**An enquiry into the formation of habit in man / by Alfred T. Schofield.**

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VICTORIA INSTITUTE.—Paper to be read at a Meeting of the Members and Associates, on Monday, Dec. 4th, 1893, at Eight o'clock, to be held at

8, ADELPHI TERRACE, NEAR CHARING CROSS, W.C.



# *AN ENQUIRY INTO THE FORMATION OF HABIT IN MAN.*

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I HAVE written this paper in some haste during great professional pressure, in answer to a request conveyed to me by the Hon. Secretary to this Society; and I feel some apology is needed, not only for its imperfections, but for the selection of a subject that is certain to raise many more questions than it answers. And my apology is this: first, that the subject is continually more or less before me in connection with the education of children on the plan advocated by the Parents' National Educational Union, with which I am connected; and secondly, because, as will be seen, no question is of greater importance in the formation of character, or has a greater bearing on the advancement of the race.

The subject is one involved in difficulty, lying as it does on the borderland of the unknown, and touching the great questions of mind and brain action. I must therefore be excused if I am found expressing the movements of the one in terms applicable to the other, or in any other way using

words coined for matter with reference to that which is immaterial.

I would also finally ask the forbearance of any physiologists that may be present, if in order to make the subject clear to those who have not pursued these studies, I preface my remarks with a brief summary of the general arrangement and structure of nerve tissues.

*Brain structure generally.*—The adult brain in man weighs between 46 and 53 ounces, with extreme limits from 23 ounces in an idiot to 65 ounces in men of the highest attainments. In women brains weigh between 41 and 47 ounces. The brain of the highest anthropoid ape weighs about 15 ounces. The brain is in two halves, right and left, and in four portions: the hemispheres and cortex, the seat of purely intelligent and voluntary actions; the middle brain, consisting of large ganglia, whence proceed the ordinary movements of animal life, not necessarily voluntary; behind this the cerebellum, or little brain, co-ordinating the movements, especially those connected with the erect position; and below, the medulla, which contains nearly all the involuntary centres connected with the maintenance of passive physical life.

The cortex, which increases in size in animals in proportion to the rest of the brain, in the ratio that intelligence supersedes instinct, is covered or rather composed of convolutions which by their number and depth afford a very fair idea of the amount of intellectual development. They increase steadily in intricacy as we ascend the animal scale; they also increase in man up to fifty years of age, after which they get gradually less marked; the brain as a whole also decreasing in weight about one ounce every ten years. The brain and spinal cord are each pierced with a continuous central tube surrounded with grey or nerve cell matter, which in its turn is surrounded by white or nerve fibre matter. The cortex or surface of the brain is covered to the depth of about a quarter of an inch with another layer of grey cell matter, the superficial extent of which is obviously greatly increased by the convolutions.

The brain is continually wasting and being repaired, the new tissue always accurately reproducing all the features of the old, whether these be congenital or acquired.

*Nerve structure generally.*—The nerve centres consist of three main elements; nerve cells, nerve fibres, and the groundwork or webwork in which both are embedded, called neuroglia. In the cortex this substance looks like ground glass, and

under a very high power is seen to be traversed in every direction with very fine white fibres less than $\frac{1}{10000}$ of an inch in diameter. The nerve cells seem to be the starting point, and the centres of nutrition for the nerve fibres. The nutrition of the attached fibres is indeed a more obvious part of their work than the projection of impulses, which was formerly thought to be their main function. Any fibre cut off from its nutrient cell soon wastes away. In early childhood the cells are of a spherical, fusiform, or pyramidal form with few or no interlacing nerve fibres. Nerve impulses, starting in infancy and increasing in numbers and complexity till adult life is reached, are believed to form intercommunicating nerve fibres between the cells in every direction, until in manhood though there are still left many unbranched cells, the greater number have fibres given off in every direction. In old age again a good many of them appear to be broken off and the cells blunted.

*Blood supply.*—The grey matter containing cells is, to a limited extent, analogous to an electric battery, of which the wires are the nerve fibres. The vitality of these nerve structures is maintained by a constant supply of fresh arterial blood. By this means when the battery has discharged its nerve force, it is speedily recharged, and as this occurs most often in the grey matter, there is about five times as much blood circulating there as in the white or fibre matter. The great proportion of blood used by the brain compared with the rest of the body is certainly remarkable. While the brain is only about $\frac{1}{45}$ part the weight of the body, the supply of blood is about one-eighth of the whole of that required by the rest of the body. The system of circulation is arranged so as to ensure the most constant and rapid change. The interdependence of mind and body is nowhere more clearly seen than in the question of blood supply. If it be suddenly cut off from any part, that part can no longer be used voluntarily; if the blood be deficient in quantity the thoughts often get confused and senseless; if it be defective in quality the very disposition seems changed, and the person gets gloomy and morose; if the temperature gets raised, delirium sets in; if effusion takes place, and the blood presses on the brain, consciousness is lost altogether in an apoplectic fit.

