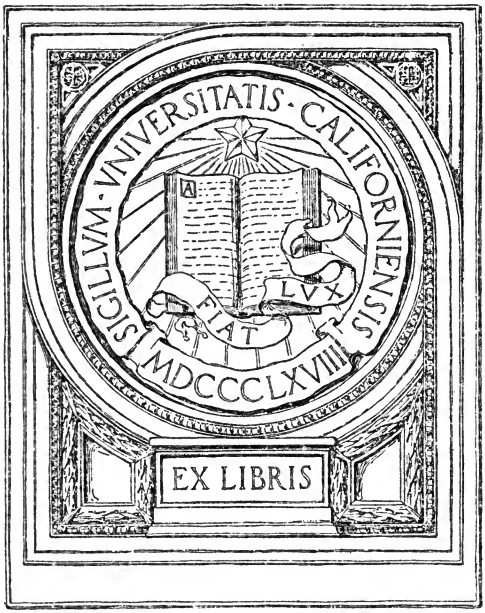
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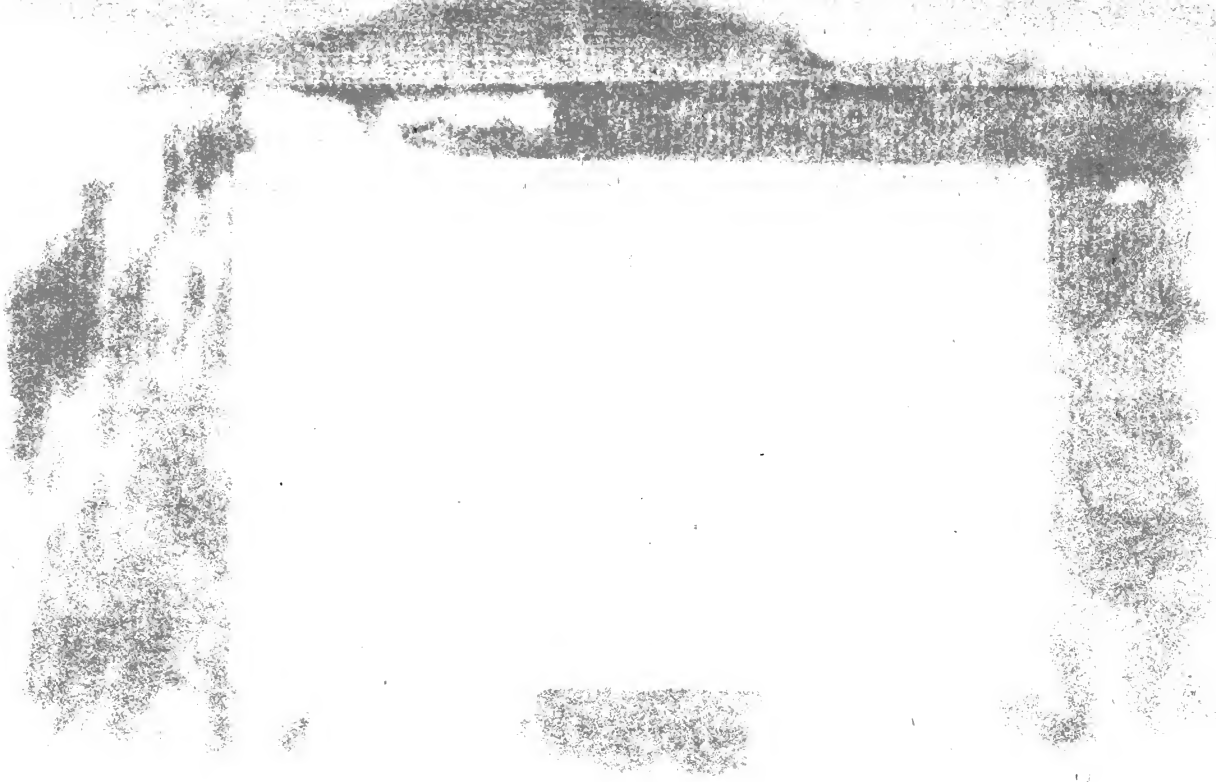

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HANDWORK AS AN EDUCATIONAL MEDIUM

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By PHILIP BOSWOOD BALLARD, M.A., D.Lit. (Lond.) *Author of* "Obliviscence and Reminiscence"

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PREFACE TO THE SECOND EDITION

THOSE who are familiar with the first edition of this book will have some difficulty in recognizing it in its new guise. Indeed it is only by putting a violent strain on the notion of identity that it can be called the same book. The essays not strictly bearing on handwork have been omitted ; the other essays have been cut down, rewritten and rearranged ; and at least one-half of the subject-matter is entirely new. So drastic a treatment of a book which has found some favour with the public calls for explanation. It lies in the change that has taken place during recent years in professional opinion and practice. The first edition has in fact virtually served its purpose, consisting as it mainly did of lectures delivered when the need for convincing teachers of the educational value of handwork was much greater than it is now. Now the profession may be said to be converted, and the laity almost persuaded. And what with the attack of the Froebelians and Montessorians on the early part of the school

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curriculum ; of those who fight under the Vocational flag on the later part of the curriculum ; and of a number of guerilla fighters on the defenceless middle, there is at present little danger of the claims of handwork being ignored in the school. What is urgently needed now is a critical treatment of the subject. We want to know where handwork fails as well as where it succeeds. And we want to know why. To meet some of these needs this new edition is issued. An attempt is made to discover and to discuss the fundamental principles upon which the claims of handwork rest ; and the language of the lecture, which was so evident in the first edition, has largely given way to a style which savours more of the study than of the platform. Although this change of style will unquestionably render the book less interesting to the general reader, it will, it is hoped, make it more valuable to the student. It is hoped, too, that the new edition will prove of greater service to the teacher ; for most of the new material has to do with the method of teaching handwork. Indeed the writer regards the strictly pedagogical parts of the book as considerably the most important, for he holds that not all forms of motor activities assist mental development. Except perhaps in the first few years of a child's life, and in the early stages of the education of the feeble-minded,

we have no reason for believing that motor activities pure and simple—motor activities stripped of all accompanying thought processes —have any influence upon the growth of the mind. They may have, but there is no evidence that they have. There is, on the other hand, abundant evidence that where bodily activities—manual occupation in particular—are so chosen and so taught as to stimulate and compel thought on the part of the pupil, they become a potent means of mental culture. The hand can demonstrably be used as an instrument for the education of the head and the heart. That being so, the problem of teaching handwork so as to make its intellectual and æsthetic concomitants as rich and varied as possible, is supremely important, and has much space devoted to its discussion in this book.

My thanks are due to Mr. John Nickal and Dr. E. O. Lewis for reading certain parts of the manuscript and making valuable suggestions, and to Mr. E. J. Kenny for correcting the proofs.

P. B. BALLARD.

DULWICH,
February 1915.

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INTRODUCTION

THE most noticeable, and probably the most significant, change that has taken place in educational practice during recent years has been the increased attention paid to practical work. Not only are subjects which were previously taught orally and abstractly (such as Nature Study, Science, Geography, and Mathematics) now being largely taught by means of practical manipulation of the material on the part of the pupils, but special exercises have been introduced under the name of Handwork, Hand and Eye Training, and so forth, with the avowed view of increasing the cultural value of the curriculum.

The most striking characteristic of a small boy in good health is that he is always on the move. This physical restlessness could not have escaped the notice of even the most casual observer, but until recent years little significance was attached to it. Most people were wont to regard it as one of the inevitable nuisances of life; there were many who thought it had

something to do with original sin ; there were but few who suspected that it had any bearing upon the gradual development of thinking power. Yet the one salient and indisputable fact standing forth out of the welter of detail supplied us in the numerous modern books on child study is that the movements of the young child are in some way, either directly or indirectly, connected with his mental growth. As his movements become more complex his mental processes become more clear and definite. Indeed, the movements of his body seem to be essential factors in the development of his mind.

It was not always thought so. The educational value of bodily activities is virtually a discovery of the nineteenth century. It is true that we find in the earlier writers—notably in Comenius—sporadic references to educational handwork, but it was not until the doctrine of Rousseau had filtered through the minds of Pestalozzi and Froebel, who early in the century clearly formulated the doctrine that the child learns by doing, that the principles of motor activity obtained sufficient recognition to affect professional practice ; and it was not until near the close of the century that an attempt was made to give them some sort of scientific justification. The popular tendency has always been to identify education with book-learning. The man in the street thinks of a school as a place where the children sit perfectly still—or at least ought to sit perfectly still—either poring over text-books or listening to the learned talk of a

bald-headed gentleman in spectacles. The mother thinks that when her little girl runs about the house and climbs over the furniture she is very naughty, and when she sits still she is very good. The father thinks that when his boy is making a rabbit-hutch or exploring the neighbouring woodland he is wasting his time ; but when he sits indoors cramming up a Latin Grammar he is laying the foundation of a brilliant future. The most they can say of the boy actively engaged in games, or in the pursuit of hobbies in the open air, is that he is gaining health, and that if he is not learning he is at least not loafing. The whole tendency has been to associate learning with sitting still.

The doctor's patients have a much stronger belief in the efficacy of drugs than the doctor himself, and the average parent has profounder confidence in the educative value of books than the teacher himself. And, as the modern physician tends more and more to recognize that it is Nature that cures, so does the modern educator tend more and more to recognize that it is Nature that teaches ; that learning is a spontaneous process which no lack of schooling can stop, and no extent of schooling can do more than modify. The study of this process provides the soundest basis for a theory of education, and of this process muscular activities are inseverably a part.

That the educational significance of physical activities in the young should have escaped popular notice is not surprising ; but that it

should have escaped the notice of the psychologist calls for comment. The older psychologist confined himself almost exclusively to one method—the method of introspection. He looked into his own mind and tried to describe what he found there. He found there what he looked for—ideas ; and he tried to analyse these ideas into elements derived from the five senses. Volition, which seemed to consist in a mysterious putting forth of power by the ego, and emotion with its vague admixture of pleasure and pain, resisted his attempts at analysis. The consequence of this method was that he always examined the mind of an adult and never the mind of a child ; that he was more concerned with mental products than with mental growth ; that he emphasized the intellectual aspect of the mind to the neglect of the volitional and emotional ; and that he sought no help from physiology. In his search for ultimate elements, and his desire to refer those elements to the five senses recognized by tradition, it will readily be seen how motor or kinæsthetic sensations were either entirely overlooked, or vaguely referred to the sense of touch. Their intellectual value was completely missed. These sensations of movement, it will be observed, are not always easy to detect. As soon as their work is done, as soon as they have fixed a habit, they descend to the region of the subconscious. To discover them, and fully realize the services they render, is a task that has been left to the more modern psychologist ; and the knowledge thus gained

has been brought to bear on the study of the child.

So important have the movements of the body come to be regarded, not in their own rights but as signs and symbols of the activities of the mind, that recent psychologists tend to discard the old definition of psychology as the science of mental processes, and to define it simply as the science of behaviour. To inquire into the educational significance of that form of behaviour of which the hand is the instrument, and of motor activities in general in so far as they throw light on manual activities in particular, is the main object of this book. An attempt will be made to arrive at general principles and to apply those principles to the solution of certain practical problems which press upon our attention in the schools.

BIOLOGICAL CONSIDERATIONS

THE branch of Psychology which has proved most fruitful for educational purposes is the Genetic. Education deals essentially with development in the individual, and especially during that period of immaturity which extends over the first twenty-five years of his life. Comparative methods prove expedient ; for the study of the activities of the higher animals and of the way in which they learn throws much light upon the mental development of the child. The fundamental biological concept of life as consisting in the adjustment of organism to environment is essential to the successful application of comparative methods. Despite certain obvious objections to the full acceptance of the Recapitulation theory, either in its psycho-physical or its " culture-epoch " form, it is now almost universally recognized that the child must, in a broad and general sense, recapitulate the important experiences of the race. He must go through in brief what the race went through *in extenso*. The general course of development is the same in both cases. Mankind won its way from savagery to civilization by constant struggle and strife. Primitive man probably

indulged in but little speculative thought; he had enough to do to keep himself alive, and to keep himself alive his muscles were indispensable. What thinking he did he was forced to do. A certain amount of intellectual subtlety was necessary in order to circumvent his numerous enemies, both animate and inanimate. The best thinker was the best dodger. The thinking was a device for the attainment of some practical end—the acquisition of food or clothing, the construction of weapons, of utensils, or of the means of shelter, the securing of the good-will and co-operation of his fellow-man. It was only during comparatively recent times that it became possible for man to lead a contemplative life. Education is an attempt to telescope the long path trodden by the race into the short period of a boy's school life. This can only be done by the omission of non-essentials. On this view motor activity cannot be omitted, for it seems to be the most essential element of all.

Equally clear and authoritative is the verdict of the physiologist. Our knowledge of the brain and its functions, though still very imperfect, is far in advance of what it was fifty years ago. The broad outlines at least are known. Early in the nineteenth century it was believed by many that the phrenologist might be right. Now it is known that he must be wrong. The phrenologist maps out the surface of the skull into small plots which he labels with long names. If a man has a bump in the middle of his fore-

head he is possessed of a mysterious faculty called Individuality. If a bump is found a little higher up he has the equally mysterious faculty of Eventuality. These "organs," as they are called, are somewhat numerous, and, as the accommodation of the cranium is limited, there is serious overcrowding in certain parts—round the eye, for instance. The phrenologist assumes that whenever there is a bulge on the skull (unless a lack of symmetry suggests domestic trouble) there is a corresponding bulge on the brain. This assumption is quite unwarranted, for the skull does not always follow the contour of the brain. Nor does a big head necessarily mean a big brain. There is such a thing as being thick-skulled. Moreover, this preposterous doctrine of faculties is in violent conflict with the most elementary principles of Psychology. The old faculty-psychologist, even in his wildest moments, never split up the soul into departments so numerous, so independent, and so redundant. They are neither simple nor ultimate, and their functions constantly overlap. But apart from its psychological absurdity the phrenologist's theory is finally and irrevocably exploded by the discovery of the true localization of function in the brain. Broadly speaking, we know now how the brain works, to what degree it specializes, and where the special bits of work are carried on. I do not mean to say that there is no leaven of truth in phrenology. There probably is. I believe it possible to tell a man's character from the shape of his head; but I

also believe it possible to tell his character from the shape of his nose, or his thumb, or his big toe. And it is possible to argue that the brain has as much to do with it in one case as the other, and no more.[1] The brain is primarily an instrument for moving the body. It moves it for the purpose of keeping it out of danger —danger arising from such sources as starvation, disease and physical violence. To carry on this work the brain has two sets of servants, the senses and the muscles. The senses are the scouts that give the alarm, and the muscles make the appropriate change in the position of the body. The messages pass along the nerves, and the current always goes the same way—from the senses to the muscles *via* the lower centres and the brain. In the year 1861, Broca, a French physiologist, made a very valuable discovery. He found that when a person suffers from motor aphasia, when, that is, he has lost the power of articulate and intelligible speech, there is always one particular part of the brain that has suffered injury—the lowest frontal gyrus. The injury appears on the left hemisphere in the case of right-handed people and on the right hemisphere in the case of left-handed people. He thought he had discovered the sole and entire seat of speech ; what he had actually discovered was the speech motor area—that part of the cortex from which pass

[1] Dr. Bernard Hollander makes a spirited defence of phrenology in his book, "The Mental Functions of the Brain." He contends that Gall forestalled Broca.

out all the incitations of the muscles of speech. This was the beginning of a long series of researches, discoveries and discussions. The researches are by no means complete, and the storm of discussion still rages ; but there are certain facts which are now widely accepted. One of these well-established facts is that specialized areas in the cortex are of two kinds, those where the nerve-currents run in and those where the nerve-currents finally run out ; those that receive messages from the sense organs and those that send out messages to the muscles. The former are the sensory centres and the latter the motor centres. The motor region is to be found near the fissure of Rolando. Of the sensory areas it is generally agreed that the visual is situated at the back of the head and the auditory near the temples. The existence of these centres was established by three distinct kinds of evidence. Let us for the sake of simplicity confine our attention to the motor area controlling the right arm. When this limb becomes paralysed, we may infer the presence of a tumour or hæmorrhage on a specific part of the left hemisphere—an inference which is found to be justified whenever direct observation is possible, as at a post-mortem examination. This is the pathological evidence. In experiments on animals of the higher type, such as monkeys or dogs, it is found that irritation of the particular part of the cortex already referred to brings about well-defined movements in the right arm or the right foreleg, as the

case may be, and that ablation of the cortical area produces paralysis of the limb. This is the vivisectional evidence. Finally, in the dissecting-room neural connections can be traced from the special area to the special limb *via* the motor tracts in the spinal cord. This is the anatomical evidence. The same three kinds of evidence prove the existence of the sensory areas. In recent books on the brain it has been customary to insert diagrams with the various cortical areas definitely marked out and labelled. This is somewhat misleading. The most we can say is that the various cerebral activities tend to cluster round certain fixed spots, and that this localization is more marked in the higher animals than in the lower. One is tempted, therefore, to think of the brain as consisting of cells of two distinct kinds—sensory and motor—with fibres connecting certain sensory cells with certain motor cells, and other fibres connecting sensory cells with one another, and to believe that when the stream of innervation passes along the former fibres we are acting with little or no thinking, and when it passes along the latter fibres we are thinking with little or no acting. Although a microscopic examination of the brain does not entirely bear out this simple theory, it may be taken as a rough and schematic representation of what actually takes place. The cells found in the brain are very numerous. Meynert estimates that there are 1,200 millions in the cortex alone. These cells are given at birth and there is

no evidence that they increase in number. They cannot multiply by fission after the manner of the ordinary organic cell: they can only develop. They develop by sending out fibres which ramify into fine tendrils, and these coming into some sort of functional connection with similar ramifications from other cells set up lines of communication between cell and cell. If this theory is sound, a man cannot by cultivation get more brains, he can only get better brains. It is consoling to know that even in the most highly educated there are large masses of cells wholly undeveloped. They are the unemployed of the cerebral community.

This rough and somewhat schematic account is subject to certain reservations. The ramifications of the cortical cells or neurons do not actually touch those of other cells, and some recent experiments of neurologists tend to show that the excitation passes from one series of fibres to another by means of a process analogous to electrical "induction."

Mr. McDougall attaches great importance to the synapses, or junctions between neurons.[1] As there is no continuity of substance between the neurons each synapse presents a certain resistance to the passage of the nervous impulse, and the formation of neural habits simply means the permanent lowering of resistances of this nature.

It will be noticed that the distinction between sensory and motor when applied to brain cells

[1] "Physiological Psychology," pp. 27–33.

is somewhat arbitrary ; for every cell is in a certain sense both sensory and motor. It is sensory inasmuch as it receives neural currents : it is motor inasmuch as the currents pass out again. Flechsig has specially emphasized this dual nature of brain elements. Although this fact, supporting as it does the theory of the dynamogenic nature of *all* ideation (the theory that every idea tends to work itself out in action), is by no means unimportant, yet it is considered wise to preserve the generally accepted distinction between sensory and motor brain areas, provided it is understood that they refer to regions that first receive excitations from the sense organs, and regions that finally emit these excitations to the muscles. It is well, however, to remember that the real distinction between sensory and motor is functional rather than structural.

It does not seem to be quite certain whether the motor areas are near the surface of the cortex or at a deeper level. The tactile and kinæsthetic areas virtually coincide with the motor areas of the organs in which these kinæsthetic sensations have their source. It may be that the different kinds of cells are mixed up, or it may be that they occupy different cortical depths.

Vague and indefinite as some of these considerations are, they press upon us the importance of the motor factor in the growth of the brain. Progress lies in the line of cell development, and cells develop in order to establish

connections between various parts of the brain. The earliest, the most rudimentary, and the most stable connections are those between sensory cells and motor cells, whether those connections are mediate or immediate. Cerebral excitement naturally sweeps from sensory areas to motor areas, so that in opening up new brain-paths the route from sensory to motor appears to offer the least resistance. As the brain becomes more highly organized the route becomes more complex. The current frequently passes from one sensory area to other sensory areas before it arrives at the motor region. In some cases it seems never to reach the motor region at all. But closer scrutiny of what takes place in the mind will reveal the fact that motor factors enter into the most abstract train of thought, and these motor factors must have some physical basis. It is easy to see why a young child lives so fully the life of sense and movement. His sensory and motor cells are being stimulated into activity. To check this healthy tendency in the interests of the higher processes of thought is probably to take away the ladder by which these higher processes are ultimately reached.

SENSORI-MOTOR REACTION

If we are to regard the reflex arc—sensori-motor reaction—as the general type of function by which the organism adjusts itself to its environment, it immediately assumes importance as the starting-point of the educative process and as the basal type of means by which development is effected. It is only by observing how an organism responds to a given stimulus that the psychologist can hope to discover the nature of the mental processes of that organism. It is only by providing a suitable environment that the teacher can produce those changes at which education aims. It is therefore necessary to examine this basal type somewhat closely.

The popular notion seems to be that adjustment to environment takes the form of successive steps, each of which may be analysed into three elements—external stimulus, central reflection, and motor response. This conception with its corresponding nomenclature may be criticized at three points. In the first place the term sensori-motor is, strictly speaking, a misnomer. In the second place the stimulus is not necessarily external, in the sense of being extra-organic. In the third place the steps are

not successive, in the sense that A is finished before B begins, and B is finished before C begins, and so forth. In other words the reflex arc is not an arc but a circuit.

The term sensori-motor is a hybrid due to looking at the process of adjustment from two disparate points of view. It has been contended that sensory is a psychological term ; motor a physical term : [1] that in the mind the counterpart of the reaction is probably entirely sensory ; in the body the whole process is motor. It must be acknowledged that all attempts to classify mental processes on the triadic basis of the reflex arc have signally broken down. There is nothing in consciousness that is exactly connected with the passage of the neural disturbance along the afferent nerve, and nothing connected with its passage along the efferent nerve. The central process alone seems to be correlated with consciousness ; and the central process is, as Bawden puts it, " the beginning of the act of the response." This point of view will become more clear later on when it will be shown that an idea (using the word in its widest sense) has motor or kinæsthetic elements as an essential part of its existence. We cannot in fact profitably analyse the reflex arc into distinct parts either on the physiological or the psychological side : we can only analyse it into aspects. Looked at as the basis of a

[1] See "The Functional Significance of the Terms 'Sensory' and 'Motor,'" by H. H. Bawden, the *Psychological Review*, vol. vii. pp. 390–400.

conscious process the arc is sensory: looked at as the basis of an act, it is motor.

To the contention that the conscious counterpart of a sensori-motor reaction is conation (the striving aspect of consciousness), it may be replied that a conation regarded concretely embraces all the mental processes concerned. Conation cannot be distinguished as a separate part of a mental process, as the incoming or outgoing currents can be distinguished as separate stages of a reflex act: it is merely an aspect of all conscious process, separable in thought but not in reality. Even so it is doubtful whether, as a mode of being *immediately* conscious, it is distinguishable from the affective side. It is true, however, that the general theory of sensori-motor reaction involves the principle that all mental processes, the highest as well as the lowest, are conative in their nature: they move towards an end. But the conative aspect does not, to the exclusion of other aspects of consciousness, rest on the kind of neural activity we have described. *Every* kind of conscious process finds in this activity its physical basis. It is the whole "neurosis."

The craving, longing, yearning, etc, of which Stout regards conation as a common characteristic may well be referred to the feeling aspect of consciousness. Wundt, in fact, does so. He supplements the pleasure-pain series of feelings by an excitement-depression series and a tension-relief series. Royce has two series, pleasure-pain and restlessness-quiescence. But

whatever the nature of conation may be it is quite certain that it bears no fixed general relation to either of the so-called elements of the sensori-motor circuit.

The theory that there are sensations corresponding to the motor discharge—feelings of innervation—may be dismissed as unsupported by sufficient evidence. The specific sensations to which the responsive movements give rise—motor sensations—are of course due to incoming currents, and are as much sensory as the sensations more immediately due to the stimulus. This fact, however, by no means disposes of the theory of feelings of innervation, if by feelings we mean something entirely different from sensations. Mr. C. H. Judd, the American Psychologist, holds the view that the most scientific classification of mental processes is based on a recognition of the (relatively) objective nature of cognition, and the subjective nature of feeling and volition. Any given mental process may, in fact, be regarded as comprising both attitude and content—the former representing the subjective reaction to "cognition."[1] They bear a relation somewhat analogous to that existing between force and matter. He regards the attitude as a mode of consciousness entirely distinct from sensation and mainly connected with the outgoing motor discharge. This way of looking at the mind is not without its advantages as a scientific method, and is perhaps the

[1] See "The Doctrine of Attitudes," *Journal of Philosophy, Psychology, and Scientific Method*, vol. v. No. 25 (1908).

nearest approach to a psychological classification based on the sensori-motor impulse. Dewey's criticism, however, that there is no cognition until some reaction takes place still applies. It may also be pointed out that the Manchester School of Realists, of which Professor Alexander is the leading exponent, make a somewhat similar distinction between the subjective and the objective (or, as they term it, the mental and the astra-mental) without connecting it in any way with the reflex arc.

We arrive at the conclusion that no part of the reflex arc is essentially sensory or essentially motor, that there is no dichotomy in consciousness corresponding to these two terms, and that the reflex arc may most profitably be considered as a unity which is motor or sensory according to the point of view from which it is regarded.

The second criticism is that the stimulus is not wholly external: it may be entirely intra-organic. In many cases this is obvious. Messrs. Angell and Moore, in analysing the simple sound-touch reaction-time experiment,[1] rightly contend that the stimulus comes from the hand as well as from the sound-signal. The hand is prepared to react in a definite way. This preparedness involves kinæsthetic sensations, which are as much a part of the stimulus to the specific reaction as the sensations mediated by the ear.

Finally, the reflex arc is not an arc but a circuit. Dewey, in criticizing the reflex arc con-

[1] The *Psychological Review*, vol. iii. pp. 244–58.

cept,[1] maintains that adjustment to environment is a continuous series of co-ordinations, with stimuli and response continually running into one another. He takes James's case of the child and the candle, and shows that it is not a case of substituting a motor response for a sensory stimulus, since the sensory stimulus in a modified form still remains. "The so-called response is not merely *to* the stimulus: it is *into* it." "The burn is the original seeing: it is seeing-of-a-light-that-means-pain-when-contact-occurs. The burn is not replacing one experience (light) by another, but the development or mediation of an experience." He further states: "Neither mere sensation nor mere movement can be either stimulus or response: only an act can be that; the sensation as stimulus means the lack of and search for such an objective stimulus, or orderly placing of an act; just as mere movement as a response means the lack of and search for the right act to complete a given co-ordination."

If these views are sound the simplest physiological correlate of consciousness is an act, which may subsequently be analysed into stimulation and reaction. "It is," to quote Dewey once more, "the movement (of seeing) that is primary, and the sensation of light that is secondary." This implies that some sort of physiological response takes place before the mental response commences. The light stimulates the eyes and reflexly produces convergence

[1] "The Reflex Arc Concept," the *Psychological Review*, vol. iii. pp. 355–70.

and accommodation before the light is apprehended at all by the child. This little adjustment then forms part of a larger adjustment. It is a case of wheels within wheels.

We have it, therefore, still more strongly forced upon us that a simple reflex arc mediates no elements in consciousness which correspond to elementary phases or parts into which the arc may be analysed.

This analysis of the sensori-motor reaction, however, need not prevent us from maintaining a broad distinction between that mode of consciousness which is mainly (it can never be entirely so) passive or receptive, and that mode of consciousness which is mainly (it can never be entirely so) active or expressive. Nor need it prevent us from referring to the candle as the stimulus and the reaching towards it as the reaction, provided we remember that we thus take a broad view of a complex sensori-motor co-ordination which includes within it as essential parts still smaller sensori-motor co-ordinations. What the inquiry does reveal is the fundamental nature of muscular movements as forming an essential part of the physical correlate of conscious process.

