MANUAL TRAINING:

ITS EDUCATIONAL VALUE.

BY

Thomas M. Balliet,

Superintendent of Schools, Springfield, Mass.

[An address delivered before the Massachusetts Teachers Association, at Worcester, Mass., Nov. 30, 1895, and published by the Association.]

MALDEN:
Geo. E. Dunbar, Printer, 382 Main Street.
1896.

Mr. Chairman, Ladies and Gentlemen:

The subject of manual training is altogether too large a one to be discussed in all its phases in a single hour; as its practical value is well understood and quite fully appreciated by the public, I shall limit this paper to a consideration of its purely educational bearing. This will involve the discussion of three questions: 1. What is the effect of manual training on the brain as a physical organ? 2. What is its effect on thought and intellectual growth? 3. What is its effect on the will and on character?

The human brain is a double organ, the right half being in communication mainly with the left half of the body, and the left half of it mainly with the right half of the body. Each half consists of an outer layer composed largely of nerve cells and an inner substance consisting of nerve fibers. Strictly speaking, these fibres are only outgrowths and continuations of the cells and are not distinct from them. It is the function of the cells to generate nerve energy and of the fibers to conduct it. These fibers are the means of communication either between different cells in the same hemisphere; or between cells in one hemisphere and those in the other; or between cells in either hemisphere and those in the spinal cord, and through the latter with the peripheral parts of the body. Whether the fibers which establish functional relations between cells are anatomically continuous from one cell to another, as the older anatomists used to teach, or whether they effect this functional relation by mere contiguity, as more recent investigations seem to indicate, is a question which is not vital to this discussion.

Neurologists tell us that whatever may be true of the brains of the lower animals, the number of cells in the human brain is unalterably fixed long before birth, and is therefore not increased either by physical growth or by education, as was formerly supposed. These cells, although all present at birth, require a long process of development before they reach that stage of maturity which enables them to function. A part of this process consists in the actual growth of the cell through nutrition and cell activity, and another part consists in the putting forth and growth of the connecting fibers with their medullary sheaths which will place the cell in communication with other cells. The proper development of connecting fibers is as essential to a well organized brain as the development of the cells themselves. The power and efficiency of a human brain depend not so much on the absolute number of cells present at birth as upon the number which are afterward developed to the point where they may be functionally active. This is mainly a matter of nutrition, of hygiene, and of education in the broadest sense of the term. It follows from this that actual brain power is less dependent on mere size and weight of the brain than on its thorough organization. It also follows as a corollary that the schools have it in their power, in effect, to "furnish brains" to pupils, if they develop into functional activity cells which otherwise would have lain forever dormant. It is probable that the number of cells which might develop into functional activity in the case of any human brain is greater than the number which actually does develop, so that the possibilities of education, using the term in its broadest sense, are not restricted within narrow limits.

The cells of the brain which we need especially to consider in connection with manual training are of two classes—sensory and motor. The sensory cells receive the different impulses which come from the special senses and those which come from the skin and the internal organs of the body. The motor cells generate the nerve energy which causes the muscles to contract. These cells are grouped together in different portions of the brain. Speaking generally, the rear lobes of the brain are sensory and the central lobes are motor. These areas are again subdivided. There is in the sensory area, a visual center, an auditory center, and probably a more or less specialized center for each of the other special senses. In the motor area, there is a distinct center for the arms, the trunk and the legs. In the arm area there seem to be specialized groups of cells for the movements of the fingers, the wrist, the fore-arm and the upper arm.

To speak more accurately, however, I ought to say that no part of the areas designated as "sensory" or as "motor" is either exclusively sensory or exclusively motor. In all these areas there are pathways for both afferent and efferent impulses. The so-called sensory area is predominantly sensory and the motor area is predominantly motor.

It is a striking fact that the area for the arm and hand is very much larger than the area controlling any other portion of the body of equal size, except the face. This seems to be due to the fact that it requires a very large number of cells to effect the fine adjustments and delicate coordinations of the muscles of the hand in its infinite variety of movements.

