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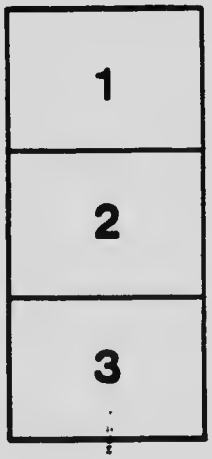

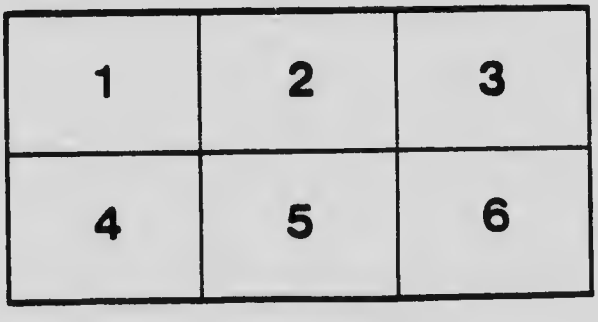

The Physiology of the Left Hand

WITH INFFRENCES THEREFROM AS TO ITS TRAINING

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PREFACE

Since one hundred copies of the thesis herein published had, in compliance with the requisites of the examination for which it was written, to be furnished to the Registrar of Toronto University, and since it was written not merely as an academic exercise, but with a sincere desire to be of some service to the teaching profession of the Province, it has been decided that publication on a somewhat more extended scale might not be unwise.

The writer's thanks are due to the authors mentioned within, whose works, extensively consulted, have been of material aid to him in dealing with a subject on which it is not easy to find authorities; and more especially to the late Sir Daniel Wilson, a kindly hint from whom first turned his attention systematically to the subject here discussed.

Uxbridge, 9th May, 1903.

THE PHYSIOLOGY OF THE LEFT HAND

with Inferences Therefrom as to Its Training

CHAPTER I.

THE IMPORTANCE OF THE HAND.

Every system of Philosophy, whether the extremely realistic, or the radically idealistic—whether it bases its explanation of the phenomena of the universe on matter alone, or on mind alone, or on any admixture of them in which they are placed on an equality, or in which one or the other is given the preference—must at least recognize an Ego and a non-Ego, the individual and the universal, the personality and its environment. It must also be admitted that this personality, by reason of its own inherent capacity, strives to reach out beyond itself into its environment, to become acquainted with it. to affect, and be affected by, it; indeed it may be taken as indisputable that the Ego cannot realize itself in any adequate measure, if at all, otherwise than by so doing. Conditions precedent to its doing this are the senses, so called, and pre-eminently among these Sight and Touch.

Of these Sight is to be regarded as vastly the more important. Even the Idealist, who, with Kant, holds that the ideas of space and time are not derivable from experience but are conditions precedent to that experience, and are, as the great philosopher of Koenigsberg calls them, the "ground forms" of all our knowledge, is forced to admit that, without the content derivable from experience, such forms would remain unrealized, if not unrealizable; and sight it is, though not it alone, through which we get our notions of extension in space; and though we get primarily from it probably only this and color, yet there go with these, secondarily, and more or less inferentially though it be, our ideas of shape, of distance and its modifications, and of simultaneousness of existence, or the co-existence in space of different objects at

the same time; and these, with their concomitants, are among the essentials of our knowledge of the world external to us, and consequently of our experience. From our sense of sight are derivable, through the possible combinations of form and color, as in Painting and Sculpture, the ideas which contribute so essentially to the æsthetic part of our nature. Sight, indeed, presents for our cognition a double infinitude for, helped in one direction by the microscope, it discloses to us a microcosm, and in the other by the telescope, a macrocosm.

But, important though it be, it needs at every step the confirmation of its fellow and coadjutor, the touch. A universe of such objects only as were presented through the medium of sight would be "the baseless fabric of a vision." It is at least an open question whether, unaided, it would form the basis of our cognition of depth or distance, as distinct from mere breadth or extensity. It is largely the passive, the receptive sense. Granted a sensation of color and form and there follows immediately the desire to reach out and confirm the reality of it by the sense of touch. Thomas the doubter would not be satisfied as to the identity of his Lord unless he put his fingers into the nail-prints and the spear-wound. It is pre-eminently the active sense, the ready instrument of the will in its desire to become more familiar with its surroundings. It is one of the most important of the means of giving content to our space-perceptions, through the so-called "Local signs," and the feelings of movement that go with it. Through it man reaches out into his environment, grapples with it, and strives to modify it.

The prominent instrument of this sense is the hand. Its facile mobility, its acute sensitiveness in certain parts, its susceptibility to training, its sub-division into fingers, its grasping or prehensile power, all go to establish its claim to be the organ par-excellence of touch. It is the instrument of the craftsman's cunning in general. The Æsthetic sense that has been wakened and fostered by Painting, by Sculpture, or by the Musician's magic would, if roused at all, be largely ideal, visionary and unrealizable without the aid of the educated hand. That very prominent and important part of our mental make-up, the will, through the manifesta-

tions of which we feel the sense of effort resulting in action, the power to originate change, and so effectively to illustrate for ourselves the principle of causation finds physical manifestation more characteristically through the arm and hand than through any other organ.

The importance of the hand is now coming to be more adequately recognized in the increased attention given the world over to technical education, which, though it is directed towards the training of the whole body to be the ready servant of the will, must, of necessity, be largely a training of the hand. The ratio essendi of the cry for increased technical education is probably not incorrectly put thus:—If the body, and especially that most mobile and prehensile part of it, the hand, be not trained at the pliant and facile time of youth when this may most effectively be done, then, ipso facto, the resulting man, physically and mentally, at least, if not morally also, is a product inferior to what might have been brought about under more favorable conditions.

Any light, then, be it from physiology, pathology, or psychology, that may be thrown on the subject of hand-training, should be both in itself, and more particularly in view of the present condition of the subject of manual training in Ontario, worth the most careful consideration of those interested in Education.

CHAPTER II.

PRELIMINARY PHYSIOLOGICAL INQUIRY.

In even the most cursory and superficial inquiry into manual operations there is thrust on one's attention the fact that, for most of them there is a decided preference of one hand, and that, under ordinary conditions, the work cannot be so effectively done if the position of the hands be interchanged; one hand takes the lead and the other follows; a given hand is placed above the other on the handle of the hoe, the axe, or the maul; one hand grasps the knife at table more readily than the other; one hand speeds the pen with more facility, trained as it has been to be the ready thought-recorder, while the other one would act only very hesitatingly, if at all, in a similar capacity.