*Ordinary functions of brain.*—The brain has already been divided into four parts, and these correspond to its leading functions. The cerebrum is thus divided into upper, middle, and lower regions; or cortex, mid-brain, and medulla. The

first is the seat of intellectual life, or the sphere of the activities of the *spirit* of man; the lower, of the necessary vital functions that carry on and store life's forces—the vegetative side of our life, or *body*; while the middle region is that of the functions of animal life, or what is sometimes called the *soul*. The actions connected with the cortex are voluntary, those connected with the medulla are involuntary or reflex, while those between the two partake of both varieties of action, being at first largely voluntary in character, but becoming more and more automatic in reflex as *habits* are formed. The difference of these four divisions of the brain is well shown in drunkenness. The upper region is affected first, and noisy manifestations of animal life are displayed unruled by the spirit. If the man be drunk, the middle region and the cerebellum are paralyzed, and all equilibrium and movements of animal life are lost. If the man is dead drunk, the medulla alone remains active, carrying on the functions of passive bodily life.

That the hemispheres or upper regions of the brain, and particularly the surface or cortex proper, are the centres for intelligent brain work, is proved by direct experiment, as we shall see when we consider the various actions of the brain. But we may here remark that the frontal region is supposed to be specially connected in some way with thoughts and ideas that do not result in bodily activity; the occipital and part of the parietal regions are the centres of sensation or perception, while the intervening portion is the centre for all motor impulses, which can be readily aroused by touching the part with electric stimuli.

In idiots the frontal region is found to be very deficient, while in intelligent men it is greatly developed.

Destruction of the sensory area in the cortex appears still to leave the *mechanism* of sensation (a dog will see, hear, and even feel, in a sense), but the *perception* is lost (it does not know what it sees, hears, and feels).

In the middle or motor area, districts have been carefully mapped out in the right and left hemispheres, corresponding with movements in various parts on the opposite side of the body; but it has been specially observed by Foster that the size of these areas does not correspond with the size of the part moved or the number of muscles or nerves it may contain, but to the more or less elaborate and complicated and intelligent use of the part. Thus the area for the arm is enormous compared to the leg, that for the

thumb large as compared with the fingers. Another proof that the nerve fibres increase according to the complexity rather than the number of movements is found in the fact that although the number of movements of the leg must be as numerous in a dog, or an ape, as in man, the pyramidal tract in the spinal cord by which they are conveyed is twice as large in man as in the monkey, and ten times as large as in the dog.

The functions of the brain develop in a fixed order, and Sir J. C. Browne has called attention to the fact that if this natural order is disregarded in education, the result is imperfect, and the mind is never fully developed. The various senses, the motions, emotions, and intellect all come to maturity at different times.

With regard to movements, those of mastication precede those of the foot and leg, then come the hand and arm, then the proper use of the tongue and lips, later on the power of speech and writing.

Imperfectly developed motor centres produce various imperfections in the execution of the movements involved, such as stammering, twitching, an imperfect gait, &c. One point of importance remains to be noticed. The brain centres are developed by exercise of the parts they govern, and whenever fully developed, the result remains. Thus if a limb be atrophied or useless from birth, it is found that the district in the cortex remains undeveloped; but on the other hand, if the centre be once fully developed by use, and the limb subsequently lost, it is found that although the lower centre in the spinal cord may waste, the higher centre in the cortex remains perfect, being probably maintained by its inter-communication with other parts.

*Nerve currents.*—The more the brain is investigated the more does its broad description as a sensori-motor mechanism appear true. If we except a certain frontal area, and even this is doubtful, it appears that apart from the hemispheres and cortex, the nerve paths in the lower parts of the brain consist of sensori-motor arcs, the nerve currents arriving at the hinder part of the brain by the posterior part of the cord, and leaving the anterior ganglia, notably the corpus striatum, and descending down the front of the spinal cord in the resulting motor impulse. To use now the words of Dr. Hill, in his paper on reflex action, read here a short time since: "On these arcs, which collectively make up the lower system, are superadded arcs, the loops of which lie in the higher grey

matter. At the same time, therefore, that an impulse flows across the spinal cord, as a simple direct reflex action, a certain part of this impulse is also diverted to the brain along fibres which ascend in the outer part of the spinal cord; and from the brain descending fibres carry the impulse back again to the lower arc. Accurate measurements of the time taken by impulses in travelling through the grey matter have done much to throw light upon the route they follow; but we do not yet know whether we ought to speak of the conversion of a sensory into a motor impulse, in its passage through the lower network under the direction of nerve currents which originate in the higher; or whether the impulse when it reaches the lower grey matter takes in some cases a direct cross path, while in others it makes its transit through a longer loop. One thing is quite certain, namely, that the routes which are most frequently used are the most open, and therefore the most easily traversed."

The functions of the nerve-cells are various and must be considered in detail; the molecules, or particles, of which a nerve-cell is built up, are in such an unstable condition that any stimulus readily excites them to change; this molecular change is believed to constitute a nerve-cell action; it may be of very various degrees of violence; it may exhaust the nerve-cell in proportion to its violence (and when exhausted the cell cannot act again until restored by nutrition from the blood); it may affect the substance of the cell, and especially of young growing cells, so as to leave an impression on the cell, permanent in proportion to the violence of the action and the number of its repetitions. When a nerve-cell acts, impulses tend to pass off from it along its various connecting fibres; the force and number of these impulses depends on the violence of the cell action; if this is gentle there may be only a slight impulse passing off through the largest connecting fibre (the freest channel); if the action is violent it may overflow through the various connecting fibres in impulses increasing in force and number with the violence of the cell action.