CONSIDERATIONS MORE STRICTLY PSYCHICAL

WHEN we come to consider the strictly psychological aspect of the question we find a wealth of evidence awaiting us. I have already tried to show that the mental powers came into being in close connection with movement. Can we by introspection verify these conclusions? If muscular activity is such an important factor in building up the mental fabric, surely we ought to find some evidence of it when we look into our own minds. As a matter of fact, we do. All students of psychology know that the five senses popularly recognized do not exhaust the list. Not only are the temperature and static senses omitted, but the most important sense of all—the motor sense—is left out. What do I mean by the motor sense? Let me answer this question by asking another. If I close my eyes and then shift the position of my arm, how do I know that my arm actually has moved, the extent and nature of the movement, and the position the arm finally occupies? It can only be by sensations of some sort. Is it by the sense of touch? No, for this sense is confined to the skin, and contact with clothing

and other objects is no essential part of the total experience. If the arm is bare and the movement unimpeded, I know what has happened just the same. This knowledge can only be due to the general "feel" of the arm—to sensory currents streaming into the brain from the muscles, tendons, skin and joints. The cartilaginous surfaces of the joints are well supplied with nerves, as rheumatic patients will readily testify, and experiments with local anæsthetics have shown how extremely important these nerves are in mediating a knowledge of position and movement. The whole sensory apparatus involved in movement has been called the muscular sense (which is manifestly inadequate), and the kinæsthetic sense (which is Greek), and the motor sense (which is simple and familiar). I shall use the last two terms interchangeably. The motor sense has no special organ: its nerve terminations are to be found in nearly all parts of the body. Neither is it given, in the majority of the diagrams published, a special area in the cortex. This omission is due to the fact that the sensory cells concerned with certain muscles are mixed up with the motor cells concerned with the same muscles. The two areas overlap, even if they do not completely coincide. In fact, the motor zone of the brain is at the same time a motor region and a sensory region.

I have already referred to the motor sense as the most important of all the senses. This statement I will now proceed to make good.

There are grounds for believing the motor sense to be the original, the basal sense, from which all the others have been developed. This claim has sometimes been made for the sense of touch. But touch can most profitably be regarded as a part of the whole motor sensibility. The amount of knowledge mediated by touch pure and simple is insignificant in the extreme. A blind man by feeling a familiar object is able to identify it. We glibly say that he identifies it by the sense of touch ; but it is nearer the truth to say that he identifies it by the sense of movement. Divest the experience of all movement and all muscular pressure, and most of its vividness and definiteness disappears. It is not without significance that the tactual area in the cortex coincides with the corresponding motor area. In brain localization they are indistinguishable. It is convenient, therefore, to regard touch as a subsidiary branch of the motor sense.

Since voluntary movement is a characteristic of all animal life, every animal, however low down in the scale, possesses a motor sense. It is a necessary condition of voluntary adjustment, and therefore of educability. Even if no special sense organs are perceptible, sensibility to impact with other substances and to change in bodily position must at least be present. The motor sense is the primordial sense.

There are, however, certain considerations of structure which seem to undermine this position.

Recent histological researches have provided certain criteria by which the relative ages of the various cortical areas may be established. It is now possible to state with a fair degree of certainty the order in which along the period of biological development the various senses got represented in the cortex. Dr. Alfred W. Campbell gives the order as follows: smell, sight, hearing, common sensation, locomotion. "The motor function is late in being represented in the upper or cortical level." "We cannot doubt that the movements of all non-mammalian vertebrates (Pisces, Amphibia, Reptilia, Aves), despite their activity, must necessarily be generated in the spinal cord, probably co-ordinated by the well-developed cerebellum. Then even among mammals, it is as likely that there are many low down in the scale in which movement is either not at all, or only indifferently, represented in the cortex cerebri." [1] These views, based mainly on a microscopic examination of the cortex of one of the higher mammals, are supported by the results of investigations among lower animals. Professor E. A. Ayers states, for instance, that nearly half the brain of the catfish is devoted to taste functions.

It may, however, be pointed out that we have no reason to believe that consciousness is in the lower animals so exclusively correlated with cortical processes as it is in man. The numerous experiments that have been made on frogs and

[1] "Histological Studies in the Localization of Cerebral Functions," by Dr. A. W. Campbell, p. 289.

pigeons tend to show that they probably "feel" processes which take place at lower levels than those which arouse distinct feeling in man. It may further be pointed out that motor sensations seem in most cases to function marginally more effectively than focally. In perfecting an act of skill, for instance, the learner does not fix his attention on the sensation of movement, but on the external situation and the series of *results* produced by his movements. Finally it may be urged that the fact that the educability of an animal appears to develop *pari passu* with the development of motor representation in the cortex, in itself tends to establish the functional priority of kinæsthetic sensations when regarded from an educational point of view.

Activity in the motor sense accompanies activity in all the other senses and co-operates with them. A parallel can be found in the fingers. The most important finger is the thumb. When a bit of business has to be done by the hand, two fingers are sufficient to form a quorum, but one of them must be the thumb. It is brought into action with all the others. In the same way the motor sense co-operates with all the other senses. They cannot act without it; it is the inevitable and indispensable partner. One cannot look at an object without a large number of muscles being brought into play. To say nothing of the necessity for turning the head in the right direction, the small muscles surrounding the eyeballs must so regulate their convergence as to bring the axes of vision to meet

at the object ; and the still more delicate muscles connected with the crystalline lens must so modify its convexity that the image falls exactly on the retina. The visual apparatus has, in fact, to be put through the same kind of focusing process as a photographic camera, allowance being made for the fact that in the camera the convexity of the lens is fixed and the position of the plate variable, while in the eye the position of the retina is fixed and the convexity of the lens variable. These muscular experiences of convergence and accommodation, even though they appear to be entirely subconscious, form an essential part of the whole process of perception. They are so fused with the purely visual impressions as to be indistinguishable from them ; but their presence is none the less indispensable. The senses present data ; the mind interprets the data ; the interpretation is an object in space. Motor sensations always form part of the data interpreted ; they are vehicles of knowledge concerning the object. They are of special service in telling its distance from the eye, its size, and its solidity as opposed to its flatness. Vision pure and simple presents a mere patch of colour : the motor concomitants help to turn this patch of colour into a three-dimensional object occupying a definite position in space.[1]

[1] The researches of Dawes Hicks, Rivers, and Lewis, into the rôle of movement factors in the production of certain optical illusions, by the comparison of momentary and prolonged exposure, discredit the view that these illusions are, in developed consciousness, due to eye movements ; and tend, in

In much the same sort of way the motor sense collaborates with all the other senses.

But apart from these motor sensations which get swallowed up in percepts, the sense organs actually stop working unless their position is changed. If you will take the trouble to sit stone still with your gaze steadily fixed on a spot on the opposite wall, you will find that at the end of about ten minutes a black veil seems to fall and blot out the whole field of vision. You become temporarily blind, but normal vision can readily be restored by a slight shifting of the eyeballs. Rest your hand lightly upon the table so as just to feel the surface. After a short while you cease to feel anything there. Move your hands ever so little and tactual sensation is immediately restored. Without movement, in fact, sensation and perception become impossible.

A third reason for claiming precedence for the motor sense is that it gives us the most vivid and convincing feeling of reality. It is through the actual manipulation of objects that the notion of a systematic external world as distinct from his own mental images gradually emerges in the mind of the young child. We ourselves always put doubtful experiences to the authorita-

consequence, to throw some doubt upon the dependence of other visual percepts on movement factors. But even if not of primary importance in present perception there is little doubt that movements of the eye and of other organs have been essential to the development of local signature in the retina, and to giving an interpretation of "depth" or solidity to the disparity of the two retinal images.

tive test of touch. The doubting apostle is the type of all doubters. Macbeth apostrophizes the spectral dagger :

> Come let me clutch thee :
> I have thee not, and yet I see thee still.
> Art thou not, fatal vision, sensible
> To feeling as to sight ? or art thou but
> A dagger of the mind ?

and so forth. The conclusion he arrives at is, " There's no such thing." In deciding the reality of a percept the motor sense is the highest court of appeal. It decisively confirms or discredits the evidence of the other senses ; the experience is stamped as real or hallucinatory. Its verdict is accepted as final.

Another ground for attaching supreme importance to the motor sense is its intimate connection with the process of attention. If I were to say that we attend with our muscles I should seem to be uttering an absurdity. Yet that is what Bain, Ribot, Lange, and other psychologists virtually assert. The focusing mechanism of the eye is also the focusing mechanism of visual attention. Looked at from the outside attention is muscular adjustment ; looked at from the inside it is mental activity. The muscular activity, according to this school, is neither the cause nor the effect of attention ; it *is* attention looked at from one of two possible points of view. The truth of the matter seems to be that muscular contractions always accompany the attentive process, helping to produce and to

maintain it ; but to say that they form an essential part thereof is probably to mistake the scaffolding for the temple. The fact, however, remains that there is a very close connection between at-tention and muscular tension. In acts of perception this is obvious. Not only is the sense organ so adjusted as best to receive the stimuli, but all movements tending seriously to interfere with this reception are inhibited. At the most exciting moments in a football match the spectators tend to hold their breath. This principle of motor impulsion and inhibition holds equally good when we attend to ideas, except that the innervation of the muscles is generally much slighter.

A marked characteristic of the motor elements of consciousness is their tendency to float farther and farther away from the focus and ultimately to enter the region of the subconscious. This is connected with the fact that all acts tend by repetition to become automatic, and in becoming automatic need a smaller and smaller amount of attentive control.

I have emphasized the ubiquitousness of motor sensations in the life of the senses. But this being granted it by no means follows that they are pedagogically important. It is indeed still an open question whether any part of the school-time should be devoted to mere sense-training. There are, in fact, three distinct views on this question. It is held by some that ordinary out-of-school life affords a sufficient basis of sense-experience for the teacher to rear thereon

the intellectual and moral structure which it is the main object of the school to build up. There are others who hold that sense-training is necessary only in the early stages of the school career of the pupil ; and there are others again who think that sense-training of some sort should form an essential part of all stages of education.

Education may be regarded as a sort of " mental hygiene " ; and it is clear that a certain amount of activity among the sense organs is necessary to keep them, and the mentality dependent on them, in a sound, healthy condition. But is a special and severe training in sense discrimination of any real intellectual and spiritual value? Is such training worth while? It is assumed by many (the Montessorian doctrine affording a modern instance of the assumption) that it is worth while ; that mental development is readily fostered by a training in sense discrimination ; and that the beginnings of a sound education should be mainly concerned with the things of sense, as things of sense—things that have no immediate bearing on the imaginative and purposeful life of the pupil. But, as Mr. W. H. Winch has frequently pointed out, the intellectual life of the child bears no very close relation to the range of his sense experience : there may be much of the one and little of the other. Indeed there lurk in the doctrine of formal sense-training most of the fallacies which are to be found in the popular belief in formal discipline—a belief in a large

general result due to a small piece of specific training.

I personally hold the view that while sense-training is necessary and desirable, and should enter largely into our educational scheme, there is no need to engage in special sense-training—in sense-training for its own sake. The activities of the senses should always be made to serve the interests of higher functions. The child need not be taught to discriminate shades of green as a disconnected exercise with no immediate purpose in view beyond the mere discrimination ; but he should learn to discern these colour differences during the purposeful activities of the nature-study or the painting lesson. Whether the teacher wishes it or not the pupil's senses are actively engaged during the whole of the time that he is being taught, and it is the duty of the teacher to utilize the pupil's natural interest in this activity to further the development of functions which are higher and more complex in their nature and more characteristic of the mind of man as distinct from the mind of the brute.

In so far as motor sensations are sensations they share with the special sensations of sight, hearing, etc., whatever credit falls to sense-experience as the ground and base of education ; but they are more important contributions to the mental fabric than those of any of the special senses, first because they are more universal, and secondly because they are so closely connected with the active as distinct from the passive side of experience.

THE NATURE AND RÔLE OF MOTOR IMAGERY

MUCH discussion has taken place with regard to the nature of the motor or kinæsthetic image and the part it plays both in the initiating of movements and in serving as a vehicle of thought. Within quite recent years widely divergent views have been set forth. It has been maintained that motor imagery pervades the whole of our mental life ; and it has been denied that we have motor images at all, as distinct from motor sensations.[1] It has been maintained that a motor image is an essential preliminary to a voluntary act (the usual view), and it has been asserted that a voluntary act can be initiated by a "naked thought," that is a thought void of all sensory content.[2] It has been claimed that all *meaning* adheres to the motor elements only of mental imagery,[3] while the ordinary view is that it can adhere to all

[1] See "A Marked Case of Mimetic Ideation," by Stephen S. Colvin in the *Psychological Review*, vol. xvii. (July 1910).

[2] R. S. Woodworth : "The Cause of a Voluntary Movement" : Studies in Philosophy and Psychology, Garman commemorative volume, pp. 351–92.

[3] See Bawden, *op. cit.*

types of imagery, and indeed mainly does attach itself to visual and auditory images. In fine, there is much diversity of opinion as to the intellectual value of motor imagery.

There seems to be a tendency among certain American psychologists to revert to the position of the older English psychologists, who regarded an image as differing from the corresponding percept in degree rather than in kind. It is, according to Colvin, no longer possible to hold the theory that images are distinguished from sensations by being centrally instead of being peripherally excited. Such facts as that some people can after visualizing a colour see its complementary when they open their eyes, cannot, he thinks, be reconciled with the theory. We do not seem to have discovered a better method of differentiating between the percept and the image than by asking the following question: Does the person believe the object to be actually present? If he does the mental process is perceptual (even though it be hallucinatory); if he does not, the process is imaginative. This test is easy to apply in the case of seeing or hearing, for these senses are as a rule concerned with extra-organic objects, but in the case of motor experiences its application is much more difficult. For, generally speaking, the source of stimulation is the part of the body that is itself in motion, and whether it is actually in motion or not it is always in organic connection with the brain—always present with its possible "resident sensations."

Nor are we able alternately to make and break the connection between the source of stimulation and the brain as we can in vision by opening and shutting the eyes. In fact it seems almost impossible to say whether the so-called "motor image" is really an image or consists of real sensations due to nascent movements in the organ concerned. There are three possibilities. It is a pure image, or a pure sensation-mass, or a mixture of the two. I am personally inclined to the belief that it is a mixture. I cannot myself, however, resolve by introspection an anticipatory image of a movement into anything but visual imagery (in the case of vocal movements, auditory imagery) plus actual sensations from the member to be moved.

Bawden, in the article from which I have already quoted, voices a fairly common opinion thus: "The way in which the kinæsthetic image tends towards movement does not differ from the manner in which any image tends towards movement. The only difference is in the immediateness with which the various types of image lead to the movement. Every auditory and every visual sensation tends to call out certain responses through the mediation of the kinæsthetic imagery. This intermediate kinæsthetic imagery does not always become conscious. It may serve as a motor cue beneath the threshold."

Several of the points raised here are open to objection. The general tendency of ideas to work themselves out in actual movement being

conceded, why postulate an unnecessary duplication of function? Is there any evidence, introspective or otherwise, of this intercalation of the kinæsthetic image? One thinks in visual or auditory terms of a movement, and the movement immediately takes place. But it takes an image quite an appreciable time to develop. Is it credible that we have first a visual (or auditory) image, then a kinæsthetic image, and after that the movement? Can we believe that in rapid speech two successive images precede each spoken word? If the two images are supposed to be not successive but simultaneous the case is simplified, and is far more convincing. If again we postulate but one image and that a sensation-complex consisting partly of an auditory (or visual) image and partly of kinæsthetic *sensations* complicated therewith, the case is simplified still further, for on this supposition, as soon as the image appears the movement has already commenced, and will actually be completed unless inhibited. This latter theory seems to me to fit the facts better than the other theories. Bawden indeed gives away his case later on when he states: "The kinæsthetic imagery always stands most immediately for the movement because it arises from the incipient state of activity of the organs in which the movement subsequently is to take place in overt form." Unless, that is, he means that an "incipient state of activity" is not a real movement.

Woodworth's "naked thought" theory cannot

be said at the present time to be either proved or disproved. The few recorded instances of what is alleged to be pure thought are supported, as is perhaps inevitable, by merely negative evidence. No imagery was discovered, but subjects more highly trained in introspection might possibly have discovered some. The tendency, however, of modern Psychology is to attach more and more importance to the purely psychical factor of consciousness. It is "thought" or "meaning" (Stout and McDougall), or "pure memory" (Bergson), and not the sensory elements that constitute the soul and essence of a conscious state. The sensory elements are, at best, merely its points of support.

To say that kinæsthetic imagery "does not always become conscious" is a gross misuse of the term imagery. Imagery of which we are not conscious is not imagery at all. There is a kind of safety in saying that certain things happen "beneath the threshold," for if the statement cannot be proved, it at least cannot be disproved. But why not frankly acknowledge that many of our motor activities are purely physiological—that they have no counterpart at all in consciousness? Are we to believe that every movement in the body, every beat of the heart, every muscular contraction or expansion, is preceded by a kinæsthetic image? And if it is contended that voluntary muscles alone have this privilege, it may be pointed out in reply that it is only part of a complex muscular movement that is really voluntary: the whole

movement includes automatisms fixed by heredity or by habit. Some of the co-ordinations, both simultaneous and serial, take place with the fatality of a machine. The cues to the various movements as they occur are either in consciousness (in the focus or in the margin ; generally, of course, in the margin) or else there are no conscious cues : the process is purely physiological. Subliminal cues are altogether superfluous.

This discussion brings out the fact that the theory of motor imagery is beset with difficulties. The one thing certain is that our motor experiences profoundly modify our mental processes and products. After having fallen on the ice and felt it, the sight of ice will never be the same to the child as it was before that experience. If motor images will cling to the subsequent sight of the ice, they will not be cases of free reproduction, but of what Stout calls " complication." The sight of the ice will have " acquired meaning " : [1] it will mean something to be trodden upon with caution, and something which feels cold and damp when touched by the hand. It will mean that when looked at ; and it will mean that when only thought about. Both percept and image have become richer and more significant. The motor phase has, to use Dewey's terminology, developed or mediated the original experience.

Some such considerations as these, together with the spread of Pragmatic doctrines, have

[1] " Manual of Psychology," Bk. I. ch. ii. pp. 8, 9.

led certain psychologists to formulate the theory that all "meaning" resides in the motor constituent of the image. The germ of the theory is to be found in Berkeley's "Essay towards a New Theory of Vision," where it is maintained that what is given in vision is a sign of something else—of experiences of touch and movement. Sight is expectation (the result of "custom" or habit) of meeting phenomena of touch and muscular movement. It is easy to see how the modern psychologist taking the biological standpoint develops this idea. If life consists of adjustment to environment, then every stimulus will naturally be interpreted in terms of that adjustment. In the case of the physical universe the adjustment must manifestly be motor in character. When we think of the abstract we can only do so by means of concrete imagery. When we think of the spiritual we cannot but think of it in terms of the material universe. Simile and metaphor are indispensable; and the motor implications of this concrete imagery still remain. When the meaning of any image is fully worked out its ultimate elements are found to be motor in character. Dewey emphasizes the fact that "meaning is the thing that grows out of our motor experiences." He says: "The acquisition of definiteness and of coherency (of constancy) of meanings is derived primarily from practical activities." [1] "And in the case of the meaning of words, we see readily that it is by making

[1] "How we Think," p. 122.

sounds and noting the results which follow, by listening to the sounds of others and watching the activities which accompany them, that a given sound finally becomes the stable bearer of a meaning. Familiar acquaintance with meanings thus signifies that we have acquired, in the presence of objects, definite attitudes of response which lead us, without reflection, to anticipate certain possible consequences." [1]

Royce takes up a similar position, as will be seen by the following extracts from his "Outlines of Psychology": "A vast number of images, visual as well as motor, relate to our anticipations of future events. But these anticipations generally go along with tendencies to prepare for the future events by one or another sort of action. In brief, the whole normal life of our imagination has a most intimate connection to our conduct, and should not be studied apart from conduct." [2] "Our perception is but a fragment of a possible consciousness involving a whole system of feeling and of conduct in the presence of such an object." [3] "If you are to train the powers of perception you must train the conduct of the person who is to learn how to perceive." [3] "Such then is the general character of thought, namely, that it is our consciousness of an act or of a series of acts adjusted to an object, in such wise as fittingly to represent that object, or to portray it, or to characterize it, and in such wise that the one

[1] "How we Think," pp. 124, 125. [2] P. 160.
[3] Ibid. p. 226.

who thinks is conscious of the nature of his act."[1] "Every complete general idea is a conscious plan of action."[2] Lange holds that all imagination depends on motor adjustment. Professor Bolton contends that all meaning depends on adjustment. In the case of the lower animals the meanings that objects have for them consists in the responses which these objects evoke. In the case of human beings the meaning of an object of perception is not merely the adjustment that has taken place, but of other reactions which are about to take place.[3]

Among the psychologists who attach importance to motor imagery Ribot stands pre-eminent. He contends that the skeleton of every state of consciousness, it matters not what it is, is always made up of motor elements. The motor factor is the most stable part of every idea : it holds together and synthesizes all the other sense elements.[4]

Henri Bergson's theory of the relation between body and mind as expounded in his book on "Matter and Memory," is based on the belief that the body is an instrument for transmitting movement, and the mind the means of securing that the movement be transmitted into appropriate channels. "The body, always turned towards action, has for its essential function to

[1] "Outlines of Psychology," p. 285. [2] Ibid. p. 290.

[3] See the *Psychological Review*, vol xv. (1908). "Meaning as Adjustment," pp. 168–72.

[4] "Le rôle latent des images motrices," *Rev. Phil.* 1912, 73, 248–56.

limit, with a view to action, the life of the spirit." [1] All perception implies action, motor adjustment. Memory falls into two divisions, which may be analysed by thought but are never actually separated in concrete experience, one of which divisions he calls pure memory and the other motor habit memory. The pure memory, the general storehouse of all our conscious experiences, the memory that never forgets, brings into actual consciousness at any moment that part of its store which is useful for the action of that moment. And the readiness, appropriations, and general success of this return to consciousness depend on the motor-habit memory, the memory that finds its support in the motor mechanisms of the brain. "The orientation of our consciousness towards action appears to be the fundamental law of our psychical life." [2]

These extreme pragmatic views of the nature of imagery and meaning stand in marked contrast with the views put forward by such English writers as Bradley and Bosanquet. But whatever may be thought about Pragmatism as a means of solving the ultimate riddles of philosophy, there can be little doubt about its value in throwing light upon certain problems of Genetic Psychology. And if the Pragmatic explanation of "meaning" does not contain the whole truth of the matter, it probably contains an important part of it, and at least presents

[1] "Matter and Memory" (English translation), p. 233.

[2] Ibid. p. 234.

the aspect likely to prove most profitable to the educator.

There is yet another way in which motor activities prove valuable in fostering mental process. It is getting to be recognized more and more that the brain is dependent for healthy functioning upon the current stimulations of sense. It used to be thought that mental concentration was favoured by cutting off all external stimuli—external, that is, to the brain. Such insulation as a matter of fact is impossible, for the organic sensations will always remain ; perfect silence is impossible, and even the closed eye sees darkness, which is in itself a kind of optical stimulus. Even if total exclusion were possible, it would not be desirable. When certain surroundings are found favourable to study, it does not mean that all sensory stimuli have been excluded, but that a selection has been made of the most favourable stimuli.[1]

Certain motor activities which are not so violent in character as to make much demand upon one's energy are often found to encourage cerebration. Certain characteristic tricks, such as fingering a button or toying with a watch-chain or an eyeglass, are popularly regarded as bad habits—useless, if not positively harmful. James regards these movements as serviceable in fostering thought by draining off superfluous brain currents. The real explanation, it seems to me, is that they support trains of thought by providing the necessary degree of present

[1] See Royce's "Outlines of Psychology," pp. 123, 124.

sense stimulation. I find that if I wish to concentrate my mind on a difficult problem I can do so best while rapidly tapping the ground with my right foot. Some can think best with a pen in the hand ; others find the typewriter, which calls more fingers into action, a better stimulator of thought. In the case of young children and adults of low racial type the importance of this auxiliary stimulation of the brain cannot be overestimated. The movements of the lips during silent reading and the abundant gesture accompanying animated speech testify to their need of motor stimulations, to which the meanings they are striving to make clear may be regarded as the responses. The ideal of a class of children sitting motionless and passive is fortunately giving way to the opposite ideal of purposeful activity.

Professor Stephen Colvin [1] suggests that all imagery, of whatever type, finds an immediate sensory basis in motor sensations. The motor sensations in the vocal organs, for instance, even if they do not entirely constitute what is sometimes believed to be the auditory image, serve as a sort of stimulus and support for that image. He asserts that his own imagery is entirely kinæsthetic, and that even his conceptional thinking is carried on entirely through the verbal-kinæsthetic images or sensations, and also by a sort of mimetic symbolism—a kind of internal speech corresponding to gesture language. The

[1] See "The Nature of the Mental Image," the *Psychological Review*, vol. xv. (1908).

cases of Laura Bridgman and Helen Keller seem to indicate that no imagery is indispensable except motor imagery ; and that a high degree of mental culture is possible when motor (including tactile) imagery is the only kind present that can possess intellectual value.

The exact relation of imagery to meaning—of the sensory content of consciousness, whether motor or other, to the thought with which this content is suffused—is a question to which modern psychology gives no authoritative answer. It is held by some that meaning and image are one and inseparable, by others that they are distinct and separable ultimates. It is believed by Gore[1] that image is stimulus, meaning the response ; image the structure, idea the use that is made of the structure. It is maintained by Pillsbury that there is no real distinction between image and meaning ; that image is in the last analysis but another kind of meaning.

The fact that there is no observable relation between the kind, quality, and quantity of the mental imagery on the one hand and the efficiency of thought on the other seems to point to at least a relative independence. The most opulent mental imagery often seems to be almost empty of meaning, while the scantiest of images may be heavily charged with thought. As the image gets used in various trains of thought there seems to be a tendency for the sensory element to get less, and the meaning it carries

[1] Quoted by Professor Pillsbury in "Image and Meaning," the *Psychological Review*, vol. xv.

to get bigger. In purposeful thinking there is an economy of sensory media. As we grow older our mental imagery grows scantier and more symbolic. Galton has given us evidence which shows that distinguished men of science nearly always think in words. Their images are purely verbal, and in the general decay of the verbal image along the line of economy the visual feature tends to disappear, and possibly the auditory, but the motor features seem to form an irreducible residuum.

In the process of "learning by heart" there is a manifest tendency for all images to pass into the motor type. We must distinguish between memorizing a poem so as to be able to reproduce it by thinking closely of the sense, and learning it by heart so as to be able to repeat it with such ease and fluency that there is no strain at all upon the attention. Is the latter kind of memory visual or auditory? The slightest reflection will show that the minimum memory necessary to achieve this is a memory of a fixed sequence of movements of the vocal chords. If these movements are controlled by images at all those images are of the kinæsthetic type. Other types of images are present, no doubt, but motor images (or sensations) seem to form the essential factor. The process becomes an acquired automatism. To learn by heart is in a certain sense to learn by muscle. The same is true of spelling. Spelling may at first be a matter of the eye or the ear; but ultimately it becomes mainly a matter of muscle. Spelling in the adult is

largely an automatic process. One test of automatism is the disorganization caused by conscious attention. I attend to my mode of walking and immediately become awkward and inclined to stumble. It frequently happens that the speller who hesitates is lost.

THE MOTOR FACTOR IN EMOTION AND VOLITION

So far we have dealt with but one side of the human mind—the cognitive side. But accepting the ordinary tripartite division of mind we can not only think : we can also feel and will. I have been at some pains to show that thinking is intimately connected with doing : it were comparatively easy to show that the same is true of feeling and willing. The nature of that curious plexus of feelings which we call an emotion is betrayed by its very name. We talk about a person being moved to anger, to pity, or to fear. Outward bodily changes become manifest. Whether the James-Lange theory be true or not the " feel " of the changes in muscle and gland constitutes no insignificant part of the emotion. Emotion is largely the mental counterpart of somatic motion. We can control our thoughts and we can control our movements ; but have we any direct control over our feelings? I think not. The content of consciousness being given, I cannot by choosing render it pleasurable or painful. If I feel a red-hot poker on my hand I cannot elect that the feeling should be a pleasurable feeling. Once having got the sensa-

tion, I am helpless. So with an emotion, which is a complex of sensations caused by some exciting percept or idea. When the sensations enter consciousness they bring their own feeling tone with them. We can neither shut it out nor alter it. Suppose I awake in the night and hear burglars at work downstairs. If I let my mind dwell upon the possibilities of personal violence and assume the crouching attitude of fear, then I cannot help feeling frightened. There are only two ways of curing my fright, both of them indirect. The first is to think of something else—rather a difficult task. The second is to assume the bodily attitude characteristic of courage. This is Henry the Fifth's advice to his soldiers at Harfleur—

> Imitate the action of the tiger;
> Stiffen the sinews, summon up the blood,
> Disguise fair Nature with hard-favoured rage;
> Then lend the eye a terrible aspect.
> . . . . . .
> Now set the teeth and stretch the nostril wide,
> Hold hard the breath,

and so forth. If I adopt this advice I shall probably get rid of my fear. To get rid of the burglars is another matter.