That this peculiarity exists is obvious enough; an inquiry into it suggests at once two possible explanations:—

(A) It may all be a matter of custom and habit and usage, persisted in, after considerations of convenience and economy in tool-using had once given it vogue, for century after century in the past, and strengthened by heredity until it has become inveterate. If this be a correct account of it, obviously, since it is more economical that all tools be formed and used uniformly to secure any ready and effective co-operation in most kinds of work, any tendency to left-handedness should, as has been the case very generally in the past, be repressed from the earliest infancy; "as the twig is bent so the tree's inclined;" start the child in the right way and he will conform to the usage of the majority, not only with no injury to himself, but with evident advantage, since the contrary course would expose him to the opprobrium so often cast upon those who, through some personal peculiarity or defect, are unable to perform manual operations, either singly or in concert with others, without that real or apparent oddness, clumsiness, or awkwardness that so soon excites comment and ridicule.

(B) But, on the other hand, this one-sided preference may supposably be one inherent in our physical or mental constitution; it may be inborn and inseparable from us, and consequently manifest itself in early infancy pointedly, decidedly, and persistently, even in the face of as persistent and decided opposition to it; and if this be so then it becomes a great question whether, in repressing it, we are not acting contrary to the best interests of the child, and therefore preventing, in one important direction at least, that natural and harmonious development which it is the enlightened educator's duty to foster and encourage, instead of artificially to check and hamper.

It is consequently of vital importance to seek enlightenment as to the true state of the case here, and not until we have done so will we have a right to deduce any maxims for our pedagogical guidance.

It is proposed, then, in the present essay, to make a somewhat exhaustive inquiry into the phenomena of right-handedness, ambi-dexterity, and left-handedness, and to found, upon the conclusions therein arrived at, some rules for the technical training of the hand in general, but with a special view to a rational treatment of the left-handed—those "Sons of Ishmael" who have been for ages covertly, but none the less persistently, fleered at as being inferior to their fellows; as being afflicted with some natural deformity for which their own stubborn persistence in gaucheries and awkwardnesses of bodily movement was largely responsible, and hence as being deservedly the subjects of reproach and ridicule at the hands of their presumably more fortunate fellows whom accident or training has conformed to the customs of the majority.

The direction of such inquiry is plainly indicated by the two preceding opposite views. Our evidence must come from an examination of the early life, both of the human race and of the individuals composing it. Clearly if this tendency proves to have been manifested in primitive times, and to have persisted in the face of the opposition that would be likely to be shown to it because of its peculiarity, and its inconvenience, which must have been more prominent in primitive times than now: if statistics show that the child

that manifests a preference for the use of the left hand does so from the beginning of its life, and perseveres in so doing in spite of serious obstacles, the inference seems unavoidable that the bias is not one due to custom or usage, fixed by heredity, but is inherent in the race.

Now the evidence is overwhelming that the child who exhibits this peculiarity invariably does so in a pronounced, persistent, and unmistakable manner. The complaint on the part of the child trainer has always been that it is difficult, if not impossible, to overcome any strong preference in this direction. Statistics ad nauseam might be here referred to; but the point is too little likely to be disputed to need such. In a paper on left-handedness, read before the Teachers' Association of Ontario in 1897, Dr. Tracy, of Toronto, states that the Association for Child Study issued to a large number of representative teachers of Ontario, in 1895, a pamphlet with, among other questions on this interesting point, the following:—"Describe any attempt you may have made to break children of the habit of preferring the left hand, and give your judgment as to the value of the results obtained." "The returns," he continues, "came from almost every part of the Province, and the total result is the judgment of several hundreds of persons, based upon observations of a still larger number of children." In summarizing the answers to this question, after stating that the means used to check the tendency varied all the way from gentle persuasion to the use of forcible or mechanical means, he says:—"As to the results, a very pessimistic tone runs through nearly all the answers to this question. A great many say the attempt is utterly useless except in the case of very young children; some say it is practically useless with any child; and some say that they succeeded, but added that their success was in reality a failure, inasmuch as the child never attained to that degree of efficiency, with either hand, which he might otherwise have done." Of course these children were not infants, but the testimony of mothers, governesses, nurses and others who have to do with the direction of infancy is so uniformly in the same direction as to render further proof on this point needless.

As to the other point, the primitiveness of the tendency,

somewhat more proof is needed because it is at once more open to question than the preceding claim, and more vital, if anything, to the question at issue. If it cannot be made good, the other only shows that some accidental bias has been in some cases transmitted by heredity and so causes the persistency previously shown.

However, the case seems to be equally able to be proved here too. It can be shown beyond question that there were left-handed (as well as persistently right-handed), men, not only in historic, but in pre-historic, times. Biblical records make it evident that the peculiarity was manifest in the days of the annals there recorded. We are told in the book of Judges of Ehud, the son of Gera, a Benjamite, a man left-handed, who succeeded, through cunning, (more secure from detection by his being left-handed), in stabbing Eglon, the King of Moab, who held the Israelites in servile subjection. The same book of Holy Writ tells of the struggles against the riotous Benjamites on the part of their brethren, the rest of the tribes of Israel, and of the slaughter caused by the former through their seven hundred remarkably accurate stone-slingers, left-handed men. First Chronicles xii. 2, mentions David's warriors as being able to use both the right hand and the left in hurling stones and shooting arrows. Gael's right and left hand are distinguished in mentioning her slaying of Sisera.

Now it is plain from the references here that left-handedness was regarded as a peculiarity in those ages, but yet that it was not so rare as to prevent the finding of seven hundred men out of one tribe alone that manifested it.

The records of Ancient Egypt prove the same contention. If it be asked how any reliable data can be reached here as to this point, where we have nothing, or very little, else but hieroglyphics to rely upon, the answer is ready to hand; the pictures themselves, that form so large a part of such annals, furnish, if observed closely enough, as nearly conclusive evidence as can be reasonably asked for, in that, though they show only a very crude attempt at perspective, yet the profiles of such animals, etc., as are represented are shown turned to the right or left, and, as might be expected, the majority of the figures face the left, while, however, a large

minority, it is true, but yet a sufficiently definite number of cases, are found turned the opposite way. Now it is naturally to be presumed that a right-handed draughtsman would make his profile figure face the left, while the left-handed man would do the reverse. It is true that cases in number can be shown of reverse profiles in the same picture, as in hieroglyphics showing a great King and his numerous attendants, some of whom face one way and some another, as being on different sides of their monarch; but the case can be incontrovertibly made out, notwithstanding, in favor of the presumption that in numerous well-defined instances the right-faced profiles show the left-handed artist.

Numerous also are the references to the distinction between the right and left hand in Homer, Horace, Vergil, and other classic authorities too numerous to mention. In Hebrew and other hand-writing the distinction is clear. Macaulay, in his Horatius, referring to the Tuscan seers of Porsena, says:—

"Evening and morn the thirty have turned the verses o'er,
Traced from the right, on linen white, by mighty seers of yore."