Nerve cells grow and develop like any other part of the body —through nutrition and functional activity. The visual cells develop through seeing, the auditory cells through hearing, and so with the rest. The visual area in persons born blind, or blinded in early life, remains in a rudimentary condition through life.

In the case of Laura Bridgman, who became blind and deaf in early childhood, the auditory and visual brain areas contained an excessively large number of undeveloped and partially developed cells. Gudden, a swiss physiologist, has shown that if the eye of a young pigeon be enucleated, the visual center in the brain is found soon afterward to have wasted away.

From this it follows that the exercise of the special senses is necessary for the proper physical growth of the brain. It also follows that sense training, in so far as it is a physical process at all, consists not in training the external sense organs, but in developing their brain centers.

Like the sensory cells, the motor cells develop through exercise. It is the function of these cells to generate nerve energy to contract the muscles, and thus to produce and to co-ordinate muscular movements. Voluntary muscular movements have therefore the effect not only of exercising the muscles involved, but also of calling into activity the motor brain cells which control them. Indeed, these motor cells cannot be made to act and develop except by means of the muscles; and muscular exercise, whether in the way of ordinary labor, of recreation, of gymnastics, or of manual training, is absolutely indispensable to the proper development of the motor area of the brain. "It is a common observation," we are told by one of the highest authorities, "that in persons who have been long bed-ridden by chronic disease, and debarred from all muscular exercise, the whole motor area of the brain is, after death, more or less atrophied and water-logged. It is unquestionably essential to the welfare of all motor-centers, and especially of the large and complicated motor centers of the hand, that the parts with which they are immediately connected should be used in an active and varied manner." Moreover this exercise of the motor cells must come during the period of brain growth if it is to be most effective, and the lack of such exercise during this period is a matter of very serious consequence to the brain. It has been found that the amputation of an arm or a leg after maturity has been reached, is not nearly so detrimental to the corresponding brain center as a like amputation in childhood.

Several corollaries may be safely drawn from these truths. First, the brain has a motor significance as well as a sensory one. It is not only the organ of the mind, but also a battery in which is generated the nerve force that moves the body. In the lower animals, this motor function is perhaps the more important of the two. Large animals, like the whale and the elephant, need relatively large and finely convoluted brains, not because of their superior intelligence, but because they have a large mass of muscles to contract and to co-ordinate in locomotion. Indeed, in the animal series, size and weight of brain seem to depend more on size of body and complexity of muscular system than on intelligence. In man, the size of the motor area in the brain depends far more on the complexity of the movements effected by a group of muscles, and on the fine co-ordinations of these movements, than on the mere mass of muscles involved. Hence the motor significance of the brain in man remains great, although it is overshadowed by its function as the organ of sensation and of thought. Physical energy implies a good motor brain area. The man of energy must be a man of brains, no less really than the man of thought, and physical laziness implies a deficiency in the motor part of the brain. With the stolidity and the stupidity of the savage, there goes also his inveterate laziness.

In the second place, it follows from what has been said, that the popular distinction between "brain work" and "manual work" is a false one. There is no form of manual labor which is not at the same time, to a greater or less extent, brain work. The difference between " manual work " and " intellectual work," so far as the activity of the brain is concerned, is simply one of degree, and one of predominantly motor or of predominantly sensory or central activity.