It will be noticed that of the physical concomitants of an emotion only half is within our control—the half that is connected with the voluntary muscles. But once this half is suppressed, the other half will tend to fade away.

It is my duty to love my neighbour, nay, even

my enemy. But how can love be a duty? How is it possible by an act of will to acquire a liking for somebody whom I instinctively dislike? There is at least one thing that I can do. I can act towards him as though I did love him. And strange to say the kindly feeling will follow. For it has often been observed that we like those whom we have benefited better than we like those who have benefited us. A warm and loving heart is not entirely the gift of Nature : it is at least in part the reward of " many nameless unremembered acts of kindness and of love." But there is more that I can do, and that more depends upon the fact that I can exercise control over my thoughts. Overt acts are in themselves insufficient. St. Paul has oft been quoted in support of this position : " Though I bestow all my goods to feed the poor, and though I give my body to be burned, and have not charity, it profiteth me nothing." I must get the right feeling ; and to get the right feeling it is sufficient to get the right mental attitude—to acquire the habit of fastening upon the lovable traits in my fellow-man, and so be to his virtues very kind and to his faults a little blind.

This brings us to volition. What is that mysterious power which we call the will? There are some who deny its very existence. They contend that it is an illusion, as the ego itself is an illusion. There is, they assert, nothing but the stream of consciousness. An orderly array of ideas come and go according to certain fixed laws. And there is no soul to witness the

process. The mind does not know the ideas: the ideas simply know themselves. The ideas are not *in* the mind: they *are* the mind. To most of us this doctrine is incredible. The man who hunts for his ego and cannot find it is engaged on the same quest as the old gentleman who went on searching for his spectacles with his spectacles on his nose the whole while. There are others who believe in the soul but deny that it has any authority or dominion. It witnesses the panorama of consciousness, but has no power to interfere with its working. It stands aloof as an impotent spectator. This doctrine is held by those who emphasize the physiological aspect of the question, who believe in the inexorableness of the law of cause and effect, and who deny that consciousness can have any effect upon matter, that the mind can ever be the cause of changes in the brain. There are others among us who repudiate the intellectual arrogance which, having found certain laws in operation in the physical realm, uses them as a basis for dogmatizing as to what is possible and what impossible in the realm of consciousness. We prefer to accept the plain verdict of consciousness. There is a soul, a self, an ego——call it what you will—and this soul is no mere passive looker-on. It enters into the *mêlée* of ideas and is an important factor in deciding the issue. Within certain obvious limits it has the power of choosing its own experience. It can attend to certain objects of thought and withdraw its attention from others. This seems

to be the simplest explanation of what we generally mean by will.

In the following brief account of the nature of will I mainly follow James's line of treatment. The first point to note is that my will can only act through my muscles. The only immediate outward effect it can possibly produce is movement in some part or parts of my own body. Indirectly it can do more; but directly it can do this and this only. To produce this movement no special force or power is needed, for ideas themselves (including, of course, percepts) are in their very nature impulsive: they belong to a current which has not reached its terminus: they tend to work themselves out in bodily activity. In the case of reflex and instinctive acts this tendency is obvious: certain fixed arrangements in the nervous system decide the matter. But what is the nature of the mechanism by which voluntary acts are carried out? Introspection can find nothing intervening between the thought of performing a movement and the movement itself. I think of taking my watch out of my pocket, and forthwith the thing is done. The mere idea of the movement is in itself sufficient, provided there is no antagonistic idea present in the mind at the same time. But the idea of the movement before it actually takes place implies images left by previous movements. How did I originally get these images? Obviously through movements of a random or reflex character. Spontaneous activities are an essential preliminary to the

voluntary life. A stock of motor images is necessary before the will can begin to operate at all. But what happens when an antagonistic idea is present, when I wish to do two incompatible things? Do the two ideas fight it out among themselves, or does the ego step in, and put its veto on the one and give its sanction to the other? As it is not always the stronger impulse that wins there is some reason for thinking that the ego does interfere. However that may be, the fact remains that one of the movements will be inhibited. This process of inhibition—of checking movement—is of the highest import in the development of intellect and character. For the will is trained not so much by doing things as by not doing them. To refrain from action often requires palpable effort. A tendency to cough at a public meeting cannot always be checked without a strong effort of will. Where there is less organic stability in the physical basis of the impulse the effort is not so manifest. But we are constantly inhibiting, we are constantly putting on the brakes, we are constantly diverting the stream of innervation which runs from every idea that enters the mind. Sometimes none of the stream seems to escape, and the energy which in a more primitive type of mind would be expended in bodily movement becomes dissipated in thought. All progress in self-control is progress along the line of inhibition. A very young child acts almost entirely upon impulse. But in course of time he learns to check those move-

ments that lead to painful issues. He begins to look before he leaps, to think before he acts. But inhibition is of gradual growth. It presupposes experiences gained by impulsion. The very reason for suppressing a movement is that its consequences are known, and known to be undesirable. Within certain limits inhibition in the experienced adult is favourable to contemplation ; in the inexperienced child it is favourable to slumber.

Looked at purely from the psychological side, will is hardly distinguishable from attention. Within the realm of consciousness the only control the mind can have is attentive control. It can think of some things and refuse to think of others. In ordinary cases all that the mind does in order to make a movement real is to attend to the idea of that movement. Tenacity of purpose means stubborn and exclusive attention to certain salient aspects of a situation or to certain ends to be achieved. And as in the control of movements inhibition is an essential factor, so in the control of thought non-attention is an essential factor. All effectiveness in thinking depends upon concentration, and concentration depends upon inattention. What seems an effort to attend to one particular thing is really an effort not to attend to anything else. To intensify the stream of thought one must narrow the current, at least to the extent caused by the withdrawal of energy from all that is irrelevant.[1]

[1] See, however, Professor Adams's "Exposition and Illustration in Teaching," p. 156.

But I have already dealt with attention and shown how closely it is connected with innervation of the muscles. There I showed that the muscles enabled us to attend ; here I show that attention enables us to move the muscles.

The upshot of our inquiry is that we cannot look at the human mind from any point of view without having the fact forced upon us that motor activity is of vital and fundamental importance ; there is no nook or cranny of the mental structure where motor elements are not found to enter ; there is no mental process or mental product that does not receive some support from muscular experiences ; there is no emotion or volition that is not mediated by movement ; there is no intellectual or moral progress that is not in some way connected with either the promotion or the inhibition of bodily activity.

THE RELATION BETWEEN MOTOR DEVELOPMENT AND MENTAL DEVELOPMENT

So far we have dealt mainly with an analysis of the mental states of the adult with a view to discovering the extent to which motor factors enter into their composition. In applying the knowledge thus discovered to the interpretation of the mental states of a very young child we are liable to misread the signs. It is an ancient pitfall. The inadequacy of the older psychology arose mainly from the fact that it was exclusively concerned with the adult mind. In the study of this mind certain more or less artificial categories of faculties and senses were arrived at, and in applying these categories to the mind of the child are we quite sure that our procedure is logically sound? Do we not read into the mind of the young child what is only true of the mind of the adult? When, for instance, a man bursts into tears we infer—and rightly infer—that his emotions are violently stirred ; but are we justified in assuming that the same is true when a baby cries? We take it for granted that the same overt movement—the same expression—is an index of the same mental

state, whether in the nebulous mind of the young child or in the highly organized mind of the adult. Dr. Dewey's view that such an assumption is quite unwarranted may safely be accepted. We want some other principle of explanation in studying the development of the young mind. The mere cataloguing of first occurrences—when the baby first smiled, or clenched his little fist, or changed the character of his cry—is of little use to us unless we can find out what these acts really express—what sort of mentality lies behind them.[1]

We seem to be within the realm of fact when we say that generally speaking the child's movements, his nervous system, and his mind develop side by side. As he grows older his movements become more purposeful, more efficient, better co-ordinated, and better adapted to meet the needs of his widening experience. At the same time his nervous system is getting more and more complex, new connections are being established between sensory and motor nerves, new lines of traffic are being set up between the higher and lower nerve centres. Parallel with this increase in neural complexity we find a corresponding increase in mental complexity. Are we justified in assuming that these three things—bodily activity, nervous system, and mental structure—grow at precisely the same pace? Does the development of one necessarily mean an equal development in the other two? Roughly speaking, it does—in the early

[1] See King's "Psychology of Child Development."

stages at least. It must, however, be interpreted dynamically ; they *grow* together. Complexity of neural structure may or may not signify complexity of mental structure ; it depends upon whether the former complexity is inherited or acquired. A man is richly endowed in brain and nerves when the arrangements and associations therein are adequate to meet the various demands of the environment. Some of these arrangements are born with him ; they subserve reflex and instinctive movements. Others were established by himself in the attempt to make his movements purposive and effective. In other words, some of his neural wealth is inherited and some acquired. It is only his acquired neural wealth that indicates actual as distinct from potential mental wealth. Before we can tell how much intelligence or emotion is behind a certain complex movement we must first find out to what extent that movement is due to congenital endowment. We have no right at all to assume that the stereotyped neural arrangements in the bee subtend the same mental angle as an equally complex neural arrangement in the boy ; nor yet that two equally well-organized bits of neural machinery in the boy possess equal mental significance.

The one characteristic common to all movements is that they are caused by stimuli, these stimuli coming either from within or from without the organism ; and the aim and purpose of the movement is to deal in some way with the stimulus—to remove it if harmful, to retain it

if beneficial, to modify it so as to satisfy some need of the organism. In the case of reflex and purely instinctive responses the neural mechanism is in perfect working order : it goes of its own accord, it needs no interference from a guiding intelligence. But the baby is born with a comparatively small number of these fixed paths of motor discharge, and the most that can be said of the bulk of his instincts is that the physiological arrangements show a *tendency* to take a certain form, but are capable of ample modifications. They are only *partly* fixed. In the majority of cases indeed the pre-arrangements for dealing with the situation are inadequate. The baby responds to the stimuli, but the response is ineffective. The nervous excitement being drained off by the most permeable channels, the resulting movements are generally wide of the mark. They fail to bring about adaptation : they do not meet the case. Sometimes he responds with his whole body. It is only by experiment that he finds out which movements are really effective. The wrong movements and the unnecessary movements gradually get left out, and the right response by repetition gradually gets stamped in. It frequently happens, too, that in order to secure more adequate adaptation he has to break up some of the older systems ; that he has to inhibit—to check certain responses and substitute others ; and these activities of inhibition and guidance are perhaps the most important of all. The operator at the central exchange—

the intelligence controlling the brain-centre—gets more and more practice (although there is no consciousness of it as such) in switching the nerve currents from inappropriate to appropriate lines of motor discharge. But for this constant vigilance at the central exchange we should soon degenerate into mere automata. For every movement we make leaves its trace in the nervous system, and every repetition tends to deepen that trace. The action gets more and more stereotyped until at last the nerve resistance vanishes, and a habit is fully formed. It is thus seen that we gradually construct our habitual lines of activity out of random impulses. The sensori-motor reaction is the starting-point of all the complex muscular adaptations of which we are capable. We start our lives with a small number of ready-made habits which we call reflexes and instincts, and spend our lives in adding to the inherited stock by making for ourselves new ones. The raw material of the new habits consists of random movements, and movements got by the disintegration of old complex habits. And in this important fact, that we can break up old habits and build up new ones, consists our educability. So long as there is constant interference with the couplings in the brain—so long as there is activity at the central exchange—so long is there resistance offered to that fatal drift into old-fogeyism against which we are warned by William James. And activity at the central exchange means intensity of consciousness. Let us, for instance,

consider what happens when a child acquires skill in a simple operation such as knitting. She has at first to attend very closely to what she is doing. She makes wrong movements, finds them ineffectual and tries others. At last she succeeds in making the first stitch. The next few stitches she finds somewhat easier, but she cannot for a moment take her mind off her work. If she does she is certain to make a mistake. But as time goes on the stitches get easier and easier, and she is gradually able to relax her attention. Ultimately she will be able to carry on the process without thinking about it at all. The act has become automatic. The amount of attention required has been gradually diminishing, while the automatism acquired has been gradually increasing. And attention merely means the mind at work: it means vigilance at the central exchange: it means intensity of consciousness. It is obvious that activity of mind is not necessary in the case of automatic movements—whether in the form of instincts or acquired habits—for these can go on by themselves; and, in accordance with the general economy of nature, it is probable that where it is not necessary it does not exist. But it *is* necessary—it is indispensable—when new situations have to be met, and new connections made in the brain. And it is just here, where one would naturally expect to find mental activity and growth, that one actually does find it. Whenever bodily movements are under control, whenever, that is, one of several equally per-

meable channels of discharge is chosen as securing a better adaptation, there do we find intelligence at work.

In a series of articles in *Mind* (1898) McDougall contends that Consciousness is determined by the novelty of the reactions between mind and the environment. It is, he asserts, correlated with "the novelty of the combination of nervous processes." It constantly accompanies the "acquirement of experience." Consciousness and experience always go together. This is in accordance with the position taken up in this book. If the theory is well grounded it follows that there can be no mental growth without the establishment in the nervous system of new lines of neural discharge, or at least a modification of old ones. For that the mind should *grow* without conscious experience is inconceivable; although it can be shown that the mind's resources may be increased without conscious experience, if among its resources may be included facility of physiological adjustment. An act practised to-day may be performed with greater facility to-morrow without any intervening practice.

The new connections made among the neurones take the same general course as the innate paths; that is, they tend towards the muscles as the natural goal towards which the neural impulses flow. In the case of very young children inhibition is comparatively infrequent, and the appropriate overt movements actually take place. Once, however, a fairly large stock

of the commoner types of adjustment to physical conditions has been acquired by actually carrying out the movements involved and noting the consequences, the possibility of mental, as distinct from physical experimentation is established. It becomes possible to recall likely means of meeting a case, to think out their implications, and to recognize, without actual trial, whether they will prove efficacious.

It seems therefore reasonable to conclude that the younger the child the more will its progress in motor efficiency serve as a reliable clue to its progress in mental efficiency. As the child grows older it is possible that the two kinds of efficiency may widely diverge ; although it is by no means necessary that they should.

This tentative conclusion is supported by a consideration of the methods by which new adaptations are acquired.

The significance of a complex movement depends not merely upon whether the movement is a personal acquisition or an inheritance, but it also depends—and very largely depends—upon *how* it has been acquired. There are three main ways by which an act may be learned : the method of trial and error, of imitation, and of reflective thought. The first method, and possibly the second, are common to man and brute ; the last is characteristically human. It generally happens that all three methods are used together. The method of trial and error unassisted by reflection is slow and uncertain. Imitation is often eked out by trial-and-error and by reflec-

tion. The most rapid and effective means of bringing about adaptation to novel conditions is reason, or thinking (in the narrower sense of the word). If the child thinks about what he is doing—if he brings the ideas he has acquired to bear upon the practical problem in hand—he is then learning in the best way. It is probable that a certain amount of ideation and rudimentary judgment is from early infancy concerned in the mastery of adaptive acts. Dewey contends that the baby's " primary problem is the mastery of his body as a tool of securing comfortable and effective adjustments to his surroundings, physical and social. The child has to learn to do almost everything. . . . These operations of conscious selection and arrangement constitute thinking, though of a rudimentary type. . . . The development of physical control is not a physical but an intellectual achievement." [1]

The extent to which thinking enters as a factor in the control of movement serves as an index to the educational value of the movement. A child who finds out for himself how to overcome a certain mechanical difficulty will, unless there has been too much " hit or miss " about it, get more intellectual training out of the experience than if he had been shown how to proceed. Self-activity is, in fact, an important factor in the acquisition of skill. But there are degrees and kinds of mental activities corresponding roughly with the three levels of learning. On the lowest level experimentation takes place in the per-

[1] Dewey, " How we Think," pp. 157, 158.

ceptual field. The trial and error process in animals is overt. Trial movements are actually made and their success or failure actually felt. But there are no free ideas : the activity is perceptual only. But it is essentially self-activity. They cannot learn by being shown how to perform the act. They can learn sometimes by being put through the movement ; but it takes a longer time than learning by their own efforts. It is doubtful whether animals ever quite rise to the second level and learn by application of free ideas. If imitation takes place it is perceptual imitation, and it can, as a rule, only occur in the case of acts to which the animals are instinctively inclined. They cannot, except in rare instances, learn entirely new acts by imitation ; and they cannot learn acts partially instinctive by imitation except under the actual stimulation of sense. Children, however, can learn non-instinctive acts by imitation ; and can carry out the movements under the stimulus of free imagery—can imitate to-day what they saw yesterday. Yet here again self-activity cannot be dispensed with. They must repeat the act in order to get it right. The experimentation is guided and abbreviated by imitation, not superseded by it. The only kind of learning, however, which brings the whole mind into operation is the third and highest. On this level it is necessary for the learner to have a clearly defined purpose in view and to experiment mentally, rather than actually, in devising means towards the accomplishment of that purpose.

The " trial and error " has been transferred from the physical to the mental realm. Some writers limit the use of the term self-activity to this last kind of learning process—a process which is guided by a clearly conceived end. In this sense of the word the greater the amount of self-activity involved in the mastery of an adaptive act the greater is the intellectual significance of the act.

If this be so one would expect to find the degree of motor skill becoming, as the child grows older, a less and less reliable criterion of his intelligence. For not only are his interests likely to develop in directions less immediately concerned with bodily activity, but we do not know on what level he has learnt his skilful movements. In the case of adults it is clear that there is no very high correlation between motor and mental efficiency. There is indeed some excuse for the opinion of the old lady who defined a genius as a man who could not earn his own living and spilled his victuals over his clothes. The mental ineptitude of certain workmen highly skilled in limited directions is balanced by the physical ineptitude of certain men of profound erudition.

With a view to discovering to what extent, if any, this divergence between motor and mental efficiency is observable among school children, I have worked out by Spearman's formula the correlation between general intelligence and proficiency in certain forms of handwork in three different types of elementary schools.

School A is an average type of London Elementary School. The general intelligence was estimated by the head teachers and the class teachers, and was based partly upon success at the terminal examinations and partly upon mental alertness and resource shown during the ordinary school work. In assessing the proficiency in handwork, marks were accorded for such subjects as drawing, painting, modelling in clay and paper, sewing, and in the case of children over eleven, for woodwork, or cookery, laundry, and housewifery.

School B is situated in a very good residential area and is attended by a class of children considerably above the average.

School C is a special school for mentally defective children, where the whole of each afternoon is devoted to handwork. The school in the poorer neighbourhood (A) had in the three departments twenty-one classes, and the school in the better neighbourhood (B) thirty-two classes. Although the results were somewhat unsteady, the tendency in both schools was identical. The correlation coefficient was high in the lowest class of the infant school (about 0·6), and there was, on the whole, a general decline in the amount until the highest class in the senior school was reached, where it sank to 0·3. Broadly speaking the correlation was positive, and diminished with age.

In the school for mentally defective children the two aspects of school work were much more highly correlated. Indeed, in the highest of

the three classes of which the school consisted it reached 0·9. This result does not mean that the children manifest a high degree of motor efficiency, but that what intelligence they possess concerns itself mainly with practical activities. Their interests are more motor than mental. It may be thought that the high correlation is due to the fact that handwork forms a large part of the curriculum of the school. But two significant facts tell against that theory. The first is that the lowest of the three classes, which consists of children recently drafted from the ordinary schools, manifests a correlation quite as high as the other two classes ; and the second is that among the classes of backward or retarded children in schools A and B the correlation is much higher than in the normal classes.

Assuming these figures to be representative, we seem to be justified in drawing the general conclusion that for children of elementary school age there is a positive correlation between motor and mental efficiency, and that this correlation broadly tends to vary inversely with the degree of mental development. The correlation is exceptionally high among children whose immature development is due to causes other than youth.

Mr. Cyril Burt, in his experimental tests of general intelligence, found a marked relation between intelligence and accuracy of sensori-motor reaction,[1] a result which accords with the statistics given above.

[1] See *British Journal of Psychology*, vol. iii. (December 1909).

The results need verifying in other schools, and in any case require to be interpreted with the utmost caution. Before we can validly infer that the handwork had influenced intelligence, or, having influenced it, had less and less effect as the child grew older, we must first answer at least three questions: (*a*) Is the amount of correlation indicated above higher than what normally exists between all forms of natural ability? (*b*) Does the high correlation mean that the connection between the two functions is causal? (*c*) Is not the decline with age merely a particular instance of a general law, viz., that the correlation between abilities lessens as those abilities are practised? Many investigations must be made, and many years must pass, before a complete answer to these questions can be hoped for.

The value, too, of these figures, as indeed of any statistics of a similar nature, is diminished by the fact that the analysis of school activities into mental and motor is extremely imperfect. All the activities by which the intelligence of a child is judged contain motor elements, and all the activities by which skill in handwork is assessed contain mental elements. And different kinds of handwork involve different degrees and kinds of headwork. Drawing, for instance, as now practised in the schools, depends quite as much upon accurate observation, and an apprehension of the different values of visual signs of solidity, as upon the skill of the hand in representing what is seen or imaged. The mental

operations are very different from those concerned in such an exercise as knitting or cane-weaving ; and equally distinct from the mental processes involved in inventing a mechanical contrivance (such as a simple windlass, or a loom, or a scientific apparatus), which shall do a certain predetermined piece of work.

In considering the significance of these relationships the following points should be borne in mind :—

1. Handwork, although an extremely important branch of motor activity, is not the only means of expression : still less is it the only basis of kinæsthetic experience.
2. Skill in handwork may be estimated from more than one point of view.
3. Motor experiences may be variously utilized in mental constructions.

The tongue as well as the hand is an organ of expression which enormously helps to fashion our thoughts. Without conventional speech, indeed, it is doubtful whether any progress at all can be made in conceptual thinking. In our investigation of the mind with a view to discovering motor elements, we found such motor elements as were necessarily involved in the use of the sense organs to have an important bearing on the nature of the percepts resulting from the use of those organs. These movements are not expressive of thought in the sense that construc-

tive movements of the hand are expressive of thought ; for they precede the mental activity. Yet are they important constituents of our mental make-up, and are particularly useful in the maintenance of attention.

The three important factors of manual skill are speed, accuracy, and fitness, and the most important of these, from the point of view of mental activity, is fitness. Speed and accuracy are largely matters of mechanical practice, while the suitability of the object for the purpose which the maker had in view is a matter of intelligence. Accuracy and " finish " should be regarded as being relative to purpose. If the constructed object meets the requirements of the case, to refine upon it may indicate artistic appreciation, but does not necessarily mean increased intelligence. A very rough plan made by a boy to indicate the route from his house to the school would probably signify more intelligence than a map of England very accurately copied. For the purpose of demonstrating the fact that the three angles of a triangle are equal to two right angles, a very carelessly drawn triangle may serve as well as an accurately drawn one ; although there may be cases in which careful construction will reveal a fallacy in reasoning, as in Lewis Carroll's so-called proof that every triangle is isosceles. In any case the product considered by itself is but a rough indication of a pupil's skill in adapting means to ends and in putting his own ideas into execution.

It is not so much a high degree of skill in a limited number of manual operations that counts : but rather the variety of the adaptations and their adequacy to meet the needs of the situation. The important thing is that the young pupil should have a rich and vital experience of spacial relations, of the properties of a variety of materials, and of the operation of simple physical laws, and should gain that experience as far as possible by bringing his intelligence to bear upon his material environment. Handwork in the school is a means to that end. For once the sensory experience mediated by movement is acquired that experience may be used indefinitely in the realm of abstract thought. It is impossible to judge the intellectual superstructure by the extent of the sensory basis upon which it is reared. So much depends upon the use to which the sensory material is put by the mind. The constructive aspect of handwork is here important. For the mind transfers its knowledge of material constructions into the ideational realm and employs it as a means of arranging and systematizing its thoughts and of carrying out trains of reasoning. To quote Bosanquet : [1] " Ultimately the condition of inference is always a system. And it will help us to get a vital notion of inference if we think, to begin with, of the interdependence of relations in space—in geometrical figures, or, to take a commonplace example, in the adjustment of a Chinese puzzle or a dissected map." We

[1] "The Essentials of Logic," p. 40.

are all acquainted with people (and they are generally very efficient thinkers) who rarely attempt to explain anything at all abstruse without taking out a piece of paper and arranging their ideas spacially.

It will thus readily be seen how it is that as the pupil grows older, he may make little or no progress in manual dexterity while his mental efficiency may increase enormously ; and how it is that the relation between the two kinds of ability differs so widely in different individuals.

The whole question of the relation between motor ability and general ability is complicated by the difficulty of ascertaining the precise nature of general ability. The popular belief in its existence is almost universal—a belief which finds emphatic literary expression in Carlyle's " Heroes and Hero Worship." A great man is a great man under all circumstances. If Napoleon had not been a great warrior he would have been a great something else. The intellectual and moral energy of a man is a given quantity, and, like murder, it will out. If it does not come out in one way, it will in another. This doctrine of the vicariousness or interchangeableness of abilities cannot be accepted without modification. Professor Spearman, who has done much to elucidate the question, has put forward statistical evidence which points to certain definite conclusions.[1] He holds that mental abilities are of two kinds, general and specific. General ability is a central intellective function

[1] See *British Journal of Psychology*, vol. v. pp. 52-84.

depending on the general fund of mental energy, which again depends on the general fund of brain energy. This central energy is expended in a variety of ways according to the specific structure of the brain. Thus, brain energy determines general ability, and brain structure specific abilities. We cannot by education increase the sum total of cerebral energy; but we can, by the formation of habits, alter the structure of the brain. In other words, general ability, or intelligence, is not educable, but specific abilities are. Motor abilities constitute one definite group of these specific factors, and although they can in themselves be trained, and can thus be made to improve all other abilities into which they enter as constituent factors, they can have no effect whatever in increasing the central fund of energy. In other words, motor training does not improve intelligence. But when we consider that, according to this view, no training of any kind is able to alter the general fund of intelligence, it is clear that the extent to which motor training influences other abilities still remains an open question. Nor is Dr. Spearman's doctrine incompatible with the view that specific training may have a very wide-reaching effect.[1]

It is clear too that the term "general ability," as used by Professor Spearman, is not quite equivalent to the term "general intelligence" as

[1] See "Qualified and Unqualified Formal Training," by Professor Spearman, *Journ. of Exper. Ped.*, vol. ii. No. 4, pp. 247–54.

it is understood in scholastic circles. A man has little if any more general ability, in Professor Spearman's sense, at forty than he had at fifteen years of age ; and yet it would hardly be contended that his mental efficiency is not far greater. His interests and aptitudes are wider and more numerous ; he has more resources, and can deal more effectively with the various problems and difficulties that daily life presents. He is commonly regarded, in fact, as being more intelligent ; and it is in this sense only, in the sense of having multiplied the channels through which the central energy may escape, that it is here claimed that general intelligence may be improved by specific training in handwork and other forms of motor activity.

FUNDAMENTAL AND ACCESSORY MUSCLES

ON *a priori* grounds it seems as though the larger and coarser muscles—the muscles we have in common with the brutes, the muscles concerned in locomotion and the swing of limb—should be the first to develop. Compared with the fine and intricate muscles of the hand and throat, the large muscles of the trunk and limbs are of remoter heritage; their control is rendered easier by the fact that some at least of the co-ordinations are instinctive; they are more closely connected with those adaptations which are immediately vital. Control of the finer accessory muscles comes later in the history of the race, and, generally speaking, the same order seems to be preserved in the development of the child. In his conquest of the body the bigger muscles are first brought into subjection. It is true that the hand is used from the first, but there is no delicate adjustment of the fingers, and the movements start from the elbow or the shoulder. When a very small child tries to bring about fine co-ordinations he signally fails. He often *tries* to make very small drawings, and this has been urged as an objection to the

theory here expounded. But a child is such an incorrigible experimentalist that he will try anything. It is not everything that a child delights to do that promotes healthy growth. He likes to wade in the puddles, to eat innumerable sweets, to stay up late, and to swagger about with a cigarette in his mouth. Nor is it quite certain that the tendency to produce very small drawings is spontaneous and natural. It is generally found that a child who draws a cat as big as a thimble has previously been taught to form letters of that size. The teaching of writing, especially of small writing, before the teaching of drawing is productive of much mischief. That a child should exercise his larger muscles before he is required to exercise the finer ones is a principle which is now almost universally accepted. The small child should deal with big things. It is the more massive muscles that are as a rule brought into use in games, athletics, and physical drill.