Among the early Celts this peculiarity must have been recognized, for their names were sometimes due to its exhibition. The Samoans, the New Zealanders, the Hawaiians, (as is shown by their language, peculiarly their numerals), the Fiji Islanders and the North American Indians all have terms which show that the right was regarded among them as the cunning, or knowing, hand, and the left as the unskilled or awkward one.

Among the most marked of the records of these latter are, as is well-known, their flint arrow-heads and the pointed stones generally supposed to have been used in skinning their slain animals. Such nicety of workmanship was here demanded that only skilled workmen, in particular neighborhoods where proper material was to be had, could turn out the required product. Often the trade descended, as in more civilized nations, from father to son. Now it can be shown, by certain peculiar irregularities of form, that some of these are the product of the left-handed workman; one hand held the stone, while the other pressed against it the

bone which produced the fissure, and the result shows plainly which hand predominated in the process.

But we have evidence which carries us further back than this; and be it borne in mind that the more remote the indication of the peculiarity the less is it likely to be the result of habit or heredity. The late Sir Daniel Wilson, in his work on left-handedness, cites, at some length, examples to prove that Palaeolithic man exhibited the distinction in question. On pages 36-7 of the above work he says:—"In so far as the drawings or etchings of the palaeolithic age are available for the application of this test, (i.e. the direction in which the profile faces), the following data may be adduced:—The mammoth drawing from La Medelaine Cave; the bison, imperfect, showing only the hind-quarters; the ibex, or reindeer-antler, from Laugerie Basse; the group of reindeers from the Dordogne, two walking and one lying on its back; the cave-bear of the Pyrenees, from the cave of Massat; in the department of Ariége; and another sketch representing a hunter stalking the Urus, may all be regarded as right-handed drawings. But the horses from La Madelaine, engraved on reindeer-antler, specially noticeable for their large heads; the horse, from Creswell Crags; and, above all, the remarkably spirited drawing of the reindeer grazing, from Thayngen in the Kesserloch—a sketch marked by incident, both in the action of the animal and its surroundings, suggestive of an actual study from nature,—all appear to be left-hand drawings." Also on page 29 of the same book he says of some of these remains:—"In so far, therefore, as they afford any indication of the antiquity of man, they point to ages so remote that it is unnecessary to investigate the bearings of evidence suggestive of comparative degrees in time."

Thus much, then, with regard to what might, not without propriety, be called the historical aspect of this quest —the evidence to be derived from the annals of the human race from indefinite antiquity down to the present time, in favor of the presumption that, much as habit and custom have influenced mankind in manual operations, left-handedness is, in the ultimate analysis, not traceable wholly to these. An attempt has been made to show that, before "use

and wont" could have had much appreciable effect on mankind, there this peculiarity was,—indeed that there it was often *in spite of* these. Dr. Wilson's conclusions are, after an exhaustive and scholarly presentation of his evidence, that the majority of men manifest no pronounced preference for one hand or the other; that a considerable percentage, however, show a preference for the right, and a smaller percentage for the left, hand. A writer in "All the Year Round" (May 8, 1875, page 138) says:—"It is an undoubted fact that all nations, in all ages, have been right-handed; and this is the reason why left-handedness appears to us so strange and awkward."

CHAPTER III.

THE CAUSE OF LEFT-HANDEDNESS.

This being the case, then, it is not surprising that thinkers interested in the subject, being convinced that the tendency was inherent and inborn, looked about for some physiological explanation.

One such hypothesis traces it to the old fighting days, the shield being needed on the left side to protect the heart and other vital organs. The left hand being thus hampered, the right became more dexterous through the additional use of it. This of course would explain only right-handedness, even if valid.

Another somewhat plausible theory would explain left-handedness as due to the fact that, since the nurse generally carries the child on her right arm, its right hand lies next her body and so only the left is free to grasp objects. But surely this proves too much, as, according to it all children should be left-handed; in which case, as Dr. Wilson pointedly says, "the left-handed nurses of the next generation would reverse the process."

A further one long held sway among scientific men, if even it can yet be said to have been discarded; it held that the preponderance of right-handed persons was due to the right side of the body being the heavier. The right lung has three lobes while the left has but two; the liver is on the right side; this side consequently is the more developed and as a consequence the right hand is the stronger. As it is not intended to do much more than mention some of these older suggestions, it need only be said that if this be so, in every case of transposition of the above organs (and pathology is not unacquainted with such) rendering the left side the heavier, the left hand should be the one preferred; and there is no proof that such is the case; the reverse, rather, is true; that is, that in such cases the right hand is still the preferred one.

Still another theory accounts for the prevalent right-handedness by the fact that in the early stages of fœtal development the anterior and middle lobes of the brain on the brain on the left side are in a more advanced condition than those on the right; hence the preference for the opposite side of the body, which is the one physiologically more directly connected with it.

Yet another, following along much the same line of reasoning, claims that, since the blood supply moves through a straighter and more unimpeded course to the left cerebral hemisphere than is the case with the other half, the right side of the body is in consequence the stronger.

These last-mentioned hypotheses bring us nearer to what is here claimed to be the true state of the case.

Had we been forced to depend on such evidence as that first adduced, however plausible it might be, it would of necessity be more or less indirect, inferential, and analogical, and as a consequence, inconclusive. Fortunately modern physiological research has put within our reach information that may fairly be regarded more in the light of direct proof; information that in itself would be intrinsically conclusive, and that, corroborating as it does the weaker body of evidence first resorted to, goes a long way towards making what is here contended for incontestable.

That the brain of man is decussated has of course long been known to science—so long, indeed, that it seems somewhat strange that it should only so lately have been made use of as an explanation of the point under discussion; but that each separate part is capable of what may be claimed to be independent action; and that not only in exceptional circumstances but under ordinary conditions each part does so act; and that each part controls its own side of the body—nay, that certain minute portions, even, of each part, control certain definitely ascertained portions of each side of the body—all this it has been reserved for modern experimental physiology, aided by pathology, to disclose to us; and all this has a vital bearing on the cause of the preference for either hand. If this position be tenable our historical and inferential proofs that left-handedness is innate and inherent in man are made doubly strong from the fact that, owing to

his physiological structure, man must be two-sided, and that for certain manual operations he is exceedingly likely to give the preference to one side or the other.

As this position is so important to the point at issue, it is purposed, as before, to elaborate at some length the proofs bearing on it.

It is capable of experimental demonstration that, extending almost the whole length of the spinal column, but in particular at the upper part of it, are great central nerve-tracts, the Pyramidal, the Lateral Cerebellar, and the column of Goll, and that, while each of these may have its own particular functions, they are all bound together laterally, obliquely, and perpendicularly, and connected as a whole with the central organs lying above them. It is also to be borne in mind that the spinal column has offshoots with connecting nerve-tracts to the end-organs of sense and motion.

