerations that enter into a case. Marvels of ingenuity are often accomplished through the lucky absence of superfluous suggestions. In the operations of animals happy efforts occur to surprise us, as being apparently out of keeping with the range of their faculties; in some of those cases the explanation is to be sought in the limitation of the views. The animal does not suffer from a crowd of incompatible associations. The same circumstance explains the extraordinary facility of speech, or the readiness in action, of men very deficient in mental force generally.

17. Obstructive association may be traced on a grand scale in the conflict of different modes of viewing the objects and occurrences of the world. There is a standing hostility between the artistic and the scientific modes of looking at things, and an opposition less marked between the scientific, or the theoretical, and the practical points of view. The artistic mind is obstructed by the presence of considerations of scientific truth, and the scientific mind, bent on being artistic, walks encumbered, and with diminished energy. Poetic fiction is never so brilliant as when the trammels of truth are set aside.

A good instance of the obstructiveness of incompatible ideas is found in the effort of guessing riddles and conundrums. These usually turn upon the equivocal meanings of words. Now a mind that makes use of language to pass to the serious import or genuine meanings, is disqualified from following out the play of equivocation, not because the requisite associations do not exist, but because these are overborne by others inimical to the whole proceeding.

ASSOCIATION OF CONTRAST.

18. Aristotle's enumeration of the associating principles of the mind included Contrariety, along with Similarity and Coadjacency. Various subsequent writers have likewise viewed

Contrast as a primitive suggesting force of our intellectual constitution.

It is a well-known fact that objects do on many occasions bring before the mind their contraries. An intense light will suggest darkness or shade; present sorrows will bring up past joys; and a moment of brilliant prosperity may not be unfavourable to the recollection of times of adversity. Yet I do not conceive it necessary to suppose an independent principle of suggestion for this class of cases. If there were a power in the mind to make contraries recal each other, as similars do, we should see much more of this suggestion of opposites than is actually found. For, after all, the bringing to mind of qualities the contrary of those present to the view, is not by any means a constant occurrence; we might call it an exception rather than a rule. In the great preponderance of cases things suggest their like and not their opposite; whereas the coexistence of two forces of restoration, one for similars and the other contraries, would necessarily lead to innumerable intellectual conflicts.

The cases of the suggestion of Contrast actually occurring are quite explicable without going beyond the principles already discussed. Both contiguity and similarity aid in the operation, as the following considerations will show.

First, as to Contiguity, it is to be observed that the greater number of contrasts are, for reasons to be seen presently, habitually coupled together in common speech, and we thereby acquire a tendency to pass from the one to the other by mere rote, like completing a hackneyed form of words. Such associated couples as white and black, high and low, up and down, large and small, thick and thin, weak and strong, young and old, rich and poor, life and death, pain and pleasure, true and false,—are in everybody's memory; if one member is presented the other is instantly ready to come up. Among our acquisitions of Contiguity, many scores of these contrasting pairs are to be found. This fact alone would suffice to render contrasting qualities suggestive of each other.

Next, as to the bearing of Similarity on the case in hand. It is an old maxim that contraries imply community of kind.

Where there is nothing common, there can be no opposition. We oppose a long road to a short road, we cannot oppose a long road to a loud sound. We can contrast black with white because they agree in kind—they are both colours or modes of light. Thus it is that when any quality is present to the mind, the opposite quality never can be far off, seeing that this is only another species of the same kind of object. When we see any one gaily attired, the subject of personal decoration is brought before the view, and one variety of it suggests other varieties by virtue of the generic agreement, and among these suggested instances there may occur cases of squalor and meanness. So when we encounter a person of low fortunes, the subject of human conditions is present to the view, and by similarity other instances may be brought up, the first to occur being naturally those agreeing in the features of the present case, but not to the exclusion of cases with varying or even contrasting features. One member of a class may at any time suggest the remaining members, notwithstanding the differences that coexist with what is common to the whole class. This is a case of the law of similarity.

We have further to note the *emotion* that contrasts give rise to, tending to impress them on the mind with more than ordinary force. This does not happen in all contrasts, but there are some peculiarly disposed to generate strong feeling.

To take one class of examples. When any quality is present in a painful excess, the opposite quality is unavoidably suggested as a remedy to the evil. Darkness in this way causes a craving for light, and too much light impels us to seek the shade. So cold and heat, hunger and repletion, exercise and rest, and many other things operate in the same way.

Again, there is a strong emotion of the poetic or artistic kind, generated by many contrasts. We are moved by seeing infancy and age placed together; the still greater contrast of life and death has a solemnizing influence. In the fortunes of men and nations, we are struck with the conjunction of the high and the low, with the greatness that has emerged from obscurity, and the pride that goeth before a fall. This effect has been worked up in the poetic literature of nations. Among the Greeks, the idea of the *nemesis* was an intense ever-present conception; even the accurate mind of Herodotus was superstitiously sensitive on this point. In no age has either the poet or the moralist allowed the reverses of human conditions to drop out of the view of the multitude. All the contrasts of this class are therefore disposed to be mutually suggestive to a very high degree.

These three influences—Contiguity, Similarity, and the concurrence of Emotion—seem to me quite adequate to the explanation of the associating force of Contrast, to the full extent of the operation of that force in the mental system.

19. There is an instance, under the present head, worthy of being briefly attended to, namely, the power of a present idea, opinion, or proposition, to recal to mind any former ideas inconsistent with this. Such a power exists, and the proper effect of it is to make us discard incompatible principles, so that unity and consistency may prevail among our beliefs. The contrast of the true and the false is herein included.

The operation is a case of similarity as illustrated in the preceding paragraph. Inconsistent propositions must have the same subject, but opposite predicates. 'Gold is heavy,' and 'gold is light,' are contradictory statements; the subject, gold, is the same, but the properties affirmed are opposite. 'The planets move in circles,' 'the planets move in ellipses;' these are incompatible assertions; the mind refuses assent to both of them when presented together. Now one of the most important functions of the resuscitating force of similarity is, to recal to mind all former assertions incompatible with one now presented, the reinstatement taking place in virtue of the common fact that makes the subject of the proposition. If I have ever affirmed or admitted the allegation, that the Homeric poems were the work of one man, and if now I am asked to believe that these poems were composed by several authors, I cannot help being reminded of my former belief, seeing that the subject, namely, 'the authorship of the Homeric poems' carries me back to former occasions when the same subject was under my consideration, and makes present the opinion then entertained on the subject. In this way the past and the present are confronted as effectually as if the opposites had been affirmed at the same moment, and I am thereupon urged, by the whole force of revulsion against inconsistency inherent in my nature, to dismiss one or other of the conflicting opinions.

20. The force of similarity, when sufficiently well developed, and not restricted in its operation, is able to rid the mind of contradictions, in so far as this can be done by bringing the conflicting opinions together. A present assertion revives any past assertion that may have been made on the same subject, and, if the two are contradictory, there is opportunity given for choosing between the two. It happens, however, in fact, that the same mind will at different times maintain irreconcilable propositions unawares. Either the power of reinstatement by similarity is too feeble, or there is some strong feeling at work that repels the approach of any fact not in accordance with the view held for the time being. Both causes are found at work. In an average intellect the power of similarity is not energetic enough to search the past for all the statements that may have been made upon any subject now in hand. Many inconsistencies are too subtle for the detection of an ordinary mind. When we add the power of emotion,—the influence of the likings and dislikings,—to this intellectual feebleness, we have a sufficient explanation of the co-existence of contradictions in the same mind. We have already observed that a strong feeling will rebut all ideas incompatible with itself, however strongly they may be suggested by the forces of association. I can suppose the Apostle Peter to have been unconscious of contradicting himself within a few hours when under excitement for his personal safety. The strong affirmations he had so lately made on the very same subject might not even have come into his mind. A current of violent emotion, besides overbearing hostile considerations that may be actually before the mind, can so obstruct, I might almost say paralyse, the workings of association, that such considerations, however near, shall not be allowed to come on

the stage. This is one of the characteristic influences of emotion. Intellect cannot perform its ordinary functions in the presence of strong feeling. The accordance or discordance of objects and recollected ideas with the character of the present emotion, counts for so much in the recovery of the past, that the purely intellectual links have but a small share in the result. The tendency of intellect proper is to banish all contradictions from the mind; in other words, to arrive at consistency, the test of truth: the tendency of men's emotions of all kinds runs counter to this, and renders the spectacle of a thoroughly consistent human being no less rare than admirable.

CHAPTER IV.

CONSTRUCTIVE ASSOCIATION.

By means of association, the mind has the power to form combinations or aggregates different from any that have been presented to it in the course of experience.

1. THROUGHOUT the whole of the preceding exposition we have had in view the literal resuscitation, revival, or reinstatement of former sensations, images, emotions, and trains of thought. No special reference has been made to the operation known by such names as Imagination, Creation, Constructiveness, Origination; through which we are supposed to put together new forms, or to construct images, conceptions, pictures, and modes of working such as we have never before had any experience of. Yet the genius of the painter, poet, musician, and inventor in the arts and sciences, evidently implies such a process as this.