Physiologists distinguish muscles as "fundamental" and "accessory." The fundamental muscles are the large masses of muscles used in locomotion and in performing movements requiring strength rather than fine adjustments and delicate co-ordinations. They are, for the most part, the muscles which we have in common with the lower animals and which we have probably inherited from our forefathers who dwelt in trees. The "accessory muscles" are those which involve fine co-ordinations. They are principally the muscles of the forearm and hand, and those of the vocal organs. Now it might be argued that manual training is not necessary for the development of the motor centers in the brain on the ground that gymnastics and outdoor physical exercise are quite adequate to accomplish it. The answer to this objection is the fact that gymnastics and physical exercise in general, appeal almost exclusively to the fundamental muscles and their brain centers and rarely to the accessories. Nothing short of manual training will reach effectively the important brain cells governing the fine motor adjustments of the muscles of the hand, as nothing short of actual speaking and actual singing can ever effectively develop the equally important brain cells governing the muscles of the vocal organs. The motor cells controlling the muscles of the joints nearest the trunk develop first, and later, in regular order, those which control the muscles of the more distant joints. Education ought to follow this order of growth; it should avoid training the fingers to make finely co-ordinated movements at a period when nature has not yet got beyond developing brain cells to make the coarser adjustments of the shoulder and elbow joints. Physical training, which appeals to these more fundamental muscles of the proximal joints, should at first precede manual training, which appeals especially to the muscles of the forearm, hand and fingers. This is a principle which Seguin followed twenty years ago in the training of the feeble-minded, and is just beginning to be recognized as a principle equally applicable to the education of all persons.

But its purely physical effects on the brain, important as they are, do not constitute the most vital significance of manual training. To justify it solely as a peculiar kind of physical exercise would probably be as wide of the mark as to find the chief significance of alms-giving in the fact that the act of giving develops the muscles of the arm.

What does manual training contribute to the development of the mind? Light strikes the retina of the eye and the impression is conveyed to the visual cells in the brain, where a sensation of color is produced. These cells, after having been stimulated many times, acquire the power of reproducing these sensations in the form of ideas. These ideas are analyzed, compared, put together in new combinations, and finally become a part of the mind's organized body of knowledge. Impressions of sound are received in like manner through the ear, and the sensations which they produce are developed into ideas which finally become an integral part of thought. The same is true of the other senses. The products of the different senses furnish in this way the material out of which and by means of which the higher thought products are developed.

Can manual training make any similar contribution to the mind's fundamental or basal conceptions? When we move a part of the body we can feel the movement; and without the use of the sense of sight we can tell accurately the position of the part moved. We can tell by mere motor perception the exact posture of any part of our body even when it has been moved, not by our own will, but by an extraneous force. The inner surfaces of the joints, the muscles and ligaments, are supplied with sensory nerves which conduct to the brain sensations of movement which form the basis of direct motor perception, just as sensations of light and sound form the basis of the perception of color and tone. These motor percepts are developed into motor ideas; which like ideas of light and tone, enter into the higher thought products and become a part of the warp and woof of the mind's organized body of knowledge—the only kind of knowledge which is power.

Just as all the conceptions into which ideas of color enter must be imperfect, and all the thinking based on them inaccurate, if these ideas of color are not developed, or are entirely absent, as in the case of the congenitally blind; so all the conceptions into which motor ideas enter must be imperfect and the thinking based on them inaccurate, if these motor ideas are but vaguely developed.

Motor ideas are developed by all forms of voluntary muscular movement with any part of the body,—by ordinary work, by play, by gymnastics, and by manual training. All these are, therefore, means of motor training. But the large motor area in the brain, governing the infinitely varied and complex movements of the hand, shows that this organ is by far the richest source of motor ideas, and especially that portion of it little appealed to either in gymnastics or in ordinary unskilled labor—namely the five fingers and their many sensitive muscles and joints. The hand is therefore a special sense organ somewhat like the eye and the ear, and an untrained hand is in many respects as unfortunate a limitation as an untrained eye or an untrained ear.

Whether the motor sensations are perceived by specialized sensory cells in the brain, like the sensations of light and sound, or whether the motor cells have also a sensory function, and receive directly these motor sensations as well as generate the different motor impulses, is a question with which we need not embarrass this discussion. Consciousness testifies to the existence of these motor sensations and ideas in the mind, no matter what the nervous mechanism may be through which they enter it.