If the foot of a sleeping (or deeply thinking) person is tickled it is quietly withdrawn; that is to say, the gentle skin irritation sends a gentle impulse to the sensory cells, which are gently excited, and send gentle impulses to a few motor cells; but if the foot be suddenly burnt, the sensory cell action, excited by the powerful impulse from the severely irritated skin, will be so violent that it will overflow through many more connecting fibres, and almost every muscle in the body

may be thrown into violent action, causing the person to spring vigorously away from the injury.

When we speak of higher loops ascending to the cortex, and when we remember that besides these loops the brain cells send off masses of fibres that ascend to the cortex and appear to end there, and when we ask what are the sources of the impulses that control these loops and fibres that are evidently the vehicle of voluntary actions, we are brought face to face with two great questions: "Is there a mind apart from the brain?" and "Can mind act on matter: or that which is immaterial on that which is material?" This subject cannot be wholly passed by, and must be here briefly touched on.

With regard to the second question Professor Clifford settles the whole point for us by the dogmatic statement that "To say will influences matter is neither true nor untrue, but simply nonsense." If this *ex cathedrâ* statement be true, I fear a good many of us talk great nonsense, and some of us will certainly do so to-night. Before answering it, however, let us consider our first question, as to the existence of mind apart from brain.

The existence of the will, which is the supreme assertion of mind, is proved by knowledge and experience. The formulæ, "*Cogito, ergo sum*," and "I know, I am, I can, I will," both express this. Feeling and thought and will are the only things we know to be real; all else is ascertained by our senses. The consciousness of effort as well as purpose in will is strong proof of its real existence. The contrary belief, that we are actually automatic, that voluntary actions are only so called because their automatic nature has not as yet been discovered, and that the mental phenomena that follow brain actions and movements, such as sensations of pleasure and so forth, are merely the products of such movements, or at any rate associates of them, as the melody is the result of playing on a harp, or motion the result of rowing in a boat, is negatived not only by experience but by the following considerations. Are we, for instance, as Dr. Courtney asks, "to consider that mental states are merely the products of movements of material molecules?" Is thought a secretion of the brain, or are we, in the words of Mr. S. H. Lewis and others, to speak of the equivalence and identity of mind and matter, so that thought and nerve action are two sides of the same thing, or to use one of the most recent similies, "that the mental and physical sensation

correspond as the convex and concave surfaces of a hollow sphere"?

The answer to all this in the first place (but by many this will be considered of no weight), is that such an idea is subversive of all moral principle.

In the next place we have the power of choice, selection, memory, and attention, all of which, when carefully analyzed and considered, have no correspondence with any form of nerve action.

Consider the faculty of attention. If all mental conditions (to quote Dr. Courtney again) were simply the material result or effect of molecular agitation of the nerves, it is difficult to say why some forms of nervous agitation should produce "attention," while other forms exactly similar should fail to get themselves registered within the brain. We are looking upon some landscape; we attend to some features in this landscape; we notice some particular tree or figure, or colour, not always because it is striking, but for some capricious fancy of ours. How can this be if there be not a mind within us with laws of its own, which has a nervous mechanism, but is not the slave or result of that mechanism? The Greeks decided long since that the mind was not the music of the harp or the motion of the boat, but the player and the rower.

A great attempt has been made to refer all actions to sensori-motor reflexes, that all organisms are merely mechanisms, but although we act often on impulse, we are equally conscious of acting against it, and of the mind conquering all the sensory solicitations of the body, and refusing to transmit the natural motor impulse that would have resulted had we had no will. The brain is certainly most carefully isolated from all external impressions —in a bony case, floating in fluid, wrapped in membranes— except those conveyed by the blood and nerve currents; and yet these totally fail to account for actions contrary to these currents, and we must superadd therefore, that it is acted on by mind.

The action of an automaton, moreover, is characterized by ease, that of mind by distinct effort, and the mental fatigue is never in proportion to the amount of work done, but as to how far that work is reflex, or automatic, or voluntary.

Again, if half the cerebrum is lost, half the powers of the body go, and yet the mind remains as a whole. Moreover the brain tissue is incessantly changing, and yet through all

our life we preserve the consciousness of the same personality. This cannot be through the medium of the body, which is not the same, but must be through an independent mind. The mind does not produce physical energy, but it guides and directs it, like a man on a horse. Dr. Carpenter says, "The influence of a great idea, conceived by a thinker in his closet in controlling the action of an entire nation, is utterly disproportionate to any conceivable play of molecular forces that can be exerted by the physical agency of the thinker putting his idea into speech or writing." There may be automatic thinkers, in whom the will is absent or undeveloped, but though the dominant power is absent, even such have mind as well as body. The existence of mind therefore and the freedom of the will may be said to be axiomatic truths.