Under the head of similarity we have had to recognise a power tending to originality and invention, as when in virtue of the identifying of two things formerly considered remote from each other, whatever is known of the one is instantly transferred to the other, thereby constituting a new and instructive combination of ideas. Such was the case when Franklin's identification of electricity and thunder led to the extension of all the properties of the Leyden jar to explain a thunder-storm. The power of recalling like by like in spite of remoteness, disguise, and false lures enters, as we have seen, into a very large number of inventive efforts, particularly in science. But we have now to consider constructions of a much higher order of complexity. There are discoveries that seem nothing short of absolute creations, as for example, the whole science of Mathematics; while in the Fine Arts, a Gothic cathedral, a frieze of the Parthenon, a Paradise Lost, are very far from repetitions of experienced objects, even with all the power of extension that the highest reach of the identifying faculty can impart.

Nevertheless, I mean to affirm that the intellectual forces operating in those creations are no other than the associating forces already discussed. For the new combinations grow out of elements already in the possession of the mind, and brought forward according to the laws above laid down. This position we shall now endeavour to illustrate.

MECHANICAL CONSTRUCTIVENESS.

2. In our mechanical education, complex and difficult actions are acquired by taking the simple acts separately. We learn part No. 1 by itself; then part No. 2, No. 3, and so on; and if each of these parts were so firmly acquired as to be maintained without any exercise of the attention, we should have no new labour in performing them altogether. The performance of the whole is the performance of the parts; a volition directing the order and time of the various exertions constitutes all that can be pointed out as peculiar to the fact of combination.

Most commonly mechanical combinations are learned by keeping up the exercise of the parts already acquired, and adding new ones in the manner now indicated. Thus in learning to dance the pupil is first put through the simple positions and steps; and when these are firmly fixed, they are performed along with other additions, and so on, until an exceedingly complex movement is arrived at. There is no new fact of mind in passing from the performance of a single act by itself to the performance of that act in company with a second; the only peculiarity of the case is the demand for the thorough acquisition of the movement requiring to be kept up while the attention is directed upon some other movement. When the degree of cohesion is sufficient to make the first of the two self-supporting, there is nothing else wanted to make it combine with the second.

Our mechanical acquirements often demand the suppression of one member of a complex action, a decomposition, as it were, of some of the concurring movements that we have seen to be natural to the system. In this case a voluntary effort is directed upon the member whose movement is to be suppressed, during the exercise of the complex whole. In walking there is a natural tendency to swing the arms and the body along with the lower limbs. By a voluntary effort these extra movements may be arrested, and the primitive aggregate reduced to a smaller aggregate. So the wild ecstasy of the animal spirits may be trained to burst out with the total suppression of vocal accompaniment. For this purpose we combine with the instinctive display a negative acquirement, an exertion for the suppression of a movement, and the result is an effect consisting of a various display, *minus* one of the members of the primitive combination.

VERBAL CONSTRUCTIVENESS.

3. The facility the mind has in passing from mere repetition into new combinations is perhaps most obvious in the use of language. Scarcely any succession of words uttered in everyday intercourse is precisely the same as any other succession formerly said or heard by the speaker. It seems particularly easy for us to adapt and modify this acquisition in an endless variety of ways.

In the early efforts of imitation, whereby words are first learned, there is a constructive process. The child has learned to say *ba* and *na*, and when these separate sounds become very easy to the organs, a chance impulse makes them run together into *ban*. Here, as before, the ripeness of the preliminary acquirements separately is the main condition.

When a number of words have been acquired, with a few simple forms of intelligible sentences, it becomes easy to make new applications of these forms. The child has learned to say 'give me,' and also the names of a number of other persons and things, 'mamma,' 'pussy,' 'dolly;' and having the wish to give something to one of these other parties, there is no difficulty in displacing 'me' from the formula and admitting 'mamma,' 'pussy,' as the case may be. An effort of volition is implied. Two utterances are present to the mind; the articulate activity is awakened and repeats these utterances perhaps in two or three ways; one is hit upon such as to satisfy the purpose of the moment, and being hit upon is retained and repeated. The effort of substitution once or twice put in practice becomes easy; the mind knows as it were to carry on the current of words so far, then stop, and fall into a different current, so as thereby to produce a third different from either. It is a part of the voluntary command that we acquire over our actions, that we can stop a train at any stage, and commence another train from that point, and this is all that is required in such a case of verbal substitution as we have now supposed. Out of the two sentences, 'I am going out for the day,' 'I am coming home for the night,' a third sentence is constructed, 'I am going out for the night,' by no further effort of volition than this, namely, to arrest the current of articulation at a certain point in the first, to pass into the second, suspending vocal articulation till the word 'for' is reached, then tack on the remainder to the words already enounced from the other. The constructiveness, therefore, lies not in any purely intellectual operation, but in the command that the volition has obtained over the movements, by virtue of which command these are suspended and commenced at pleasure in the service of a particular end. The intellectual forces bring to mind the former acquisitions bearing on the situation, and if no one previous form is strictly applicable, it is a property of the volition to take part of one and part of another, and to make successive trials if necessary, until the want is satisfied.

Throughout the whole wide-ranging operation of adapting old forms of words to new meanings, this is essentially the process pursued. When all the elements requisite for a new combination are at hand, a volition alone is needed to make the selection and adaptation suited to the end in view. When there is not a sufficiency of forms within reach of the present recollection, the processes of intellectual recovery must be plied to bring up others, until the desired combination is attained. A voluntary effort is quite equal to the task of cutting down and making up, choosing and rejecting, sorting and re-sorting; the feeling that possesses the mind of the end to be served, is the criterion to judge by, and when this is satisfied the volition ceases, the stimulus being no longer present. In all difficult operations, for purposes or ends, the rule of trial and error is the grand and final resort.

It would thus appear that the first condition of good verbal combinations for the expression of meaning is a sufficient abundance of already formed combinations to choose from, in other words, the effect depends on the previous acquisitions, and on the associating forces whereby old forms are revived for the new occasion. If a complex meaning has to be expressed, every part of this meaning will revive by contiguity and similarity some former idea of an identical or like nature, and the language therewith associated; and out of the mixed assemblage of foregone phrases, the volition must combine a whole into the requisite unity, by trial and error. The more abundant and choice the material supplied from the past by the forces of intellectual recovery, the better will be the combination that it is possible for the mind to form by the selecting effort. This process is one so obvious and familiar, that I need not waste space on examples.

4. Let us next advert to some of the other conditions that have to be satisfied in making verbal combinations; for as yet I have alluded only to the one condition of conveying a given meaning. Certain grammatical forms have to be observed; likewise there are rhetorical proprieties or rules of good taste; a certain melody or cadence is sought to be imparted; and in poetic composition this last quality has to be attained under the restrictions of metre and rhyme. As a matter of course, the more numerous the conditions, the more difficult it is to satisfy them all; but the mode of proceeding is not altered in any essential point. When there are four or

five different conditions to satisfy, the range of choice must be so much the wider. It is not enough that I can combine one form of words sufficient to express a certain meaning, I must be able from my verbal resources, recovered from the past, to construct several forms all equally good as regards meaning, so that I may be able to choose the one that satisfies the other conditions as well. In fact, the mind must possess not one way of bringing out a certain effect, but a plurality of ways, and out of this plurality we fix upon the form that yields some second effect also desired. If a third effect is wanted there must be a power of altering the combination already made without losing those already gained; and for this end we must be able to command a choice of equivalent phrases in the room of those that are discordant as regards the new end.* Thus it is that we must have a plurality of ways of expressing any given meaning; a plurality of forms of the same grammatical construction; a plurality of forms of the same rhetorical propriety, and a great variety of sequences observing the same cadence. Out of this opulence of synonymes, we can at last light upon a combination that satisfies all the conditions of the case. The refusal to combine in any case can only be met by bringing forward new varieties of phrase, sometimes by the bond of meaning, at other times by the bond of grammar, of taste, or of cadence. The more richly stored the mind is on any one of those particulars, that is, the greater the number of words associated with meanings, or with melodious falls, the more surely will that one condition be observed, whatever may become of the rest. If the tendency of the mind has been to lay up stores of expressions adapted to the conveyance of meaning, there will be no difficulty in matching a new meaning, although there may be a difficulty in getting the language to comply with other requisites. If, on the

* Southey's lines on the Fall of Lodore are an instance to show that a word-artist is a person that can bring up for any occasion a large variety of names for the same thing. It is by means of this abundance of past and recoverable phraseology that the elaborate constructions of high composition are at all possible. The number of words that pass across the mind in forming a single couplet may be a hundred times those actually made use of.

other hand, through a great susceptibility to cadence, and by being very much versed in melodious forms of speech, these forms be ready to occur in great abundance on all occasions, the flow of speech will be sure to be musical, but there will be no security for the compliance with the other conditions; and it may happen that both sense and grammar are neglected. Still out of the abundance of choice presented by this acquisition, a patient mind may seize upon forms that shall not be devoid of any of the other important attributes. Or if the first suggestion of the material of a sentence is left to the associations with meaning, it will be very easy for such a mind to make substitutions and alterations to meet the oratorical condition. In these efforts of combination, the disposition of the mind to be satisfied with a more or less perfect reconciliation of the conflicting claims is always an element in the result.