There seems to be, however, considerable evidence, from the field of pathology, which tends to show that the motor sensations are received in the brain by specialized sensory cells, distinct from the motor cells. Demeaux reported a case, over 50 years ago, which is typical of many others since observed. It was the case of a woman, affected with partial cerebral anaesthesia. He describes it as follows: "She moved the limbs voluntarily, but she had no sense of the movements effected. She did not know in what position her arm was, nor could she tell whether it was flexed or extended. If she were asked to touch her ear, she immediately executed the proper movement, but if my hand were interposed between hers and her ear, she was quite unconscious of the fact; and if I arrested her movement in mid-career, she was utterly unaware of it. If I tied her arm to the bed without her knowledge, and asked her to raise it to her head, she made an effort and then ceased, believing that she had done what was wanted. If I told her to try again, pointing out that her arm had not been moved, she made a greater effort, and only when she had to throw the muscles of the other side of her body not affected with anaesthesia into action, did she become aware that some obstacle had been interposed."

This and many similar cases would seem to indicate that the sensory function which may thus be lost does not reside in the motor cells whose motor function is not affected. Indeed, Ferrier goes so far as to say dogmatically that "the cortical centers for the movements of the limbs are concerned purely with efferent impulses, and are clearly differentiated from the paths and terminal centers of the afferent impressions on which muscular discrimination is based. The destruction of the afferent, or sensory centers, abolishes muscular sense, though the power of movement remains. The destruction of the efferent or motor centers abolishes the power of voluntary movement only."

Motor perceptions and ideas are gained through muscular movements. Let us notice how they develop and what their reflex effect is on these very muscular movements themselves. I try to hit a mark with a stone. My first effort sends it beyond the mark; my second not quite to it; my third becomes more accurate, and perhaps my fifth or sixth effort will exactly hit it. After I have once hit it, I find it comparatively easy to hit it again. What is the explanation of this common experience? In throwing the stone the first time I made a guess as to how much muscular effort was required to send it to the mark. When I come to throw it the second time I recall the muscular feeling which accompanied the first throw, and construct in my imagination a motor feeling in the form of effort which will send the stone a shorter distance. I again and again correct this imagined motor feeling, or idea, until I hit the mark. After that I remember as accurately as I can the motor feeling which accompanied the successful throw, and find it comparatively easy to hit the mark again and again.

From this we may deduce the proposition that motor ideas are not only developed by muscular movements, but that it is motor ideas which guide voluntary muscular movements. The element of apperception enters into motor training, just as it does into all other forms of sense training. Just as we "see with all we have seen," so we perform muscular movements with the help and under the guidance of the very motor ideas which similar movements in the past have developed. From this becomes obvious the important truth that manual skill does not reside in the hand, but primarily in the brain and in the mind; that manual training is but another form of mental training, and that the hand is but a sixth sense,—an additional avenue to the mind.

To speak of an education which "trains the mind *and* the hand," is, therefore, to show an utter misconception of the function of manual training. Well co-ordinated muscular movements of the body imply a well organized brain, a brain with well developed motor functions. Imbecility affects muscular movements quite as much as it affects thought and speech, and the hand of the idiot is unable to acquire skill, not because it is imperfectly formed, but because the brain centers controlling it are so defective as to be unable to develop accurate motor ideas.

Motor ideas form the basis of manual skill. The degree of skill depends primarily on the number, variety and accuracy of these ideas. From this it follows that exercises in a manual training school must involve a great variety of movements; and, furthermore, that these movements must be as accurate as possible. The sacrifice of accuracy is the sacrifice of almost everything in such training, not simply because habits of accuracy must be developed—habits which can also be learned outside of the manual training school — but because the only way in which accurate motor ideas can be developed, is by means of accurate muscular movements. This is a kind of accuracy which cannot be learned elsewhere; and inaccurate motor ideas vitiate all after thinking based on them, just as inaccurate ideas of color vitiate all later thinking based on these. A stream of water may become clear although its fountain be turbid, a current of thought never; for a stream of water is made turbid by bodies foreign to the water, a current of thought by imperfections in its own constituent elements. Clear and accurate thinking can never result from vague and inaccurate sense-perception, whether of the eye, of the ear, or of the hand.