And now to return to Dr. Clifford as to the relation of this mind with matter. Professor Ladd, in his *Physiological Psychology*, says: "The human brain is a vast collection of material molecules, whose constitution and arrangement is such as to connect them with certain forms of external physical energy.

"But they are also capable of standing in a yet more surprising and unique relation to a being of a different nature from their own, *i.e.*, the mind. These latter relations involve a causal connection, as truly as do the relations of the natural physical forces. That material molecules and a being of the kind called mind can be causally connected is indeed a mysterious fact; but because of its mystery it is not less to be acknowledged as a fact. The assumption that the mind is a real being which can be acted on by the brain, and which can act on the body through the brain, is the only one compatible with all facts of experience."

Neuroses, or nerve actions, produce psychoses, or mind actions; thus a prick produces pain. The light on the eye is a physical action, the impression on the sight centre a physiological one, the perception of it a psychical one.

The ordinary condition of the nervous system is that of a moderately charged battery that can be discharged by the completion of the circuit and re-charged by the blood. The will can complete this charged circuit. Mental causes can, as we have said, produce physical effects, and physical causes can produce mental effects. "We have every reason to believe," says Professor Bain, "that with all our mental processes there is an unbroken natural succession."

We must notice however, carefully, as to automatic

actions, that what we have power to will is not the action of certain muscles or nerves, but effects or results. The automatic machinery is all there; our will puts it in motion. The word voluntary muscle is therefore to a certain extent a misnomer, as few are under the direct control of the will. We cannot will the method but the result.

*Actions classified.*—Having then admitted that action may be originated in the body by a purely mental impulse called the will, we are now prepared to classify roughly the entire range of actions from the lowest to the highest in both body and mind. They are as follows:—

(*a*) Pure natural physical reflexes of three varieties:—

1. *Unconscious excito-motor actions*, generally called automatic because the exciting agency has not been discovered, such as the regulation of the size of the capillary blood-vessels, of which we are unconscious.
2. *Conscious excito-motor actions*, as the acceleration of the beat of the heart, producing palpitation, of which we are conscious.
3. *Sensori-motor actions*, such as laughing when tickled, when we are conscious of the causal sensation.

(*b*) Mixed physical reflexes, which are of three varieties:—

1. *Mixed sensori-motors and voluntary actions*, such as breathing, which, though generally reflex, can be controlled to a large extent by the will through the cortex.
2. *Deferred natural reflex actions*, such as the erect position, which is apparently learned artificially, but is really a reflex action not seen at birth, but of deferred development.
3. *Instinctive habits.* These are combinations of simple reflex actions for definite purposes, but without need of intelligence. They are best noticed in animals, as in the flying of birds. Pigeons can fly after the removal of the cortex. Frogs, when deprived of the cortex, can balance themselves on a board slowly turned round, and will croak when stroked, but never move voluntarily. At the same time if all the brain is taken away they can only execute simple reflex movements with their limbs. These

experiments show respectively the seats of reflex action (the cord), of complicated automatic action (the lower brain), and of voluntary acts (the cortex). It has been said by Romanes that instinct is partly due to lapsed intelligence. It may have come out of confirmed habits, and in this case mind must precede instinct and not succeed it. This carries mind a long way down the scale, and prepares us for Professor Ladd's remark that "automatism belongs to all living protoplasm." It is for this reason it is said, "an amœba has a will of its own."

Instinct appears to culminate in the articulates, such as ants and bees, while intelligent action culminates in the vertebrata, as man. The former are like barrel organs, and can only play certain fixed tunes, however complicated, while the latter are like organs that can produce any melody at the will of the player.

(*c*) We come next to *psycho-physical acts*, mixtures of mind and brain. These are :—

1. Artificial, or acquired reflexes or habits; these originating in the will became automatic by use, and are the chief subject of this paper.
2. Voluntary actions acting *with* physical impulses.
3. Voluntary actions acting *against* physical impulses.

(*d*) Lastly, we reach *actions purely psychical*, which we will simply enumerate :—*Reflex* ideas, desires, emotions, and perceptions produced by the mind without the will.

*Artificial reflex* thoughts started by the will, continued by association; and lastly, purely *voluntary* ideas and emotions.

Before now passing on to enquire into the nature of habit, let us pause for one moment to consider the wisdom displayed by fortuitous evolution (if such, indeed, be our origin) in the great fact that all the processes in our body are of a reflex or automatic nature that are connected with the mechanism of life, and are not subject to the control of our will, but proceed in a large measure even without our consciousness: while on the other hand all the actions of physical life or the expenditure of animal force is placed in the direct control of our will; so that while we have little or no share in the accumulation of our life capital, we have a

large control over its expenditure. I do not say "entire," because some is used in carrying on the natural functions of the body. Were the fact otherwise, and our will had to control the processes of physical life, life would indeed not be worth living, and intelligent existence an impossibility. The voluntary and non-voluntary systems form, as a whole, two well-marked centres of government, each having at its command the necessary nerves, muscles, and organs. In the former case the nerves are white and the muscles striped, in the latter the nerves are mainly grey or non-medullated, and the muscles plain or smooth.