FEELINGS OF MOVEMENT.

5. We next proceed to exemplify constructiveness among our feelings and perceptions, or the more passive elements of the mind.

Movement gives rise, as has been seen, to a variety of conscious states; some emotional, as the states of exercise and repose, and others with an almost exclusively intellectual character, as the feelings of pressure, space, and form. I shall here take a few examples from the last class.

Having acquired a discriminative sensibility corresponding to some one resistance or pressure, it is possible for us to construct the feeling of another differing in degree. I possess in my hand, after much practice, the engrained impression, say, of a pound weight; and I am commanded to construct, conceive, or imagine, the impression corresponding to three pounds. For this end I must endeavour to fuse the two notions of one pound and of a triple, being formerly very familiar with both in their separation; the notion of doubleness being derived from my experience of the fact in quantities of various kinds. By keeping my mind very much bent upon the two elements in question, I may succeed in conjuring up an impression compounded of both, and very nearly corresponding to the actual feeling of a three-pound weight in my hand. If there be any difficulty in the case, this will arise from my not being perfectly in possession of the separate notions, more especially the feeling of the one pound. In the same way I might attain a conception of half a pound, of two pounds, and less accurately of ten or twenty pounds. The more delicate my perception of the degrees of the quality as felt by my muscular sensibility, the nearer I should come to the mark, for it is quite easy to increase or diminish a perception of this kind, and if we have a sufficiently nice judgment of the result when actually attained, we shall succeed perfectly in the construction aimed at.

We are not unfrequently called upon to make efforts implying this sort of adaptiveness. If I have been accustomed to jump a ditch three feet wide, I can easily increase the notion of the effort requisite for five feet. So in throwing objects to hit a mark; we have in this case a power of graduating our strength by combining our notion of increased or diminished quantity with the sensibility acquired, corresponding to some one distance. In this case the constructiveness is first operated upon the pre-conceived *idea* of the action, whence it passes to the action itself.

The same power of changing degree may be put forth in reference to size and form. Having acquired the arm sensibility to a sweep of one foot, we can construct a feeling corresponding to the sweep of two feet, or half a foot. We can also change a given area from one form to another. By fixing the mind upon the form of a circle, and the area of a pane of glass, we can construct the conception of a round piece of the same extent.

The emotional feelings of movement present a somewhat different case. Under the two next heads I shall bring forward examples, bringing out the peculiarity attaching to the case of emotional constructiveness generally.

CONSTRUCTIVENESS IN THE SENSATIONS.

6. Beginning with organic sensibility, we might cite instances of constructiveness in the endeavour to conceive pains or hurts of a kind different from any we have experienced. We can as usual make the change of degree; and if the new state is a combination of two already familiar to us, or one minus some second, the conception is more or less in our power.

The agreeable and joyous states of general sensibility are very various. Each one has experience of some of them, and starting from these we may be made to conceive others, if the description, that is, the method of compounding the known into the known, be clearly given. I may never have experienced the ecstasy of intoxication by opium, but if I have felt a number of states whose combination would amount to this effect, and if these are pointed out to me, I can by an effort recal and fuse them into one whole, so as to construct the feeling in question. This is by no means an easy undertaking to the generality of people; and the reason is, that the strong organic feelings are not readily recoverable at all times in their entire fulness. Some one leading element of the combination sought would require to be present in the reality, and then it might be possible to bring up others, and to form a new conception, by introducing the requisite modifications. But, on the other hand, this method has its disadvantages; it is not easy to modify a strong and present reality by mere ideas; it would be more practicable to modify a mere recollection, which is itself an ideal thing. The non-intellectual nature of the organic feelings rendering them stubborn to recal, however powerful they are in the reality, is the great obstacle to our easily conceiving inexperienced varieties of them. A person may have enjoyed the pleasures of eating in a sufficient number of forms to possess all the elements necessary for conceiving the most luxurious feast that ever mortal man sat down to, yet it may not be possible to attain to the conception. The difficulty of forming new combinations, in some one region of sensations, is only another proof of the difficulty of retaining and recovering our own experiences in that region. If I cannot easily conceive a degree, or kind of hunger, beyond anything I have ever known, it is because the times of hunger that I have actually gone through cannot be well restored after they have completely passed away.

Tastes, properly so called, being somewhat more intellectual than organic states, we can do more in the way of forming new combinations of them. Given a bitter, such as bitter aloes, and a saline taste, as of common salt, one might construct a taste combined of the two. So a sweet and an astringent might be fused. We might thus attain to the conception of tastes not actually experienced. The effort would doubtless be laborious in most instances, owing to the imperfect recollection that we have of tastes even after much repetition. A person specially educated in tasting would have so much less difficulty. If we wished to retain and revive the new conception, and to make it a possession of the mind, as much as the taste of sugar, we should require to repeat the effort of fusion a great many times.

7. Without waiting to dwell upon the almost parallel case of smells, I shall pass to the first of the intellectual senses. Touch, including the muscular feelings associated with the proper tactile sensibility, furnishes a more abiding species of recollections than the sensations just noticed, and we may therefore look for a higher degree of combining power among the feelings characteristic of this sense. I can acquire the touch of an orange, that is, the bulk, the weight, and the character of the surface. I have acquired also the touch of a marble table, and the weight of marble as compared with other substances. By a voluntary exertion of the mind, directing the view on the round figure of the orange, and on the touch and specific gravity of the marble, I can make to emerge a new conception, the collective impression of a marble ball equal in size to the orange. Part of the difficulty in this trial consists in the disassociating or separating of elements

that have grown together in the mind; this exercise is commonly spoken of as an effort of abstraction, or analysis, and is arduous, on the one hand, according to the hold that the property to be disassociated has taken of the mind, and on the other hand according to the little hold that we have of the property to be substituted. If I were very strongly affected by the peculiar soft touch of the orange, and had very little interest in the cold hard contact of the marble, there would be a repugnance in my mind to the proposed transmutation, and the effort of abstractive, or analytic, volition preparatory to the new combination would be very severe. A mind sensitive to the warm and sensuous elements of touch and colour revolts from the operation, so familiar to the mathematician, of stripping these off, and leaving only naked forms and arbitrary symbols to engage the intellect. The double decompositions illustrated by the above example, are made laborious by every circumstance that favours in the mind a preference for the combinations already existing, and correspondingly easy, when there is a partiality for the new combination that is to be the result. Thus it is that even when we have got into subjects very conceivable and retainable, unlike the organic sensations lately noticed, other difficulties may arise to clog the constructive operation. The mere effort of analysis is itself something considerable, so much so, that this is not a favourite avocation of the untutored mind, with which associative growth is more genial than disassociating surgery; but when the analysis has to be applied to break up favourite combinations, and constitute others of an unattractive kind, we are then aware of the tyrannical influence that the likings and dislikings, the sympathies and antipathies, exert over the intellectual processes.

The very great difference between the constructions of Imagination and the combining operations for a Rational end is herein faintly shadowed.

In the definition or description of the tactile quality of surfaces, — woods, cloths, minerals, metals,—&c., reference must be made to touches familiar to us, by whose combination we are supposed to make up the feeling of an inexperienced surface. Touch is one of the defining properties of minerals.

8. In the very various states of mind excited through the sense of Hearing, there is great room for new combinations and constructions, the mode of operating being much the same as in the preceding instances. We may hear a note or an air sounded by an instrument or voice, and may wish to imagine it on a different instrument or voice. If we have a good mental grasp of the air and of the tones of the second instrument, this transference may be effected after a certain amount of effort. We have heard a piece performed on a fine band; and we desire to conceive the effect of some other piece performed on the same band. Some faint notion of the result of such a combination might be attained, but the exercise is not one that is much attempted. Few people engage in an occupation of this nature, or endeavour to create to themselves inexperienced impressions with all the vividness of reality.

'Imagine Macready, or Rachel, delivering that passage.' We have heard the passage, and we have heard Macready. A constructive effort taking place upon firm recollections of the two things to be combined might be successful in such an instance. A good imitator or mimic actually succeeds in modifying his recollections of his original to suit an entirely new discourse. The ability to make the combination, as in all other cases, rests in the first instance on the vivid possession of the separate elements.