Immediately above the spinal cord is the Medulla Oblongata, which, without entering upon a minute description of it, may be roughly outlined as a prolongation and extension of the cord, preparatory to its entering the brain proper. It has posterior and anterior branches, corresponding, in the main, to those of the cords, and in it are tracts, like it, of nervous substance, both white and gray. But there are important variations in the disposition of these substances in the medulla. The white matter of the posterior part of the cord spreads and becomes thinner, thus permitting the central gray mass to come to the surface here. The tracts, vertical for the most part in the spinal cord, become broken up, and their branches interlace transversely and obliquely, and other tracts are here gathered together and interlaced with these, from the cerebrum and cerebellum above; the neuclei, too, found here and there below, here become more numerous. The posterior and anterior horns of the spinal column here change their direction and move obliquely forward or backward into and through the medulla. Ladd's description (page 54 of his Phys. Psychology) of this organ is so clear as to the functions it performs that it may be here quoted in full:—"The Medulla Oblongata is obviously an organ of conduction between the spinal cord below and the parts of the brain lying above itself. Its peculiarities in discharging

this office are twofold. The nerve-tracts from above are greatly compacted, are gathered together—as it were—into shape to be further compressed within the Spinal Cord. The nerve tracts from below, on the other hand, are broken up and distributed to the side, into the cerebellum and into the principal parts of the crura-cerebri. Moreover, a great amount of *crossing of the nerve-tracts* takes place in this organ. This is significant of the important fact that certain functions belonging to the trunk and limbs of the body are to be connected with the *opposite side* of the higher central organs. It indicates that the 'right-handed' man is 'left-brained.'"

Not only does the peculiar structure of the Medulla Oblongata bear on the case under discussion. As above stated the brain is decussated,—deeply so—and, while it is true that there is a very remarkable correspondence between the two parts—that the one acts in sympathy with the other in such a way as even on occasion to take upon itself by substitution the functions of the other, yet it is also an undoubted fact that the nerve-tracts, spoken of as crossing one another in the Medulla, run to the separate sides of the cerebrum, thus giving each side of it an individuality of its own, and a controlling power over the opposite side of the body. Among the many other phenomena of pathology, this accounts for the well-known manifestations of paralysis, which usually affects one side of the body only, the part of face affected being the opposite to the affected side of the trunk.

As it is essential to the position here maintained that the independence of the separate sides of the brain be definitely shown, (while admitting also their intricate connection, which is not only admitted but made the basis of certain other theories later) it is purported to again quote from Ladd, who seems to have collated and tabulated the results of statistics from almost every available source, making his deductions valuable as summarizing all the existing evidence on the points discussed. He says (Phys. Psych. p. 188) "E. Hitzig in company with G. Fritsch began to experiment by applying electricity to minute areas of the cerebral cortex of dogs and watching the results. The

notable fact was thus discovered that some areas respond to stimulation by co-ordinated contractions of the muscles of the *opposite half* of the body." On page 194 of the same work:—"In one such case (of defective brain) the place of the right hemisphere was discovered to have been filled with a serous fluid and there had been from birth *lameness of the left side of the body.*" Page 194:—"Another communicates the case of an Italian laborer whose skull was crushed in the right parietal region by a stone. This patient subsequently lost so much of the substance of the brain that it was calculated the lesion must extend down to the corpus callosum. He lived, but with a laming of the limbs on the *left side.*"

Pathology, indeed, as well as experiment (extirpation, etc.) and comparative anatomy and Histology, have shown beyond question this two-sided nature of the brain. So fully accepted is the theory now that a writer in "All the Year Round" (8th May, 1875,) makes an ingenious use of it to explain the phenomenon of so-called Double-consciousness, i.e., the leading of two mental lives by the one person at different times, remembering during one of these only what he knew in the corresponding precedent state, and knowing nothing of what occurred in the intervening time, under the dominance of the second personality. If it be a correct supposition that this is due to the brain being two-sided, it would seem necessary to carry the hypothesis further into more minute sub-divisions of the sides, for there are well-authenticated cases of cataleptic patients who indicate the astounding phenomena of a triple personality. Interesting speculations, too, would naturally follow along this line as to the manifestations of Hypnotism. It looks extremely probable that a reasonable explanation of the mysterious facts of this Science might be found in supposing some portions of the brain completely dormant in the hypnotic patient, the other portions alone being active, and presumably preternaturally so, in that they are not naturally inhibited by the rest of the brain functions in this condition.

Again Ladd (p. 209) says:—"The cortex of the cerebral hemispheres in man may be divided, functionally, into two parts, motor and non-motor, according as destructive lesions do or do not cause permanent paralysis on the opposite side

of the body." And again (p. 212):—"The percentage of such cases (loss or disturbance of tactile sensations) arising from injury to the right hemisphere is about twice as large as that of the left. This has led some to conclude that sensibility is the predominating function of the right hemisphere, as motion is of the left."

In all these and numerous other places does Ladd imply the cleavage between the two hemispheres of the brain; indeed it is assumed everywhere in any of his chapters relating to the localization of brain-functions. Other authorities will be later cited to the same effect.

It would seem, then, that we have now found the true cause of a preference in the human being for the use of either the right or the left hand (which one is not material)—namely the Decussation and partial independence of the cerebral Hemispheres. But since no deductions as to hand-training are to the purpose unless founded on indisputable cases, it is purposed to make assurance doubly sure, if possible. Not only is it possible to assert that the halves of the brain work, to some extent at least, independently of each other, particularly so far as the "motor-functions" are concerned; through the later disclosures of Physiology and Pathology the position seems tenable that certain spots in the brain-cortex and these only, are connected with definite physical functions; that, in other words, it is possible to localize the cerebral functions: and though the establishing of this position is not necessary to prove our point, yet if it can be shown that brain-localization can be scientifically established it will be admitted that the preceding position is by it immensely strengthened. Some evidence then is now to be offered with this in view.

Of this, again, Ladd's Physiological Psychology furnishes numerous examples, all the more valuable because of the judicial attitude in which the author stands in regard to the facts. He who wishes to follow a minute discussion of the case, pro and con, must go to the book itself (Cap. VIII) where is to be found a very full, fair, and judicial account of the reasons for holding or opposing the theory, with conclusions as follows (page 195):—"And yet, a large amount of concurrent testimony from all these main sources of evidence

warrants us in announcing certain positive results. A science of the localization of cerebral functions, in some justifiable meaning of the words, may be said to be fairly defined." Only some leading examples in its favor are needed here:—

Exner, a German investigator and authority on this point, after examining carefully one hundred and sixty-nine test cases, with record trustworthy, full, and unambiguous, concluded that these "seemed to show that the 'absolute field' (areas within which no lesion occurr' ' without the expected result) for the upper extremities on the right hemisphere—i.e., the left arm—includes the paracentral lobule, the anterior central convolution—except a small part of its lower end—and the upper half of the posterior central convolution. On the left hemisphere the fields for the right arm are more extended. Here the absolute field extends over the greater part of the upper parietal lobe; and perhaps over portions of the median surface of the occipital lobe." (Ladd, p. 207).