What we have now to consider is how, in the evolution of higher intellectual life, we have the power at will to change voluntary into involuntary action, to an almost unlimited extent, by the formation of habits; a process important to be understood, and of the greatest bearing on the well-being and progress of the race?

*What habit is.*—Having therefore now briefly touched on a few of the leading points connected with the ordinary action of the nervous system, we proceed to consider the direct subject of this Paper, "the formation of habit in man." Let us first of all see what we mean and understand by "habit."

It is difficult to conceive of habit with reference to inanimate objects, and the word is no doubt to some extent inapplicable, and yet it is an interesting question as to what are the limits of its sphere of action.

Are the very laws of motion the result originally of habit? Are the chemical combinations of elements and the formation of different constant natural compounds and mixtures the result originally of long repeated repetition forming at last habits with cast-iron bonds that cannot be broken? Again, do we not see in an old dress, even in a room, a something that speaks of habit, an adaptability of shape and crease from constant wearing and use, or of fittings and furniture, that cannot be seen in a new coat or in lodgings? Does not an old violin that has been the property of some great master (not only made by some great maker) retain in its very fibres the habit of resounding to the grand chords he struck with far greater ease than any instrument that had not acquired this "habit" by long use? Passing on to living things. Do not trees acquire habits of growth from their environment, and in the lower forms of animal life does not this open up the whole of the great question of the formation of natural

reflexes or automatic action and instinct? Are the rhythmic pulsations of the jelly-fish or the movement of an amœba the outcome of purely reflex action, or were they at first voluntarily acquired habits passing by long use into hereditary reflexes?

In the marvellous labours of the ant and bee instinct seems to have reached its apogee. Do they, as Romanes suggests, speak to us of a lapsed intelligence that having by long use formed all needed habits, has ceased to act when these have been crystallized into instincts? These questions, fascinating and interesting though they may be, are unanswerable in our present state of knowledge.

Habit in man, as generally understood, means an act or thought, or sensation, or any combination of these, simple or complicated, that has been sufficiently often repeated to no longer require the same intelligence and will-power for its execution that were at first needed. It thus becomes an acquired or an artificial reflex.

Nearly all natural instincts in animals have thus to be formed as artificial reflexes in man. In man artificial habits formed at will replace instincts of a fixed character, or, if you please, voluntary habits replace automatic habits. Routine is living by habit. We sow acts and we reap habits; we sow habits and we reap character; we sow character and we reap destiny. Habit has well been called the railroad of character. Habit is physical memory. Memory is psychical habit. Character is organized habit. It is wonderful to note that even fixed habits that have passed (as we have suggested) long since into instincts or reflexes, can be modified by environment. It is the habit of all ova to build organisms in accordance with certain exact laws. But the ovum of a working bee that would produce a working bee is made to produce a queen bee by altering its food and feeding it on royal bee bread.

*The force of habit.*—The force of habit is, however, very great, and is only short of natural reflexes, which are omnipotent in the body. No power of mind or will can stop the beating of the heart or the movement of the stomach, and a habit may be so formed as to be almost as difficult to check. Darwin found he had acquired in common with most men the habit of starting back at the sudden approach of danger, and no amount of will-power could enable him to keep his face pressed against the plate glass front of the cage of the cobra in the Zoo while it struck at him, even though

he exerted the full force of his will, and his reason told him there was no danger.

The Duke of Wellington is credited with the dictum that habit is as strong as ten natures, and certainly to see what a soldier will do and is worth in a campaign when seasoned and well drilled, compared with a raw recruit, one feels that this statement is under rather than over the mark; for he owes all his value to "habit"! If an established habit is broken by the will the lower centres rise up in rebellion, so accustomed are they to the easy yoke of that which has been often repeated, that the effort of control required, as is the process of breaking a habit over lower physical centres, often extremely painful.

*Physiology of habit. How formed.*—Referring to the description of the brain in childhood it will be remembered that it is something like a wide common over which are traces of many ancient tracks but no fresh paths. Habit strikes out fresh paths if the result of education, or re-forms old ones if they are the outcome of heredity. In all cases of true artificial reflexes or habits the will is the starting point, and a purely voluntary action takes place. This is repeated continually until, as C. Bastian and others believe, not only is a well defined brain path established between the arbitrarily associated groups of cells, but this path is physiologically present in the brain in the form of nerve threads or fibres; or in the graphic language of Dr. Michael Foster: "The will, blundering at first in the maze of the nervous network, gradually establishes easy paths. When once this is effected the slightest impulse seems to start the nerve current along the whole of the associated groups and produce the habitual action. The nerve current follows this route not now because it is guided by intelligence, but because this route offers the least resistance from habitual use."

There are one or two interesting points in the formation of a habit.

In the first place the action must never be varied even for a day. If it be the learning of some steps in dancing they should never be changed till fixed in the brain. Again, it is of great importance, and this has a very wide application to the training of children, that the habit be taught and executed accurately. If the steps are taught in a slovenly way they will always be executed in a slovenly manner.