It is clear, too, that manual training exercises must be carefully graded. Motor ideas develop in a certain order, just as ideas of color and of tone do. As in developing ideas of color we begin with the fundamental colors and then pass on to the shades, tints and hues; so in manual training there are fundamental exercises which must precede those involving fine motor perceptions and complex motor adjustments.

It is a matter of no little moment to decide, on scientific grounds, what kinds of manual work are educational and what kinds are not; in short, what kinds of manual exercises are to be introduced into a manual training school. Large groups of muscles are more easily contracted than small groups, and the fundamental muscles are more easily contracted and co-ordinated than the accessories. A boy ought to write only with the muscles of his arm and hand, but in his first attempts he contracts muscles all over his body, and twists out of shape even many of the muscles of his face. It requires less skill to grasp the handle of an ax, using all the muscles of the hand and arm, and chop wood, than to seize a penholder by means of two fingers and the thumb, and perform the act of writing. What we commonly call "unskilled labor" involves large groups of muscles, and mainly the fundamental muscles with their coarser adjustments, whilst "skilled labor" involves small groups, and in the main the accessory muscles with their finer adjustments. Unskilled labor, therefore, develops but few and crude motor ideas, skilled labor on the other hand develops accurate motor sensations and ideas, and fine co-ordinations of muscular movement. The latter alone is educational. Indeed, the heaviest kind of manual labor dulls the motor sensations and makes men stolid. Human beings are not educated by being made beasts of burden.

This, again, enables us to determine what kinds of tools are to be used in a manual training school. The ax, the crow-bar and the pickax have no place in such a school; they appeal to large groups of muscles, and require but crude motor co-ordinations. On the contrary, the jack-knife, the chisel, the saw, the hammer, the jack-plane and the lathe appeal to small groups of muscles, and require accurate motor ideas and delicate muscular co-ordinations.

I have been speaking of the brain only. The spinal cord also must be considered in education. Some writers have supposed the spinal cord to be endowed with a dim sort of consciousness, and they have spoken of the "soul of the spinal cord." This is more than doubtful, but it is certain that the cord cannot be ignored in studying educational problems. The spinal cord is made up of sensory and motor cells in the center, and of conducting fibers in the outer portions. Many impressions made on the senses go no further than the cells in the cord;

they never reach the brain. You tickle the foot of a good-natured friend when he is asleep; he draws it back without waking up, and without being conscious either of the tickling or of the movement. The impression was carried from the skin along sensory nerves to the sensory cells in the cord. From there the nerve energy traveled to the motor cells, and thence along motor nerves to the muscles, causing them to contract. It never reached the brain. Such an act is called a reflex act. The spinal cord is the organ of reflex action. Many acts at first require conscious action of the brain, but later become habitual and unconscious. Such acts are relegated by the brain almost wholly to the basal ganglia and the cord; they become almost identical in character with strictly reflex acts.

In this way the brain is relieved of much work. To illustrate: At first a child uses his brain in walking, later he can walk from habit, and walks therefore with his spinal cord. At first we spell with painful consciousness, later we spell familiar words of our vocabulary with little or no consciousness. Children ought to be trained to write and spell mainly with the spinal cord, and use all their brain power in thinking the thoughts to be expressed. We do many things with the spinal cord to relieve the brain. We walk with the cord, we write and spell with the cord; I suppose we knit and gossip with the spinal cord; indeed we may sing and pray, not with our hearts, nor with our brains, but with the upper part of our spinal cord. We tip our hats to each other, not with our brains, but mainly with our spinal cord; and when we meet people whom we do not wish to see, we often shake hands mechanically with our spinal cord,—hence we speak of a "cordial welcome."

Much time is lost in the life of every one of us because our early training did not relieve the brain of a great deal of the purely mechanical work which the spinal cord can do with very much more precision and accuracy. To make a conscious cerebral process of what ought to be short-circuited and made a function of the cord, is a waste of power.