Page 209:—"For example, a case is reported, definitely connecting spasms beginning in the right lower, and extending to the right upper, limb and to the face, with a lesion in the upper third of the ascending frontal convolution on the left side; and another case, connecting cramps in the left thumb and fore-finger, spreading up the arm, with a tumor situated at the line of junction of the lower and middle thirds of the ascending frontal and parietal convolutions." Page 212:—"Exner's induction included 22 cases of marked disturbance of tactile sensations. Of these 16 were located wholly in the two central convolutions, and three others partly in the same convolutions. The percentage of such cases arising from injury to the right hemisphere is about twice as large as that of the left."

The evidence above bears largely on the possibility of the localization of motor centres; the sensory centres are similarly dealt with, being located further back in the cavity of the skull; but, from the nature of the case here, it is harder to draw definite conclusions, and, when drawn, they are less to be relied upon. It is obvious, for example, that in this case the evidence to be adduced from comparative anatomy,

so valuable in the motor investigations, is relatively of little value. Fortunately, it is not needed.

Page 225—Summary of the whole evidence:—"In the cerebral cortex, as elsewhere through the entire nervous system, certain parts have, in all normal and ordinary circumstances, certain specific functions to perform. . . . . The evidence adduced in the last two chapters establishes beyond reasonable doubt the existence of the same principle as applied to the different parts of the cortex of a man's brain."

One peculiarity of the brain which has probably helped more than any other to obscure this matter of Local Brain-centres, and to confuse and nullify the conclusions from experiment or such other sources of information as are here available, is that of Substitution—the capacity which one side of the brain can be proven to manifest, notwithstanding its independence, or semi-independence, of the other, of, under proper conditions, assuming, and effectively performing, the functions of the other side; and, as already hinted, it is here mentioned because it is later made use of in the practical conclusions for pedagogical guidance.

To quote finally from Ladd (p. 226):—"So-called 'centres,' or 'areas,' or 'fields,' of the surface of man's brain are in no case, however, to be regarded as portions of its nervous substance that mark the limits within which specific functions are always rigidly confined. Such 'centres' are not to be thought of as mathematical points, or as definitely circumscribed collection of cells. They do not appear to be perfectly isolated localities. They are not necessarily the same in their exact outlines for individuals of the same species, or for the same individual at all times. They widen when a heightened energy is demanded of them. They obviously overlap and interpenetrate in certain cases. Especially is this true of the regions in which the motor and sensory functions are connected for the control of the same parts of the body. They are intimately interconnected and associated in function; so that one of them cannot, as a rule, be cut out without injury to others: or its function greatly impaired without disturbing the functions of other associated centres."

Just as, in the problems of Political Economy, though grievances may admittedly exist, and may be definitely traced and located, yet, since, in dealing with a body so complicated as a whole nation, there are such varied interests to be served, so many classes, trades, and employments, with inter-relations minutely ramifying to others, to be considered, and such delicately-balanced equiposes that the slightest unskilled touch may rudely disturb, with lasting consequences of mischief to one or more; and since, therefore, those who best understand the state of the case hesitate lest, through an honest desire to benefit a given trade or occupation, they may cause that, the consequences of which may result destructively to some other, joined to it by bonds so subtle, far-off, and remote as to defy every effort to trace them beforehand; so does it seem with the localized motor or sensory centres of the brain; their connections are so far-reaching, so unsubstantial and changeful, and so complicated that the consequences of removal or injury of any portion of them may well be beyond the reach of human ken to calculate.

But, to resume, Ladd goes on:—"Furthermore, the performance of the functions allotted, as it were, to these so-called centres, is not necessarily, under all circumstances, confined to them. If such areas become absolutely or relatively unfitted to perform their normal functions, it is possible, within certain limitations, for other areas to assume these functions. The areas, however, which can be substituted must have the proper connections. It is due, in large part, to the working of this principle of substitution that animals subjected to experiments in extirpation, as a rule, recover the powers of sensation and motion which they have temporarily lost. . . . . The portions of the same hemisphere of the brain that are adjacent to the so-called 'centres'—the larger areas surrounding or continuous to the smaller—and, on account of its bi-lateral structure, the corresponding portions of the other hemisphere, are best capable of exercising their substitutive functions."

A brief review of what has been attempted to be proved thus far, then, will show us that certain individuals of the human family have exhibited so universal, remarkable, and

persistent a tendency to give the preference to one or the other hand, (and this, too, from the earliest times, traces of it being fairly well shown in prehistoric man,) as to shut us out from the possibility of adequately accounting for it by habit or custom, however strengthened by heredity; and that the alternative supposition that it is natural to, and inherent in, man finds remarkable confirmation in the physical structure or the human brain, which consists of two distinct parts, which, though capable of very curious and interesting interchanges of function, even to the extent of the substitution, on occasion, of the one side for the other, are, in the main, connected with the separate sides of the body and exercise a motor control, for the most part, only over that side. Much more evidence along the line followed might have been adduced; there was room in an essay as concise as the present one is intended to be for only such leading and apparently conclusive cases as have been cited. Further confirmation may be found, among other places, in Stout's Manual of Psychology p. 45; in Prof. Preyer's Mind of the Child, Part I, pp. 34-8-9, 222, and elsewhere; and in James' Psychology, Vol. I, pp. 31-3-4, 48, 54, and elsewhere. All of these, it may be mentioned, express themselves with by no means so much hesitation or qualification on the point as Ladd.

CHAPTER IV.

SOME OBJECTIONS ANSWERED.

So far as the writer knows, the late Sir Daniel Wilson, in his work on left-handedness, was among the first, if not the first, to definitely put forward this theory as an account of the cause of this peculiarity. Among some reviews of that work, and from other sources, the writer of this essay has gleaned some objections to this theory, the leading ones of which it is now proposed to briefly examine.

(A) Some other theories have already been summarized and one or two of them rejected, with what is regarded as valid ground, in a preceding part of this essay.