If a child learns sometimes that two and two make five, and at other times that they make four, there will

always be confusion in the mind or brain paths as the case may be.

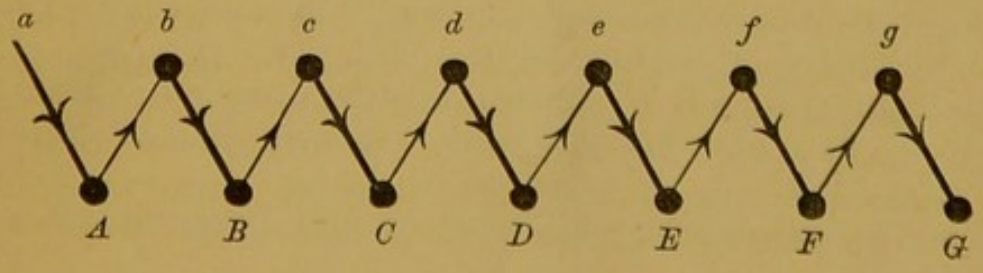
Again, there is a great tendency in the young for all repeated acts to become fixed habits, as in making grimaces, or the use of slang words.

In those whose mind is not developed this is far more marked. All such cases are creatures of strong habit and routine, and they like everything done at the same time each day. Miss Martineau tells us of an idiot who required any new thing done to be repeated at the same hour each subsequent day. His hands were washed and nails cut at 11.10 one morning, and next morning at exactly the same hour he came to have it done again, and yet he had no knowledge of time, and could not tell it on a clock. There must have been some very accurate unconscious cerebral process that told him when the twenty-four hours had elapsed. If seven sweets were given him one day, he would take neither six nor eight the next.

Again, fresh nerve paths tend to consolidate apart from actual repetition. A new task learned on the Saturday becomes easier to perform each morning than it was the night before, and easier still on Monday morning than it was on Saturday evening. The Germans go so far as to say that we learn to skate in summer and to swim in winter. What is exactly meant is that having been taught skating one winter, we go on learning it unconsciously all through the summer, or that we begin much better next winter than we left off at the end of the preceding one.

Attention in the formation of the habit seems greatly to deepen its impression on the brain, and make it much more easy to establish. A good memory, which is a psychical habit, is thus established by attention.

*Results of formed habit.*—A formed habit of average complication produces a sort of reflex peristaltic nerve current between the associated groups of cells. Supposing it is a question of learning the clog dance and alternately tapping the floor with the toe and heel in rapid succession, the process is somewhat like this—



The small letters being sensory, and the capitals motor centres connected by the nerve threads of habit. The will starts the nerve for this step by placing the toe on the ground by an impulse from *a* to *A*. Before the habit was formed this would be all, but now it is but the first link in a long connected chain, along which the nerve current passes with great rapidity. The moment the toe strikes the ground, the sensation is passed to the brain along *A b*, and this is reflected as a motor impulse to strike the heel along *b B*. This in its turn producing a sensation along *B c*, starts the motion of toe-striking along *c C*, and thus the motion continues till stopped at *G* by the fiat of the will.

Once a habit is well established on such lines as these, the interference of will or mind only spoils its perfect action. Whenever knitting has become automatic, if you think about the formation of each stitch, you have to knit much more slowly, and are more liable to make mistakes. A fixed habit is thus deranged by volition.

The more fixed a habit becomes, the less of the body is required to execute it, and thus a great economy of force is effected. In commencing piano-playing, the young performer plays with her hands, and arms, and body, and legs, and head, and often her tongue. As she forms a perfect artificial reflex, less and less of the body is moved, until at last it is literally nothing but the hands and wrists that are engaged, the brain being at perfect rest, or thinking of something else altogether. Habit is thus of great economic value.

Habit which is physical memory is of such importance to character that a spinal cord or brain without such memory is either idiotic or infantile. Artificial reflexes last long if well formed. In early life Robert Houdin, the conjurer, trained himself in the difficult habit of reading aloud while keeping four balls going in the air. He did not practice this for many years, and yet after thirty years found he could still read and keep three balls going. Any one who tries this feat will understand its difficulty.

Artificial reflex habit resembles respiration, and still more coughing, in that these occur naturally by reflex action, but can be modified or stopped by the will.

Habits, in spite of Weissman, formed during life strongly tend to become hereditary. This is clearly seen in the love of strong drink.

*When to form habits.*—The easiest and best time to form

habits is in the growing structure in early childhood, notably from fifteen years of age. The earlier the period that habits are formed the more lasting are they, and reappear at a late period of life when other habits acquired since have passed away. Plasticity of brain is essential, that is, tissues weak enough to yield to influences, and yet strong enough to retain them. After the brain is fully developed, that is, after thirty, or perhaps later, to acquire new habits or to give up old becomes alike more difficult. In old age we find, as we have said, that those habits that are acquired last, are lost first. As a rule, personal habits are acquired before twenty, professional habits between twenty and thirty.

*Physical habits.*—Let us now consider a few leading habits, physical, mental, and moral.