9. Under Sight, the sense of easy conception by pre-eminence, the examples of constructiveness are extremely copious. Light and shade, colour, size or dimensions, shape, distance, position,—are the constituents that concur in the complex perceptions of sight; and it is possible to vary any given combination by putting out and taking in elements at pleasure. I see or remember a line of houses; I can imagine it prolonged to double or triple the length; or I can transform the whole line by the addition of a story to the height. In the landscape I see a mountain and wood standing apart; I place the wood upon the mountain. Or to take Hobbes's

example of constructiveness :* I have the idea of a mountain and the idea of gold, and by superimposing the one upon the other, I can evoke the image of a mountain of gold. The facility in all such cases, depends as usual, on the perfect and easy command the mind has of the separate ideas, owing to their having acquired a good ideal persistence. The combination takes place of its own accord, if the elements are once properly brought together and kept, as it were, in close contact for a sufficient time. A continuance of the effort will enable us to retain the new image until the parts of it acquire a certain contiguous adhesiveness, after which we shall possess it as a mental recollection not differing essentially from the recollections of things actually seen. As in former examples, the decomposition and recomposition implied in the constructive effort may be aided or retarded by emotions. Hobbes's mountain of gold would emerge the more readily that the image is one to excite men's feelings, being an example of imagination in the more limited sense of the word, or in that sense wherein lies the contrast between it and the creations of the intellect for scientific or practical ends. If I see a dress, and want to conceive it of some other colour, I can most easily substitute the colour that I am most familiar with, or have a special affection for.

The disposition of the parts of a complicated object is rather trying to the constructive faculty. Wishing to rearrange the furniture of a room, I endeavour to conceive beforehand the effect of a proposed arrangement. So with a garden; a person must have a good retentiveness of the ideas

* 'As when the *water*, or any liquid thing moved at once by *divers* movements, receiveth *one* motion compounded of them all; so also the brain, or spirit therein, having been stirred by *divers* objects, composeth an imagination of *divers* conceptions that appeareth single to the sense. As for example, the sense showeth at one time the figure of a *mountain*, and at another time the colour of *gold*; but the imagination afterwards hath them both at once in a *golden mountain*. From the same cause it is, there appear unto us *castles* in the *air*, *chimeras*, and other monsters which are *not* in *rerum naturâ*, *but* have been conceived by the sense in pieces at several times. And this composition is that which we commonly call *fiction* of the mind.'—*Discourse on Human Nature*, chap. iii., § 4.

of the parts in order to put together and hold firmly the new plan so as to judge of the effect of it before taking any measures to realize it. There is a great economy in the possession of such a power. A mind naturally pictorial, or disposed to retain visual images in general, and an education in the particular subject operated upon, are requisite for success in such an operation. The susceptibility to beauty, or to the emotional effects of the several combinations, acts in favour of every construction that yields the emotion, rendering it possible to put together those and separate others with far less difficulty. A person of sensitive taste can readily break up in idea a distasteful combination, and form a new one calculated to satisfy the craving for beauty; while the same person might be totally incapable of breaking up a tasteful conjunction to compose a new arrangement devoid of this quality, and ministering solely to some end of practical utility or scientific truth.

CONSTRUCTION OF NEW EMOTIONS.

10. We may revive emotional states by contiguity or similarity, or by a composition of associating bonds; and from two or more states thus revived new emotions may be generated by the working of the principle now under discussion. I have already touched upon this in speaking of the organic sensations, these being almost purely emotional in their character. But if we pass to the feelings that are more recoverable and more retainable in the ideal form, we shall be in a better position for elucidating the peculiar features of the case.

The problem is to realize emotions such as we have never experienced in ourselves, or have experienced too rarely to recal them by any effort of mere recollection. The feelings belonging to men whose character, position, occupation, &c., are totally different from our own, can in general be conceived only through a constructive process, operating upon feelings that we do possess.

There are certain elementary emotions that belong to human nature in general, although manifested very unequally in consequence both of primitive differences of character, and of variety in the outward circumstances of individuals. Every one has experience of love and hate, of property and pride, of feeling beauty and bestowing admiration. Should any one of the elementary feelings be absent from a character, no constructive process is sufficient to create it; for what constructiveness can produce is by that very fact not elementary. If, for example, a person were naturally devoid of the emotion of fear, this emotion could not be generated by any effort of composition that I am acquainted with. In like manner the irascible feeling seems so distinct and peculiar that we could not be made to conceive it without direct experience. When any emotion not entirely wanting is yet allowed to sleep in the character, the difficulty of rousing it may prove insuperable; thus it is that some men are unable to enter into the sentiment of religious veneration, and others are unable to comprehend the pleasures of the fine arts; one class are utterly incapable of sympathising with the pursuit of scientific truth, and another can never be made to understand the feeling of disinterested usefulness.

The emotions that can be acquired by constructiveness are, therefore, the compound emotions, or some conceivable varieties of the elementary. We must be able in each case to specify certain primary feelings possessed by the person whom we address, the combination of which in a particular way shall yield the emotion that we desire to communicate or evoke. If the constituent elements are actually made present to the mind in their proper degree, the fusion will take place as a matter of course. Perhaps the best commencing exercise in this art of conceiving other men's feelings would be to change the degree of one of our own emotions. I have a certain disposition to take on fear; it being, however, apparent that another person, whose character I am desirous of realizing, is susceptible to a much greater extent, I must endeavour to assume for a time a pitch of terror much beyond my own. This can be done in various ways. I may go back upon times of my life when the emotion took a greater hold of me; I may conceive occasions and circumstances of a kind to produce a more than ordinary degree of the state; or I may revert to the particular subject that most easily depresses my courage. By these means I can be made to assume an unwonted amount of the feeling, and can come to approach the state of mind of the person supposed, so as to comprehend the actions flowing from that particular state.

By some such efforts one might acquire an exalted cast of any familiar emotion. The exercise would cost both effort and time, but if we are able to revive with ease the past states of our own experience that bear on the case, we shall not be long in accomplishing the end in view. To acquire a new degree of intensity of any emotion so thoroughly as to be able to follow out all the influences and consequences of the feeling is a very high effort and demands iteration and time; inasmuch as there is implied in it the process of fixing into a permanent possession a state of mind that has been worked up with labour. Thus for the man that is only alive in a moderate degree to the pleasure of music to be able at any time to rise to the state of an enthusiast so as to depict that character in all its phases, there would be required a somewhat laborious training. Writers whose province it is to trace out and depict all the windings of character different from their own, must work themselves into a number of un-experienced degrees and modes of feeling, as a preparation for their task.

11. The exercise of combining two emotions, so as to bring out a third different from either, is not intrinsically arduous. Everything depends upon the facility of assuming the elementary feelings. Supposing a person inexperienced in the sentiment of property in land, but perfectly able to recal the feeling of property in other things and to conceive the emotions connected with land in men's minds generally, a fusion of the two states would make some approximation to the proprietorial feeling. If a person has ever known an affection of the nature of a passion for any one object, such a one is capable of conceiving, by an effort of transference, a passion for an object very different. Thus it is that Michelet in endeavouring to portray the attachment of the French peasant proprietor for his land, brings into the picture the feelings of strong personal attachment. The difference of subject is great, but the

attempt is not therefore hopeless. It would doubtless be much easier to transfer the feelings of love in one personal relation to some other relation by making allowance for the difference, as to pass from friendship to marriage, or to the parental relation.

The historian, who has to deal with extinct modes of feeling, and who has to study truth in his delineations, is necessarily much versed in the exercise now under discussion. Mr. Grote forewarns his reader 'that there will occur numerous circumstances in the after political life of the Greeks which he will not comprehend unless he be initiated into the course of their legendary associations. He will not understand the frantic terror of the Athenian public during the Peloponnesian war, on the occasion of the mutilation of the statues called Hermæ, unless he enters into the way in which they connected their stability and security with the domiciliation of the gods in the soil.'—*Hist. of Greece*, Preface, p. 17.

Any man requiring to deal with his fellow beings practically needs this power of accurately conceiving and appreciating their feelings. An artist, on the other hand, who cares principally for the effects that he produces, and not for the strict truth of his conceptions, proceeds in a different way.

CONCRETING THE ABSTRACT.

12. Under a former head, I have supposed the case of fusing the properties of two different objects so as to make a third different from either. Given a brick city and a marble surface, to conceive a marble city. This is to form a new concrete out of two pre-existing concretes. But we may go a step farther. Given the abstract properties to construct the concrete whole. Take, for example, the geometrical form of a pyramid and the colour of granite, and conceive the actual object as existing in nature. This is in most cases a somewhat more difficult operation than the foregoing, but can hardly be said to involve any new or distinct effort. If we realize the constituent elements with sufficient vigour, and keep the two together in the mind, the construction is sure to

follow. If we have but a feeble hold of one or other of the parts, a certain effort will be requisite to make them fall into their places in the new compound.

When a plan and sections of a building are given, we have the means of realizing the form of the solid building; when we add the colour of the surface or the appearance of the material to the eye, the concrete emerges in all its fulness. In this case the plan and sections would not be enough to give the solid conception, unless we had previously seen solid shapes. We require to fasten upon some remembered building or form of building, and to alter this in the mind till we bring out a correspondence between it and the plan supposed. Thus, in order to realize a gothic church from a builder's designs, the easiest way would be to direct the view upon some church already familiar to us, and on that to make the alteration prescribed by those designs. This is a general maxim in concrete realization, and on it we can easily understand the conditions that render the operation easy. It is evident that a previous store of well-fixed objects of the particular kind in question is the great requisite. If the past experience of the individual has given great opportunities for laying in such a store, and if the mind is naturally of a pictorial and concrete order, the process of new construction has every advantage in its favour. Not to speak of the chance of possessing firm and recoverable ideas of objects approaching very near the new construction, there is a great facility in making the required alterations if the thing operated on is vividly and easily held in the view; provided always that there is no serious obstruction arising from the feelings.