PLAY AND WORK

THERE is much variety of opinion with regard to the function of play in education. There are many schoolmasters who regard the school as a place where the pupils are to be imbued with a spirit of work, and where play must be regarded as a reluctant concession to mere physical health. The distinction between work and play is not rendered sufficiently definite by stating that the former is engaged in for the sake of its consequences, and the latter is engaged in merely for its own sake. "The true distinction is not between an interest in activity for its own sake and interest in the external result of that activity, but between an interest in an activity just as it flows on from moment to moment, and an interest in an activity as tending to a culmination, to an outcome, and therefore possessing a thread of continuity binding together its successive stages. Both may equally exemplify interest in an activity for its own sake." [1] Dewey regards play, except when it represents a mere overflow of physical exuberance, as the domination of activity by meanings of ideas rather than by the sense objects actually present.

[1] Dewey, "How we Think," p. 164.

When the child begins to adopt the attitude of work he is no longer content to react to the meanings which the things suggest, but demands congruity of meaning with the things themselves. There should on this view be a gradual passage from the play attitude, which is the characteristic attitude of infancy, to the work attitude which characterizes the adult. There is no doubt that a false antithesis between work and play is fruitful of much harm in the school. To exclude either is fatal to sound education. To regard the infant school as a place where children learn by play and the senior schools where they learn by work is equally mischievous. There is no abrupt transition from one attitude to the other. "When the play of the child becomes suffused with the sense of a higher coercive force that compels its continuance, even though the caprice of the moment would lead elsewhere, it is transformed into work."[1] This coercive force may arise from the consideration of the remoter consequences of the activity either in the pleasure he will derive from the product or from the approval of his teacher or his schoolfellows. Generally speaking, the coercion is social in character and leads to an appreciation of the ethical significance of "ought."

Groos's theory of play as a native impulse whose biological utility is preliminary practice in the serious pursuits of later life is, on the whole, more satisfactory than the "surplus

[1] Henderson, "Text-Book in the Principles of Education," p. 409.

energy" theory of Schiller and Spencer and the "recreation" theory of Lazarus. Children play because their instincts drive them to it. And intellectually it has enormous value in the way of giving, vivifying, clarifying, defining and organizing a large number of ideas bearing upon the child's physical and social environment. Looked at purely from the point of view of mental development, the most important of these activities is the imitative play of young children. This kind of play is in closest touch with the group of thoughts with which their minds are constantly occupied. The child of five dwells in Wonderland. The commonest sights and sounds have for him "the glory and the freshness of a dream." His wonder and admiration find expression in speech, in drawing, and in imitative play. A little girl finds a dolls' tea-party far more wildly exciting than the real tea-party of which it is an imperfect copy. It is *her* party. It is she who has to do everything. She may pour out imaginary tea and sweeten it with imaginary sugar. Make-believe may invade every province but one—that of the actions involved. These at least must be real. It is through them that she fully and completely realizes the delirious joy of giving a tea-party; it is through them that her ideas of this particular social function gain clearness and precision. This is the period of toys. A toy forms a nucleus about which a child's activities cluster. If it fails to call forth these activities, it is a delusion and a snare. It

is patent to all who have observed children that their appreciation of a toy has nothing to do with its complexity. A miniature motor-car that goes by clockwork may at first excite a burst of admiration, but there is no wearing quality in the joy it gives. A simple wooden cart that a child can drag along himself will afford him far more permanent pleasure. The essentials are present in the one and absent in the other. It is not the doll that rolls her eyes and squeaks that is abidingly dear to the heart of the little girl, but the old rag doll, the doll that can be cuddled and coaxed, or violently smacked and put to bed. In fact, the value of a toy depends not upon what it does, but upon what can be done with it. It follows that all automatic mechanism in a toy tends to rob it of its *raison d'être*. Mechanical toys, which were really invented for the benefit of the rich uncle rather than the gift-receiving nephew, should be ruthlessly abolished. Nor should a child be allowed to buy a toy which he could conveniently make for himself. In this respect the boys of the last generation, who made the bulk of their own toys with the indispensable jack-knife, possessed an advantage over the boys of this generation. Simplicity or even crudeness in a plaything is often more of a merit than a defect. It leaves a wider scope for imagination, and a bigger margin for skill on the part of the player.

In these early games, with or without toys, the child is realizing his social self, and is setting up rough muscular co-ordinations which

are not only useful in themselves but also form a basis for further and finer development. At this stage skill and strength are of slight importance. Make-believe and a general rightness of action are the essential desiderata.

After the child reaches the age of seven the character of his play undergoes a change. He for the first time begins to distinguish between play, which is an end in itself and always pleasurable, and work, which is a means to an end—a means that is sometimes distinctly unpleasant. His games are no longer predominantly imitative. They become more or less self-contained, and their social significance changes. He has reached the stage of athletic sports, which are of two distinct kinds—that in which he plays for himself, and that in which he plays for his side. In the one case his own personal skill or prowess is the sole consideration ; in the other subordination to the success of the team is superadded. The latter is unquestionably the more valuable ; but whichever of the two kinds is taken up—whether individual or organized sport—its intellectual import is debatable. The muscular co-ordinations are in the main those in which the larger muscles are involved. The activities are often of a kind in which the lower animals excel. No amount of training would enable a boy to run as fast as a horse, or to jump as far as an antelope. A sea-gull can catch a small fish thrown into the air with greater skill than a cricketer can catch a ball. It is admitted that every gain

in muscular efficiency involves perhaps some sort of gain in mental efficiency as well ; but that gain may be great or small. The mere acquisition of skill in a simple overt movement, such as hitting a ball with a bat, does not in itself mean much. There is no need for consciousness to rise above the perceptual plane. The batsman arrives at his skill purely by trial and error. He fumbles after the right response. When he misses the ball, he knows not why he misses it—he merely hopes for better luck next time.

But it may well be urged on the other side that the mere striking of the cricket ball is but one element in the game, and that to play the game well requires mental alertness, initiative, and judgment. It has, moreover, been claimed that the player learns to take a licking with good humour ; he gets to recognize himself as part and part only of an organized system ; he learns to subordinate his own wishes and actions to the general good of the whole ; in fine, he receives an excellent preparation for citizenship. That there is a considerable measure of truth in this contention will readily be conceded if the degree of validity which will be ascribed later to the doctrine of formal training be accepted. There is no doubt that certain habits are cultivated in the playing field which tend to foster a social spirit and to serve as some sort of preparation for citizenship.

The value of athletic sports is not, however,

merely indirect. They not only afford a field for the indirect cultivation of good social habits, but they directly prepare for and lead up to the avocations of adult life. Moreover, they conduce enormously to the maintenance of physical health ; and in promoting healthy physical growth they provide a favourable, nay, an indispensable condition for healthy mental growth. The same may be said of physical drill. It is a corrective to the somewhat unhealthy conditions under which collective instruction must necessarily be carried on. Looked at purely from the standpoint of systematic muscle training, it is superior to play, for the exercises may be so framed as to train all the voluntary muscles in any proportion. But boys and girls never get so keen on drill as they do on games. The mental exhilaration throws the balance indubitably in favour of games.

HANDWORK AS AN EDUCATIVE FORM OF MOTOR ACTIVITY

IT will be noted that among the things that a man can do and an animal cannot, two stand pre-eminent—he can speak and he can use his hands. It is impossible to believe that his superiority over the beasts is unconnected with these two kinds of activity. Neither kind is instinctive. Each has to be acquired by persistent effort on the part of the individual. A baby babbles in almost precisely the same way, whatever nationality he belongs to. A French baby has no congenital predisposition to produce nasal sounds, nor a German baby to produce gutturals. Each has to learn the language for himself, to build up the delicate muscular co-ordinations for himself, by pure imitation of his elders. And as with vocal co-ordinations so with manual co-ordinations. A child inherits few, if any, fixed modes of using his hands. All the various kinds of manual dexterity, from driving a nail to playing the piano, have to be learnt *de novo* by every child born into the world. Here then, if anywhere, in vocal and manual activities, do we find a fruitful field for the promotion of mental growth. The multitudinous co-ordina-

tions of which the fine lingual and manual muscles are capable, render the vista of improvement indefinitely wide and extensive. The possibilities are practically inexhaustible. Never does one come to the end of the tether in acquiring skill in speech and handcraft. The man who is fluent in many languages is inarticulate in many more. The wonderful hand of Velasquez would falter on the harp, and Rubinstein would bungle at a picture. As media of instruction speech and handwork cannot be surpassed. But there are cogent reasons for regarding the hand as in some respects a more important instrument for mental development than the tongue. Speech comes comparatively late, and takes no part in forming the earliest impressions on the child's mind. But his hand has been active from the day of his birth. It is probably the first sense organ that is brought into use, for during the first few weeks of his life neither his eyes nor his ears are of any service to him. It is in touching and grasping things that the first vague awareness of a systematic world comes into being. It is in the manipulation of objects that his ideas are first formed and moulded, and he gains a notion of the distinction between himself and the rest of the world. It is indeed probable that a child's first ideas are not ideas of objects but of actions to be performed with respect to objects. Even in later childhood the tendency is to fix upon the dynamic aspect of an object. A boy, as Binet and others have observed, always defines a thing by its use.

To him a stone is not an indurated mass of earthy matter but a thing to throw at a bird. A little girl, with this tendency strong upon her, once defined an average as a thing for hens to lay eggs on. A child's thoughts are thoughts of doing ; rarely are they thoughts of being. And in doing things the hand is all-important. The vocal organs are used almost exclusively for expression ; the hand is used for impression as well. It investigates and exploits the environment, and the knowledge it conveys is suffused with a strong sense of reality. The sounds of the voice perish almost in their birth : their life in perceptual consciousness is too brief to be of much import in itself ; but the works of the hand are abiding. They crystallize the thoughts of the race and mark the progress of humanity. Take away from our lives everything that is directly and indirectly the work of the human hand, and we are immediately reduced to the most primitive conditions of savagery.

The obvious advantages of speech as a means of social communication and an instrument of conceptional thought need not here be insisted on. It may, however, be pointed out that the use of the hand for gesture language probably preceded the use of the tongue for conventional language, and prepared the way for it. Moreover, the two functions have probably a close physiological connection, as will be shown later in the section on Ambidexterity. Language has always formed an essential part of the training of the young, although it is too often a foreign

tongue, and is in any case treated far too formally. There is, in fact, a tendency to deal with language in separation from the living thought which finds in it appropriate embodiment. The one branch of school instruction which aims specifically at increasing the motor efficiency of the children is handwork. This subject does not, of course, cover the whole of the child's motor activities, but the hand is regarded as the main organ of the muscular sense. These important muscular adjustments of the senses which were shown to form an essential part of every percept are in the main excluded. It remains, therefore, to justify more fully the claims of handwork as a medium of education.

What is the amount and kind of evidence supplied by educators who have introduced manual training into the school curriculum? In the bulk of the elementary schools boys over eleven years of age receive instruction in woodwork for one half-day a week, and there is a consensus of opinion among the teachers concerned that the children receive intellectual benefit therefrom. There is a general belief that the ordinary academic work is done better than it was before instruction in woodwork was introduced. Within the last few years various forms of handwork have been taken up in the lower classes of several senior schools with which I am officially connected, and the children appear to have been rendered brighter and more intelligent. They unquestionably take a much greater interest in their schoolwork.

The system of drafting mentally defective children into special schools where they are mainly trained in handwork has proved a great success. I have seen quite remarkable cases of mental development brought about by this means after all other means had failed.

Sir Harry Reichel gives a striking instance of the way in which manual training had improved the general work at Cheetham's Hospital School, an old endowed Bluecoat School. An experiment was tried for a year, during which half the boys attended a course of systematic handwork and the other half devoted the whole time to the ordinary studies. "At the close came the test examination, and then it appeared not only that the boys who had devoted four hours less a week to book study were not behind the others in any of the book subjects, but that in the mathematical part they were markedly in front of them, more particularly in Geometry." [1]

Sir John Gorst, in an address given at Hull, on April 13, 1909, spoke as follows :—

"I was talking a week or two ago to one of the most successful headmasters of a public school in this country, and he told me that he had set his face against the common practice of public schools. If boys could not keep up to the rest of their class in the classics and mathematics it was thought to be detrimental to the school, and better for them and for the school itself that they should be withdrawn. This

[1] Address to Scottish Sloyd Association, May 28, 1909. See also *Educational Handwork* for September 1909.

gentleman told me he had set his face against the practice, and in the school of which he is headmaster he had established a technical department, and the boys who were behind the rest in their classics were no longer sent away from school, but were sent into the technical department ; and he said extraordinary results had followed. He had been quite astonished that some of the supposed stupid boys when they got to mechanical work were positively geniuses —and, far from being the worst intellects in the school, they were often the best. He had found boys who had failed in the ordinary classes to appreciate or to understand mathematics, as soon as they used mathematics in joinery or carpentry or some other technical work, not only become efficient in that particular branch, but go back into school and do its mathematics as well as anybody else. Then, besides the experience which I have just mentioned of that English headmaster, there is the extraordinary change which has been made by that great German educator, Dr. Kirschensteiner, in the schools of Bavaria. He was so impressed with the great importance of work as a foundation of knowledge, that he has now transformed all the public elementary schools in Munich into work schools, where the business of the school is doing a certain kind of work, and upon that manual instruction all knowledge in the school is engrafted. He describes in a report he has made the extraordinary change in the children in the school. Instead of being listless, instead of

disliking school, they are now active ; they delight in school hours, they go to school with the greatest possible pleasure, and enjoy themselves all the time they are there, and, what is perhaps still more remarkable is that, after the school age, they take the greatest possible pleasure in the continuation of their studies. They have not to be driven to the continuation school, they go on their own accord to carry on the pursuit of knowledge to which they have become so attached during their school years."

Such is the nature of the practical evidence of the value of handwork, and it must be admitted that it is meagre in quantity and poor in quality. It partakes too much of the nature of opinion and hearsay, and too little of the nature of practical proof.

I venture, therefore, to present here one or two types of evidence of a statistical and experimental nature, slight enough in themselves, but sufficient to suggest other experiments and to indicate the kind of testimony likely to carry weight.

The most trustworthy record we possess of the relative efficacy of the teaching in the middle of the London elementary schools is provided by the marks obtained at the Junior County Scholarship examination of the London County Council, regard being had to the proportion of children presented in each school. Of the schools which I knew best I selected five where the most handwork was taken ; and I compared the marks obtained in those

schools in February 1909, before handwork was introduced into any of them, with the marks obtained in November 1912. The former examination was more difficult than the latter, and it was necessary to standardize the results before a fair comparison could be made. The first four schools were attended by boys, and the fifth by girls. Comparing the standardized marks, there was in school A a loss of 4 per cent., in school B a loss of $2\frac{1}{2}$ per cent., in school C a gain of 50 per cent., in school D a gain of 26 per cent., and in school E a gain of 12 per cent. The loss in school B was partly explained by the larger number of children presented (sixteen in 1909 and twenty-one in 1912), and the gain in school C by the smaller number presented (twenty-three in 1909 and fifteen in 1912). In the other schools the numbers were about equal for both examinations.

More definite evidence is afforded by a comparison of these five departments with the corresponding departments of the same schools attended by children of the opposite sex. School A, for instance, is a boys' department. In the girls' department on the same premises no handwork is taken. Although on the whole the handwork-taking departments presented more children than the other departments, the average marks obtained were in every instance higher. The actual percentages of advantage were twenty-five, one, sixty-five, thirty, and four, respectively.

I admit the meagreness of the data and the presence of certain unsatisfactory elements in the grounds of comparison, but the evidence, such as it is, tends to support the view that handwork has the effect of raising the standard of efficiency in the academic branches of study.

I will give one definite instance of the advantage of learning by doing over learning by listening. About a year ago an ingenious piece of apparatus for teaching fractions was brought to my notice, and I was empowered to test its efficacy by experimenting in one of the London elementary schools. A large mixed school was chosen where the headmaster took an exceptional interest in mathematical education. The only classes in this school where fractions had not been dealt with at all were the lowest two, consisting of boys and girls about eight years of age. All the brighter of those children were put into class A, and the rest formed class B. For six months both classes worked at precisely the same scheme of fractions for precisely the same time per week. Indeed, the conditions of study were as similar as possible, except that class A (the brighter class) was taught by means of the apparatus, which was manipulated and explained by the teacher, while class B (the duller class) was allowed to measure in fractions, to cut out pieces of paper, to compare them by superposition, and so forth. It must be understood that the apparatus used was really as admirable a device as could possibly be conceived for rendering the equi-

valence of fractions and the simple operations perfectly clear. And yet when the two classes (fifty-four children in one and fifty-two in the other) were tested by me after six months' time, class B did better than class A. Of ten questions set, both classes got the same marks for three, class A got higher marks for two, and class B higher marks for five. Enormous as was the advantage of superior natural intelligence, it was in this contest outweighed by the advantage of learning by doing.

The next piece of evidence I wish to bring forward has reference to the general attitude of the pupils to the school as reflected in their conduct and diligence. It points to the conclusion that the introduction of handwork into a school tends to reduce the necessity for corporal punishment. This tendency is typically shown by the records of school D referred to above. Although it is attended by a good class of boys, the school had under the previous headmaster attracted attention by the inordinate number of cases of punishment. The record for the last six years is as follows :—

Year	1908	1909	1910	1911	1912	1913 (1st half)
No. of cases	1406	1070	746	745	521	280

In 1909 the school was increased in size, and there was a change of headmaster. Since 1910 the *personnel* of the staff has remained unchanged ; yet in 1912, at the beginning of which handwork was introduced, there was an immediate drop in the number of punishments.

In school C, where an increasing amount of handwork has been taken since 1911, the number of entries in the punishment book are again seen to decrease, thus—

Year	1911	1912	1913 (1st half)
No. of cases	530	502	134

In school A, where handwork has been taught for a somewhat longer period, the same tendency is observable :—

Year	1910	1911	1912
No. of cases	213	190	176

The other two schools afford no indication one way or the other ; because in school E (a girls' school) the number of punishments has always been very small, and in school B the record of punishments was inordinately swelled last year through an exceptional number of out-of-school offences.

Other inquiries which I have made, and which need not be recorded here, fully convince me of the truth of the general rule that punishments tend to decline as manual occupations increase. And they decline through the removal of the worst and most disheartening type of offence—insubordination to the teacher and hostility towards the very spirit and purpose of schooling. Indeed, handwork helps to reconcile the pupil to the school. His general attitude towards his teacher and his training seems to undergo a radical change for the better. Hatred is often changed to liking, and

liking to loving. And striking thus deep into the emotional life of the child, handwork cannot fail to modify his whole moral and intellectual nature. It is indeed not unlikely that much of what has in the past been ascribed to a direct transfer of training from manual work to mental work is really due to an indirect influence. The service of the hand reaches the head through the heart.

Various attempts have been made to explain why handwork is supposed to have so marked an influence upon the intellect. That it should increase manual dexterity in specific directions is readily conceivable ; that it should give clearer notions of the processes engaged in and the results obtained is comprehensible ; but that it should have a wide general effect is, in these days when the tendency is to believe in specific as opposed to general training, a matter which requires both practical demonstration and theoretical explanation. The nature of the practical demonstration is indicated above. To solve the complete problem two questions must be answered.

1. What are the nature and extent of the motor and mental processes that take place during the handwork exercise?
2. To what extent, if any, does the training given during the exercise spread to other mental and motor functions? In other words, is there a "transfer" of training, and if so how much?

The answer to the first question depends upon the kind of exercise set and the method of teaching. If the exercise is of a purely mechanical nature carried out under the direction of the teacher—if it is mere drill—then the mind is scarcely influenced at all and the benefit is almost purely physical. Bodily skill is acquired, and little else. If, on the other hand, the pupil is engaged in the construction of an object which he ardently desires to make, if he clearly has before him the goal he wishes to reach, and if he is allowed to devise his own means for accomplishing that end, then there is little doubt that his whole mind is brought to bear upon the work. He is learning on the highest level. It is a real occupation, in the sense that the whole boy, body and mind, is "occupied." He is interested in the work and attends closely to it. If he lets his attention wander ever so little he will probably spoil his work. And any error that is made becomes obvious and self-corrective. Errors in spelling, in arithmetic, or in the facts of history are not obvious to the pupil who makes them ; nor do they as a rule cause him much concern if they are detected ; but with handwork it is different. He sees his mistake and feels annoyed thereat. He resolves to be more careful next time. Indeed all the higher processes of thought are involved in the pursuit. Reflective or logical thought is a necessity. Observation, discrimination, imagination, judgment—all are brought into requisition. The pupil is, in fact, forming habits of

two kinds, bodily habits and mental habits—habits of movement and habits of thought.[1]

The answer to the second question is far more difficult, as it involves a solution of the vexed problem of formal culture. Is bodily skill acquired in one direction available for use in a totally different direction? Is a man who has become a very skilful billiard player able by virtue of that skill to play golf better than if he never practised billiard playing? Can skill at cricket be transferred to carpentry? Skill is a special form of habit ; and so is rote memory. It is likely, therefore, that the conclusions arrived at by experimental psychologists with regard to the training of memory apply equally to the training of skill. William James contends that one's retentiveness pure and simple is dependent on the natural plasticity of one's nervous system. It varies with age, fatigue, and general health, but cannot be improved by practice in memorizing. Numerous as have been the experiments on memory that have been made and recorded since that opinion was expressed, none of them has succeeded in shaking that sceptical position. For such improvement as had taken place could be readily explained without assuming that natural retentiveness had been strengthened. And as retentiveness depends upon association paths in the cortex, so does skill depend upon

[1] It may be contended that all habits are bodily, inasmuch as they depend upon neural arrangements. Since, however, the habits manifest themselves in two different ways the above distinction is both legitimate and useful.

association paths in the sensory-motor apparatus. We have no evidence, experimental or otherwise, that training in a specific act of dexterity has any effect upon the general aptitude to acquire dexterity. Cases have been recorded of the transfer of skill from the right hand to the left, but the amount of evidence is meagre and the transfer claimed is very slight. It does not follow, however, that there is no spread of training. For two complex habits—an act of skill invariably involves minor automatisms—frequently have common elements. There are neural paths that belong to both ; so that when one of the complex habits has been fixed, part of the work of fixing the other complex habit has already been performed. The habits involved in writing with the pen have much in common with the habits involved in painting with a small brush. Learning one set of habits facilitates the learning of the other set of habits. There are, however, circumstances when the fact of having acquired a fixed way of doing a thing interferes with the formation of a new habit which takes in part of the old habit. Suppose, for instance, that the series of movements involved in a given act of skill is *a, b, c, d, e, f, g,* and they have by practice been welded together into an automatic system. If it is desired to learn a new co-ordinated series, *k, l, d, e, f, m, n,* the learning is facilitated by the fact that the series *d, e, f,* is already mechanized, but retarded by the fact that the strong tendency of *d, e, f,* to run into *g* has to be inhibited before it can

be diverted into *m*, *n*. The balance of advantage is large in proportion to the amount of the common automatic process. It must further be remembered that the higher kinds of skill involve a large amount of attentive control. It is only the partial processes that are automatic. The physical habits are, in fact, mixed up with mental habits and attitudes. Taking into consideration, therefore, the physical plane only, we can come to no other conclusion than that general handiness cannot be produced by specific exercises. General dexterity is a relative term. We can only say that one kind of dexterity is more general than another when the number of distinct skilled operations is greater in the first case than in the second ; and the only way to make sure of this wider generality is to increase the number and variety of manual exercises.

When we consider the mental functions involved in manual training the case for a general as opposed to a specific training appears much stronger. All training, whether physical or mental, depends ultimately upon the formation of habits. If, therefore, habits can spread, then training can spread ; if habits can be generalized then can training be generalized. It has been insisted on by recent writers [1] that a habit is always specific, and that a general habit is a contradiction in terms. Is it not possible, however, for a habit to be generalized in the same way as McDougall has shown instincts to be generalized? While the emotional nucleus

[1] Such as Thorndike, Bagley, and Judd.

of an instinct remains fairly constant, the range of stimuli capable of arousing that feeling may be indefinitely widened, as also may be the range of motor responses. New situations may evoke the instinct, and new adaptations are found for old situations. Habits, on the other hand, however complex they may be, are devoid of this emotional nucleus, and if the response is changed the habit itself is changed. For the motor response exhausts the habit, while it does not exhaust the instinct. On the side of the stimulus, however, generalization takes place in the habit as well as in the instinct. This is specially true of the mode of procedure in a special habit.[1]

For this may be found applicable to an extensive field of service. It may be a skeleton key to fit many locks. Methods of procedure in making a model in woodwork, in carrying out a chemical analysis, in attacking a certain type of arithmetical problem, in parsing and analysis, in scientific discovery, and so forth, are manifestly applicable to a large number of operations differing individually from one another. They are general forms which may remain the same while the contents vary. They are not general habits in the sense of being vague and indefinite : they are general in the sense that they can be applied to an indefinite number of cases.

These modes of procedure, ways of setting to work, methods of attack, arrangement, and achievement, are valuable by virtue of their

[1] See S. H. Rowe: "Habit Formation and the Science of Teaching," pp. 245–6.

generality. They mean a large return for a small amount of training. It has already been shown that handwork in engaging the whole powers of the child trains his attention in a particular direction. When a boy makes a kite his attention is at least being trained to function in this particular kind of activity ; and, though to a less extent, in other activities akin to it. This much is practically agreed to by all. But can we go further than this? Can we say that attention being a factor common to all forms of mental activity, every other mental function must benefit to some extent by the training in attention got by kite-making? On at least the importance of this question William James is emphatic. " The faculty," he says, " of voluntarily bringing back a wandering attention, over and over again, is the very root of judgment, character, and will. No one is *compos sui* if he have it not. An education that should improve this faculty would be *the* education *par excellence*." It is true that this refers to voluntary attention as distinct from the spontaneous or non-voluntary kind. But then the latter needs no training. Can voluntary attention be trained? The practical schoolmaster who has " licked into shape " many a listless and inattentive class answers with an emphatic " Yes " ; and no amount of fulmination against formal discipline is likely to alter his view. If improvement seems to have taken place in the power of a class of children to attend to their studies, how can this seeming—if it be but seeming—be explained?

It is probably due to the fact that certain habits of motor adjustment have been formed, which tend to stimulate and maintain attention. It has already been shown how important—nay, essential—are certain motor innervations and inhibitions to the maintenance and furtherance of attention. These habits of adjustment are what we mean when we talk about habits of attention. They are both general and specific. There are certain habits of attention which facilitate the concentration of the mind upon kite-making only ; but there are others which are common to all attentive processes, whether directed to percepts, images, or concepts. We conclude that a specific exercise in handwork may give a general training in voluntary attention. The same remarks are true of observation, ideation, and reasoning. Handwork may be so taught as to encourage the formation of habits which facilitate observation, ideation, and reasoning, some of which habits are applicable to certain narrow types of handwork only, some to handwork generally, and some to a much wider field of service. If that is so, why not, it may be asked, ally oneself with the advocates of formal discipline and of the old-fashioned theory of faculties? If it is true that one's attention, observation, etc., can be improved as a whole by manual training, then the position of the disciplinarians seems to be established. But it is not so. The theory put forward here differs fundamentally from that held by the older and more extreme advocates of formal discipline.

The difference may be illustrated by reference to eyesight—to vision as an optical fact. The healthy development of the physical apparatus involved in vision depends upon nutrition and such informal exercise as the ordinary circumstances of life cannot fail to ensure. No special exercises are needed to train the eyesight. In fact, it is mature at a fairly early age, and after that it tends to deteriorate rather than to improve by being used. No man will contend that his eyesight when he was thirty was better than when he was twenty. The only kind of practice that produced improvement was that afforded in the early years of childhood, when certain muscular habits were being formed. These habits, which all tended to the more favourable reception of the stimulus, comprised the turning of the head and eyes, the convergence of the eyeballs, and the accommodation of the crystalline lens. These co-ordinations are no doubt partly congenital, but they need to be developed and perfected by habit. The more important of these habits are probably acquired during the first few months after birth, and after they have been fully formed, training can do no more for the improvement of the physical part of seeing.

That is the position taken here with reference to the mental powers. They are gifts or natural powers, just as eyesight is a natural power, dependent on such factors as age, heredity, nutrition, and health ; and the only thing that training can do for them is to fix such habits of mental and motor adjustment as will best facilitate their operation. Training can grease

the wheels of the machinery : it cannot increase the motive power.

The advocates of faculty training, on the other hand, would contend that these natural powers are themselves directly improved by exercise, and improved almost indefinitely. To cultivate in the child the habit of observation does not mean to them the cultivation of a complex of habits which aid and abet observation ; it means that observation is itself of the nature of a habit which can be improved by practice.