Physical habits that modify natural reflexes. Thus, one may get accustomed by degrees to digest indigestible things, or to tolerate an excess of alcohol, or to blush very readily, or not at all, or to vomit at the sight of certain articles of food, and so on.

Or physical habits that are new products altogether; that is, real artificial reflexes. These are innumerable; they extend through all our being, are insensibly being formed whenever an act is repeated sufficiently often, and are often only detected when it is too late to alter them.

They are amazing in their intricacy and variety as well as in the extraordinary ease they give when once firmly established in the performance of the most difficult and at first impossible tasks.

The old adage,—

"If at first you don't succeed,
Try, try, try again."

simply means, if a thing is too hard to do, establish a habit and you will accomplish it.

I would repeat here that in what we call voluntary actions all we do is to will a result, as of raising the hand to the mouth. The ease with which we do it and indeed the power to do it all arises, not from our will-power being able to control the so-called voluntary muscles, but in their being already associated for the purpose by long established habit. Where no such habit exists an action becomes well nigh impossible, however strongly it may be willed. By long habit, hereditary in nature, we always swing our right

arm with the movement of our left leg, and the left arm with the right leg. Let any one *will* the contrary, *i.e.*, to move the right arm with the right leg and *vice versâ*, and however strong the effort of will may be, they will find in the end that it is powerless to overcome this established habit, except most awkwardly, and for the shortest time. The intense difficulty of the one movement and the perfect ease of the other, both in themselves equally easy, is most striking.

Let any one *will* to play the violin, or piano, or to skate, or swim, or in short to do anything that requires the formation of habits, and they will see it is impossible ; and that to do so at all a habit must necessarily be formed for the very purpose : and then behold ! the thing which was impossible before is executed with almost contemptuous ease. Few of us know what bundles of habits we are, and we imagine many of our actions to be voluntary which are really artificially automatic. Let any man over forty try to wash and dress himself in any but the accustomed order, and he will see what difficulties arise. He may not know the order in which he washes his face, but the hands know. He cannot tell which arm is put into the coat first, but the arms know. He cannot tell which foot is put into his stockings first, but the feet know. Before I begin to dress, from long habit I am almost compelled to pull up the blind a certain exact height, and if I fail to do so, I feel an inward impulse that is not satisfied till it is obeyed.

Consider the habit of shooting ; the perfect ease with which the trained sportsman, the moment the grouse rise, aims and fires well nigh automatically at the birds, who themselves have acquired *fin-de-siècle* habits (as Sir Joseph Fayrer told us) in learning to avoid the telegraph wires as they fly, which in earlier times they always struck against.

Look what an automaton a soldier becomes ; so that the very dinner he may be carrying, as Huxley tells us, is dropped unconsciously into the gutter if he hears that magic word "'Tenshun," which in his mind is so associated with his little finger and the seam of his trousers that his hands at once fall to their allotted place. But time would fail us to describe the marvels of physical habits, and we must pass on, especially as we have still greater wonders in store.

*Mental habits.*—Habits of thought are as truly and readily and often unconsciously established as habits of body, and indeed the two are sometimes inscrutably mixed ; as in

character as displayed in handwriting as well as in the lines that habit has traced upon the face, rendering physiognomy a true science. We have also ideal habits, and here as elsewhere habit means ease.

*Attention* may be deliberately manufactured as a habit by the inattentive. For this is the charm and value about habit; that if we begin soon enough, and particularly in childhood, and pre-eminently before the age of ten, we can absolutely engraft into the child's character many of those valuable mental qualities which it may lack. The habit of *enquiry* is easily acquired in young life, and is invaluable in after years, and simply means going through life with one's eyes open instead of shut.

The habit of *perfect execution* is invaluable, but must be taught early. Perhaps no other mental habit leads to greater success in every calling in life. Sloyd is the physical means by which this habit is best taught in childhood; for the essence of sloyd is not what is made, but that it should be perfectly finished in all its parts.

*Industry* is another invaluable habit.

*Moral habits.*—But we must pass on to moral habits. Now if we wish to produce some valuable moral quality in a child, the easiest way to do it is to establish the quality as a habit; the most difficult and uncertain is to depend on direct precept. To be always telling a child to be truthful is a poor way of making him so; but to accustom him to use his words in talking exactly as a painter uses his colours in painting, so that his word picture shall be a faithful copy of what he is describing, painted in words instead of water colours; this persevered in, will give him the habit of truthful speaking as a fine art, apart from its moral value, which of course will only strengthen the habit. In a similar way most moral qualities can be formed as mental habits—deliberately, surely, and easily, as compared with any other method; and if sufficiently well established, it is harder to depart from them than to display them. Thus decision, self-control, obedience, self-respect, unselfishness, courtesy, reverence, can, one and all, be formed by frequent repetition in early life. We know nothing of the mind tracks that ensure their permanence; all we know is that they are as sure and lasting as physical habits.

In this connection those words of Holy Writ derive an added meaning: "Train up a child in the way that he should go, and when he is old he will not depart from it," for we would add "because he cannot."