To imagine a country from a map is a case of the same nature. The effort consists in holding before the mind's eye a series of scenic views in all the richness of the colouring and all the fulness of the details, while performing the operation of cutting out and taking in so as to suit the prescribed outlines. An intellect rich in concrete, or living, conceptions of actual nature possesses the prime requisite for such a task.

The mode of describing the objects of natural history is to enumerate the abstract properties. Thus a mineral is described by such abstractions as crystalline form, hardness, nature of surface, colour, lustre, &c. Now by a vigorous effort of constructive conception one might realize an actual specimen from the assemblage of abstract qualities. So with a plant or animal. The condition of success in this event is exactly the same as in the preceding examples. The mind must be well versed in actual specimens so as to be able to lay hold of some concrete recollection, by operating upon which a new specimen will emerge possessing all the properties of the description. A botanist can readily form to himself the picture of a new plant from the botanical description; a person less familiar with plants would find the construction very laborious, perhaps impossible.

13. The more we analyze or decompose concrete objects into the abstract qualities that make them up, the more difficult is it to remount to the concrete. Hence the most arduous attempt of all is to make actual nature rise up out of scientific and technical language,—to conceive minerals from a book of mineralogy, and the parts of the human body from anatomical description. This is the repulsive or unfavourable side of science and of abstract reasoning. On the other hand, it is by this process of resolving natural aggregates into their ultimate abstractions that we obtain the means of making new constructions widely differing from, and superior to anything that exists in our experience, by which many important ends in human life are furthered. New creations of science, and new devices of industry, result from this power of reconstituting the ultimate abstract elements of existing things. Even the artist will find his account in it, although it is not usual with him to carry abstraction so far as the man of science, or the man of practice. Many great poetic conceptions are the embodiment of an abstract idea, as in Milton's personification of the spirit of evil, and in many other attempts to construct characters so as to set forth some grand leading attribute in a manner different from anything in our experience of life.

REALIZING OF REPRESENTATION OR DESCRIPTION.

14. What we have to state on this head is little else than an application of the remarks already made. When we are desired to conceive an object differing from any that we have ever known, we can only do so by constructing it out of qualities and particulars indicated in a representation or description. The machinery of representation for such an end is known to be very various; including pictures, sculptures, models, diagrams, and greatest of all, language. If we wish to conceive a living human face by means of a coloured portrait, we require an act of constructiveness to make up the difference between the painting and the reality; and for this purpose we must fuse or combine a living face with the features of the portrait till the one is completely adapted to the other. The difficulty lies in separating the suggestive part of the picture from the gross total of canvas and colour, and the labour is greater according as the painter has attempted to produce a work of art, that is, a pleasing combination of colour and forms. There is here that effort of analysis that I have already alluded to as the preliminary of many constructions, rendering them often very hard to accomplish. The same remarks apply to busts and sculpture in general. An unartistic model is the best medium for enabling the mind to rise to the living and actual reality of the thing aimed at.

15. Verbal description is the most universal mode of imparting to the mind new ideas and combinations; and the hearer or reader is called upon to put forth an effort of constructiveness to realize the intended image. There is only one method of procedure open to the party giving the description —to compose the unknown out of the known,—and the hearer must implement the process by the force of his own mind bringing together the suggested particulars into a combined total, with the requisite inclusions and exclusions. Language is made the medium for indicating the things that are to be brought together in the formation of the new compound; the

constituent elements being concrete or abstract as the case may be.

16. With regard to the describing art in general, as applicable to all cases where a complex object or scene has to be represented to the view, the leading maxim is to combine a concrete or a *type* of the whole with an *enumeration* of the parts. This is in accordance with what has just been laid down respecting the best method of rising from abstract elements to a concrete embodiment. Some comprehensive designation that may spread out the main features of the object is indispensable to the description; and within this the details may be arranged in proper form and order. The following is a very simple instance from Milton, which seems as if it could not have been stated otherwise than he has done; but art shows itself in carrying into complicated cases the method that appears self-evident in easy cases. The words in italics mark the comprehensive designation or type, the rest of the description giving the details:—

> They plucked *the seated hills*, with all their load—
> Rocks, waters, woods—and by the shaggy tops
> Up-lifting, bore them in their hands.*

* Carlyle's description of the town and neighbourhood of Dunbar, the scene of Cromwell's decisive victory over the Scotch, is rendered vivid and conceivable, in consequence of his always prefacing particulars and details by terms and epithets that are at once comprehensive and picturesque:—

'The *small* town of Dunbar stands *high and windy*, looking down over its herring boats, over its grim old castle, now much honeycombed, on *one of those projecting rock-promontories* with which that shore of the Firth of Forth is niched and Vandyked as far as the eye can reach. A beautiful sea; good land too, now that the plougher understands his trade; *a grim niched barrier of whinstone* sheltering it from the chafings and tumblings of the big blue German Ocean. Seaward, St. Abb's Head, of whinstone, bounds your horizon to the east, not very far off; west, close by, is the deep bay, and fishy little village of Belhaven: the gloomy Bass and other rock-islets, and farther, the hills of Fife, and *foreshadows of the Highlands*, are visible as you look seaward. From the bottom of Belhaven Bay to that of the next sea-bight St. Abb's-ward, the town and its environs form a peninsula. Along the base of which peninsula, 'not much above a mile and a half from sea to sea,' Oliver Cromwell's army, on Monday, 2d of September, 1650, stands ranked, with its tents and town behind it, in very forlorn circumstances.

'Landward, as you look from the town of Dunbar, there rises, some short mile off, *a dusky continent of barren heath hills;* the Lammermoor,

CONSTRUCTIVENESS IN SCIENCE.

17. The Abstractions, Inductions, Deductions, and Experimental processes of science, which we have already seen to be mainly dependent upon the workings of the law of similarity, afford likewise examples of Construction.

The first in order of the scientific processes is Abstraction, or the generalizing of some property, so as to present it to the mind apart from the other properties that usually go along with it in nature. Thus a square in Euclid is an abstraction: in the world squareness is always accompanied with other properties, making the concrete, or actual, square,—a square pane of glass, a square of houses, &c. We have already seen that the forming of these abstract ideas is generally a result of the identifying action expressed by the law of Similarity. (See Similarity, § 34.) We have now to point out a class of cases, where a considerable constructive effort is required in addition to the force of identification. There are abstractions of a peculiar order of subtlety, which cannot be arrived at, or embraced by the mind, except through a constructive operation, adapted to the case by much study of the particular instances. To take as example, the abstract idea of a gas. Here the material eludes the senses, and cannot be represented by an example, or an outline; like a mountain, or a circle, or a genus of plants. And if the individual gases are so difficult to represent, there must be a similar difficulty in attaining an idea of the property common to them all as a class. A case of this nature must be circumvented. When we have ascertained by experiment the properties of one gas,

where only mountain sheep can be at home. The crossing of which by any of its boggy passes and brawling stream-courses no army, hardly a solitary Scotch packman, could attempt in such weather. To the edge of these Lammermoor heights David Leslie has betaken himself; lies now along the utmost spur of them, a long hill of considerable height. There lies he since Sunday night, in the top and slope of this Doon Hill, with the impassable heath continents behind him; embraces, as with outspread tiger-claws, the base-line of Oliver's Dunbar *peninsula*.'

See on this subject a short treatise, by the Author, on 'Rhetoric and Belles-Lettres,' in *Chambers's Information for the People*.

such as the air, we record them in the best language we can obtain, by comparison with the more palpable phenomena of solids and fluids. We find that the air is inert, and has weight; that it is elastic, like a spring; but that it is extremely light. Trying other gases we find similar properties to hold good. When, however, we experiment on the visible vapour of water, we find an absence of the elastic property belonging to air and invisible steam; in fact, this substance has nothing in common with aëriform bodies, but lightness or tenuity: and, in the exercise of our best discretion, we think it right to exclude it from the group, and embrace together only those that have the property of elasticity, or spontaneous expansion, constituting this the defining mark, or the abstract idea of the class.

By a similar process of groping experiment, and the exercise of judgment, the scientific world has arrived at abstract conceptions of the subtle properties expressed by Heat, Electricity, Chemical affinity, Cell-reproduction, &c. The definitions of these attributes are constructions laboriously worked out. Nevertheless, the means of effecting them, so far as intellect is concerned, is still by the ordinary laws of association, which bring up to the view various facts, expressions and comparisons, in order to make tentative combinations; and these are gradually improved upon, as their unsuitability to the particular phenomena is discovered on examination. An intellect well versed in the kind of conceptions necessary, and acting vigorously in the reviving of these by association, is naturally qualified for the work. Next to this, there is required a clear perception of the subject to be seized, for unless we are able to judge accurately of the fitness of the constructions proposed we shall rest satisfied with something far short of the truth. In every kind of endeavour this power of judging clearly is indispensable; without it the most copious intellectual resources are wasted to no purpose.