From all this we may deduce this principle for manual training: The muscular movements involved in the handling of tools are made at first by nerve energy which comes from the brain, but after these movements become automatic by practice, the brain relegates them almost wholly to the spinal cord. Such movements cease to be of much educational value when they are no longer directed consciously by the brain. Any process in manual training ought to stop when it ceases to be brain work. Here we have the difference between the manual training school and the trade school. The manual training school stops when the point mentioned is reached. Its purpose is purely educational. The trade school continues the training in skill even after the process is relegated to the spinal cord,in order that the person may develop the power of producing as large a quantity as possible of goods of a high grade of finish, in a given time, for the market. Its purpose is economic. This is a basis for the distinction between the two which has been overlooked in discussions of manual training.

The partridge comes out of the shell a complete partridge in all respects except size. It can run, peck with unerring certainty at food; it can do almost everything the mother can do. There is no such helplessness as there is in the case of the new-born child. The cat and the dog mature in about a year; the horse in five or six years. The human being is born the most helpless of all creatures. Whilst its brain grows rapidly during the first seven years of life and reaches almost its maximum size and weight by the end of that period; there is yet a period of very gradual growth after this, which is probably due to processes of organization, and which lasts to the age of 25 or 30, and in some cases, as recent investigations have shown, extends into the forties. Here we have a process of maturing reaching over 30 or more years. What does all this mean for education? The partridge's brain and nervous system are matured before the partridge leaves its shell, and hence it cannot be materially modified by the impressions it receives from the world around it. Heredity determines its whole life. The young partridge is a second edition of the old—without revision. Progress and education are impossible. The cat, the dog, and the horse have brains and nervous systems considerably matured before birth; heredity, therefore, determines much but not quite all. Their brains are plastic for a year or a few years; hence they can be trained—scarcely educated.

The human infant has the most immature brain at birth of all animals. It is, therefore, so early in its development brought under the power and the influences of its environments that these forces can very largely determine its development. This long period of maturing after birth, giving environments and education an opportunity to act upon the brain and nerves and to fashion character, is the one thing which makes progress and civilization possible in the human race, whilst the same are not possible in the case of cats and dogs. It renders it possible for individual character to be developed, and for the child to be better than the parent; it accounts in part for Franklins and Lincolns.

Many rich lessons for education can be drawn from this truth; they are so obvious that I need not stop to refer to more than one. It is this. There is a time in the maturing of the brain when it is most susceptible to given influences, and can be most effectively modified by certain kinds of training. These opportune periods have been called "nascent periods" — the periods when given aptitudes are born and blossom out. The determining of these nascent periods is one of the pressing educational problems of the day. Such a nascent period is approximately known for the development of manual skill. We all know that if a child is to learn to play on an instrument it must begin young, and that if a boy is to learn a trade he must likewise begin early. Some one has said, "You can make something of a Scotchman, provided you catch him young." The same is true of the Yankee, the Englishman, the Frenchman, and the rest.

The nascent period for developing the various forms of manual skill is roughly estimated to extend from the age of about four to the age of about fourteen. During this period the brain centers which preside over the muscular movements of the hand develop into functional activity, and can attain a degree of efficiency, if properly trained, which it is impossible for them to reach at any later period in life. In this fact is found the weightiest reason for connecting manual training not only with high schools, but also with the grades below the high school. If a boy cannot receive such training in school, he must either miss his opportunity for getting it during the period when he can develop the highest degree of skill, or must leave school before the age of fourteen and neglect the education which comes from books.

There will, no doubt, be a judgment day after death. Many people seem to dread it. But few realize that life is full of judgment days—days after which it will be forever "too late" to do certain things. Every one of these "nascent periods" in the life of the maturing human being is a judgment day which forever determines certain things vital to its character and life. A lost opportunity in early education is not merely a loss of time—a loss which can afterwards be made up,—it is a loss as irrevocable as youth itself.

What does manual training accomplish in the way of developing moral character?