(B) An objection which seems a strong one, if tenable, is that drawn from comparative anatomy. It is claimed that if the cause of the preference for the right or left hand be, as held above, then there should be right or left-handed (or footed) dogs, horses, elephants, monkeys, etc., and that, since it cannot be successfully shown that there are or have been such, the case is not proven. To this it is answered, in the first place, that it is the definitely ascertained results of experiments on these very animals and numerous others such as rabbits, pigeons, etc., that go to prove brain-decussation, with all that has been shown to follow from it in the way of independence of action of its sides, and the localization of brain-function. Again, it may be held that, since in none of these animals is there so pre-eminently a prehensile "tool-user" as the human hand, there is by no means so much need of a preference for one side or the other. A dog, or an elephant, uses all its four limbs alike for locomotion; there exists no particular reason for favoring one limb or the other, as would be the case in man in handling the tools he works with; and consequently there would be nearly equal development of the motor-parts (if such there be) of the brain-cortex. Further, it is by no means certain that, even in these cases,

there is no ascertainable preference of one limb or the other. Dr. Wilson, in the above-mentioned work, cites the case of an elephant which was claimed to be left-footed, showing as it did an unmistakable preference for that limb in walking or pulling. The "Scientific American" of a few years ago in an issue which the present writer has since unfortunately not been able to get possession of, but which he remembers distinctly, mentioned at least one case of a left-handed monkey, while claiming that the phenomenon had never elsewhere been found exhibited among that order of the earth's inhabitants; and since left-handed men are supposed to form no more than about four per cent. of the total population, the fact that even one left-handed monkey was discoverable among the comparatively few in captivity is by no means an unimportant one. Further research and study may show much more numerous cases.

(c) A further objection offered is that, if the left-handed man is right-brained the right side of the brain should in his case always be found to be the heavier; but it is not always so found. To this the answer is that, though evidence on the subject is conflicting, it is more than likely that careful post-mortem examination (by no means easy, even from the point of view of the mechanical difficulties in the way) of definitely-ascertained cases of persistent right or left-handedness would show almost invariably a preponderance of weight of the opposite side of the brain. But it is obvious that, even if this could not be done, the theory is not thereby vitiated. It is not necessarily quantity always, irrespective of quality, of brain-cortex, that accompanies phenomenal capacity in any direction; it is supposable that the right side of the brain, though the smaller in a given instance, might have more convolutions, or be more acutely and sensitively developed in some particular locality in such a way as to be the prime cause of left-handedness, and yet that in the same instance a post-mortem would show the other side of the brain the heavier, since, though not as well developed as the right in the motor regions, it might be easily better developed somewhere else.

(d) Other less serious objections must be here passed over, from want of space to deal with them. One, apparently

of more weight than all the others, is made by a writer in "The Nation" (24th Sept., 1891,) in a review of Dr. Wilson's book. After disputing the position that very young children are in some cases persistently left or right-handed, the writer says:—"It is with the earliest attempts at use that the left-handed habit becomes fixed, and by its exercise determines the greater development of the right hemisphere in the individual. Greater development of this hemisphere follows from the greater use of the left hand, as surely as greater development of the muscles, vessels, nerves, and bones of of the left side of the body. Exceptional development of a right hemisphere is a *consequence* of left-handedness, and may not be the cause of it." This argument is also used by Dr. Tracy in the paper read before the Ontario Educational Association in 1897, and already quoted in this essay.

To fully answer this requires a fuller explanation of Dr. Wilson's theory. His contention is that, if the cause he advances holds good, it is reasonable to suppose that in the vast majority of cases there is no preference of one hand over the other; and he claims that statistics bear him out here. But it also follows from his theory that there are likely to be numerous exceptional cases, where there is a marked and decided preference for one or the other hand; here also he claims that statistics support him, showing as they do that in a very considerable number of cases there is a manifest preference for the right hand, while in fewer cases, it is true, but yet enough to form an important factor in the case, (about four per cent. or so) the preference is for the left hand. Now to any impartial reader of the book it will be obvious that Dr. Wilson's position, consistently maintained throughout, is that in every case of such preference there is a manifestation of it early in life; as soon, in fact, as the will gains control of the muscles; and also that it is manifested, in the case of the left hand, especially, *in spite of*, and *in direct opposition to*, tendencies that continuously incite the child in an opposite direction, such as the mother's opposition, the awkwardness of using tools made for the right-handed, the inability to perform with comfort any co-operative work, the ridicule of companions, etc., etc. His language is unmistakable here. For instance he states (p. 205):—"Under

no enforcement of a violation of his *innate impulses* does the left-handed person ever exchange hands." How account, on any other theory, for those innate impulses? By the action of heredity, the reviewer might reply. But some time or other in the history of his ancestors this tendency must have had its beginning, and how account for its rise? The most favorable supposable solution would seem to be that, at one time or another, some forefather had accidentally been obliged to turn to his left hand, through his right failing him from disease or accident; and the preference thus brought about was hereditarily transmitted. Surely a slender thread of argument this, on which to hang an important criticism of the central theory of a book! Is the indisputable fact that a very considerable percentage of human beings show a preference for one or the other hand (and have done so from primitive times) to be thus satisfactorily accounted for?

The conclusion seems unavoidable, then, from any impartial estimate of the foregoing evidence, that any strongly-marked preponderance in favor of one hand or the other is due to physiological causes, and can be satisfactorily accounted for only from them, and that these causes are innate and fixed--not acquired through habit or custom and heredity.

Next, then, as to the end towards which all the foregoing has tended, namely, some conclusions as to the training of the hand in general, and more particularly of the left hand.

CHAPTER V.

HOW TO TRAIN THE LEFT HAND.

It requires no deep philosophizing to realize that the foregoing arguments point unmistakably to *ambi-dexterity* as the rational aim of the educator in hand-training. The reasons (following, of course, from the preceding theory) may be roughly classed into two:—mental and physical, First, therefore, as to the former:—

If it be true, as it doubtless is, that the body of the trained athlete in manhood is so different from what it was in infancy as to require the strongest evidence of personal identity to enable us to believe that it is in any sense the same, how much more true is this of the mind! Between the mind of the infant, in which there are only the first faint glimmerings of the dawn of consciousness, and the same mind in adult manhood, trained as it may be to fathom the depths of the profoundest reasoning, to appreciate the most delicate and subtle shades of humor, to respond to the deepest emotions, and to feel all that the words right and wrong, duty and obligation, space and time, God and the universe imply, there is a difference so vast as to amount almost to an act of creation—a production of something out of nothing. In infancy, however great the capacity in posse, there is nothing, or next to nothing, in esse. The infant mind is as yet only a vague and shadowy, even if almost infinite, potentiality, so subtle, so intangible, so latent, so undeveloped as to be, in a sense, a mere blank nothingness.