Possessing thus the material of the construction and a clear sense of the fitness or unfitness of each new tentative, there is needed nothing but patience, or as Newton termed it 'patient thought,' to attain the highest construction that is attainable in the case. This is the moral or volitional property of constructiveness, which I pointed out at the outset, as entering along with the properly intellectual forces into the constructive faculty. The power of patient thought, when highly developed, must repose upon a strong congeniality of mind towards the subject in hand, a passion or fascination for the peculiar class of ideas concerned, such that these ideas can be detained and dwelt upon without costing effort. The mathematical mind in addition to its intellectual aptitude for retaining and recovering mathematical forms, should have this congenial liking for these forms, in order to prepare it for original discovery. The number of trials necessary to arrive at a new construction is commonly so great, that without a positive affection or fascination for the subject we would inevitably grow weary of the task. The patient thought of the naturalist, desirous of rising to new classifications, must repose on the liking for the subject, which makes it to him a sweet morsel rolled under the tongue, and gives an enjoyment even to the most fruitless endeavours. This is the *emotional* condition of originality of mind in any department. When Napoleon described himself as '*un homme politique*,' we are to interpret the expression as implying a man of the political fibre or grain, a character whose charm of existence was the handling of political combinations, so that his mind could dwell with ease in this region of ideas.

18. What has been said above, with reference to the Abstractive process of science, applies also to Induction, or the generalizing of propositions, or truths. This may be either a simple effort of the reproductive force of similarity, or there may be wanted a constructive process in addition. In generalizing the law of the bending of light in passing from one medium to another, Snell constructed a proposition by bringing in a foreign element, namely, the geometrical sines of the angles: he found that the degree of bending was as the sine of the inclination of the ray. This is a good example of the devices required to attain to a general law, and a mind well versed in such foreign elements, apt to revive them, and

disposed to dwell upon them, will be the most likely to succeed in the happy fetches and combinations that clench great principles of science.

19. In the processes of Deduction, by which general laws and principles are applied to the clearing up of particular cases and the solving of problems, the same line of remark might be pursued. The mind being prepared beforehand with the principles most likely for the purpose, and having a vigorous power of similarity in that region, incubates in patient thought over the problem, trying and rejecting, until at last the proper elements come together in the view, and fall into their places in a fitting combination.

The vast structure of the mathematical sciences is a striking example of constructiveness, as distinguished from the discoveries of mere identification through the law of similarity. In Geometry, in Algebra, in the higher Calculus, and in the endless devices of refined analysis, we see an apparatus perfectly unprecedented, the result of a long series of artificial constructions for the working out of particular ends. It would not be difficult to trace out the course of this creative energy; the mental forces involved in it being no other than those that we have been endeavouring to explain.

20. In the devices of Experimental science there comes into play a constructiveness, akin to invention in the arts and manufactures. The air-pump, for example, is an illustrious piece of constructive ingenuity. The machine already in use for pumping water had to be changed and adapted to suit the case of air; and it was necessary that some one well versed in mechanical expedients, and able to recal them on slight hints of contiguity or similarity, should go through the tedious course of trials that such a case required.

PRACTICAL CONSTRUCTIONS.

21. The region of inventions for the practical ends of life might be traversed for illustrations of constructive genius. Likewise the department of administrative capacity in every

class of affairs and every kind of business might be explored with the same view.

Not one of the leading mental peculiarities above laid down as applicable to scientific constructiveness can be dispensed with in the constructions of practice;—the intellectual store of ideas applicable to the special department; the powerful action of the associating forces; a very clear perception of the end, in other words, sound judgment; and, lastly, that patient thought, which is properly an entranced devotion of the energies to the subject in hand, rendering application to it spontaneous and easy.

In the case of originality in all departments, whether science, practice, or fine art, there is a point of character that is worth specifying in this place, as being more obviously of value in practical inventions and in the conduct of business and affairs, I mean an active turn, or a profuseness of energy put forth in trials of all kinds on the chance of making lucky hits. In science, meditation and speculation can often do much, but in practice, a disposition to try experiments is of the greatest service. Nothing less than a fanaticism of experimentation could have given birth to some of our grandest practical combinations. The great discovery of Daguerre, for example, could not have been regularly worked out by any systematic and orderly research; there was no way but to stumble on it, so unlikely and remote were the actions brought together in one consecutive process. The discovery is unaccountable until we learn that the author had been devoting himself to experiments for improving the diorama, and thereby got deeply involved in trials and operations far remote from the beaten paths of inquiry. The fanaticism that prompts to endless attempts was found in a surprising degree in Kepler. A similar untiring energy—the union of an active temperament with intense fascination for his subject—appears in the character of Sir William Herschel. When these two attributes are conjoined; when profuse active vigour is let loose on a field which has an unceasing charm for the mind, we then see human nature surpassing itself; and, with the aid of adequate intellectual power, the very highest results may be anticipated.

The greatest practical inventions being so much dependent upon chance, the only hope of success is to multiply the chances by multiplying the experiments.

The invention of Daguerre* illustrates—by a modern instance—the probable method whereby some of the most ancient inventions were arrived at. The inventions of the scarlet dye, of glass, of soap, of gunpowder, could have come only by accident; but the accident in most of them would probably fall into the hands of men who had been engaged in extensive trials with the constituted materials. Intense application,—'days of watching, nights of waking,'—in all likelihood attended ancient discoveries as well as modern. In the historical instances we know this to have been the case. The mental absorption of Archimedes is a proverb.

22. The present topic furnishes a good opportunity for singling out for more special notice the quality of mind well known by the name of Judgment. I have already included a clear perception of the end to be served, as essential to a high order of constructive ingenuity, simply because without this, though there may be a great profusion of the requisite devices and suggestions towards the required combination, the fitting result is really not arrived at. Some combination short of the exigencies of the case is acquiesced in, and the matter rests.

The various regions of practice differ very much in respect of the explicitness of the signs of success. In some things there is no doubt at all; we all know when we have made a good dinner, when our clothing is warm, or when a wound has healed. The miller knows when there is water enough for his mill, and the trader knows when he has found out a good market. The end in those cases is so clear and explicit

* The wonderful part of this discovery consists in the succession of processes that had to concur in one operation before any effect could arise. Having taken a silver plate, iodine is first used to coat the surface; the surface is then exposed to the light, but the effect produced is not apparent till the plate has been immersed in the vapour of mercury. To light upon such a combination, without any clue derived from previous knowledge, an innumerable series of fruitless trials must have been gone through.

that no one is deluded into the notion of having compassed it, if this is really not the case. But in more complex affairs, where perfect success is unattainable, there is room for doubts as to the degree actually arrived at. Thus in public administration, we look only for doing good in a considerable majority of instances, and it is often easy to take a minority for a majority in such a case. So in acting upon human beings, as in the arts of teaching, advising, directing, we may suffer ourselves to fall into a very lax judgment of what we have actually achieved, and may thus rest satisfied with easy exertions and flimsily put together devices. A sound judgment, meaning a clear and precise perception of what is really effected by the contrivances made use of, is to be looked upon as the first requisite of the practical man. He may be meagre in intellectual resources, he may be slow in getting forward and putting together the appropriate devices, but if his perception of the end is unfaltering and strong he will do no mischief and practise no quackery. He may have to wait long in order to bring together the apposite machinery, but when he has done so to the satisfaction of his own thorough judgment, the success will be above dispute. Judgment is in general more important than fertility, because a man by consulting others and studying what has been already done, may usually obtain suggestions enough, but if his judgment of the end is loose, the highest exuberance of intellect is only a snare.

The adapting of one's views and plans to the opinions of others is an interesting case of constructiveness, and would illustrate all the difficulties that ever belong to the operation. A more abundant intellectual suggestiveness is requisite according as the conditions of the combination are multiplied; we must transform our plan into a new one containing all the essentials of success, with the addition that it must conform to the plan of some other person. There is in that case a considerable amount of moral effort, as well as of intellectual adaptation; the giving way to other men's views being by no means indifferent to our own feelings.

The subject of Speech in general would present some aspects of the constructive mechanism not hitherto brought to light in our exposition. A fluent speaker constructing verbal combinations adapted to all the exigencies of meaning, grammar, taste, and cadence, as fast as the voice can utter them, is an object interesting to study in the present connexion. The sufficiently rapid action of the associating forces is here of prime importance. Real power is not usually identified with a specific pace of mental movement; a slow action may be as effective as a quick, but in this particular instance the ready revival of all the associations that concur in the common stream is of vital importance.

FINE ART CONSTRUCTIONS.—IMAGINATION.

23. The grand peculiarity of the case now to be considered is the presence of an emotional element in the combinations. In the constructions of science and practice a certain end is to be served—the attainment of truth, or the working out of a practical result. And the mind has to choose means suitable to those ends according to the vigorous laws of nature's working. A builder has to erect a structure that will defy wind and frost, and accommodate a certain number of human beings. Nothing must enter into his plan that is not calculated to effect these purposes. The construction is considered a pure effort of intellect, because it is by intellect that we comprehend the laws and properties of stone, wood, and iron, and choose out and combine such materials as will serve for warmth and shelter. We should not properly call this operation 'imaginative,' although there is a constructive operation gone through; and that because no feeling or emotion enters in as an element excepting the one feeling of answering a practical end. Volition there is in abundance, but not emotion in the sense implied in the constructive processes of the imagination.

