

## **Study of a case of two-handed synchronous writing / by George M. Gould.**

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## STUDY OF A CASE OF TWO-HANDED SYNCHRONOUS WRITING.

By GEORGE M. GOULD, M.D.,

PHILADELPHIA, PA.

SUPPOSING the tale to have been true, Newton, I believe, would never have discovered the law of gravitation if the individual apple had fallen on his shoulder instead of on his nose, or if it had not been peculiarly colored, if it had not been blown by an odd gust of wind, or if the philosopher had not turned his ankle that morning, etc. Something individual is needed to bring truth to recognition, and the greater the number of the idiosyncratic elements the more speedily and accurately, probably, will the abstract principle or general law come to light. Generalizing over a lot of malobserved and colorless facts gets us "no forrarder." Being and nonbeing are indeed one, but what kind of a "one," and how useless is such "being," and such "nonbeing?" One swallow may make a summer if a good ornithologist is the observer of the migrating bird. In medicine all wise physicians know there is no "typical case," and that one instance of any common disease studied thoroughly to the bottom, in all its relations and details, is worth more than a hundred glanced at, worth more than all the glittering generalities of the text-books, worth more to the doctor as well as to the patient. The same truth, is it not applicable to physiology, to neurology, and even to psychology?

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For example: A patient, aged 52, upon whom rests heavy responsibilities, a highly trained civil engineer, cannot think and write at the same time. He can dictate to a stenographer thoughtful and planning letters, but to write the simplest business or even social letter requiring any intellectual attention or phrasing is absolutely impossible. He is under the necessity, therefore, in travel and at home, of having a stenographer about in order that he may answer letters, describe and attend to his work, etc. As a child, he was tortured for years to make him write with his right hand. The natural writing-center in the right cerebral hemisphere was thus rendered atrophic, crippled, or unusable, and the artificially stimulated mechanism in the left side of the brain could never be made to work correctly or easily by the other intellectual organs during the instant in which they had their own tasks to perform.

Another patient, a beautiful but sickly and also morbid-minded girl, never could go into society, to balls, dinners, etc., because she could never act naturally, dance, use the knife and fork unconsciously, or in any definite fashion; her eyes, brain, and body had been confused, made awkward and sickly, and her life had become a strange tragedy. The "ambidextral" tyrants had taken away from her, when a child, her natural left-handedness; they had not made her right-handed; she could never, expertly or promptly, do the task or purpose desired; they had also given her lateral curvature of the spine and life-long indescribable misery.

In still another patient, although the tragical aspect had not been so noteworthy, there was found abundant interest in details. She is now left-handed for all except writing. She also cannot write and think at the same time; indeed, she posi-

tively "hates to write," and must also dictate to a stenographer a simple description of her symptoms. She is a highly capable and educated woman, a famous teacher, and constantly addresses large audiences on pedagogical subjects with ease—except in regard to certain "slips of the tongue." She frequently transposes words and even parts of words when speaking, immediately becoming conscious of the error and correcting it promptly. These transpositions began at the age of 13, after long and severe training ("with great agony"), had forced her to disuse the left hand for writing; she began asking for, or speaking of "mish and filk," for instance, instead of "milk and fish." Words with an opposite meaning are still used, as *warm* instead of *cool*. "West bay" instead of the intended "best way" will be uttered. If she has something in each hand she will lay down the wrong one, or throw that she wishes to keep in the waste-basket. The greater the general fatigue the more frequent such mistakes. Each eye is equally dominant, *i.e.* the pencil throws two equally-clear images on the wall. At about the age of 17 she discovered that she could write with either hand, and synchronously with both, normal, or mirror-style, with one or with the other, etc. I append a series made recently to illustrate (pp. 718-720).\*

In order to get a clear understanding of the teachings of the case I report, and of other similar ones, one must hold in mind several facts, and the most important is that there is no adequate knowledge of the significance of a biological structure except his-

\*In all such bimanual writing it is to be noted that the pens were placed on the lineless blank sheets with gaze and attention, although the movements were subsequently executed without these guides. The spacial and topographic accuracy were thus better than would have been true under other conditions.