In the first place, it develops respect for manual labor in the minds of young people and helps to eradicate the vicious notion that selling goods over a counter at $5 a week is more genteel than laying bricks at $3 a day. Finding as they do that skill in manual occupations is as difficult to acquire as a knowledge of mathematics or of a dead language, they realize that it demands a high order of brain power, and that those who engage in manual labor of a skilled kind may be the peers of those who are supposed to be engaged in intellectual work. The association, too, in their minds of the literary or academic work of the school with the shop work, increases their appreciation of the dignity and worth of the latter.

In the second place, whilst the manual training school does not aim to teach a boy a trade, it gives him a training which will enable him at once, on leaving school, to earn from $1 to $2 a day, and thus become self-dependent. I believe that few things in a boy's life appeal more deeply to his manhood than this feeling of self-dependence; and I fail to see why the earning of an honest dollar by a boy, purely for the sake of the dollar, should be more sordid than the begging of an unearned dollar from his father, or the depending on his father for all the dollars he needs for his support without furnishing any equivalent for them. If idleness, shiftlessness and pauperism are immoral in their tendency, if not in their very nature, then there are worse things for which our schools may be responsible than teaching a boy how to earn an honest living.

In the third place, manual training creates sympathy for the laborer in those who do not earn their livelihood by manual labor. It establishes a bond of sympathy between laborers and employers of labor. If the future employer of labor takes a course in manual training as a boy, he will not only have more respect for his employees, but, having performed difficult manual work himself, he knows what it means to earn one's bread in the sweat of the brow. That this is not always the effect, simply shows that manual training shares the fate of all teaching.

In the fourth place, manual training helps effectively to develop habits of accuracy which are carried into other lines of work. This is the universal testimony of those in the best position to know.

In the fifth place, if it is true, as is maintained by many psychologists, that all thought is motor in a greater or less degree; that what we call thought is repressed action, and what we call volition is simply thought carried into execution, then these motor ideas which control directly the voluntary muscles, must have an important function to perform. They are, in a peculiar sense, the raw material out of which the ethical will is formed; they are at least the soil out of which it grows.

More than this, inhibition in the nervous system lies at the root of self-control in morals. The man who cannot effectively inhibit his muscles cannot effectively control his passions and desires. Flabby muscles and weak will, if they are not related to each other as cause and effect, are at all events concomitant effects of a common cause—lack of motor efficiency in the brain.

Whilst all forms of physical exercise contribute more or less to this power of inhibition—football included,—it yet remains true that manual training makes a very important contribution to it. All skilled labor, as already shown, involves small groups of muscles. The natural tendency of motor nerve centers is to drain off energy through all the channels open to them, and hence to contract large groups of muscles; to limit the contraction to small groups means a delicate inhibition of all muscles not used in the movement, especially such as are commonly associated with those used. This power of inhibition, and the necessary concentration of attention, form a most important element of strength to the higher ethical will, and may, in fact, be regarded as an integral part of it.

More than this, manual training, appealing to eye and hand, establishes a co-ordination between the sensory and the motor parts of the brain, which is a most important step in the thorough organization of the brain. This proper knitting together of different centers, this opening of paths of association between the sensory and central portions of the brain on the one hand and the executive portions on the other, is most vital to its health and efficiency. It makes for perfect sanity and mental health, for well-balanced adjustment of life to environment, for good judgment, for self-control, and for firmness and poise of character. Much of our present school work divorces knowing from doing, and often exaggerates the relative value of the former as compared with that of the latter. Examinations test knowing more than doing, and even university degrees are conferred on the basis of attainment in knowing rather than attainment in doing. This may be to a large extent unavoidable, but it is nevertheless unfortunate. The legitimate end of knowing is doing. Right thought, to remain healthy, must ultimately issue in right deed. This is an unalterable law of moral hygiene; and anything which can be accomplished in the schools to establish the necessary physical co-ordinations in the brain, which will open lines of least resistance between the centers of thought and the centers which execute thought, will make powerfully, I believe, for the prevention of that utter divorcement of thought and morals which we find in such characters as Rousseau, and which is expressed so forcibly by the Roman poet when he exclaims:

> I know the better, and approve it, too,
> Condemn the worse, and still the worse pursue.