When, however, any practical construction, such as a building, in addition to the uses of shelter and accommodation, is intended to strike the refined sensibilities that we term the feeling of the beautiful, the grand, the picturesque, a turn must be given to the plan so as to involve this other end. Here we have emotion viewed in a certain narrow sense as exclusive of direct utility for the wants and necessities of life. There is a feeling of hunger, a feeling of cold, a feeling of fatigue, all which are emotions, but not emotions of the fine arts. The practical operations of life are engaged in consulting these strong sensibilities connected with the preservation of life itself, with present subsistence and the security of future subsistence; and no other emotion ought to interfere in the processes for attaining these fundamental ends. The builder must not let a sentimental delusion in favour of one material blind him to the insufficiency of it for resisting the tempest and the cold; this would be to let in imagination at the wrong place. But when what we look upon as practical ends,—the support of life and of healthy sensation,—are once secure, there are other feelings and sentiments belonging to human nature that can be appealed to so as to increase the sum of human happiness. These feelings are variously called the pleasures of Taste, the æsthetic sensibilities, the emotions of Fine Art; and combinations shaped with the view of gratifying them are called artistic, æsthetic, or imaginative compositions. In all such compositions an element of fine emotion is the regulating power, the all in all of the creative effort.*

* The following passage will aid us in working out the distinction between the constructions of imagination and the constructions of science and practice:—

'The trains of one class differ from those of another, the trains of the merchant for example, from those of the lawyer, not in this, that the ideas follow one another by any other law, in the mind of the one, and the mind of the other; they follow by the same laws exactly; and are equally composed of ideas, mixed indeed with sensations, in the minds of both. The difference consists in this, that the ideas which flow in their minds, and compose their trains, are ideas of different things. The ideas of the lawyer are ideas of the legal provisions, forms, and distinctions, and of the actions, bodily and mental, about which he is conversant. The ideas of the merchant are equally ideas of the objects and operations, about which he is concerned, and the ends towards which his actions are directed; but the objects and operations themselves are remarkably different. The trains of poets, also, do not differ from the trains of other men, but perfectly agree with them, in this, that they are composed of ideas, and that those ideas succeed one another, according to the same laws, in their, and in other minds. They are ideas, however, of very different things. The ideas of the poet are ideas

24. In adducing examples of combinations controlled by an emotional element I shall not confine myself to the narrowest class of artistic feelings, the feelings of Taste

of all that is most lovely and striking in the visible appearance of nature, and of all that is most interesting in the actions and affections of human beings. It thus, however, appears most manifestly, that the trains of poets differ from those of other men in no other way, than those of other men differ from one another; that they differ from them by this only, that the ideas of which they are composed, are ideas of different things. There is also nothing surprising in this, that, being trains of pleasurable ideas, they should have attracted a peculiar degree of attention; and in an early age, when poetry was the only literature, should have been thought worthy of a more particular naming, than the trains of any other class. These reasons seem to account for a sort of appropriation of the name Imagination to the trains of the poet. An additional reason may be seen in another circumstance, which also affords an interesting illustration of a law of association already propounded; namely, the obscuration of the antecedent part of a train, which leads to a subsequent, more interesting than itself. In the case of the lawyer, the train leads to a decision favourable to the side which he advocates. The train has nothing pleasurable in itself. The pleasure is all derived from the end. The same is the case with the merchant. His trains are directed to a particular end. And it is the end alone which gives a value to the train. The end of the metaphysical, and the end of the mathematical inquirer, is the discovery of truth: their trains are directed to that object; and are, or are not, a source of pleasure, as that end is or is not attained. But the case is perfectly different with the poet. His train is its own end. It is all delightful, or the purpose is frustrate. From the established laws of association, this consequence unavoidably followed; that, in the case of the trains of those other classes, the interest of which was concentrated in the end, attention was withdrawn from the train by being fixed on the end; that in the case of the poet, on the other hand, the train itself being the only object, and that pleasurable, the attention was wholly fixed upon the train; that hence the train of the poet was provided with a name; that in the cases of the trains of other men, where the end only was interesting, it was thought enough that the end itself should be named, the train was neglected.

'In conformity with this observation we find that wherever there is a train which leads to nothing beyond itself, and has any pretension to the character of pleasurable (the various kinds of reverie, for example), it is allowed the name of Imagination. Thus we say that Rousseau indulged his imagination, when, as he himself describes it, lying on his back, in his boat, on the little lake of Vienne, he delivered himself up for hours to trains, of which, he says, the pleasure surpassed every other enjoyment.

'Professor Dugald Stewart has given to the word Imagination a technical meaning; without, as it appears to me, any corresponding advantage. He confines it to the cases in which the mind forms new combinations; or, as he calls them, creations; that is, to cases in which the ideas which compose the train do not come together in the same combinations in which sensations had ever been received. But this is no specific difference. This happens in every train of any considerable length, whether directed to any end, or not so directed. It is implied in every wish of the child to fly, or to jump over the house; in a large proportion of all his playful expressions, properly so called, the fact being that even in the creations of the artist all the strong emotions may come in to swell the current of interest excepting only a few of the more exclusively animal feelings. Rage, terror, tenderness, egotism, are not æsthetic emotions, but still the artist uses them in his compositions. I should also remark that the influence of an emotion, while just and legitimate in the artistic sphere, is usually a source of corruption and bias in the combinations that have truth or practice for their end. This is only another way of saying that imagination is not to occupy the place of judgment and reason.

The emotion of Terror gives a character to all the ideas or notions formed under the influence of the feeling. A man once thoroughly terrified sees only objects of dread. It is difficult to form any combinations free of this element. Ghosts and hobgoblins fill the imagination of the superstitious, while more substantial forms of evil haunt the mind superior to the dread of the supernatural. The terrified imagination is powerful to form creations of terror, such as may prove an interesting excitement to the cool spectator, but which are also likely to vitiate the truth of any narrative of matter of fact given out under the influence of the moment. Hence the accounts that a terror-stricken and routed army relate as to the numbers and power of the enemy on its heels; hence the exaggerations that prevail in the public mind on occasions of popular panic. We see the power of an emotion not merely to give its own character to the conceptions formed on all subjects, but to induce belief in the full and exact reality of such conceptions.

With reference to examples of constructiveness of the class

as puss in boots, a hog in armour, a monkey preaching, and so on. It is manifested in perfection in every dream. It is well known that, for the discovery of truths in philosophy, there is a demand for new trains of thought, multitudes of which pass in review before the mind, are contemplated, and rejected, before the happy combination is attained, in which the discovery is involved. If imagination consists in bringing trains before the mind involving a number of new combinations, imagination is probably more the occupation of the philosopher than of the poet.'—MILL'S *Analysis*, vol. i., p. 181.

now cited I may repeat the remark already made, to the effect that no new principle of association is at work in making an original combination; the only thing requisite being the presence or concurrence of the proper ingredients as furnished by the working of contiguity and similarity. When these ingredients appear in the mind together they fall into their places as a matter of course. In the present instance, and in all imaginative, or emotion-ruled combinations, the laws of association can be proved to be sufficient to furnish the constituents of the combination; for we know that each strong feeling or passion has associated with it in the mind a large number of kindred objects, in consequence of the previous frequent companionship of such objects with the feeling. The passion of terror is associated in the mind with the things that have roused the feeling in the course of each one's experience; one man has associations between it and a cruel parent or master, another with money losses, a third with attacks of illness, a fourth with defamation, a fifth with religious workings; and most men are familiar with a plurality of causes of dread. When therefore the feeling is once excited, no matter how, these often experienced adjuncts rush up and possess the mind, and mix themselves up with the other ideas of the situation so as to constitute a medley or compound of images with terror as the predominating tone. Seeing the approach of a hurried messenger with distracted countenance, the trader's mind is already full of disasters at sea or depressions of the market, the parent of a soldier is possessed of the calamities of warfare, the usurper is ready with the anticipation of a popular rising.

An exactly parallel illustration might be given from the passion of Anger. Once roused, this passion resuscitates the objects in harmony with it, and constitutes combinations wherein these enter as elements. The fanaticism of rage and hatred ascribes every diabolical impulse to the unfortunate object of the feeling; all the things that have customarily inspired anger are brought forward by contiguous association, and the instigator of the present outburst is looked on as guilty of innumerable crimes, in addition to the offence of the moment. This is an extreme case, but not unexampled in the history of the world. Party-rage brands opponents with the most unheard-of crimes; the term calumny only expresses this surplus of accusation against those that have roused the passion of hate.