*Value of habit.*—And now in bringing these fragmentary remarks to a close, let me point out first the value of habits as a whole, and lastly their drawbacks; for they have drawbacks.

Habit is economical. It has been well described as using the interest of nerve energy instead of the principal. The absence of fixed habits is misery, and is the source of nearly all indecision of action and of character.

Habit alone enables things otherwise impossible to be accomplished, such as playing the flute, violin, or piano. But for habit we should spend a whole day in doing one or two things with great fatigue of mind and body, such as the continued effort to balance the body in the erect attitude by sheer force of will, or to read a book, or to walk.

Habit gives speed, accuracy, and ease. The will, as we have seen, can only set habits in motion, and is powerless to act when such do not exist. The unconscious ease of a well-formed habit has been well illustrated by fixing a wafer on a looking-glass, and while keeping the eyes fixed on it, moving the head in a circle. The eyes will be seen to be moving in every part of the orbit, but cannot otherwise be known to move at all: so unconscious and without effort is the action of the complicated muscles that move them, which by the way are all so-called voluntary muscles.

Habit forms character, or at least a good deal of it. Up to a certain point our character is formed *for* us by heredity, beyond this it is formed *by* us by habit. Skill is entirely the result of habit. To seek to be ambidextrous is folly. Specialism is everything in the body, and the habits that suit the right hand do not suit the left, nor the left the right. The left hand is just as awkward with a knife, as the right is with a fork. Some callings may require a certain measure of ambidexterity, but it is against all true development, and is common in idiots.

Habit adapts us to our environment, without which we should die. A bookbinder in a little den in Paternoster Row is as happy and healthy as a farm labourer in the Midlands. Each has become adapted to his environment by habit. Let them change places, and the chances are both will die. Sir Charles Lyell tells us of some English greyhounds exported to South America for coursing hares on a raised plateau some 6,000 feet high. They were useless on account of the unaccustomed rarity of the air, but they produced pups who could course as well as the dogs of the country

from a formed habit. Some habits are the offspring of necessity, others of caprice.

*Drawbacks of habit.*—But there is another side to habit that must be alluded to in conclusion, and that is its drawbacks. An illustration will explain this. In suburban dwellings, with a garden and locked gate in front, there is often an arrangement by which the gate can be opened from the house by pulling a handle that raises the gate latch. When the gate bell rings in the hall it is equivalent to a sensation reaching a conscious brain. The maid then comes and looks out to see who is there before she pulls the handle. If it is a person she wishes to admit, she pulls the handle which lifts up the gate latch. The maid is the mind which considers the impulse received by the brain, and does not send a motor impulse until the will determines what shall be done. This is a type of a pure voluntary action.

If, however, to save herself trouble, the girl fastens the wire that should ring the bell round a pulley in the hall to the wire that opens the gate, the result will be that when a man pulls the bell handle, he rings no bell but opens the gate by a reflex action. This is the formation of an artificial reflex, only it cannot be thus made at once by the will but must be gradually formed by frequent repetition. The advantages of the voluntary action were—the maid could admit whom she pleased, and none could enter without her knowledge and consent. The drawbacks were—it took her nearly all her time to answer the bell, and the man had always to wait for a time at the gate.

When the action is changed into a reflex one, the advantage is that the man is never kept waiting, for pulling the wire opens the gate, and the servant never has to answer the bell. The disadvantage is she no longer knows or can control who enters the garden. Habits thus may become our masters. There is a story of a lady engaged to play at a concert who took too much at supper, and the result was she not only kept on playing too long, but whenever her fingers rested on the keys she started playing like an automatic musical box, and could not be stopped. Girls who drill holes in buttons in Birmingham are said during their dinner hour as they pass along the streets to be constantly continuing unconsciously the same movements with their fingers.

Habit is often used to excess with bad results. Hammer-palsy arises from incessantly using the hammer in making

knives till the associated group of cells is worn out, and paralysis sets in; writers' cramp is another illustration.

Habits that have become unconscious may be put in action by using wrong stimuli. When dressing for dinner one frequently winds up one's watch by mistake, and some in changing their clothes have gone to bed unconsciously.

A bad habit is a terrible thing when thoroughly fixed. Swearing is a good example of this, and of the tenacity of a habit when firmly established.

Habit blunts the feeling both as to right and wrong, and as to pleasure and pain, and when purely automatic abolishes it. A man may get such an inveterate habit of lying as to lose all sense of evil. So with other sins.

A person travelling or yachting takes great pleasure in it at first, but if he is ever doing this and gets into the habit of the thing, it loses its charm.

Games amuse when occasionally played, but when they are incessantly pursued, and an automatic habit is established, a large amount of the pleasure goes.

Habit may induce error, as when at the close of the year from long habit the same date is carried on into the next year, until the new habit overcomes the old.

Such then are some of the pros and cons of this important variety of brain action, and I must now leave the matter in your hands for discussion, asking in conclusion your forbearance if I have wearied you with details which some here know far better than myself; or if in using more popular language than is perhaps general in this learned atmosphere, I may have failed somewhat in preserving the high standard of preceding papers.

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