The theory of ancillary habits, as it might be called, is more in accordance with the facts as disclosed by experimental psychology. It explains why Winch found children's memory capable of improvement, and William James found his own memory incapable of improvement. Ancillary habits of adjustment and procedure which had been formed in the second case had not been formed in the first. It explains the transference of training in memory recorded by Ebert, Meumann, and Fracker. It explains why the amount of transfer is roughly proportional to the similarity of the material ; for similarity of material involves a similarity in the ancillary habits of procedure.

There is yet another kind of general training, both intellectual and moral, which is supposed to be afforded by handwork. It is said to cultivate such qualities as accuracy, neatness, thoroughness, the " spirit of work," the " spirit of craftsmanship," and so forth. In what sense, if any, is this true?

Bagley, in his book on " The Educative Pro-

cess," deals with some of these qualities. He gives an instance of neatness in arithmetic not being transferred to other subjects. He points out that these qualities are sometimes transferred to provinces other than those in which they are acquired, and sometimes they are not. When transference does take place it is due, he contends, to the fact that a general ideal has been formed in the pupil's mind. A boy who has been trained to do neat handwork will not write neatly in consequence unless he consciously forms a general ideal of neatness in penmanship. There is, in fact, a family of habits of neatness—one for each separate kind of activity—and an ideal of neatness is the father of the family. Professor Henderson analyses the case more thoroughly.[1] He shows that "Neatness is a definite quality, tested by a definite criticism, and demanded by a definite type of situation. The detailed factors of the quality differ from case to case, but there is always sameness in the fundamental factors." These fundamental factors comprise cleanliness (the absence of matter out of place), and such orderly arrangement as favours easy inspection and gives æsthetic satisfaction. To secure neat effects certain modes of procedure must be habitually adopted. In fact neatness resolves itself into certain habits of procedure, which are of varying degrees of generality. Indeed the ideal itself becomes a habit; for if it frequently recurs in the mind it cannot fail to take on the characteristics of a mental habit. To use

[1] "Text-Book in the Principles of Education," pp. 311–12.

Bagley's terminology, it first functions as judgment, and then as habit.

So with all the other qualities mentioned. Each is a complex of habits of a physical, intellectual, emotional, and volitional nature involving elements of judgment and mental attitude. That manual training can cultivate these qualities there can be little doubt. The extent to which they are actually cultivated depends largely upon method—upon the manner in which the pupil is induced to acquire the qualities in specific instances. Mere mechanical drill, for instance, renders any sort of spread of training highly improbable.

We have elaborated the theory that handwork is valuable as a means of cultivating certain habits, some of which are useful in the sphere of practical activities only, while others can by good teaching be rendered available for use in other fields of activity. But this does not exhaust the disciplinary effects of handwork; for it tends to create certain desirable attitudes of mind. The term "attitude," which has crept into educational literature within quite recent years, appears to supply a real need. The Herbartians, who believe that the mental contents do everything and the mind does nothing, have no use for the word. It is, however, definitely established in common speech, and denotes a very real factor in human experience—a factor which has under other names been recognized in psychology. A is said, for instance, to adopt a hostile attitude towards B. All A's reactions

to situations in which B figures partake of a different nature from what they would if his attitude were friendly. His attitude colours the whole series. It may be that this so-called attitude is a function of mental content, or that it may be resolved into more familiar elements. Dr. Rowe, for instance, regards it as a vague and figurative expression "implying often, perhaps usually, habit, while at other times it refers to the particular massing of ideas in response to a given situation." [1] Baldwin's Dictionary defines the term as readiness for attention or action of a definite sort. Professor Judd uses the term extensively,[2] and so does Dewey. The latter calls Play and Will mental attitudes.[3] In the preface to "How we Think" he says: "This book represents the conviction that the needed steadying and centralizing factor (in education) is found in adopting as the end of endeavour that attitude of mind, that habit of thought, which we call scientific." Dr. Henderson in dealing with the Education of the Reason, which he regards as the supreme intellectual aim in education (agreeing herein with Dewey), selects two attitudes as of vital importance—the attitudes of originality and criticism.[4] He regards resourcefulness and judgment as the

[1] "Habit-Formation," p. 33.

[2] See his article on "The Doctrine of Attitudes," in the *Journal of Philosophy, Psychology, and Scientific Method*, vol. v. No. 25.

[3] "The School and the Child" (Blackie), p. 48, and "Educational Essays" (Blackie), p. 132.

[4] Op. cit. pp. 211–13, and chap. ix. *passim*.

two factors of ideational readjustment, and contends that each involves a factor of content and one of attitude. In the case of resourcefulness the content is experience and the attitude originality, and in the case of judgment the content is a knowledge of standards of relative value and the attitude the power to apply these standards—that is, the critical attitude. He regards the attitudes and contents as distinct elements as they are found to vary independently. To cultivate these attitudes is, he thinks, to secure for training the greatest possible degree of generality. "The essence of the attitude lies in certain habits and associated feelings, which, when aroused, stimulate both the imagination and the judgment." These seem to be the motor adjustments involved in attention. We thus come back to our doctrine of ancillary habits. Whether these two important attitudes can entirely be resolved into habits or whether there is an independent residuum matters not for our purpose. The important issue is that the best, perhaps the only, means we know of cultivating them is by putting the pupil in such a situation that he is compelled to reason. In other words, we must present the appropriate stimulus, which is a new situation—in short, a problem. But the problem must be to the pupil a real problem—a problem connected with the main stream of his interests—a problem the solution to which seems to him to be worth while.[1] All other problems are spurious. No

[1] Idem, p. 273.

subject provides for the young child such a large number of these real problems as constructional handwork. Kirkpatrick, in his "Genetic Psychology," gives another version of the value of manual training.[1] In dealing with the types of learning activity, he classifies the nerve centres into three levels corresponding with the three levels of learning. He calls them sensory motor centres, representative centres, and conceptual centres. He points out that the representative centres are primarily excited by the sensory motor centres, and the conceptual centres by the representative centres, and variety in such excitation helps to get the higher centres ready for independent activity. "After they have thus become independent of immediate stimulation from the lower centres, there is need for the reversal of the process so that the higher centres may send back stimuli to the lower and thus excite *them* to activity." "Usually this reversal of the course of impulse so that the higher centres stimulate the lower to activity takes place gradually; and the fact that the processes are distinct has received little attention." He uses as an illustrative example the fact that one who understands grammar well may use poor language, while one who uses good language may know little grammar. In fact he tries to explain the difference between theoretical knowledge and practical ability, between knowing how a thing is done and being able to do it. "The value of manual training and of other

[1] Chap. x, particularly p. 312.

forms of expression in learning, is not because movements are made, but because the higher centres are gaining power to stimulate and direct the activities of the lower. This is also the psychological justification for the general principle of having impression followed by expression."

The claims of handwork as an educational agency are strengthened by the fact that manual activities aid the healthy development of certain instincts with which all children are naturally endowed—particularly those of curiosity, acquisition, and construction. The whole system of man's activities and pursuits are ultimately rooted in his instincts. Thence come the primary impulses that lead him to establish wider and more complex relations with his environment. The habits he forms are merely ways in which these instincts may be modified, extended, or more firmly fixed. The particular instincts in question mature during the pupil's school life ; and any activity which legitimately calls these instincts into play is certain to enlist his interest and to engage his mind profitably. It is a matter of common experience that manual occupations rarely fail to make a strong appeal to young children. They like to take things to pieces to see how they are made up, or how they " work " ; they like to make things ; and they like to possess things that they themselves have made.

THE DEFENCE OF HANDWORK REGARDED AS AN INDIRECT MEANS OF EDUCATION

WHATEVER may be the final outcome of the controversy on Formal Discipline, there is at least one point upon which educationists are now virtually in agreement, and that is that the disciplinary value of a branch of study is not a sufficient justification for including it in the school curriculum. It is true that this principle is not fully recognized in the schools, particularly the secondary schools and the older universities, but the case for the traditional classical course as a complete instrument of liberal education has broken down. Discipline is not the monopoly of any one branch of instruction. The subjects of school instruction having been selected on social and utilitarian grounds, they may then be so taught as to provide the necessary training. In fact, what might be called the theory of indirect attack is coming to be generally regarded as an exploded theory. The study of Greek, for instance, is not so good a preparation for a commercial pursuit as the study of Book-keeping. If there is a transfer of ability from one kind of pursuit to another, the transfer

is never complete. There is always more or less loss. The reasonable conclusion seems to be that the best method of attacking a subject is the method of direct attack. But handwork is almost invariably advocated, not on the ground that it trains the hand, but on the ground that it trains the mind. A boy is not taught woodwork in order that later on he may be able to make his own household furniture, but that he may be able to think more clearly and more efficiently. Dewey states the case thus : "The problem and the opportunity with the young is selection of orderly and continuous modes of occupation, which, while they lead up to and prepare for the indispensable activities of adult life, *have their own sufficient justification in their present reflex influence upon the formation of habits of thought*." [1] Again : "In the main, for most persons, the primary resource in the development of orderly habits of thought is indirect, not direct. Intellectual organization originates, and for a time grows as an accompaniment of the organization of the acts required to realize an end, not as the result of a direct appeal to thinking power." This is a concise statement of the view that manual training is not ultimately directed towards manual but mental efficiency. And this, I take it, is the right view.

The justification for taking this indirect course is to be found in the fact that in the education of the young it is as a rule the only course that

[1] "How we Think," p. 43.

is at first open to us. For other means fail to promote real growth. The handwork method is not, however, so indirect as it seems. Henderson, dealing with the question of Formal Discipline,[1] gives two instances of school subjects taught for their supposed disciplinary value—Latin and Manual Training. Other writers have tended to regard these as similar cases. But as a matter of fact they rest on entirely different footings. Manual operations form an essential part of the life of every normal individual. If a man of the most sedentary and contemplative habits were to put his right hand in a sling for a whole day he would immediately realize the large part that manual activity plays in the ordinary routine of his life. This is not the case with Latin. To the bulk of mankind the word Latin is little more than a name: it has no vital connection with either their vocations or their avocations. When one remembers that by far the majority of mankind is actively engaged in the production of wealth by manual work, one sees that the theory of the curriculum as roughly mirroring the more important activities of social life demands, in the case of the primary school, the inclusion of handwork and the exclusion of Latin. The school curriculum should be regarded as a function of two variables —the child and his environment. Not solely the future environment, but also the present environment must be considered; and not merely these but also the natural instincts and

[1] Op. cit. p. 283.

propensities of the child which enable him to enter into suitable relationship with his environment. When the subject introduced into the school satisfies all these conditions, then, and then only, will it contribute to healthy and vigorous mental growth. In the case of the young, handwork satisfies all these conditions, while Latin satisfies none of them. Latin supplies to the young child no single problem, the solution of which seems to him to be worth while.

HANDWORK AND BOOKWORK

HANDWORK is advocated as affording during the early stages of childhood the best means by which interests and intellectual activities may be engaged and developed. It is only in an atmosphere of motor activity that a child's bodily and mental powers find an adequate stimulus for growth. It is in attempting to secure some tangible result that his movements get co-ordinated and organized; and in organizing his acts he organizes his experience. His interests are as a rule so fully absorbed by practical pursuits, that it is in them that real problems present themselves to him—problems which make to him a sufficiently strong appeal to call forth intellectual and physical effort, and can be adequately solved by his own devices. But as he gets older and his more theoretical interests develop, while there is still need for self-expression, that self-expression tends to take a more symbolic form. While constructive handwork is the typical form of presentative expression, language is the typical form of symbolic expression. In handwork the expression is an attempt at reproducing, albeit in an imperfect and often very schematic form, the impression; in language the expression in no way resembles

the impression: it is a symbol conventionally attached to a thought which is often incapable of pictorial presentment. The term "language" is here used to include the symbolism of mathematics, logic, and chemistry. The difference between the two kinds of expression, both serving as an aid to thought, may be illustrated by the two kinds of arithmetic now taught in the elementary schools—Practical Arithmetic and Theoretical Arithmetic. The differentia of Practical Arithmetic is that the material objects dealt with are either actually present or are represented by natural, as distinct from conventional, symbols. If, for instance, a boy were asked to find the diagonal distance across a rectangular garden 30 yards long and 25 yards wide, and proceeded to draw the garden to scale and to find the approximate length of the diagonal by measurement, that would be considered an exercise in Practical Arithmetic; for although neither the actual garden nor the actual unit of measurement was used, yet was each adequately represented by things which made the same kind of perceptual appeal. When worked out by the Pythagorean formula it is an exercise in Abstract Arithmetic.

Thus we have in our schools a division of school activities which cuts athwart the usual classification into branches of study. The distinction broadly corresponds with the popular distinction between the practical and the theoretical, the concrete and the abstract, the empirical and the rational, the useful and the academic, the (practically) scientific and the

classical. None of these pairs, however, accurately connotes the distinction I wish to make. Probably the terms "practical" and "academic" will most adequately serve my purpose. The characteristic feature of the practical work of the school is handwork : the characteristic feature of the academic work is language. It is not a case of distinction between motor and mental, for both motor and mental elements enter into each : it is rather a distinction in the kind of thought and in the kind of motor activity. In the practical work the thinking process takes place for the sake of some practical result, which in its turn often serves as a starting-point for new lines of thought. In the academic work the thinking is directed mainly towards the acquisition of knowledge, which tends to be regarded as an end in itself, or is at least not acquired with a view to immediate practical application. Practical efficiency is the ideal in the former case ; personal culture in the latter.

Except perhaps in the kindergarten, the academic element has dominated nearly all our schools up to the present day. The traditional curriculum is the academic curriculum. The "humanities" have served as the main medium of culture : the classics have constituted the staple course of instruction. And with the aim involved we have no quarrel. What modern psychology has thrown doubt upon is the means of achieving the aim. The academic curriculum is largely based upon the demands of adult interests : it does not help to develop a child's interests : it does not satisfy the system

of conations which naturally grow in his mind. It stands outside the main current of his vigorous and impulsive life-stream. The teacher's problem is to bring it within this current. The solution is probably to be found in utilizing practical pursuits as the starting ground. The understanding of language presupposes a store of experiences in the terms of which the hearer interprets that language. It is palpably a mistake to think that words leave the lips of the speaker saturated with his meaning, pass into the mind of the hearer and yield up this meaning unchanged. They are mere stimuli which stir into life some of the hearer's own ideas—ideas which he has acquired in his commerce with the world of real things. Indeed we are all strangely dependent for our intellectual progress upon our familiarity with the world of matter. For we can only think of the things that are unseen under the similitude of the things that are seen. Handwork helps to supply the child's mind with this essential outfit. It is a necessary stepping-stone to higher things. But handwork can familiarize him with his immediate environment only. To escape from these narrow limits he must use and understand at least his mother tongue. The speech of his elders and the printed page extend the child's environment indefinitely—not only his physical environment, but, what is far more important, his spiritual environment. They enable him to come into as much of his social inheritance as he can intellectually compass. It would be difficult, therefore, to overestimate the value of the edu-

cation that comes by books, so long as it is borne in mind that the key to their understanding is to be found in the reader's personal first-hand experience.

It seems reasonable therefore to infer that the bulk of the work in the lower part of the school should be practical, and that the amount of academic work should be gradually increased as the pupil passes up the school. The centre of gravity of the curriculum should gradually shift from the hand to the tongue. Literary training should be present from the very first, and manual training to the very last : but there should as a rule be a transfer of emphasis from the latter to the former. This is, however, but a rough generalization, for individual differences in interests and abilities cannot be ignored. It often happens that a child displays an extraordinary aptitude for linguistic studies or abstract thought, and but little aptitude for manual occupations ; and it quite frequently happens that a child who has no ability for the ordinary school studies displays quite remarkable powers at the manual training centre. It is well known that children who were regarded as dullards at school have often proved to be very successful in the practical pursuits of life. It is the business of the teachers to discover these individual aptitudes and to provide for each a suitable course of instruction so far as is possible within the limitations of school organization. With the gradual diminution in the size of the class this individual attention is being rendered increasingly possible.

THE SOCIAL ASPECT OF MANUAL TRAINING

To say that the school is a social institution is a truism. The school is founded and maintained by society for the sake of society. It is the only way in which a community of such complex organization as a European nation can perpetuate itself. The training afforded by the home and by chance intercourse with adults being an inadequate preparation for the manifold duties of the future father and citizen, the State, for its own preservation, insists on the establishment and maintenance of schools. The kind of training to be given at these schools is ultimately a matter for the State to decide. For the State gives its own interpretation to "efficiency" and requires that its citizens should accept its own standards of value and utility. Thus there is a sense in which all education is specific as opposed to general. The English child is taught English and not Japanese because he has to live in England and not in Japan. The school curriculum in fact bears a vital relationship to the environment both material and social. If the environment changes, the curriculum should change as well. And this is true both

of the present and the future environment of the child ; for education is quite as much a participation in life as a preparation for life. England has during the last hundred years changed from an agricultural to an industrial community ; but the corresponding change in the curriculum has lagged behind. Where the conditions of life are more primitive, where man lives close to the soil and has a wide range of occupations, it is not to the children an unmixed advantage to be captured and put into schools. The farmstead in a primitive community is a place where innumerable activities are constantly going on. Each household is almost entirely self-supporting, supplying its own food, making its own clothing, solving its own problems of shelter, warmth and lighting. The children see these practical processes going on. They frequently take an active part in carrying them out. Thus are they brought into vital contact with the essentials of human society—with the experiences that through countless ages moulded and educated the mind of man. England was like that once. Before the industrial revolution of the nineteenth century the bulk of the population was rural. The home was a place for technical training, the boy being virtually apprenticed to his father and the girl to her mother. And such work as the children did was carried out in the spirit of play. And so varied and so interesting were the occupations that they constituted an education in themselves, sane and effective and fruitful enough so far

as it went, and forming the best preparation for the learning to be got in the school—the acquaintance with those instruments of knowledge (reading and writing and reckoning) which would enable the pupil to extend and communicate the knowledge he had already acquired. He got his motor training on the farm ; it was not necessary to duplicate it in the school.

But England has changed since those days. Her people have deserted the fields and crowded into the towns. The urban child of to-day gets little or no practical training in the home, and seldom does he see the solution of any of the abiding problems of life. The need for food is not met by hunting, fishing or gardening ; the food is simply purchased at a shop. The home industries are reduced to a minimum. Everything that can be bought at a shop is bought at a shop. Time was when the fundamental activities of social life were open to the view ; now they are hidden away in workshop, factory, and office. The boy sees not his father's daily occupations. Even if he did it would avail him little, for it is generally such a small part of such a big process that its relation to the whole is not seen, and its social significance is not grasped.

This stupendous social change means much to the child. It means that many of the simplest and most fundamental operations of family and social life no longer form part of his environment. It means that the natural stimulus to manual dexterity has disappeared. It means,

in fine, that he gets no effective motor education in the home. And those educative factors which are lacking in the home should obviously be supplied by the school.

Dewey and some of his followers hold the view that the best education for the young is afforded by what might be called the generic occupations of mankind—fishing, weaving, hunting, cooking, gardening, etc. By actually engaging in these occupations they encounter the difficulties which our ancestors met and mastered; they re-think their thoughts, and re-discover their discoveries. Thus are they enabled to analyse modern society by realizing how such a society came to exist. It is claimed, too, that since the conditions of the school pursuits approximate more nearly to those of the home and the street, there is more opportunity for the cultivation of those traits of character which make for social efficiency.

It is manifest that without a direct vital acquaintance with some of the more important of the industrial arts it is difficult for the pupil to realize their social importance, and to take a sympathetic interest in the pursuits of the bulk of his fellow-creatures. Such occupational work in the school enables him to combine freely with his school-mates in carrying out a scheme which would be difficult to perform by himself, and thus presses upon his notice the advantages of co-operation and the conditions of "give and take" under which co-operative work can be effectively carried out.

AMBIDEXTERITY

IT was Plato who first mentioned it. You will find the passage in the Laws, vii. 794 :—

"The right and left hands are supposed to differ by nature when we use them ; whereas no difference is found in the use of the feet and lower limbs ; but in the use of the hands we are in a manner lame, by reason of the folly of nurses and mothers, for, although our several limbs are by nature balanced, we create a difference in them by bad habit. In some cases this is of no consequence, as, for example, when we hold the lyre in the left hand and the plectrum in the right ; but it is downright folly to make the same distinction in other cases. The custom of the Scythians proves our error ; for they not only hold the bow from them with the left hand and draw the arrow to them with their right, but use either hand for both purposes. And there are many similar examples in charioteering and other things, from which we may learn that those who make the left side weaker than the right act contrary to Nature" (Jowett's translation).

From that time onward, at varying intervals, men have arisen and proclaimed to the world

as an important discovery the fact that we use one hand more than the other. They have added as an obvious corollary that such preferential treatment is irrational. It is within the memory of some of my readers that Charles Reade started in the *Daily Telegraph* a controversy that raged furiously for a short time and then suddenly dropped. And the British public heard no more of sinistral and dextral until in 1903 the Ambidextral Culture Society was inaugurated. Then appeared an epidemic of printed matter on the subject. In America the craze has waxed and waned, has had violent advocates and equally violent opponents. What is more to our purpose, it has invaded the schools, in the matter of drawing at least. A few short years ago ambidextral drawing was the latest thing in our infants' schools. It was regarded as the hall mark of up-to-dateness. It is now gone with " the snows of yester year."

The advocates of ambidexterity claim that we can not only make ourselves more useful by cultivating two-handedness, but that we can considerably increase our brain power. For in disturbing the symmetry of our limbs we have also disturbed the symmetry of our brains. We are not only right or left-handed : we are also left or right-brained. The cerebral hemisphere that controls the unskilled hand is always underdeveloped. This, they say, is deplorable. We are less than we might be. But the remedy is easy. Train the unskilled hand. If you bring both hands to the same level of efficiency, it

is argued that you will bring both halves of the brain to the same level of efficiency. Many a man has done so—as far as his hands are concerned at least. General Baden-Powell, for instance, can write and draw just as easily and just as skilfully with his left hand as with his right. We are asked to believe that this has something to do with his level-headedness. We are further told of certain people who can write two letters on entirely distinct topics at one and the same time. The story is told of Sir Edwin Landseer drawing two things simultaneously. With one hand he sketched the head of a stag and with the other the head of a horse. On these grounds it is asserted that the two halves of the brain may be trained to work independently. It has even been hinted that one may be got to play a stiffly contested game of chess with oneself, or carry on a hot political argument between the right hemisphere and the left.

Other advantages are claimed. Ambidexterity insures against fatigue and accident. One hand can rest while the other works. If either hand were injured or paralysed, the other could act as a substitute. With the ordinary man the left hand is a bad understudy to the right. Lombroso found criminals in many instances exhibiting an extraordinary degree of physical lop-sidedness.

In view of the demerits of what we may call unidexterity, or one-handedness, the Ambidextral Culture Society strongly urge that the

children in our schools be taught to write, draw, paint, sew, and use the various manual training tools with both hands equally.

What are the real facts of the case? It is estimated that the bulk of European adults (about ninety-seven out of every hundred) are right-handed, and the rest left-handed. Mr. John Jackson, the secretary of the Ambidextral Culture Society, asserts that 97 per cent. of English people are right-handed, 17 per cent. congenitally right-handed, 3 per cent. congenitally left-handed, and 80 per cent. naturally either-handed. It would thus seem that some are born right-handed, some achieve right-handedness, and some have right-handedness thrust upon them. Most children, according to Mr. Jackson, show no initial tendency towards the preferential use of either hand, but are trained by their mothers, nurses, and teachers to use the right hand in conformity with social custom.

The opponents of ambidexterity deny that any child is naturally ambidextrous, and contend that before he is able to walk, before he is one year old, he shows unmistakable signs of unidexterity.

Baldwin, referring to experiments with his young child, states that "a distinct preference for the right hand in violent efforts in reaching became noticeable in the seventh and eighth months." [1]

Some observations on the development of right-handedness in a normal infant have

[1] "Mental Development in the Child and the Race," p. 64.

recently been made by Mrs. Helen T. Woolley.[1] Her conclusions agree with Baldwin's. She found that during the seventh month the right hand was invariably used whenever it was necessary to stretch forward in order to reach the object. When the object grasped was within easy reach it seemed impossible to discover by mere casual observation which hand predominated ; but when the cases of grasping were counted it was found that out of 400 cases the right hand was used 206 times and the left 194. Towards the close of the seventh month, however, the preference for using the right hand became more marked. These observations support the view that right-handedness is a normal part of physiological development, and is not to be adequately explained by training.

The truth seems to be that all mankind have an inherent tendency to use one hand more than the other (generally the right), that this tendency is much stronger in some people than others, that it matures within the first few years of infancy, and becomes fixed by imitation and practice. Everybody, in fact, is either a born dextral or a born sinistral. The few who seem to approach the ambidextral ideal are probably left-handed people who have endeavoured to conceal their sinistrality.

The left hand of the ordinary mortal is much maligned by the ambidextral culturists. They call the right hand the useful hand and the left the useless. Such a distinction is manifestly

[1] *The Psychological Review*, January 1910, pp. 37–41.

absurd. Ask a pianist, or a violinist, or a surgeon, or a tinker, or a tailor, or indeed anybody of normal physique, whether he finds the left hand useless. Keep the left hand in a sling for a day and note the consequences. As a matter of fact the two hands collaborate : they share between them the business of the hour. And in any given piece of work each has its own special duties to perform ; and by thus specializing each acquires its own particular kind of skill. If you try to eat your dinner with the knife in your left hand and the fork in your right, you will find the right hand just as awkward with the fork as the left is with the knife. There are some things which you can only do with your left hand—scratch your right elbow for instance. And there are many things that one can do with greater facility with the left. It is true that the left generally plays the humbler rôle, but it is a rôle necessary for the success of the piece. In fact the two hands rarely act as independent units : they form a partnership, and there is between them, as there should be, a differentiation of function.

Many observers have thought that they have discovered some sort of dextrality or sinistrality among animals. Livingstone, for instance, held a belief that all lions were left-footed. But these opinions are unsupported by evidence. Even if there were an inherent superiority in one limb over another, such superiority would be difficult to detect, for even a man's right-handedness or left-handedness is concealed from us

until we see him use a tool of some sort, such as a pen, a knife, or a hammer. It is indeed probable that if man had not been a tool-using animal he would never have known his right hand from his left. It is confidently asserted by Grant Allen that primitive man was ambidextrous. He bases his assertion on the ground that the cave man drew just as often and just as well with his left hand as with his right. If you take a pencil-stump between your finger and thumb and try to draw a human profile in the most natural way, you will find the face turned towards your left shoulder; if you try with your left hand the face will be turned towards the right. Children and savages always draw in this way. The earliest men of whom we have any definite and scientific knowledge were wont to etch with sharpened flint on bone or ivory the profiles of men and beasts turned indiscriminately to the right or to the left. The inference is that they were ambidextrous. But the inference is not irresistible, for unless it could be shown that the animals looking rightward and the animals looking leftward were drawn by the same artist, the utmost that the evidence could be made to prove would be that left-handed people were more numerous in those days than in modern times. The balance of probability is, however, in favour of Grant Allen's theory. It is fairly certain that if we could get far enough back—if we could get to the time when mankind first assumed the upright posture, we should find the

bulk of them ambidextrous, or, if you prefer to call it so, ambisinistrous. They were equally awkward with both hands. How then did the race become right-handed? There are really two questions involved. First, how did ambidertrous people become unidextrous? Secondly, why should unidexterity have taken the almost universal form of right-handedness? Regarding the matter from the point of view of natural selection, it is clear that in the struggle for survival the unidextrous people must have possessed some sort of advantage over the ambidextrous, and of the unidextrous the right-handed some sort of advantage over the left-handed. What was the nature of this advantage? It is useless seeking for an explanation within historic times, for right-handedness was well established in the human race long before the earliest period of which we have any written record. No tribe or nation, savage or civilized, has ever been discovered which is not predominantly right-handed. Even the seven hundred left-handed Benjamite slingers referred to in the Book of Judges formed less than three per cent. of the whole tribal army. Dr. F. W. Mott maintains that the ambidextrous savage would show some degree of hesitation at critical moments—moments when to hesitate would be fatal. If, for instance, at the sudden approach of an enemy he showed the slightest indecision as to which hand he should use for picking up his spear, he would give his enemy the overwhelming advantage of getting in the first blow. It is not

implied that he would stand like the hypothetical donkey between two bundles of hay ; it is not implied that there would be conscious deliberation on his part ; but it is implied that where there were two equally permeable channels of customary response to a given situation, the actual response would not be of such lightning rapidity as it would be if there were only one channel. And this is a case in which a fractional part of a second might make all the difference there is between slayer and slain. As the doggerel rhymster puts it :—

> Thrice is he armed who hath his quarrel just—
> But blest be he who gets his fist in first.