25. The purely Egotistic feelings are remarkable for the superstructure of imaginative creations that they can rear. Self-complacency suggests merits and virtues, and constructs an estimate of self most flattering. Vanity sets up pictures of admiring assemblies and devoted worshippers. But most curious of all are the day-dreams of ambition in a sanguine temperament; these will embrace a whole history of the future, the baseless fabric of a vision of wonders and triumphs, which is not only constructed without labour, but whose construction no labour can arrest. In former sections we have adverted to the difficult efforts of constructiveness; we have seen how hard it often is to comply with the numerous conditions that a construction must fulfil, or to give a place for all the ingredients that should be represented in it; so much so that the attempt may have to be repeated time after time, before everything will fall into the proper place. A scientific man framing a definition for a very comprehensive class of objects, a mechanician constructing a new machine, a politician devising a state expedient, a general circumventing a hostile army,—will be each engaged in deliberations, for days or months, ere the proper combination occur to the mind. One suggestion includes something to be avoided, another omits something that ought to be present, and long delays and repeated substitutions and trials precede the successful termination of the struggle. But in the case now supposed, all is different: stupendous constructiveness, unbounded originality, flow out at once as fast as thought can evolve itself. Wherein lies the remarkable difference in these two forms of constructiveness? The immortal crockery merchant constructed, in a few minutes, a lengthened fiction, totally distinct from anything he had ever seen realized in actual life. Why has emotion such power? The answer is simple. A predominating emotion, such as ambition, is every day at work associating

itself with objects and incidents suited to gratify it. The feeling is called into play by every spectacle of power and grandeur that meets the eye, or is presented in story. The associating link is soon forged in the hot fire of passion; and, after months and years of indulgence of a favourite emotion, a rich growth of the corresponding objects and ideas is formed and ready to flow out at any moment when the feeling is roused. Imagination, in those circumstances, becomes a power needing restraint, rather than an effort of laboured constructiveness. The foregone associations with the feeling are so copious that they present themselves freely for any purpose. Construction is easy where materials are abundant and the conditions few: the owner of the crockery basket had amassed pictures of happiness and grandeur, which required only to be cast into a consecutive order to make his epic, and an extempore effort was enough for this. The only thing he wanted was to satisfy one feeling, all restrictions were thrown aside, and he had plenty of images to suit the single emotion that lorded it over his dream. Very different would have been the pace of his execution, if he had insisted that this foreshadowing of his career should be in accordance with the stern experience of human life; if his picture should have been regulated by natural calculation founded on actual observation. This would have dried up his facility in a moment; he would then have been in the contrasting position above described, of the man of science, or the man of business; a feeling might have still been the end, but purely intellectual estimates of the facts and laws of the world would have entered into his construction of the means. The reconciliation of his desires with the resources of his position would have been as arduous as a string of airy successes was facile. The process might have ever so much of the constructive intellect, and the combination might have been never so original, but the term 'imagination' would no longer be used to describe it.

26. The Fine Art emotions properly so called, the emotions of harmony, beauty, sublimity, picturesqueness, pathos, humour, become associated in the artistic mind with the objects that radiate the influence on the beholder, and from the materials

thus stored up and reproduced by association the artist makes his constructions. I have in a former chapter (Contiguity, § 75) adverted to the mental equipment suitable to the artist in any department; and it is scarcely necessary to repeat, what I have endeavoured to illustrate throughout the present chapter, that when all the elements are present that fit into a particular construction they will take their places as a matter of course. The labour consists in getting up the constituent parts from the repositories of the mind, and in choosing and rejecting until the end in view is completely answered. Because the imaginations of a dreamer are easy and fluent, it does not follow that the imaginations of a musician, an architect, or a poet, shall be equally easy, although in principle the same, being governed by an emotion powerfully developed and richly associated with material. The artist has more stringent conditions to fulfil than the dreamer. He has to satisfy the reigning feeling of his piece,—the melody, harmony, pathos, humour,—of the composition; he has also to make this effect apparent to the minds of others; he has moreover to exclude many effects discordant to the taste of his audience; and if his work be the decoration of some object of common usefulness, he has to save the utilities while in search of the amenities. Every new restriction adds to the difficulty of a combining effort; and an artist may be so trammelled with conditions, that the exercise of imagination shall be rendered as laborious as any construction of the reason. To call up combinations that produce powerful and rich effects upon the minds of men is not easy in any art; but the gathered abundance of the artistic intellect is the secret of the power. The more rich the granary of material, the more is the artist prepared to submit to the numerous conditions involved in a really great performance.

27. I do not purpose at present to enter upon a minute illustration of the mental processes of art-construction. Not only would a large space be requisite for spreading out the examples in detail, but there would soon come to be involved a strenuous polemical discussion in consequence of the prevalence of theories of art that seem to me erroneous. Con-

ceiving as I do that the first object of an artist is to gratify the feelings of taste, or the proper æsthetic emotions, I cannot assent to the current maxim that nature is his standard, or truth his chief end. On the contrary, I believe that these are precisely the conditions of the scientific man; he it is that should never deviate from nature, and who should care for truth before all other things. The artist's standard is *feeling*, his end is refined pleasure; he goes to nature and selects what chimes in with his feelings of artistic effect, and passes by the rest. He is not even bound to adhere to nature in her very choicest displays; his own taste being the touchstone, he alters the originals at his will. The scientific man, on the other hand, must embrace every fact with open arms; the most nauseous fungus, the most loathsome reptile, the most pestilential vapour, must be scanned and set forth in all its details.

The amount of regard that the artist owes to truth, so far as I am able to judge, is nearly as follows. In the purely effusive arts, such as music or the dance, truth and nature are totally irrelevant; the artist's feeling and the gratification of the senses of mankind generally are the sole criterion of the effect. So in the fancies of decorative art, nature has very little place; suggestions are occasionally derived from natural objects, but no one is bound to adopt more of these than good taste may allow. Nobody talks of the design of a calico as being true to nature; it is enough if it please the eye. 'Art is art because it is not nature.' The artist provides dainties not to be found in nature. There are, however, certain departments of art that differ considerably from music and fanciful decoration, in this respect, namely, that the basis of the composition is generally something actual, or something derived from the existing realities of nature or life. Such are painting, poetry, and romance. In these, nature gives the subject, and the artistic genius the adornment. Now, although in this case also the gratification of the senses and the æsthetic sensibilities is still the aim of the artist, he has to show a certain decent respect to our experience of reality in the management of his subject, that not being purely imaginary, like the figures of a calico, but chosen from the world of reality. Hence when a painter lays hold of the human figure in order to display his harmonies of colour and beauties of form and picturesqueness of grouping, he ought not to shock our feeling of truth and consistency by a wide departure from the usual proportions of humanity. We don't look for anatomical exactness; we know that the studies of an artist do not imply the knowledge of a professor of anatomy; but we expect that the main features of reality shall be adhered to. In like manner, a poet is not great because he exhibits human nature with literal fidelity; to do that would make the reputation of a historian or a mental philosopher. The poet is great by his metres, his cadences, his images, his picturesque groupings, his graceful narrative, his exaltation of reality into the region of ideality; and if in doing all this he avoid serious mistakes or gross exaggerations, he passes without rebuke, and earns the unqualified honours of his genius.

28. The attempt to reconcile the artistic with the true,—art with nature,—has given birth to a middle school, in whose productions a restraint is put upon the flights of pure imagination, and which claims the merit of informing the mind as to the realities of the world, while gratifying the various æsthetic emotions. Instead of the tales of Fairy-land, the Arabian nights, the Romances of chivalry, we have the modern novelist with his pictures of living men and manners. In painting we have natural scenery, buildings, men, and animals represented with scrupulous exactness. The sculptor and the painter exercise the vocation of producing portraits that shall hand down to future ages the precise lineaments of the men and women of their generation. Hence the study of nature has become an element in artistic education; and the artist often speaks as if the exhibition of truth were his prime endeavour and his highest honour. It is probably this attempt to subject imagination to the conditions of truth and reality that has caused the singular transference above mentioned, whereby the definition of science has been made the definition of art.

Now I have every desire to do justice to the merits of the truth-seeking artist. Indeed the importance of the reconciliation that he aims at is undeniable. It is no slight matter to take out the sting from pleasure, and to avoid corrupting our notions of reality while gratifying our artistic sensibilities. A sober modern romancist does not outrage the probabilities of human life, nor excite delusive and extravagant hopes, in the manner of the middle-age romances. The improvement is a most beneficial one.

Nevertheless, there is, and always will be, a distinction between the degree of truth attainable by an artist, and the degree of truth attained by a man of science or a man of business. The poet, let him desire it never so much, cannot study realities with an undivided attention. His readers in general do not desire truth simply for its own sake; nor will they accept it in the severe forms of an accurate terminology. The scientific man has not wantonly created the diagrams of Euclid, the symbols of Algebra, or the jargon of technical Anatomy; he was forced into these repulsive elements because in no other way could he seize the realities of nature with precision. It cannot be supposed that the utmost plenitude of poetic genius shall ever be able to represent the world faithfully by discarding all these devices in favour of flowery ornament and melodious metre. We ought not to look to an artist to guide us to truth; it is enough for him that he do not mis-guide us.

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