Now the close connection between brain and mind is undeniable. The materialist would explain even self consciousness, that profoundest of mysteries to the metaphysician, as a subtle phase of matter, while his opponent, the realist, would stand up stoutly for the mind as an independent, separate, spiritual entity, entirely distinct from, and totally unexplainable as a property of, anything material whatever;

but both would agree at least that the brain is a condition precedent to the human intelligence. If the head receive a sudden heavy blow, if the blood supply of the arteries be irregular or fail, if the blood-vessels of the brain be too much distended, if there be brain-disturbance through mechanical lesion or drugs, a disturbance or cessation of consciousness invariably follows. Even if the term "causation" be understood in Mill's or Huxley's sense as only the "invariable antecedent" of certain phenomena, it must be admitted that there is a causal nexus between Brain and Mind. Any detailed study of the cerebrum and cerebro-spinal axis, with its afferent and efferent nerves branching to all parts of the body, its nerve-tracts, its infinitely intertwined and intertwinable ganglia-connections, and its capacity for rapid and infinitely-variable molecular combinations and separations, leading to more or less static states, which themselves can be made more stable by repetition, cannot fail to show how marvellously its structure is fitted to serve as a physical basis for the indescribable and infinite complexity of mental life.

It is not surprising to find, then, that, co-temporaneously with the enormous mind-development of the human being from infancy to manhood, there is a corresponding brain-development. Like the mind, the brain is, in infancy, largely in posse rather than in esse. From the earliest feeble, aimless attempts of the child, amounting at first to nothing more than reflex-actions, but leading in the end to definite control over the motor and sensory nerves, and the muscles connected with them, to the finished efforts of the skilled artisan, the musician, the painter, or the sculptor there is a continuous brain-growth, a gradual unfolding of inherent capacity into actual performance, an additional readiness on the part of the nerves to carry their messages, and on the part of the cerebrum to respond to the afferent nerve-impulses, which readiness grows more apt, by gradual repetition, while the response, too, besides being more ready, is also more definite and accurate. In short the law of habit, with all that it involves, supervenes and aids nature's development.

It may be shown that, until the child performed its first movement consciously directed towards an end, not only was he without will power except as a possibility, but also

that those particular parts of the brain which are connected with bodily movements were not yet developed; the necessary nerve-tracks and their co-ordinated branches were as yet unbroken paths; they grew towards development in each movement that led towards the final purposeful one, but their growth was not complete till numerous repetitions of that final act. Similarly does brain growth and training and development grow out of every act of memory or of reason performed by the child. Education, too, of this sort, the human infant, as Prof. Preyer points out (Infant Mind p. 70-1) stands much more in need of than the young of the lower animals, since in the latter instinct holds such powerful sway.

All this being so, (and the somewhat lengthened reference to it was due to its importance), it follows that the normal adult should have been so trained as to leave no brain faculty undeveloped: that his brain should, in the fullest sense of the words, be a systematically proportioned whole, each part being given its due, and no more than its due, prominence. Education is an unfolding of man's capacities in full and harmonious activity; and this should be conspicuously so of this subtle link between matter and mind, the brain. Accordingly, since the human cerebrum is in independent, or semi-independent halves, the fully developed man should be ambi-dextrous; the pronouncedly right or left-handed child is not well-balanced either mentally or physically. He is lop-sided and to a certain extent lop-brained. If one hand is exclusively or preponderatingly used there will be a corresponding over-development of the motor-centres on one side of the brain, and an under-development of the other. Any training then that would unduly foster this one-sidedness is to be avoided, and any tendency to bring the two sides of the child into harmony and balance should be in the right direction. There would seem, in the abstract, no more valid reason for preferring one hand to the other than one eye or ear or leg to the other. We are told by those physiologists who have made such matters a special study that it is a great rarity to find the two sides of the body exactly alike, which they should be if symmetrically

developed, (and with this symmetry of body goes symmetry of brain and mind). One cheek is more prominent than the other, one eye-brow has a slightly increased slant, the nose is not exactly straight, one ear or eye is higher, one foot or one hand bigger than the other, one shoulder is higher than its mate, etc., etc.: and if such deformities are undesirable surely also is persistent right or left-handedness, which involves with it a one-sided brain development, with possible parallel consequences to the mind itself.

So much for some of the mental considerations in favor of ambi-dexterity: next, as to the physical ones:—

(A) One strong reason has already unavoidably appeared in the above: an organ grows with use and shrinks with disuse: if the use of one hand be cultivated at the expense of the other the result, besides lack of facility and strength in the feebler member, is lack of harmonious bodily development.

(B) The less used member is in all probability more liable to disease; and here again the fact that an enfeebled or impaired member of one side of the body means more or less debility or lack of development in certain localities of the brain is to be carefully noted. Paralysis almost invariably attacks the weaker side of the brain, and through it the body.

(C) The laborer who favors one hand sacrifices a great deal of his efficiency—it might not be extravagant to say nearly fifty per cent. of it. The instances in proof of this are legion in number. The idle whittler with a pocket knife is more efficient if two-handed. The woodman, whose higher hand on the axe needs more muscle pressure to deliver his blows, could rest himself, (not to mention the added advantage of being able to make an evener "cut" in his tree), if ambidextrous, by a change of hands, without cessation of labor. Similarly is it with the shovel, the hoe, the saw, the gimlet, or the rake. The same is true with regard to the spade if there be preference for neither foot in pushing. A carpenter cannot plane an ordinary board without having to change the ends of it through having to humor the grain of the wood. How much handier for him to be able to change sides in pushing his plane instead of having to reverse the

wood! Similarily is it with regard to his hammer, his adze, and numerous other tools. In his ordinary building operations he is constantly confronted with corners and cramped places where a given hand only can be used, hence he who can handle these tools with both hands alike works to double advantage. Shipwrights are almost of necessity ambidextrous, the cramped positions in which they have to work requiring it. The writer is credibly informed that ambidextrous boiler-riveters command double the wages of their less handy mates. The coureur-du-bois of old was more efficient if he could paddle with either hand uppermost. The two-handed pugilist, base-ball player, hockey player, or swordsman, like the slingers of King David's time, is the more formidable opponent. One can perform the operations of dressing, shaving, etc., to better advantage if able to use both his hands. It is more than likely that famous pianists are gifted, in addition to rare mental temperament, with more than ordinary ambidexterity; at all events one of the main troubles of the student of the piano is the manipulation of the left hand, which naturally halts behind the other. The blacksmith who can use his hammer with right or left hand can perform his work with more ease to himself and less discomfort to a restive animal. The engraver finds it to his advantage to be double handed. The surgeon, who not only needs to be dexterous but swift at his work, is more efficient if able to manipulate his instruments equally well with either hand. So with the dentist, to say nothing of the lessening of expense in the purchase of costly right or left handed implements. The sculptor, in working out minute angles and corners of his marble, would find now his right hand, now his left, the more needed, and for work as delicate as his or the painter's nothing but a perfectly-controlled manipulation of the brush or chisel would be tolerated. Leonardo da Vinci was left-handed, which is tantamount to saying he was ambi-dextrous, for the ordinary needs of co-operative work drive the naturally left-handed man, perhaps fortunately for him, into at least some measure of practice with his right hand.