There is another, and more cogent, reason why the unidexter should be better fitted for survival than the ambidexter. He was more skilful. There is no ground for thinking that the earliest members of the race exercised their bodies with the conscious aim of acquiring bodily prowess. The only practice they got was forced upon them by the pressure of circumstance. In hand-to-hand contest with his kind, or in the precarious hunt for animals that supplied food or clothing, a premium was laid upon bodily skill. His life depended on success in the one sphere, his livelihood on success in the other. The time devoted to practice was therefore virtually the same in all cases. And given the same amount of time, the degree of skill attained by practice with one hand only would be greater than if the practice were distributed between the two hands.

This accounts for the extinction of the ambidextrous; but how are we to account for the fact that unidexterity took the almost universal form of right-handedness? The most reasonable explanation seems to be that right-handed people were better able to protect the heart. We cannot suppose that it took our primeval ancestors very long to discover that wounds on the left side of the body were more dangerous than those on the right. Even before the use of weapons it was probably observed that a well-directed blow over the left breast was sometimes sufficient to cause death. The fighter (for whatever else he was, primitive man was of necessity a fighter) had therefore to protect that specially vulnerable region at all costs. This was done with the left arm while the right did the bulk of the fighting. When man became sufficiently civilized to use weapons of war, the shield was held on the left arm so as to cover the heart, and the right hand was set free to do what execution it could with club, spear, or sword. Thus did the right hand acquire an adroitness which the left hand had no opportunity of acquiring. And thus did the right hand begin to gain its superiority over the left. The balance between right and left once destroyed, the growing arts and industries but tended to make the disparity wider and wider. To account for the facts it is not necessary to assume the transmission of personally acquired characteristics, for natural selection—the dying off of the unfit—affords a sufficient principle of explanation.

The tendency to weed out the left-handed by such drastic methods as natural selection implies would become less and less as civilization advanced; for in the pursuit of the arts of peace the left-handed man would suffer no disability. Some slight social prejudice still remains—a prejudice made manifest in the various meanings that have clustered round the word "sinister." Nor is left-handedness without certain minor disadvantages. These are mainly due to the fact that it is exceptional. As one example out of many, I may mention that the ticket pocket in a man's coat is so placed as to be readily accessible by the right hand only. The left-handedness of to-day has probably been transmitted down the ages from very remote ancestors. The theory of its hereditary nature is supported by the fact that it tends to recur in certain families.

Thus has Nature presented us with a standard of values. She gives the first place to right-handedness; left-handedness comes second, and ambidexterity makes a bad third. Many are inclined to accept Nature's pronouncement as final. Grant Allen, for instance, is emphatic on the point:—

"Man's special use of the right hand is one of his points of superiority to the brutes. If ever his right hand should forget its cunning, his supremacy would indeed begin to totter. Depend upon it, Nature is wiser than even Charles Reade. What she finds most useful in the long run must certainly have many good points to recommend it."

Ruskin, whose prejudice against Darwinism was as deep-rooted as Grant Allen's prejudice in its favour, found justification for his fondness for the Gothic curve in the fact that Nature had multiplied it in all the grasses of the field and all the leaves of the forest. Abraham Lincoln's rebuke to the man who called him common-looking was dignified and just : "The Almighty prefers common-looking people—that's why He made so many of them." Apart from any religious implication, Lincoln's remark embodies a deep biological truth. Nature has set her *imprimatur* upon the many.

But we are not obliged to accept Nature's standard of values. As a matter of fact, man never has accepted it since the days when he first evolved an ethical creed. Not in Nature are to be found the springs of "admiration, hope, and love," but in man.

Matthew Arnold strikes a true note when he says :—

> Man must begin, know this, where Nature ends ;
> Nature and man can never be fast friends.

We talk glibly about the survival of the fittest, often forgetting that "fittest" merely means "fittest to survive." There have been conditions under which the finest flower of humanity could not possibly flourish, when Nature put a premium on those harder and cruder qualities which have, since the advent of Buddhism and Christianity, had to take a much lower place in the scale of virtues. Man's

social values do not equate with Nature's values. To the brute creation Nature is indeed a mother —a cruel mother often, but still a mother ; to man, whose spiritual nature is of alien birth, she is at best nothing more than a kindly step-mother. Man is not entirely the victim of circumstances ; he makes circumstances for himself. He is not only adapting himself to his environment ; he is constantly adapting his environment to himself. In fact, he imposes his own ideals upon Nature, and is himself becoming a more and more important factor in determining the general trend of things. There is no finality, therefore, in Nature's verdict. It may well be that the conditions necessitating the extinction of the ambidextrous no longer exist, and that characteristics which were impossible in primeval times are not only possible but desirable in these latter days.

On evolutionary grounds alone, therefore, I should not be inclined to condemn the ambidextral doctrine. If there were no other reasons for rejecting it I should regard it to be at least worthy of careful experiment. But there *are* other reasons—reasons connected with the mechanism of speech.

In the literature dealing with ambidexterity it has frequently been urged by the opponents of the doctrine that interference on the part of parents and teachers with the natural unidexterity of children sometimes gives rise to a serious disturbance of the function of speech ; that the interference generally takes the form of

an attempt to break a child of what is regarded as a "habit" of left-handedness, and the disturbance takes the form of stammering. But although this statement has frequently been made, and striking individual instances have been cited, there has never, so far as I am aware, been any attempt to ascertain statistically the prevalence of stammering among normal people, and to compare therewith the proportion of stammerers found among people whose natural sinistrality has not been allowed free scope. Nor has there been any research respecting the degree (if any) to which the speech function is disorganized.

The problem has been brought home to me by sporadic cases of stammering (a term which I use in its broad sense as including stuttering) which come under my notice while inspecting schools. Some years ago, for instance, I came across two pronounced cases in the same school. Both were naturally left-handed boys who, having learnt to write with the left hand, had been constrained by their teachers to change it for the right; and both had acquired the stammer during their school career. I accordingly made three distinct investigations into the matter, two in London and one in Glamorgan.

In the spring of 1911, I issued a questionnaire to the head teachers of some of the elementary schools of South London, asking for certain information respecting left-handed, ambidextrous, and stammering children. The early returns that came in showed at once that

the terms left-handed and ambidextrous were ambiguous. In some schools there were reported to be several ambidextrous and no left-handed children, and in others several left-handed but no ambidextrous children. It was found necessary, therefore, to omit the question referring to ambidexterity. I felt the less reluctant to abandon this part of the inquiry as a personal examination of several of the cases convinced me that a child alleged to be ambidextrous always showed a preference for one particular hand in learning a *new* act of skill. It confirmed the view, in fact, that a so-called ambidexter is merely a congenitally left-handed person who has acquired such skilled activities as writing and drawing with the right hand. It was further necessary to define left-handedness, for I found that some teachers were inclined to regard a boy who usually performed even one skilful act, such as bowling or using a knife, with the left hand as a left-handed boy. The reference of the term was therefore limited to those children who performed with the left hand all the common dexterities, except those that they had been forced to acquire with the right hand. The terminology of this topic is in sad confusion, and I have no desire to add to the confusion by using new terms. Still, to avoid clumsy phraseology, I propose to use the term dextral to mean a right-handed person ; sinistral, a left-handed person ; pure sinistral, a person whose left-handedness has never been interfered with ; and dextro-sinistral, a congenitally left-handed

person who has conformed with social custom in writing with the right hand.

The results of the inquiry were as follows :—

Children observed	13,189
Dextrals	12,644
Sinistrals	545
Dextro-sinistrals	399
Stammerers	160
Dextro-sinistral stammerers	17

According to these returns over 4 per cent. are sinistral. This percentage is higher than the usual estimate ; but the number includes many who would be regarded by some people as ambidextrous. Of the total number about 3 per cent. are dextro-sinistrals. Apart from any preconceived theory of the cause of stammering we should naturally therefore expect about 3 per cent. of the stammerers to fall within that group. As a matter of fact, however, the percentage is not 3 but nearly 11.

Again, the percentage of stammerers among the total number observed is 1·2, among pure dextrals and pure sinistrals 1·1, and among dextro-sinistrals 4·3. This indicates that stammering is about four times as frequent among dextro-sinistrals as among the rest of the children. After these statistics had come in I conceived the idea of obtaining similar data concerning a different type of child. I accordingly made inquiries at seven schools attended

exclusively by mentally-defective children, and obtained the following figures :—

Children observed	944
Dextrals	882
Sinistrals	62
Dextro-sinistrals	47
Stammerers	23
Dextro-sinistral stammerers	9

Here the results are more striking. Sinistrality reaches $6\frac{1}{2}$ per cent., and while only 5 per cent. of the children are dextro-sinistral, 39 per cent. of the stammerers belong to that group. The percentage of stammerers among the dextro-sinistrals and the non-dextro-sinistrals reaches 19 and 1·56 respectively ; that is, it is about twelve times as great among the former as among the latter. The schools selected for this inquiry were of varied types, and in each case all the children in each department were taken into consideration.

It may be contended that the figures do not necessarily support the hypothesis that there is some connection between stammering and interference with the natural "handedness" of a child ; but rather that there is a connection between stammering and left-handedness. The detailed returns, however, lend no colour to this alternative view, for most of the cases of pure sinistrality occur in a few schools where the head teachers are in sympathy with the views expressed at the close of this chapter, and in these cases there happen to be no left-handed stammerers.

I was not altogether satisfied with this investigation, as it was only a small percentage of the cases that I personally examined.

In the early part of this year (1912) I made a careful examination of 322 distinctly left-handed children. All doubtful cases were rejected. The total number of children in attendance at the schools from which these sinistrals were drawn amounted to 11,939. This is the outcome of the inquiry :—

	Boys.	Girls.	Total.
Total number of children	6,181	5,758	11,939
Pure sinistrals	25	26	51
Dextro-sinistrals	193	78	271
Pure sinistral stammerers	0	0	0
Dextro-sinistrals who stammered at time of inquiry	32	14	46
Dextro-sinistrals who stammered earlier in their school career but not at time of inquiry ...	21	3	24

The evidence for the earlier stammering referred to above rests mainly on the confession of the children ; but as they seemed to be somewhat ashamed of the defect, and disposed to conceal it as far as possible, there seems to be no reason for doubting their word.

It is seen that the percentage of sinistrals is 2·7, or, separating the sexes, 3·5 for boys and 1·8 for girls. It is frequently mentioned in medical books that stammering is far more prevalent among men than among women. The more fundamental fact seems to be that left-handedness is far more common. There are

probably about twice as many left-handed men as there are left-handed women.

Among the dextro-sinistrals 17 per cent. stammer at present and 25·8 per cent. have stammered during some period in the past. They are not all cases of bad and persistent stammering. In many instances indeed the child stammered merely when reading aloud or when excited in some way.

It is highly significant that among those cases where no serious attempts had been made to change the skilful hand, not a single instance of stammering appeared.

The reader will not fail to be struck with the marked discrepancies between the results of the two inquiries. These discrepancies are due to differences in the fields of inquiry and in the methods of investigation. The first inquiry dealt with all children ranging from the ages of 4 to 14; the second was limited to children between 8 and 14. There was some overlapping of the school areas, many of the children concerned in the first inquiry appearing again in the second; but much new ground was covered. The more important factor, however, was the method of procedure. A questionnaire is often perfunctorily and carelessly answered. In the second investigation the selection of sinistrals was stringent and the tests and inquiries thorough. The second results are consequently far more reliable.

Indeed, these results receive further confirmation from the outcome of a third inquiry

which I was enabled, by the courtesy of the Glamorgan Education Committee, to carry out in the county of Glamorgan. There were in this case a new and independent class of observers—the head teachers of schools in the rural parts of South Wales—and a type of child widely different in heredity, environment, and up-bringing from that with which my previous inquiries were concerned. The statistics for Glamorgan are as follows :—

	Boys.	Girls.	Total.
Total number of children	4,858	4,345	9,203
Pure sinistrals...	26	21	47
Dextro-sinistrals	130	30	160
Pure sinistral stammerers	1	1	2
Dextro-sinistrals who stammered at time of inquiry	12	6	18
Dextro-sinistrals who stammered earlier in their school career but not at time of inquiry ...	6	1	7

Here again it is evident that the percentage of dextro-sinistral stammerers is much higher than a mere chance distribution would warrant us to expect. Precisely the same is true of statistics I have obtained from the Director of Education for Brighton.

If it is true that stammering is caused by a change from left to right ; then a change back ought to have the effect of stopping the stammering. In February 1912 I selected a number of cases of dextro-sinistral stammerers and asked the head teachers to allow them to write and draw with the left hand exclusively, to keep them under observation, and to report to me

the effect upon the speech. In nearly every case the parents objected: they did not want their children to write with the left hand. In ten cases, however, the parents raised no objections, and the result after eighteen months is as follows:—

In two cases the change had no effect.
In two cases there was a slight improvement.
In five cases there was a marked improvement.
In one case the child was almost completely cured.

The following case reported to me by the head teacher of one of the schools is clearly evidential: "D—— B—— came to this school on February 2, 1908, and entered Standard VI. On admission she stammered, was left-handed, and had been made to write with the right hand. For two years she was allowed to use her left hand, and the stammering disappeared. Her parents then stated their intention of sending her to the C—— (secondary) school, and finding on inquiry she would be compelled to use the right hand, I advised practice. Hesitancy in speech followed and slight stammering. She left on July 10, 1911."

In view of all this evidence it seems impossible to escape the conclusion that some sort of connection exists between "handedness" and the motor mechanism of speech, so that a disturbance of the former gives rise to a disturbance of the latter—a conclusion which suggests a further problem. Is the disturbance confined to the physiological apparatus con-

cerned in the production of articulate speech, or does it extend further and invade the complex psycho-neural realm concerned in verbal imagery and thought? In other words, is the general lingual efficiency of the sinistral impaired by interference with his sinistrality?

Dr. G. M. Gould records the case of a naturally left-handed friend who was compelled when a child to write with his right hand. For all other acts he was left-handed. All through his life he hated writing, and never seemed to be able to use his pen and his brain at the same time. If he tried to write while thinking there was a positive inhibition of thought. But as soon as he laid down his pen and started dictating to a stenographer, his ideas flowed freely and rapidly.[1] Doctor X—— told me the case of his little boy, whose speech was delayed for two years by what he now regards as an ill-advised attempt to change the child's sinistrality. It was to solve this more general question of the relation between speech and sinistrality that the second investigation was originally made. I strongly suspected that the lingual ability of dextro-sinistrals was below the normal, but the results of my researches have entirely falsified my expectations. Two queries were raised: First, How does the lingual efficiency of the child, as disclosed by his success at the terminal examinations in reading, composition, recitation, etc., compare with the class average in these branches? Secondly, How does

[1] Appleton's *Popular Science Monthly*, October 1904.

his lingual ability compare with his abilities in other directions, such as mathematics and drawing? The tabulated results are as follows :—

	A	B	C		A^1	B^1	C^1
Pure sinistrals ...	49	12	39	...	47	18	35
Dextro - sinistrals	45	16	39	...	42	22	36

A = Percentage of children whose marks in English were above the class average.
B = Percentage with marks equal to the class average.
C = Percentage with marks below the class average.
A^1 = Percentage of children with marks for literary subjects higher than the marks for other subjects.
B^1 = Percentage with about equal marks for both kinds of ability.
C^1 = Percentage with lower marks for literary subjects.

These results tend to indicate that sinistrals, as a class, are in no way deficient in their general power of verbal expression; for although the pure sinistrals are better than the dextro-sinistrals, both are better than the dextrals. The numbers are manifestly too small to justify us in pressing this inference, for the superiority in the cases examined may be accidental. The results were so unexpected that I obtained further data which would serve as some sort of check. I obtained records of the position on the last terminal examination lists of 43 pure sinistrals and 187 dextro-sinistrals, and found that a position in the first half of the list was held by 25 pure sinistrals and 104 dextro-sinistrals; that is by 58·1 per cent. of the former and 55·6 per cent. of the latter.

If the numbers may be taken as typical, they

point to a slight deterioration both in lingual and in general ability, resulting from attempts to make sinistrals ambidextrous.

We must now consider the dextro-sinistral stammerers as a separate class. Dr. Edward Conradi gives statistics to show that stutterers are, as a rule, backward in their school work.[1] This retardation he believes to be due to psychic depression brought about by the mockery to which the child is exposed. If this explanation is sound, the backwardness would be a secondary effect and not an immediate and inevitable effect of that which caused the stuttering. My own results are at variance with Dr. Conradi's. The marks obtained by the stammerers in English, which includes reading and recitation, are, as might be expected, rather low ; but in general ability, as indicated by the class lists, they are, on the whole, rather above than below the average. My researches, however, were limited to dextro-sinistrals.

The conclusion at which we arrive on the general question is that although dextro-sinistrality tends to give rise to stammering, there is little or no evidence that it produces a wider disturbance of the function of speech, beyond what stammering itself inevitably entails.

How is the stammering to be explained? Brain physiology is clearly indicated as the ultimate ground of explanation. But before we enter this speculative region, it would be well

[1] See *Journal of Educational Psychology*, vol. iii. No. 1, pp. 35–8.

to determine what are the facts of dextral and sinistral asymmetry that are open to common observation. What are the phenomena that go together? Are all the organs on one side of the body more efficient than the corresponding organs on the other side? Does the superiority refer to the organs of movement alone, or does it refer to the organs of sensation as well? Does dextropedality, for instance, always accompany dextromanuality? And what is the nature of dextrocularity? Dr. Gould, in the article referred to above, asserts that the root fact is dextrocularity. He regards the predominance of the right eye as the initial fact of dextrality. We are right-handed because we are right-eyed. In playing the fiddle, for instance, the fingering is done with the left hand, for it is thus that the right eye can the better observe the movements. If this theory were sound, one would expect to find the correlation between dextrocularity and dextromanuality to be nearly absolute. Right-handed people would be right-eyed, and left-handed left-eyed. By means of a simple instrument constructed out of a cigar-box I tested the eyesight of several children with a view to discovering the dominant eye. It is obvious that an experiment of this kind is complicated by peculiarities of vision due to astigmatism, different focal lengths for the two eyes, and so forth. An effort was therefore made to select children whose eyesight seemed to be normal. The lid of the cigar-box was fastened and the

ends of the box removed so that it formed a sort of rectangular tube. Over the middle of each open end a piece of black thread was stretched. The child tested was asked to take the box in both hands, look through it, and adjust it in such a way that the two threads covered one another and were seen as one. The 60 boys tested in this way seemed to secure the alignment without much difficulty; 46 used the right eye, and 14 the left. Out of the 74 girls tested in the same way, 48 used the right eye and 12 the left, and 14 failed entirely to see both threads as one. The only left-handed girl among them used the right eye. The girls were on the whole very much slower in "sighting" the threads than the boys.

The same sort of experiment was made in another school, with the difference that the box rested on a table and the children were not allowed to touch it with their hands. The results tended to confirm my suspicion that in the previous experiment the right hand tended to drag the box towards the right eye; for in this case only 33 boys out of 60 used the right eye, and only 35 girls out of 60. In all these cases the children were right-handed. Out of 41 left-handed children tested in the same way 23 used the right eye.

The figures lend support to the view that the preference among school children for the use of the right eye is but slight and in no way comparable with the preference for the use of the right hand, and (as far as my own figures are

concerned) the right-eyedness has no essential connection with dextrality.

In my recent examination of sinistrals, I carefully tested their vision with a view to finding the "fixing" eye. I found it best to discard all apparatus and to adopt the following simple plan. The child was asked to stand at the one end of the room while I sat at the other and covered my left eye. He was then told to stretch out his arm, and with both eyes open, point to my right eye. I could, as a rule, tell immediately which eye he was using for the alignment. This test was repeated in various forms, such as by pointing with the other hand, or forming a loop with the thumb and index finger and looking at my eye through the loop. The result was generally quite definite: one eye was persistently used for purposes of alignment. Of the 51 sinistrals thus tested, 57 per cent. proved to be right-eyed, and 43 per cent. left-eyed. The corresponding percentages for the dextro-sinistrals were 55 and 45.

It will be seen, therefore, that this theory of the priority of dextrocularity (or sinistrocularity) is disproved by facts that can easily be verified. If the theory could be established it would fail to support the doctrine that the fundamental source of all dextral phenomena is the superior development of the left cerebral hemisphere, and of all sinistral phenomena the superior development of the right cerebral hemisphere. For the anatomical relations between the eyes and the cerebral hemispheres are of an entirely

different nature from the relations between the hands and the hemispheres. The right eye is not, like the right hand, connected with the left hemisphere only: it is connected with both hemispheres, the nerve fibres from the right half of each retina proceeding to the right hemisphere, and the fibres from the left half to the left hemisphere. To be right-eyed is not, therefore, as in the case of right-handedness, to be left-brained.

Another fatal objection to the theory is to be found in the fact that among people born blind the proportion of dextrals and sinistrals is about the same as among sighted people. This same objection holds against the hypothesis put forward by Mr. H. C. Stevens, who claims that certain experiments made by him indicate that a difference in the perception of size exists between the right and left halves of the retinæ of both eyes.[1] When two discs of equal size were so presented that the image of one would fall on the margin of the right half of the retina, and the image of the other on the margin of the left, the disc to the right of the observer was generally judged to be the larger. Mr. Stevens made 183 observations altogether, and found that to 100 persons the right disc appeared larger *to both eyes*, and to 45 persons the left disc appeared larger to both eyes. Of the 100 persons to whom the right disc appeared larger, 76 were right-handed, 8 ambidextrous, and 16

[1] "Right-handedness and Peripheral Vision," *Science*, **N.S.**, vol. xxvii. pp. 272–3 (1908).

left-handed. Of the 45 persons to whom the left disc appeared larger, 15 were right-handed, 3 ambidextrous, and 27 left-handed. Mr. Stevens cites these figures in support of his theory that if the reflex arc concept is valid, the ascendancy of the left hemisphere must in the first instance exist in the sensory neurons. "Where there is motor bilateral asymmetry there must first be sensory bilateral asymmetry." He explains the development of right-handedness by saying that "objects situated in the right half of the field of vision of a left-hemisphered infant would, by appearing larger, attract its attention." "The fact that the predominant use of the right hand is developed by trial and error is against the assumption that there is a natural prepotency in the path of discharge into the right arm. If it were merely reflex there would be no period of uncertainty in which both arms are used. A fact which supports the view suggested here is that the time (7 months) at which pronounced right-handedness developed in Baldwin's child was but a little later than the time (5 months) at which Raehlmann found that an object was recognized when its image fell on the periphery of the retina."

The fact that people, blind from birth, exhibit the same dextral or sinistral proclivities as normal people, disproves that Mr. Stevens has discovered the fundamental factor. It may be further pointed out that the judgments of size involve the higher mental processes, and that they were made, as was inevitable, by subjects

whose dextrality or sinistrality had already been developed. There is no proof of asymmetric sensibility pure and simple in the retina, still less is there proof of a particular kind of casual nexus between retinal sensibility and right or left-handedness. *A* may be the cause of *B*, or it may be its effect, or both may be the effect of a common cause.

Is there evidence of greater tactual sensibility on one side of the body than on the other? Or that right-handed or left-handed people hear better on different sides? In the absence of such evidence we must confine our attention to the motor phenomena. It will readily be admitted that finer kinæsthetic discrimination necessarily accompanies the more complex motor co-ordinations involved in the superior skill acquired by hand or foot, but the physiological factors open to ordinary observation are motor rather than sensory.

It can be shown that right-footedness generally goes with right-handedness, and left-footedness with left-handedness. Since it is but rare that any delicate act of skill has to be performed by the foot, it is very difficult to ascertain which is the more dextrous of the two. Out of 153 children who were tested in jumping I found that 94, or 62 per cent., made the leap with the right leg. The percentage of those who used the right leg increased somewhat with the ages of the boys. In playing football about 75 per cent. of the boys showed a preference for the use of the right leg. It may well be

doubted whether in the matter of jumping and kicking, the element of skill, as distinct from strength, is sufficiently pronounced to serve as a criterion of dexterity. The muscular development of the legs is brought about almost exclusively by exercise in walking; and as each leg gets an equal amount of practice there is but little reason to anticipate that in mere feats of strength preference would be given to either leg. I myself, for instance, seem to use both legs indiscriminately for jumping and for kicking a ball, but I find by trying to write with my feet (an art which is not difficult to acquire) that I have much greater control over my right foot than my left. The testimony of some of my friends, whom I have induced to experiment in the same way, accords with my own.

In my more recent examination of sinistrals I endeavoured in each case to discover the more skilful leg. I had to rely mainly on the judgment of the children themselves. The majority of the left-handed boys were emphatic in stating that they could play football more skilfully with the left leg than the right. It was, as a rule, more difficult to get a decided statement from the girls. The children were further requested to trace out words on the floor with their feet, and to state which foot they could the more easily control. A few boys were put to write and draw with their feet, by means of pencil and paper. This, of course, involved taking off shoes and stockings and was open to certain objections. Moreover, it was quite impossible

to tell from an examination of the results which of the two feet was the more skilful: they seemed equally awkward. This method was consequently abandoned. By applying the other two methods I found that 88 per cent. of the pure sinistrals were left-footed, and 86 per cent. of the dextro-sinistrals. It is not improbable that if acts of greater skill were required of the foot a still higher degree of correlation between hand and foot would be revealed.

We seem justified in concluding that the hand and the foot on the same side of the body are related to the same group of dextral or sinistral phenomena. Since these organs are connected with the same cerebral hemisphere, it is a reasonable hypothesis that other organs whose movements are controlled by the same hemisphere partake of the same sort of asymmetry. That the vocal muscles are concerned in dextral and sinistral asymmetry is a commonplace of physiology. Although these organs are anatomically connected with each hemisphere they are, as a matter of fact, functionally connected with one only. The researches in aphasic disorder have established the fact that the vocal organs are normally controlled by the superior hemisphere—by the hemisphere that controls the skilful hand and foot. Dextrals have their speech centres in the left hemisphere and sinistrals in the right. Sinistrality, therefore, affects the motor co-ordinations of the right arm, the right leg, and the vocal apparatus; and functionally connected with them all is the right hemisphere.

How does this sinistral system hang together? How did the asymmetry originate in the life of the individual? Was it, as Plato thought, and as the modern advocates of ambidexterity teach, a mere matter of accident or training that the left hand started to gain an advantage over the right? And did the left hand then educate the right hemisphere and the right hemisphere transmit the advantage to the left foot? Or was the left-handed child born with a right cerebral hemisphere slightly different in structure and in function from the left? Modern physiology favours the latter view, and regards the basal fact of dextrality or sinistrality to consist in congenital cerebral asymmetry.

Sir James Crichton-Brown ascribes all dextral and sinistral phenomena to the root fact that the hemispheres differ in shape and function. The two halves of a rabbit's brain are as indistinguishable as the two cheeks of a young baby ; but in the brain of an anthropoid ape there begins to appear a lack of symmetry in the ridges and hollows of the two hemispheres. This divergence is seen to increase as we pass to higher and higher types until it reaches its maximum in the brain of civilized man. And this difference in structure is the correlative of a difference in function. Sir James accepts Dr. Hughlings Jackson's doctrine that in ordinary people the left hemisphere is the more voluntary and the right the more automatic. This, and this alone, accounts for the ascendancy of the right hand and the unilateral

position of the speech centres. He says we can go no further: we must accept this cerebral peculiarity as an inexplicable and ultimate fact. We are here face to face with another form of the old problem of the chicken and the egg. Which came first? Did the supremacy of the left hemisphere secure the supremacy of the right hand? Or did the preferential use of the right hand secure in the course of ages a better education for the left hemisphere?

Are we now in a position to give a physiological explanation of the prevalence of stammering among dextro-sinistrals? To the facts adduced above must be added the teaching of physiology regarding the special cortical centres concerned in speech. It is a generally accepted theory that there are in the normal adult four highly specialized centres involved—the auditory, visual, vocal, and graphic word centres, and that these four centres are situated in the dominant hemisphere. The sinistral system of the left-handed child, who can speak but has not started writing, contains as related factors a superior right cerebral hemisphere in which have been developed two sensory and one motor speech area and a superior left hand. If this left hand is used in the acquisition of the art of writing, a writing centre is believed to be developed to accompany the other three in the dominant hemisphere. But what happens when the right hand is used for writing? We are driven to assume that in this case the writing centre forms in the inferior hemisphere. But how can this

in itself give rise to stammering? The mere establishment of a highly specialized centre in the inferior hemisphere is not in itself a sufficient cause. It is difficult not to believe that a centre is so formed in the case of a right-handed violinist, and no special tendency to stammer is observable among this class of people. The secret probably lies in the intimate functional connection of the writing centre with the system of word centres, and particularly with the speaking centre. Whenever writing takes place all the language centres are probably active, ideationally if not perceptually, and the extent to which nascent or partial articulation accompanies writing depends upon the type of child. The pathological explanation of stammering is obscure, but there is little doubt that the motor speech area is the seat of the disorder. No lesion is discoverable : the defect is functional merely, thus differing from all forms of aphasia.[1] There is no lack of effort, no lack of innervation—of a kind ; but the current runs into the wrong channels. The right co-ordinations are not promptly brought about. This may conceivably be due to two causes. Either the special motor area itself is enfeebled, in which case the defect is analogous to the stammering of young children when they first learn to speak ; or there is some sort of functional conflict leading to inhibition, hesi-

[1] It is held by Th. Hoepfner, however, that stuttering is momentary aphasia due to associational defects. (Quoted in the *Journal of Educational Psychology* for January 1912, p. 53.)

tancy, or stammering. What precisely happens in the case of dextro-sinistral stammering is purely conjectural. It may be that the writing centre alone is formed in the left hemisphere, or it may be that, as some have contended, the writing centre "drags" the other centres to its own side; or it may further happen that, as the advocates of ambidexterity affirm, two sets of speech centres are developed, one in each hemisphere. In any one of these cases it is conceivable that the dominant speech area is either robbed of some of its energy, or that some sort of competition takes place which tends to disorganize its function. These speculations, however, cannot, so far as I am aware, be either confirmed or refuted by established physiological facts. It is more profitable therefore at present to pass on to the practical issues.

If we neglect the question of social conformity it is clear that there is nothing to be gained by trying to make a left-handed child right-handed. There is a grave risk of stammering resulting from the change; and there is no gain in mental power. It is true that the ordinary parent and teacher do not encourage the cultivation of the sinistral's right hand with a view to improving his mental capacity, but merely with a view to removing a peculiarity; but the members of the Ambidextral Culture Society do maintain that both hands should be so cultivated as to be able to perform all skilful acts interchangeably. And the reason alleged is that brain power is considerably increased thereby. More-

over, attempts have been made to introduce ambidextral drawing and writing into the elementary schools. I am not here concerned with refuting the doctrine of ambidexterity, but with pointing out that the sinistral may be changed into a dextro-sinistral by the unsophisticated parent or by the cultured advocate of ambidexterity. The former tries to make the boy write exclusively with his right hand, the latter tries to make him write with both interchangeably, or even simultaneously. Both types of sinistrals were examined by me in my recent investigation, the child who then preferred writing with his right hand, and the child who used his left when nobody was watching him ; and both types seemed equally inclined to stammer. It appears, therefore, that no kind of interference with the natural sinistrality of a child is educationally justifiable.

And if this be so it is reasonable to infer that attempts to interfere with the natural dextrality of a child would be fraught with equal danger, and that ambidexterity, if it can be achieved, is liable to bring with it a serious disability.

Let us examine a little more closely the alleged advantages of ambidexterity.

It is first of all asserted that we should be more generally useful if we were equally dexterous with both hands. Surgeons and boiler-makers are instanced as finding left-handed skill extremely serviceable. If all the boys and girls in our schools were destined to be surgeons or boiler-makers the argument might be worth

considering. There is, in fact, no objection to training the left hand in its own sphere of usefulness ; for the usefulness of the left hand is, as a rule, different in kind from the usefulness of the right. The left hand is useful for steadying the paper while the right hand holds the pen, for holding the cigar while the right hand applies the lighted match, and for playing on the piano the notes in the bass clef while the right hand deals with the notes in the treble clef. Instances of this differentiation of work may be multiplied indefinitely. There is a certain low level of serviceableness which both hands may profitably attain. We ought, for instance, to be able to pass the butter just as readily with the left hand as with the right. But when it comes to delicate manipulation we wisely specialize.

The next contention, that we can double our brain power by merely training the left hand is quite unsupported by evidence. There is no proof that the trained ambidexter has one jot more intellectual capacity than he had when he was unidextrous. He can write two scripts at the same time. But that is a mere trick. The specimens that appear in Mr. Jackson's book on Ambidexterity are entirely unconvincing. They reveal no originality, except in spelling. There is little doubt that they were not really simultaneous, but merely alternate. A bit of A was written, and then a bit of B, then another bit of A and another bit of B and so forth. Even if the two writings seemed to be severally continuous, it is evident that the thinking was not

continuous. The attention was not split up into two parts, each part undertaking its own special task ; it simply oscillated from one task to the other. Genuine cases of dual personality and of split-off consciousness are not unknown to psychologists. But these are pathological.

We are told that ambidexterity is a kind of insurance against injury to the right hand. It is the logic of the old lady who bought at a sale half a dozen crutches, on the ground that they would come in very useful should her dear husband happen to get his leg broken.

The word " lop-sided " continually recurs in the literature of the ambidextrians as a term of reproach. Nature, they say, has made us symmetrical, but we have made ourselves lop-sided. But *has* Nature made us symmetrical? In internal structure we are terribly out of balance. Even the two halves of our brain are not similarly convoluted. And if Nature has made us structurally one-sided, why not functionally as well? Nature, indeed, has no great love for either absolute similarity or absolute symmetry. She does not like to repeat herself without some variation—not even on both sides of a straight line. She draws no line down the middle : she designs no South Kensington drawing copies. Let us be content, then, to remain a little lop-sided like the rest of Nature's handiwork, remembering—if it gives us any consolation—those words of Bacon so constantly quoted by Edgar Allan Poe : " There is no exquisite beauty without some strangeness in

the proportion." So in the matter of beauty, dear reader, a *soupçon* of lop-sidedness is one's only chance. It is said that the swiftest runners have limped a little : one leg has been a trifle stronger than the other. And the most artistic of nations, such as the Assyrians and the Greeks, have shown the most pronounced tendency to dextrality. The Japanese, far from being the ambidextrous race they are asserted to be by the ambidextrians, are so inveterately right-handed that when Jingors, one of their great wood-carvers, was found to be left-handed, they nick-named him Hidari—the Sinister.[1] Among the great masters of painting in Europe, Leonardo da Vinci was the one left-handed exception. And there were no ambidexters. Nor is there any record of a left-handed or ambidextrous sculptor.

Why, we are asked by the ambidextral culturists, should our speech centres be confined to one half of the cerebrum? Why should we not have two series, one in each hemisphere? They assert that the speech centres have been dragged to one side by an artificially acquired right-handedness. Even if we admit that down the long line of human evolution the right hand has been instrumental in establishing the supremacy of the left hemisphere, we can admit the existence of no such potency in the right hand of the individual. The supremacy of the left hemisphere is now innate—it takes the lead by right of heredity. It is very possible that

[1] See Sir James Crichton-Browne's lecture on Ambidexterity.

the speech centres are of necessity unilateral, that they cannot co-exist in both hemispheres. This is a point upon which physiologists have not yet enlightened us. Human ambidexters are few, and their brains have not been available for examination and experiment. The only ambidexters that have been vivisected, such as monkeys and rabbits, have had no speech centres at all.

We arrive, therefore, by a variety of routes at the conviction that the Ambidextrians are wrong ; and that their doctrines are opposed to the requirements of social and industrial co-operation, and to the teachings of modern biological science. Civilization and right-handedness have arrived together. The history of the one is the history of the other. And as the members of the body politic have shown a progressive tendency to specialize, so have the members of the body physical. That way efficiency lies. Apart from considerations of manual skill, the gift of dextrality is bound up with the gift of speech. The cerebral springs of speech are one system, just as the soul is one and attention is one. To disorganize dextrality is to deprive this lingual system of some of its natural stimulus, and possibly to imperil its unity. Let not the right hand, nor yet the left, forget its cunning ; neither let one hand usurp the province of the other.

PEDAGOGICAL APPLICATIONS

BEFORE particular pedagogical problems can profitably be discussed, it is necessary to formulate clearly the aim the teachers should have in view when introducing handwork into the curriculum. The narrow utilitarian aim of preparing for a specific life occupation may be dismissed without comment. The ideal of manual dexterity—a general handiness—may be rejected on the ground that it rests on a discredited form of the doctrine of formal training. Within the limited period of the ordinary boy's school life it is only possible to develop manual skill in a few specific directions. The acquisition of skill in any direction is not to be underrated. It is better to be handy in doing plain household carpentry, or plumbing, than to be entirely at the mercy of the carpenter and the plumber. Skill in drawing or painting or modelling is a thing which no one can afford to despise. Each school occupation, if wisely chosen, has a real intrinsic value. But that is not, from the point of view of a liberal education, its main value; for this consists in the degree to which it ministers to the growth of the pupil's whole personality. The supreme aim of manual train-

ing should be to increase the pupil's power of adjustment to his physical, social, and spiritual environment. It should be regarded as a means of general culture—of mental, moral, and æsthetic development. Its significance should extend beyond the mere control of that portion of the physical universe with which the particular exercise is concerned, and invade the region of ideas, emotions, and purposes. It should in some way help to turn a self-minded creature into a social-minded creature. In following those lines of instinctive activity which subserve worthy ideals, it should aid in the realization of the highest self. What we precisely believe that highest self to be depends upon our religious or ethical creed; but all will agree that it should be at least a rational self, and a social self. But the manual work actually done in the schools is, as a rule, far from satisfying this ideal. As regards aim, method, and material, general confusion reigns. In the elementary school we have in operation two systems which are diametrically opposed to one another. The elder boys attend a woodwork centre, the infants engage in kindergarten occupations. In the middle part of the school, it may be noted, there was until quite recently no specific handwork except drawing. The woodwork done at the manual training centre is a logically worked out system. The exercises are carefully graduated. They proceed from simple to complex. They are devised with the object of acquiring mastery over the material and mastery over the

tools. The acquisition of skill is the aim the teacher has primarily in view. He may have a secondary aim. He may believe, and he probably does believe, that the manual work develops intelligence as well ; but he does not think of this in devising or working out a scheme. What he asks himself is this : How can I most rapidly and effectively give this boy mastery over this branch of handicraft? The standpoint is the standpoint of the adult who wishes to gain the rudiments of a trade. The child, his instinctive tendencies, his interests, his desires, are entirely left out of account. It does not matter whether the boy likes the course or not ; it does not matter whether he is interested in it or not ; it does not matter whether the object made is such as he would spontaneously make—as he would make if left to his own resources. What does matter is that his manual dexterity should be trained by an orderly sequence of exercises.

The occupations in the infants' school are of quite a different character. Here there is no ordered system, no careful gradation of exercises, no adherence to one medium of expression. No attempt is made to give the child perfect mastery over any instrument or any material. The primary aim of the teacher is not the acquisition of skill, but the clarifying and vitalizing of ideas. It is true that skill is incidentally acquired, but the important thing is that the child should make his ideas clear, vivid, and usable, by indulging his innate tendency to express them in a variety of media. The manual

work in the infants' school is expressional work. A child is interested in making anything ; he is still more interested in making something which serves some purpose ; he is most interested of all in making something which serves his *own* purpose. Thus the manual work in the infants' school grows naturally out of the child's life in the home and the school. It has no independent basis of its own. Cut adrift from the rest of the mental life of the child it becomes a meaningless jumble of exercises. To-day he sketches a daffodil with coloured crayons, to-morrow he models a rabbit in plasticine, and the following day he makes a little basket of bast. There is no continuity in these exercises. They are not connected with one another : they are merely connected with the intellectual course set forth for the child. It is not denied that there is an attempt at gradation in the clay modelling, paper folding, etc., but the gradation is subservient to the main idea—the idea that the work is expressive, that it is a practical way of assimilating knowledge.

It will be seen that these two principles are poles asunder. While one aims at giving the child control over matter, the other aims at giving him control over mind ; in the one we have motor training as an end in itself, in the other the motor training is a means to some other end. In the one mechanical skill is aimed at, and the intellectual training becomes incidental ; in the other intellectual training is aimed at, and the mechanical skill is incidental. In the one

the intellectual interests of the child are not taken into account ; in the other the intellectual interests of the child form the one determining factor in the selection of the kind of exercise. In the one, accuracy forms the basis by which progress can be gauged ; in the other, accuracy forms a very inadequate criterion of progress. You cannot tell by merely looking at a thing made by a boy how much brains he has put into it.

It is clear that the general aim which I have formulated finds completer fulfilment in the kindergarten than in the woodwork centre.

I will now proceed to deal seriatim with some of the more important problems that arise in the teaching of handwork.

IS HANDWORK A SUBJECT OR A METHOD?

THIS is a problem which has given rise to much controversy. Those who hold that handwork is a method deny that it has in itself much educational value, and affirm that its value mainly consists in illustrating, in making real and vivid, and in other ways serving as ancillary to, the teaching of other subjects.[1] They contend that its worth is instrumental rather than intrinsic, that the child learns by doing; not merely that he learns to do by doing, but that he learns to think and feel by doing. On this view there should be no specific time allotted to clay modelling, cardboard modelling, raffia work, woodwork, etc., but these exercises should form essential parts of the lessons in arithmetic, geography, science, etc. There should be as complete a fusion as possible between the intellectual and the constructional elements of each subject of instruction.

Those who, on the other hand, regard handwork as a "subject," maintain that it should be taught for its own sake, and should have a

[1] Mr. H. Holman criticizes this use of the word method in reference to handwork in his "Hand and Eye Training" (second edition), p. 87. Dr. Percy Nunn's terms "substantive" and "instrumental" are preferable to the terms "subject" and "method." See the *Journal of Exper. Pedagogy*, i. 2, p. 116.

definite place on the time-table. The pupils aim at the production of some beautiful or useful object—something which they regard as in itself worth doing. If the other subjects of instruction are connected with it they should be regarded as incidental rather than essential. The constructive exercise may suggest ideas other than those necessary in the adaptation of the material means to the material end, or it may afford an opportunity for the application of ideas acquired in other provinces ; but the construction itself is the central point of interest in the process. On this view, the acquisition of skill is important, and it is desirable that there should be some sort of progressive development of the subject.

Now it is obvious that these views are not necessarily incompatible. It is possible to teach both the instrumental and the substantive forms of handwork in the same school. That is, in fact, the usual mode of procedure. Each form has its merits and its dangers. In the former case the teacher, in his anxiety to " correlate," is liable to give unsuitable exercises ; and it must be recognized that constructive handwork is not always the best form of motor expression. Literature, for instance, finds its natural expression in reading aloud, recitation, and dramatic representation.

In the case of handwork as substantive there is the serious possibility of divorcing the motor from the mental. The constructive exercises are in danger of becoming extremely mechanical. One occasionally finds a school where the ordi-

nary subjects of instruction are abstract and academic, and some independent handwork lessons of a mechanical nature are given to supply the need of what is called "motor training." This is the very worst type of motor education. The intellectual factor is not motorized, and the motor factor is not intellectualized. But the essence of the newer educational creed is that impression and expression should go together—that the mental and the motor aspects of knowledge should be inseparably linked.

The extreme form of substantive handwork is far more revolutionary than the extreme form of instrumental handwork; for while the latter does not necessarily alter the content of the traditional time-table, the former in constituting the centre from which intellectual pursuits radiate must profoundly affect the nature and sequence of school studies. This becomes manifest when we examine the course of studies pursued by the pupils at such a school as Dr. Dewey's experimental school at Chicago.

The line upon which handwork has been developing in England has already been indicated, and this line, provided the teaching methods are sound, is probably as good as any other. The changes that are being made are gradual and tentative. Both types of handwork are being tried; and, so far as I can judge from many years' intimate acquaintance with a large number of schools, both types when well taught are productive of sound results; nor is either exempt from the evils due to bad methods of teaching.

SHOULD THE DEVELOPMENT OF SUBJECT-MATTER FOLLOW THE LOGICAL OR THE PSYCHOLOGICAL ORDER?

LEAVING out of consideration the preliminary stage when a subject is introduced into the school for social and utilitarian reasons and is taught in empirical and haphazard fashion, each subject of instruction tends to pass from the logical to the psychological stage. The phraseology of this distinction is open to objection, but I retain it for the present. In the logical stage the subject-matter is presented, not in the order of discovery—not in the order in which the subject actually evolved in the history of the race, or would naturally develop in the experience of the young pupil—but in the order in which the adult intelligence after mastering the subject-matter rearranges it on what seems to be the most logical and systematic basis. It does not represent the order in which the adult has himself assimilated the facts; still less does it represent the order in which the child is best capable of assimilating the facts. The English boy learns Latin in the logical order; the Roman boy learnt it in the psychological order. The logical system first presents elements which

have been arrived at by the analysis of a complex unity, defines those elements, combines them, arranges them in classes or series, and generally follows some preconceived principle of systematization. The psychological system demands that the concrete facts be presented to the child when he is either actually curious about these facts, or could by various teaching devices be made curious about them, and the analysis and synthesis should be made as far as possible by the child himself, the motive for such processes springing from the fact that they are necessary steps in furthering his interest in the subject.

This antithesis which it is customary to set up between the logical and the psychological is from certain points of view unfortunate. It seems to correspond to the opposition between the artificial and the natural, the formal and the informal, the forced and the spontaneous, external pressure and internal motivation, effort and interest, the subordination of the child to subject-matter and the subordination of subject-matter to the child, the education of the school and the education of life. Several of these antitheses are false and are likely to do just as much harm as good. Dewey, in Chapter V of "How we Think," strongly protests against the notion that the logical and the psychological are in any way mutually exclusive. He contends that the immature mind has a logic of its own which is as valid in its own sphere as that of the adult. It represents the vital and subtle movement of his mind which cannot, without injury, be inter-

fered with by the mechanical devices of a cast-iron external scheme. The so-called psychological and logical merely mean the two ends of the same movement—the earlier and later stages in one continuous process of normal growth. This is beyond question the right way of looking at it. Those who defend the logical method argue somewhat as follows: If the subject-matter is not to be systematized for the learner, why should he come to school at all? Of what use is the teacher? If the haphazard method of picking up knowledge—the method of the home and the street—is to be followed in the school, we have to abandon the methods and devices for teaching much in a short time which have been laboriously accumulated and handed down by many generations of teachers. To follow the mere caprices of the child is not only to forgo all hope of moral training, but also, by failing to evoke effort, to miss the best means of intellectual discipline. Such objections are based upon a misconception of what the so-called psychological method means. It is not haphazard: it follows the course of natural growth. It does not do away with the need of a teacher; it makes a greater and more subtle demand upon his skill and resourcefulness. He must possess some psychological knowledge of each particular pupil in his class. The caprices of the child are not to be unreservedly humoured. Effort is demanded on his part; but the effort should be secured through the right motive: it should be regarded by the child as a means to the attainment of an end which

is a desired end, not merely to the teacher, but to himself as well. The discipline secured by this means will be of a deeper and more permanent kind than that secured by appealing to a motive which is foreign to the subject itself and has no bearing on the child's self-development.

The two methods may be illustrated by reference to the stages through which instruction in woodwork has passed in this country, and to the way in which the teaching of one branch of handwork (drawing) has virtually passed into the psychological stage, while the teaching of another branch (needlework) remains almost exclusively in the logical stage.

The woodwork system has already passed through two stages and shows some signs of passing into a third. In the early stage, the process was everything, the product nothing.[1] The pupil was put through a series of barren exercises in planing, marking, sawing, chiselling, etc., with bits of wood which were afterwards thrown away. Joints of various kinds were made purely for practice. It then passed into a second stage in which the product was regarded as of some importance, although still subservient to the process. The pupil was allowed to make objects which could be put to some use ; but the use had reference to the adult, not to the child. They were not objects which a boy would spontaneously make. This is the stage of Sloyd, and is, generally speaking, the stage in which woodwork is found in England at the present

[1] See Raymont's "Principles of Education," pp. 214–15.

time. But there are not lacking signs that it is about to enter upon a third phase, in which the dominant interests of the boy determine the objects to be made, and the process is regarded as subservient to the product. In the first stage he makes something which is useful to nobody, in the second stage he makes something which is useful to somebody, in the third stage he makes something which is useful to himself. In the first stage he expresses nothing, in the second he expresses something, in the third he expresses himself. And when I say he expresses himself I mean that the exercise has a close and vital connection with the system of purposes and ideas developing in his mind. It helps him to realize more fully and more clearly what was but partly and vaguely apprehended before. It becomes a genuine aid to self-realization.

The teaching of drawing in the elementary school has been revolutionized during the last ten years. Previous to that time it was taught, except in the infant school, on the most formal principles ; and even in the infant school the newer method is of quite recent introduction. The starting-point was practice in the elements—the straight lines and curves into which all drawings, however elaborate, could be analysed. Straight lines in various positions and curves of various kinds in various positions constituted the staple of the earlier exercises. These were then combined in a variety of ways, generally forming a symmetrical arrangement about a central line. From simple arrangements the pupil proceeded to more complex arrangements, and even

during his fourteenth year—his last year at school—he was still found practising medieval ornament of the most uninteresting description. He had done no colouring, no "mass drawing," no light and shade, no sketching from real objects (unless indeed he was put through an equally formal course of model drawing in which the geometrical models were the only objects sketched), he had in fact done nothing which made a vital appeal to his constructive instinct, and his natural love of colour. This method has still its advocates both among professional artists and among art teachers and inspectors. The President of the Royal Academy got out some years ago a series of drawing copies intended for use in the schools, a series which embodies all that is dry and formal in the older system. It is claimed by the supporters of this older system that it is the only method which gives a "thorough grounding" in art, that the procedure must always be from simple to complex, that it is useless, nay dangerous, to allow a child to attempt to draw something manifestly beyond his powers (such as a man or a ship), and that line-drawing, being the basis of all pictorial representation, should be thoroughly mastered before shading or colouring is attempted. The fallacies lurking in these statements need not be here refuted. Some of those common to all forms of handwork will be dealt with in the next section. Suffice it to say here that this method of teaching drawing has, for the time at least, been virtually abandoned, that children in the schools now

draw in mass and colour from the real object instead of from the flat, and they do this from their first entry into the elementary school. The results have in my opinion abundantly justified the change. The children are much happier in their work, they take much more interest in the subject, and spontaneously carry on the work in their homes ; and the standard of merit in the drawings themselves is considerably higher than was attainable under the older system. It is curious to note that the method which is now adopted and is generally considered to be one of the newest of doctrines, is the very one which was clearly and definitely advocated by Herbert Spencer in 1861.[1]

Needlework is still in many of our schools taught by the logical method. First comes a series of drills—thimble drill, needle drill, and work-holding drill. Until quite recently children of three were put through these barren exercises ; now the instruction is postponed until they are six or seven. After the drills they begin to make stitches. They carefully imitate the teacher, and all do the work in precisely the same way. And for years they continue to practise stitches on little bits of calico or other material before they begin to construct garments. The exercises constitute a sort of grammar which is to be applied in after years. A change has however begun to set in, and a vigorous movement is afoot which aims at the introduction of constructive exercises from the very beginning, and the subordination of drill

[1] See "Education," Chap. ii (pp. 80–2, the 1887 edition).

to the immediate attainment of definite ends which are objects of desire to the pupils themselves.

The distinction between the psychological and the logical order of presentment is now clear, and the superiority of the former consists mainly in the fact that it follows the course which the study of child-nature has shown to be the actual line of growth. It lays great stress on motives, purposes, and interests. It makes allowance for the fact that a child's activities are mainly concerned with present achievement. Remote ends and consequences make an ineffectual appeal to him. That the right sort of interest should be evoked and maintained is regarded as of greater importance than that a certain standard of achievement should be at any given time attained.

The theory that learning naturally starts with the elements into which a complex whole may ultimately be analysed, and that these elements are generally built up by the mind into systems of increasing complexity, is based upon a misconception of the nature of the learning process even in the mind of the adult. If I wish to master a map of London I do not first of all consider the individual streets and, starting at one corner, memorize their names, forms, and arrangements. My eye does not creep over the map inch by inch. I start by trying to get a general impression of London as a whole. I note that the river divides it into two sections. I try to pick out the main thoroughfares and note their general trend. I fix the positions of

the buildings I happen to have heard of, and of any streets I happen to know. And none of these is considered in isolation. Oxford Street appears in my mind, not as a mere street, but as a street parallel to the Strand running east and west in the part of London north of the river. In fact the thought of the whole of London is always present in the background of my mind when I am thinking of any particular part of London. Ward's theory of the presentation continuum and its gradual development applies to all learning processes. "We shall find in the growth of a seed or an embryo far better illustrations of the unfolding of the contents of consciousness than in the building up of molecules: the process seems much more a segmentation of what is originally continuous than an aggregation of elements at first independent and distinct." [1] He applies this concept a little further on to the mode in which one studies a flower. The general outline is noted first, next the disposition of petals, stamens, etc.

To put it generally the notion of a whole, however vague and schematic it may be, always precedes a detailed knowledge of its parts. It frequently happens indeed that the parts have no interest at all except in their relation to the whole. This is particularly true of objects made by children. The details of the process have for them no value except as means to the construction of the complete object. It is the idea of the complete object that should guide their activities all through.

[1] Article on "Psychology" in the "Encyclopædia Britannica."

THE PLACE OF DRILLS IN MANUAL EDUCATION

THE question of the nature, the amount, and the sequence of exercises for securing automatism is one which calls for inquiry. Broadly speaking there are two factions, holding strongly opposed views. First there is the faction whose favourite words are discipline, training, effort, work, habits, thoroughness, and reliability; and secondly the faction who prefer such words as interest, growth, play, spontaneity, initiative, and self-resource. The opposing doctrines correspond broadly to the distinction that is sometimes drawn between the hard and the soft pedagogy.

The former school of educationists hold that drills should be frequent and thorough—thorough in the sense that they should be continued until complete automatism has been attained. They maintain that habit is the important thing in education, that in fact virtually the whole of education could be expressed in terms of habit; that progress in manual work consists in first mechanizing certain simple elementary processes and gradually proceeding towards more complex processes, which should in their turn be

mechanized ; that preliminary exercises of a disciplinary nature are essential, and that frequent disciplinary exercises should be given all along the course ; that without these frequent drills the work becomes slipshod and the children get discouraged ; that without the careful drilling at the beginning the children fall into bad habits which are extremely difficult to eradicate later on ; that although the exercises are often distasteful they serve nevertheless as a valuable means of moral training, and although meaningless to the child at the time, their meaning and value will become evident to him later on ; that what is known as "good form" in any of the arts or crafts is impossible without careful vigilance on the part of the teacher in order that a correct mode of manipulation may be practised from the very first ; that without this thorough training no rapid progress will be made and no high standard of attainment ultimately reached. The opposing school, on the other hand, assert that skill should be acquired not so much by exercises devised *ad hoc*, as by the construction of some useful or beautiful object which the learner really desires to make, and that if he finds that his skill is inadequate for his purpose he may then profitably analyse the work, strengthen by special exercises the weak element, and finally apply himself again to the original complex task. The drill is thus lifted from the level of meaningless drudgery to the level of conscious adaptation of means to ends.

Let us submit the views of the disciplinary school to detailed examination. It is true that habits cover a very large field in education, but the more important habits to be cultivated at school are not physical but mental; and even in the mental realm the part not covered by habit, although perhaps small, is probably of greater import than all the rest put together. For habits enable us to deal with familiar situations only. Born as they are of repetition—of repeated adaptations to the same or similar situations—they are obviously inadequate to deal with novel situations. Whether the novelty is due to new elements which challenge adjustment, or to a new combination of familiar elements, habits necessarily fail to meet the case. Or if an old habit does meet the case it is clear that it still requires something which is not habit to discover the fact, and to select the appropriate habit. In fact we can never bring the whole of the mind's functions under the caption of habit. What then is that mental faculty or power which enables a person to adjust himself to conditions which are new to him? It has been variously named Accommodation (Baldwin), Intelligence (Binet, Spearman, Burt), Judgment (Bagley), Idea (Rowe), Noetic Synthesis (Stout), Reflective Thought (Dewey), Scientific Thinking (Armstrong), Apperception (Herbart), and Understanding (the older English Psychologists). It seems to coincide roughly with what the vulgar mean by "nous" or "gumption," and the ancients meant by

"wisdom." But whatever name we give it we cannot but recognize it as being in its highest form the essential characteristic of man as distinct from the brutes. The latter, it is true, have a certain power of adaptation to which we give the name Intelligence, but it is very limited in range, and can in no way compare with the potency of reason or reflective thinking in man.