(D) In case of disablement of one side, a frequent oc-

currence in old age at least, the ambidextrous man would suffer less inconvenience. Carlyle, in his reminiscences, regrets the loss of use, through paralysis, of his right hand, and complains of the difficulty of learning to use his left. Less trouble along this line would ensue if ambidexterity were the rule. It might not be out of place here to insist on the benefit of a like training of both eyes as well as both hands; in shooting, in using the microscope, or telescope, for example, it would be of manifest advantage to be able to change eyes, as one grew dimmed through fatigue.

(E) Marked one-handedness (particularly left-handedness) prevents advantageous co-operation in many manual operations, for example in military drill (including shooting) in orchestral playing, in mowing, or in reaping.

(F) The fact twice previously called attention to, namely, the readiness of interchange of function of the two sides of the brain, forms by no means the weakest of the reasons for a levelling-up process in training the hands. Does it not seem as if nature, beneficient and provident as usual, had shown design here too? The writers on Psychology frequently before referred to give numerous striking instances to the point here, but the already too-extended length of this essay prohibits more than one reference (Ladd, p. 310):—"It is a very surprising discovery that practice exclusively with a member of the body on one side, will result in improving the corresponding member of the other side. Thus Volkmann reduced the minimum perceivable distance (between two points) with the tip of his finger on both hands,—on the right from .85 to .4, and on the left from .75 to .45 of a line, —by practising exclusively with the left finger." The writer, who is naturally left-handed, but who was never allowed to practice writing with the preferred member, finds that he can write with a fair degree of facility and clearness with the left hand, if allowed to do so with reversed slope and movement —the mirror-script, as it is called. Thus does nature, by already doing some of the work for us, show us the proper direction of training here, if we do not shut our eyes to her teachings!

Train both hands, then, where it is possible. This

could be done with no loss of time or efficiency, in many cases at least, by using one hand one day prominently and the other the next day, or oftener or less often as the case demanded. If the foregoing statistics are reliable the great majority of mankind, having as we have seen no bias in either direction, should offer little opposition to the judicious teacher here. Special care would seem to be needed only to prevent any development of one-sidedness due to commonly occurring causes, such as the tendency to carry burdens on one side more than the other, the performance of naturally one-handed or one-sided operations with one side exclusively, etc., etc.

But what of the art of writing in relation to this recommended ambi-dexterity? From the fact that it requires a natural slope *from* the body as well as a movement *away from* it as the written line advances, it falls naturally under the heading of the one-sided operations, and to train the left hand to write in the same style as the right is to force it to use both an unnatural slant and a movement (invariably awkward-looking, though perhaps not so awkward-feeling) towards the body, instead of away from it. In the absence of any feasible plan to enable naturally left-handed children to write with reversed slope and from right to left, which all who could freely use the right hand in writing would readily learn to do, there would seem at present no alternative but to admit that all persons be obliged to be right-handed in using the pen. It is with the utmost reluctance that this admission is made, for the writer knows well by experience how much this handicaps the inveterately left-handed child, who can never do so well under these circumstances what so vitally concerns him as that most important means of giving outward expression to the inner soul, writing, second only to speech, if even to this. No like objection holds in the case of Drawing, however, that other powerful means of outward expression. Children should be ambi-dextrous here; a child who cannot draw one side of a leaf with one hand and the other half of the same leaf with the other is in this respect one-sidedly trained. Neither does it hold in the case of shorthand; and the help to be derived from the modern

type-writer tends still further to minimize the difficulty. It would seem, to, a wise plan to allow the left-handed penman to adopt the vertical plan in handwriting, as tending to do less violence to nature.

But does all this lengthened exposition tend only towards the inculcation of ambi dexterity after all? By no means, else were the title a misnomer. In holding, as would seem rational if the preceding position is tenable, that the vast majority of persons have naturally no bias in favor of either hand at birth, and that proper training should preserve carefully this even balance, the writer has by no means forgotten those exceptional cases, the pronouncedly and persistently right or left-handed. Not that these should not be ambi-dextrously trained too—perhaps all the more carefully in that the initial bias is so one-sided. This should be done in their case, too, but—and this cannot be too carefully insisted on—it should be by carefully fostering additional practice with the less-used hand, and most decidedly not by any repression of the favored member. It is probably not an exaggeration to say that all truly right or left-handed persons are exceptionally dexterous; and if so it would be absurd to hamper this dexterity. If there is any force in that so fruitful central idea of Rousseau's—"Go back to nature and follow it,"—we should apply it here as elsewhere: and how have we done it in the past, in the case of the left-handed man in particular? Not alone by neglect but by repression: not alone by hampering him but by jeering and gibing at him; as if it were a merit to be biassedly "left-brained" but a disgrace to be "right-brained"! It is not a mere accident of language that the *Bar-Sinister* on the escutcheon marked the man of illegitimate birth: this semi-contemptuous heraldic use of the word but too faithfully reflected what was once the general opinion as to the dexterity of the man who preferred his left hand. We have gone out of our way to make tools—scissors, for example—which could almost, if not quite, as well have been left similar-sided, so awkward for him as to almost prohibit his use of them by his preferred hand. It is quite clear that all this is irrational; tools in as common use as those mentioned should be so constructed as to be similar-

sided and capable of use with either hand wherever possible; and where this cannot from the nature of the case be brought about, then his tools should be made in such a way as to consult his idiosyncrasy; for be assured he will never on any other condition develop to the full the dexterity that is in him. And this holds good with even more force in the sphere of such of the fine arts as are most peculiarly dependent on exceptional manual dexterity for their expression, namely, music, sculpture, and painting. The inward ideal may be never so high and lofty here; it is comparatively fruitless if it find not the cunning hand to express it; and it really seems not unreasonable to suppose it almost providential that at least some portion of mankind seems to be born with pronounced manual aptitudes in certain directions. Such are the pronouncedly right or left-handed believed to be. Far from being repressed, then, this tendency needs every encouragement.

"Did ever on painter's canvas live
The power of his fancy's dream?
Did ever poet's pen achieve
Fruition of his theme?
Did marble ever take the life
That the sculptor's soul conceived?"

And if human ideals are thus doomed to fail of fulfilment even under the most favorable conditions, what folly in us to run counter to natural aptitudes in our educational methods, as we are fairly chargeable with having persistently done in our treatment of the naturally left-handed! The writer is not without hope that what he has here contended for may possibly be of some little avail to bring about a better state of matters; the honest desire to be able to do something in this direction has, at all events, cost him much anxious thought on the subject.