It is not here claimed that it is possible through handwork to cultivate a general faculty of reason or intelligence ; but it is claimed that handwork can be so utilized as to cultivate certain *mental* habits which will give what natural intelligence one possesses an opportunity of showing itself. It is also claimed that it can be so taught as to foster certain attitudes of mind—including a certain belief in the mind's own power to deal with the case effectively—which favour reflective thinking.

And as physical habits can be so acquired as to foster the formation of good mental habits, so can they be so acquired as to foster the formation of bad mental habits. To acquire a physical habit in such a way as to neglect intelligence altogether is not merely to miss an opportunity : it is to produce a positive evil in the way of encouraging lazy and slipshod habits of thought. For if the waking mind will not think, it will daydream. And although daydreaming is not in itself an evil, it is an evil when the mind should be thinking.

The conclusion at which we arrive is that

the full intellectual and moral benefit to be derived from the formation of a physical habit is only attained when the whole mind co-operates in the formation of that habit. And this will not happen under any of the three following circumstances : when the sequence of movements is due to unthinking imitation ; when it is carried out in obedience to a series of orders given by the teacher ; and when the child fails to see or feel its relevance to some of his own real purposes.

The maxim "First acquire skill and then apply it" seems at first sight to be not only innocent but eminently reasonable. It is in fact the maxim on which much of the educational work of the past has been based. Experience, however, tends to show that unless the skill has been intelligently acquired, it is not likely to be intelligently applied. If it is learnt parrot-fashion it will be applied parrot-fashion.

The following objections may be urged against preliminary exercises of a disciplinary nature such as needle drill, knitting drill, pot-hooks and hangers in writing, straight lines and curves in drawing, ruling and cutting and folding in cardboard modelling, blobbing in brushwork, and so forth.

1. A physical habit is best learnt in its natural context. A simple habit when required to form part of a complex habit is, as a rule, better gained as a part of the complex habit than as an isolated item.

2. A physical habit should be used by the learner as a means to an end. It should fall into its natural place as an expedient for attaining a rational purpose. If this condition is not satisfied the exercises tend to deaden interest and to retard progress.
3. A physical habit should possess meaning for the learner. It should have a reflex influence on mind and character. It should aid in the development of ideas and of mental and moral habits. It should form a nucleus from which mental activities radiate.

Preliminary exercises fail in these respects. It has been recognized in other departments of learning that to teach little isolated bits in the hope that these bits will be properly combined by the pupil later on is bad methodology. The baby does not first learn separate sounds: he learns words, phrases, and sentences. The schoolboy does not first learn the Latin dictionary and then begin to translate: he learns each word as he comes across it in the text. Even when it is not a question of elements which enter into varying combinations with other elements (such as words to be used in speech or writing), but when it is a question of elements which have to be learnt in fixed sequence—which have to cohere as a habit—the habit can as a rule be more economically gained as a whole than in parts. It has been abundantly demon-

strated that a piece of poetry or prose can be committed to memory more easily and more rapidly by learning it as a whole than by learning it a line, or a phrase, at a time. This is true even when the whole amounts to as many as 240 lines.[1]

Much light has been thrown upon the acquisition of skill requiring the active co-operation of the mind by the researches of Messrs. W. L. Bryan, E. J. Swift, and W. F. Book in the psychology of learning the telegraphic language, shorthand, and typewriting.

Swift has shown that in learning typewriting simple and complex factors and habits have no separate periods: both are present all through. The learner gradually passes from a period when lower-order habits predominate to a period when higher-order habits predominate. By lower-order habits he means reaction to letters rather than words. The learner gradually gets to react to words or even phrases. The whole word serves as a simple cue which brings into action the whole of the complex series of movements necessary to type the word. Except that it is successive instead of simultaneous, it corresponds to the way in which an expert pianist responds to a group of notes forming a chord rather than to each single note. This process of learning higher-order habits is largely subconscious. The learner finds

[1] See "The Most Economical Unit for Committing to Memory," by W. H. Pyle and C. J. Snyder, *Journal of Educational Psychology* for March 1911.

himself doing something that he had not before been aware of. The new acquisition is well advanced before it is discovered.[1]

This tends to discredit the theory that elements should first be thoroughly mastered before the combinations are attacked, and that these elements should be consciously combined to form new wholes.

These conclusions are fully confirmed by W. F. Book. I quote from an article of his on the "Rôle of the Teacher in Economic Learning": "None of the elementary habits reach complete maturity before the next higher-order habits become possible. On the contrary the various associations to be formed naturally develop together, and before any of the special habits have become fully perfected the next higher-order habits are already well along in the process of their development, and operative in the work. Bryan and Haster found, for example, that practice in receiving telegraphic messages in sentence form increased their learner's ability to take isolated letters and words. They also found that more mistakes were made in receiving disconnected letters than in receiving, at a much more rapid rate, letters forming words; more mistakes made in receiving disconnected words than in receiving, at a still higher rate, connected discourse, showing that the development and mastery of higher-order habits leads to greater accuracy in detail

[1] See "The Acquisition of Skill in Typewriting," by E. J. Swift, *Psychological Bulletin*, August 1904, pp. 295–305.

by helping perfect the elemental habits involved." [1]

"The natural and most economic method of learning demands that we practise with the highest-order habits possible, thus learning all the units in their proper setting." [2]

"Elemental habits can best be perfected in and through the development of the higher-order habits." [3]

The second objection to introductory drill in the element of a complex occupation is based upon the uninteresting nature of the exercises. A child takes delight in physical activities of any sort provided they are sufficiently varied. But the repetition of the same act over and over again robs it of all interest it may possess as a mere output of physical energy. A child takes delight in constructing things, provided he regards them as either beautiful or useful. But pot-hooks and hangers, straight and curved lines, "blobs," needlework "specimens," and woodwork joints that join nothing, are neither the one nor the other.

The first essential in any educational occupation is that it should be properly motivated. The child should engage in it because he wants to do it. Whatever the purpose he has in view, it should be essentially his own purpose. Whatever a child does in school or elsewhere, he must of course be actuated by *some* motive ; generally indeed by a mixture of motives, some of them

[1] *Journal of Educational Psychology*, April 1910, p. 191.
[2] Idem, p. 192. [3] Idem, p. 193.

acting as a blind "vis a tergo," others taking the form of a consciously conceived end. The impulses that push and the ideals that attract, are often both operative. It is probable that the impulsion of instinct or habit lies behind nearly all our activities ; but if the activities are to be in the highest sense educative they must be motivated and guided by something ahead—by a desired end. The pupil should, in fact, have in his mind some definite purpose. Without this purpose his interest in the work will dwindle, and but little benefit of any sort will accrue from the exercise. Of these conscious purposes some are better than others. The more intimately the purpose is connected with the particular activity, or the product of that activity, the greater is the intellectual value of that activity. This may not, however, hold good for moral values. Suppose, for instance, that two boys, A and B, are both making picture-frames in the woodwork room. A loves making picture-frames—both the activity and the product. B, on the other hand, wishes to make a present to his mother. He is not keen on the occupation as such, but simply wishes to give his mother pleasure. A's interest, which is intrinsically connected with the occupation, is more likely to result in the application of ingenuity to the overcoming of obstacles than B's interest, which is only indirectly connected with the occupation. A's mind, in fact, would probably be more fully "occupied" in the work, and the intellectual implications be more numerous. Moreover, A's interest is a guarantee of the same

kind of occupation being continued : B's interest offers no such guarantee.

We have supposed that B's motive is a good one from a moral point of view. But extrinsic motives need not necessarily be good. In the school the motive too often is the fear of punishment, or of arousing the anger of the teacher. Such interest as is taken in the work under those circumstances is of a very superficial nature. It is just as likely to result in an ultimate distaste for the occupation as in an ultimate liking for it.

When it is asserted that a pupil should like the task in which he is engaged, it is not meant to imply that he should do what he likes. There is a great difference between doing what one likes and liking what one does. It is not often that a man knows what he will like before he has experienced it ; it is less often still that a boy knows. An astute and experienced teacher will, in point of fact, often know what a boy will actually like to do better than the boy himself.

This discussion of motives leads to the conclusion that exercises in which the pupil is likely to take no *intrinsic* interest should be avoided. It may be that the exercise in itself is dull—or rather would be dull if regarded as an isolated exercise—but if it inevitably leads to consequences which the pupil desires, and if he sees clearly that it will lead to those consequences, then it satisfies the condition of intrinsic interest. The exercise, in fact, is relieved of its dulness ; or even if not, the drudgery is cheerfully faced. For though the path be wearisome it is seen

to be the only thoroughfare to a pleasant land beyond. It is a case of interest of the right kind giving rise to effort of the right kind.

It is to be noted, however, that the degree to which pupils can be influenced by remote motives depends largely upon their stage of growth. Young pupils demand quick returns for their labours : the task should come to immediate fruition. To a child of six an event which will occur a week ahead seems a very long way off. Its power of motivation is insufficient to carry him over a week's drudgery. But the manual occupations which we are considering are nearly all commenced when the child is about the age of six. Whatever, therefore, may be said for older pupils, for young pupils exercises unconnected with a purpose that is almost immediately achieved are quite out of place.

The third objection to preliminary drill is based upon its intellectual barrenness. This follows as a direct inference from the second objection ; for the attention paid to a pursuit—the amount of mental activity involved—varies directly with the interest taken in that pursuit. To say that we are interested in anything and to say that we devote thought to it are two different ways of expressing the same concrete fact. It is almost certain that even a little girl of six attaches some significance to the practising of stitches on a small rectangular bit of calico ; but it is equally certain that she does not attach *full* significance. She does not regard it as a *sine qua non* to the construction of a good

garment. And even if she does, the construction of such a garment is an event of such remote futurity that its thought-compelling power is reduced to a minimum. She thinks as little as possible about the task immediately in hand ; she is unlikely to think about the end towards attaining which the task is a means ; she is equally unlikely to think about other ends (moral or intellectual) indirectly connected with the task ; the exercise is, in fact, almost purely mechanical.

Preliminary drill, in spite of the damaging admission that it tends to deaden interest, is defended by educationists of widely different types on the ground that it is vitally necessary that the learner should start the course with an equipment of good habits. This is specially insisted on in those cases where there is a consensus of opinion that there is one right way of doing a thing—a way which is better than any other way, and which must be followed if the highest results are to be secured. There is, for instance, supposed to be a right way of holding a pen, a fiddle, and a pair of scissors ; a right way of plying a needle, a right way of driving a plane, and a right way of playing a piano. It is further thought that unless the pupil is correctly instructed at the very beginning he will inevitably form bad habits of manipulation which will be difficult if not impossible to eradicate later on. He should never, it is contended, be allowed to experiment with any other way ; he should never be allowed to adopt

what seems to him to be a more natural mode of manipulation ; he should never make a single departure from the right road.

Bain's warning against exceptions, especially in the form of James's maxim,[1] is constantly quoted in support of this view. Dr. S. H. Rowe affords a typical example. He devotes the whole of Chapter X of his book on Habit-formation to the exposition of methods of preventing exceptions in the formation of habits. It is perfectly clear, however, from the way in which Bain and James applied the maxim that they had in mind a special kind of habit-formation. Bain applies it to early-rising, and James to the abandoning of such habits as drink and opium-indulgence. Here we have not simple cases of creating new habits, nor yet simple cases of breaking up old habits and forming new ones ; but cases where new habits have to be formed in the teeth of an organic stimulus which persistently impels towards indulgence in the old habits. Early rising is attained in direct antagonism to the seductive allurement of the warm bedclothes. If the drunkard has to form temperate habits he has to drink water when every fibre of his being seems to urge him to drink whisky. Rules which apply to such exceptional cases do not necessarily apply to normal cases. It may reasonably be contended that after a child has arrived at school age the formation

[1] "Never suffer an exception to occur until the new habit is securely rooted in your life" ("Principles of Psychology," vol. i. p. 123).

of new physical habits necessarily involves the breaking of some habits either wholly or partially formed. The whole field of motor activities is so cobwebbed with lines of preferential discharge that new lines must inevitably cut athwart old lines. But it cannot be maintained that there is a persistent and imperative impulsion to run along the old lines. The "no exception" theory, if universally applied, would do away with experimentation. The "trial and error" method, even though it were supplemented by reason, would have to be regarded as wholly pernicious. But we know, as a matter of fact, that experimentation—testing, rejecting, selecting—goes on all through life, and that this constitutes one of the most valuable factors in human experience.

The root of the objection to allowing children to experiment a little for themselves as a preliminary means of bringing them face to face with the main difficulties to be encountered is to be found in the belief that a wrong line of activity is very difficult to erase. As a matter of fact, the nervous system of a young child is so plastic that new lines of activity are readily established—lines deep enough to drain off the excitations from the older channels. A young child, in fact, readily sheds his bad habits—unless, that is, they have been drilled into him. Too much stress is probably laid on habituation, and too little on the opposite tendency, which Baldwin has called accommodation. A child has not merely a natural tendency to repeat a mode

of activity that has once taken place, but he also has an equally natural, although not equally strong, tendency to vary that activity. And the more successful an activity, the greater is the tendency to persist in the activity and the less the tendency to vary it ; while the less successful the activity, the greater is the tendency to vary and the less the tendency to persist. There is, in fact, a natural provision by which blunders are remedied, and it may be that the educator is too distrustful of that natural provision. The chief danger really lies in the possibility of the child remaining content with a partially successful result, or not realizing that the result is defective. "The good," as the old Welsh proverb has it, "is the enemy of the better." This is where the teacher comes in. It is his duty to bring the child to the recognition of his non-success ; not by telling him, but by certain questions and suggestions which will enable him to discover for himself that he has not realized his purpose. It may be that the child's achievement is low, but he has actually achieved what he set out to achieve. It is then a matter for the teacher to decide whether the result is for the time being adequate (as in the case of expression-drawings in the infant school), or whether the pupil's purpose or ideal should be modified.

When a new art is begun by older pupils the objections to introductory exercises are less cogent, for the pupils' minds are capable of reaching farther into the future and of acting upon the incentive of a more ideal purpose.

If exercises designed to produce facility in the performance of a skilful act are out of place at the beginning of the course of instruction, where is the legitimate place for these exercises? It is clear that they are occasionally necessary. Progress in skilful adaptation depends upon the fact that co-ordinations as they gain stability are relegated more and more to the lower nerve centres so that effective work can be done with less attentive control. The mind is free to establish new co-ordinations, or to think out new relationships. It does not follow that the mind actually will do either of these things. It may become lost in unprofitable reverie, or engage in carrying out a train of thought which has no bearing at all upon the problem in hand. But progressive automatism is a necessary, though not a sufficient, condition of improvement ; and progress is often retarded because certain fundamental processes have not been sufficiently mechanized. What these processes are will become manifest during the construction of some interesting object. As far as possible discipline should be secured in handwork, as in headwork, by the solution of problems. " First do a thing and then learn how to do it " is on the whole a sound educational maxim. It is only when a pupil has tried to do a thing that he knows what he wants to know, or knows what specific skill he must possess in order to accomplish his aim. Besides the original problem, how to construct a certain object, there has arisen in his mind a subsidiary problem : how to overcome

a specific difficulty. After a little practice with a certain tool in constructing a model, the subsidiary problem may be : How am I to get out of this tool the maximum result with the minimum effort? This is a legitimate basis for an exercise in the mere manipulation of the tool in question. But this problem of tool manipulation is not the one that first presents itself.

The vexed question of mechanical exercises is often obscured and complicated by a confusion of aim. There are two distinct issues.

The first is : How can the pupils in the shortest time and with the least expenditure of energy gain a complete mastery of a given art? The second is : How can the pupils' interest in this art be so maintained and so utilized as to secure to them the greatest intellectual and moral benefit? In the first case the teacher's problem is to find the shortest cut to a definite goal ; in the second case the problem is how to find the route which will compel the children to think the most. In the first, skill is supreme, ideas subsidiary ; in the second, ideas are supreme and skill subsidiary. In the first case, mechanical drills would enter largely into the course ; in the second, they would be reduced to a minimum. Even in the first case, mechanical exercises, if so frequent or prolonged as to deaden interest, tend to defeat the end in view. For unless practice is undertaken with zeal and with a genuine desire to improve one's record, very little benefit accrues. Practice does not necessarily mean improvement. The frequent cases in which

handwriting deteriorates as it proceeds down the page of the copybook is evidence of the effect of lack of interest leading to lack of effort, and lack of effort leading to the intrusion of inferior co-ordinations.

Bagley in discussing habit-formation emphasises the importance of complete automatism. "Unless the process reaches the stage of automatism all of the initial repetitions represent time and energy practically thrown away." [1] This is an exaggerated statement. If the habit is an important one, then it probably comes into frequent use in ordinary life. This fact in itself provides an opportunity for practising the habit; and the previous repetitions have given rise to at least some degree of facilitation. Moreover, a habit, as the term is generally used, comprises a number of minor automatisms, and these are in themselves useful when they enter into a new combination to constitute another complex habit.

Important, nay essential, as is the formation of good habits as the basis of all training, it is well to remember that no habit is got gratuitously. The price that has to be paid is a loss of adaptability. The nervous system becomes less plastic, less flexible. All habits are due to the establishment of new pathways of discharge in the central nervous system. There is almost certainly an actual growth in the neurones. Fibrils of communication extended in a specific direction drain off a previously diffused discharge, and rob other parts of the possibility

[1] "Class-room Management," p. 18.

of exercise. These parts tend to become atrophied and less ready to function. But a change of external conditions may render the functioning of these weakened parts desirable. It will thus be seen that the specialized nerve growth by monopolizing nutriment and exercise has probably caused a slight deterioration in other elements and rendered more difficult the formation of new habits. In other words, there has been a loss of flexibility.[1] Bain expresses a somewhat similar view with regard to memory. In dealing with the classical languages he says : " For one thing, there is abundant employment given to the memory ; but the proper word for this is not ' trained ' but ' expended.' A certain amount of the plastic force of the system is used up, and is therefore not available for other purposes. This is the cost of the operation, for which we have to show an equivalent in solid advantages." [2]

There is, in fact, something to be said for the maxim of Rousseau : " The only habit which the child should be allowed to form is to contract no habit whatever." [3] Although it is manifestly impossible to carry out the maxim literally, it serves as a useful warning against drilling into children a number of fixed and rigid habits which are of too limited a usefulness to justify the loss of versatility ; and which might prove an obstruction later on.

[1] See Dr. Henderson's " Principles of Education," pp. 43 and 153.

[2] " Education as a Science," p. 367. [3] " Emile," Book I.

DIRECTED HANDWORK AND ORIGINAL HANDWORK

A HANDWORK lesson may be conducted in two directly opposed ways—the directed and the heuristic. In the directed method, the teacher guides the pupil step by step. He gives an order and waits until it has been correctly obeyed by the whole class before he proceeds to give another order. All the pupils are kept going at the same pace. The dexterous are checked : the clumsy are urged on. They all do precisely what they are told and no more. There is no experimentation, and little opportunity for original work. The results at the end of the lesson are gratifying to the teacher ; but the main aim and purpose of the handwork lesson have been missed. The pupils have made little or no progress in constructive power ; they have not enlarged their capacity for thinking out constructive problems ; they have not even learnt to make the object. Left to their own resources they cannot as a rule repeat the processes they have just gone through. The various steps were not guided by a clearly conceived personal purpose and do not, therefore, form a rational sequence. If the mode of construction

is remembered at all it is by a mere mechanical adhesion of the various stages.

The evils of the method are still further accentuated when the teacher conceals from the children the nature of the object they are trying to construct. This frequently happens in taking paper-folding exercises with young children. The children are given various directions, and after many bendings and foldings, behold, a boat emerges, or a fan, or a piece of miniature furniture. The children are supposed, when they see the final result, to feel a pleasant shock of surprise. But to surprise the children is not the legitimate end of the handwork lesson. The main purpose of the handwork lesson is to make the children think; and no one can think, in the strictest sense of the word, unless there is a definite goal towards which thought is directed.

To the extent, therefore, that the directed method of teaching fails to cultivate habits which make for originality and resourcefulness, must it be condemned.

Contrast with this the heuristic method—the method of original discovery. By this method the completed object is shown to the pupils. They are allowed to do what they like with it—look at it, sketch it, measure it, or pull it to pieces. For they have by their own unaided efforts to construct a similar object. To accomplish this intellectual vigilance is indispensable. They have to consider alternatives, to make guesses and verify them, to reject the unsuc-

cessful and accept the successful. In other words, they have to reason, to experiment mentally and physically, to learn on the highest level.

The directed method tends to make a boy dependent on others ; the heuristic method tends to make him dependent on himself. The former tends to produce sailing vessels which cannot move until they are driven by wind or current ; the latter tends to produce steamboats which are independent of wind or tide, for they have their motive power within themselves.

There are certain objections that have been urged against the heuristic method. The first is that the results are bad. If the results refer to an external product, the point may be conceded : the results, at the beginning, are inevitably bad. Without affording the pupil an opportunity for going wrong, reasoning on his part is impossible. The only occasion when a blunder is not educative is when it remains undetected and unrectified. But in handwork there is little danger of a serious blunder escaping notice. As a rule it jumps to the eye : it stands as a palpable barrier on the road to a destination which the pupil is eager to reach. If he takes them rightly he will be all the better for his mistakes ; for each mistake, even if it does nothing else, closes up for him one of the many possible avenues of error.

But even from the point of view of external results, in the long run the second method will prove the better. It is, indeed, the only way to

produce a craftsman who is not only skilful, but thoughtful and ingenious as well. The superior potency of this method is nowhere more manifest than in the vast improvement that has taken place in drawing in the elementary schools during the last few years.

To the objection that progress is slow, it may be replied that all development that ends in great things is necessarily slow.

The really serious objection to the free use of the heuristic method arises from a consideration of the nature of originality. It is evident that originality cannot function independently of experience. To be original is to make the best use of what resources one possesses : but one must have resources ; and these resources are largely due to past experience. Ideas of possible ways of meeting new emergencies are indispensable for originality, and these ideas do not arise *ex nihilo*. Royce contends that initiative, or originality, consists in nothing more than mere persistence in experimentation, in calling up one's resources and stubbornly testing them as a means towards the solution of the problem in hand. Professor Henderson regards originality as an " attitude " the operation of which is at least partly dependent on one's mental contents. Before, therefore, the teacher should require his pupils to attack a constructive problem by themselves he should be sure that they have a sufficient acquaintance with similar cases or similar methods to render the solution possible. Much valuable time may be wasted in trying to get

pupils to perform tasks, towards the accomplishment of which they do not possess the essential ideas. The heuristic method, in fact, requires to be seasoned with a considerable amount of common sense.

RÉSUMÉ

THE rapid extension of manual and other motor activities in our schools calls for a critical examination of their educational value and the formulation of principles which would serve to guide them into the most profitable channels.

The fundamental biological conception of life —and by implication of education—as interaction between organism and environment ; the physiological conception of the brain as a means of controlling the body ; the discovery of sensory and motor localization in the cortex ; the theory that the reflex arc is the basic type of all neural activity, and in its higher and more complex form, the physical correlate of consciousness ; —all serve to emphasize the importance of the motor factor in the development of individual experience. The sensory-motor reaction comes to be regarded as the starting-point of the educative process, and the development of the mind of man as capable of being expressed in terms of the development of his instincts.

In the purely psychical realm the contribution of the kinæsthetic sense to the mental contents —both as sensations and (probably) as images— is not only large but indispensable ; for it seems

to be an inseparable element in all mental processes. The growth and elaboration of mental systems in the life-history of the individual could not have taken place without bodily movement, nor could their definiteness and integrity be maintained without expressive reactions. It is, indeed, a tenable theory that the *meaning* of an idea or percept resides solely in the kinæsthetic constituent.

There are grounds for thinking that motor activities, if not of too violent a nature, favour cerebration by providing a healthy degree of sense-stimulation.

The motor factor is no less important in the emotional and volitional realm than in the intellectual, for a not insignificant part of an emotion has its root in somatic movements ; and will cannot manifest itself apart from muscular action.

In considering the relation between motor and mental development we are led to conclude that mental growth takes place when new adjustments give rise to new connections in the nervous system ; and as these adjustments are in early life mainly motor, it follows that there is in the young child a close connection between mental and motor efficiency. As he gets older, there takes place at least a partial transfer of the readjusting activity from the motor to the mental realm, and the connection between the two forms of efficiency becomes less marked. These conclusions are confirmed by an investigation into the correlation between intelligence and hand-

work in elementary schools, and are indeed well supported by the casual observations of ordinary life.

The method by which motor skill is acquired often serves as an index of the mental significance of the acquisition. If, for instance, reason has played an important part in the learning of a purposive movement, it is obvious that the mind is more profoundly modified than if the act had been learnt by the method of trial and error.

Muscular development proceeds as a rule from the fundamental muscles to the accessory.

Play as a rudimentary form of certain instinctive activities constitutes an almost indispensable factor in early education. It should be so utilized as to develop organized systems of ideas (probably its main function in the infant school), and to foster the formation of habits which are socially serviceable. From the play attitude should gradually emerge the work attitude.

Handwork is, however, the main medium of motor training adopted by the teacher. Its inclusion in the school curriculum is justified on social and utilitarian grounds, on the ground that impression and expression should always go together, and on the ground that children are instinctively interested in manual occupations. Manual pursuits provide a fruitful source of concrete problems which make an effective intellectual appeal to young children. Such experimental evidence as we possess of the value of

handwork as a means of general culture needs to be extended and placed on a basis more stringently scientific. There arises, however, from the experience of elementary schools during the last twenty years a mass of facts sufficiently large and varied to point clearly to the beneficial influence of handwork over both character and intellect. An attempt to explain the nature and extent of this influence raises the controversial question of formal discipline. Accepting the limitations fixed by the general rule that ability acquired in one set of circumstances is available for use in another set of circumstances in proportion as the second set resembles the first, we conclude that the natural aptitude of the pupil for acquiring skill is not increased by any specific exercise in handwork, but that the habits, both mental and physical, which are acquired during the specific exercise may be rendered available for use in other fields of activity. The habits involved in widely applicable modes of procedure are specially valuable by virtue of their generality.

Although handwork is to a certain extent an indirect means of education, it differs from the traditional classical course for which similar claims have been made in presenting to the child real problems, and in serving as a direct preparation for the vocations and avocations of the majority of adult mankind.

As the child grows older the manual occupations, having largely served their purpose, should be gradually superseded by activities more ex-

clusively mental. There should be a gradual shifting of the centre of gravity of the school curriculum from the hand to the tongue—from the practical to the academic.

The social significance of the manual training movement becomes evident when we consider the dependence of civilization on the arts, crafts, and industries. The manual work of the school affords an opportunity for the cultivation of social virtues, and may be so taught as to give an insight into the fundamental conditions of human society.

Attempts have been made to introduce ambidextrous drawing into the schools, and to encourage the interchangeable use of the hands in all manual work. These attempts are ill-advised ; for not only is the cultivation of ambidexterity opposed to the natural trend of evolution, but there are cogent reasons for thinking that interference with the natural unidexterity of a child tends to disorganize the function of speech. I have given statistics which point to an attempt to change natural dextrality as constituting one of the contributory causes of stammering.

Before dealing with the methodology of handwork it is well to state that the aim which the teacher of the subject should have in view is the cultivation of certain habits of mind and body which have a wide range of usefulness. The training of the hand should be used as a means of training the mind.

To the question whether handwork is a sub-

ject or a method, the reply is that it is both. It is a subject inasmuch as it has definite claims of its own for a place in the school time-table, and it is a method inasmuch as it is a means of acquiring, amplifying, clarifying, and suggesting knowledge about other subjects.

An arrangement of handwork exercises in what seems to be the most logical and systematic form is not as a rule the best arrangement for teaching purposes, since it does not represent the order in which the young pupil's interests naturally develop.

The place of formal exercises, or "drills," in manual education can only be determined by adjusting the conflicting claims of habituation and accommodation. In the first place, practice is necessary in order to produce that cumulative automatism upon which all progress depends; and in the second place practice may, by deadening interest and by reducing the general plasticity of the nervous system, hinder the full development of the pupil's powers. It is important that all disciplinary exercises should be invested with meaning for the pupil—should be regarded by him as an essential means to a desired end.

During the handwork lesson too much guidance by the teacher should be avoided; for if the highest educational benefit is to be secured, the pupil should as far as possible solve his own difficulties, and should be given ample opportunities of exercising what initiative and originality he happens to possess.

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