torically. Secondly there is no history so exact and so illuminating as that given in the most comprehensive of all biological laws, "the ontogeny repeats the phylogeny." That sentence is the master-key of almost all the mysteries of living things. The statical or anatomical phasing gets its explanation only through physiology, becomes clear only genetically. All pathology is in origin nothing more than aberrant and morbid physiology, and all organic structure is the product of precedent and repetitive function. There is no "pod" without a preceding pseudopod. Instead of the common scientific nonsense that there is no inheritance of acquired characteristics, the truth is that there can be no inheritance of any characteristics except acquired ones. To come to details, the eye as an organic structure appears defined within a month after conception; the differentiation of muscular tissue only at five months; righthandedness (or lefthandedness), however, commences to appear only fourteen months after conception, *i.e.* about five months after birth. If, therefore, the individual organism epitomizes and illustrates the history of all the ancestry, there are certain psychological and metaphysical conclusions which no monistic or other materialistic logic can escape. Embryologically, the eye is an extension of the brain; the brain comes out to see. It is not so of any other organ of the body. The eye precedes the appearance of muscular tissue by some four months; the inference is unavoidable that the perfection of visual function long antedates and conditions free motility, which is itself the condition of the existence of all higher organisms. *Ubi motus, ibi visus est.* That is the greatest of the Darwinian factors, strangely ignored by all Darwins, governing the survival of the fit and the exclusion of the unfit. A foreseeing and purposive planning

Abraham Lincoln

1aL.

Abraham Lincoln

1aR.

No. 1aL and No. 1aR illustrate the natural ordinary single-hand, or discrete, writing, each made under the influence of the visual (which also includes the central, mental, or intellectual) attention. In each case the writing is equally clear, equally respecting the laws of symmetry, and equally correct in topography, direction, localization in space, etc. The slant of the letters, a visual result, is in each case that common in dextrmanual writers, and in sinistromanual writers. It should be borne in attention that these slantings of the individual letters are in occidental nations dictated by visual function and, when unconscious, are always present; they are preserved even in the most peculiar or abnormal of the tests to follow. The origins of these slants I have set forth elsewhere. Noteworthy in the illustrations above is the fact that the sinistromanual writing does not fill the allotted 3 3-8 in., but is condensed laterally, not vertically, so that relatively the object occupies only about three-fourths of the longitudinal space taken by the dextrmanual writing. It must not be forgotten that the "patient" or "subject" was congenitally lefthanded, but by practice and lifelong habit a dextrmanual writer. The preservation, under these circumstances, of a sinistromanual proficiency equal to that of the dextrmanual is significant, both for the neurologist and for the "ambidexterity" societies.

Abraham Lincoln  
1bL

Abraham Lincoln  
1bR.

No. 1bL and No. 1bR, also written separately with closed eyes, bring out the effects of the absence of visual attention. Central attention alone appears to be at best a somewhat vague and inaccurate representation and product of visual attention, yielding want of sense of direction (slanting of the left line upward, of the right downward to an equal degree), and relatively equal inaccuracies in the forms of individual letters in both samples. That the topographic or spacial sense is the direct product of visual attention is again suggested by the fact that, without its aid, the central attention reverses the result seen in 1aL and 1aR, as to filling of the allotted longitudinal or lateral space. With the left hand (right cerebral center) it fills the entire space, with the right hand (left cerebral center) only about three-fourths is occupied. Lack of the influence of the acquired and inherited visual attention has therefore generally an effect in laterally contracting the space-content in the acquired dextromanual habit, and correspondingly enlarging that of the congenital and disused sinistromanual habit. The inheritance of spacial sense of all past ancestors requires the instant's influence, in the act, of visual attention to insure the best accuracy.

Abraham Lincoln

2aL

Abraham Lincoln

2aR

No. 2aL and No. 2aR are synchronous writings, under the influence of visual attention (which includes central attention) upon the forms made by the dextral hand. The sinistral is here the hand of nonattention; let us call it *The Trailing Hand*. Although for writing it is the life-long habitually disused hand, it was the one first used and habited in writing, and its central mechanism in the right cerebral half-brain has preserved perfection of function, despite disuse, and "trails" more perfectly than the dextral in the next example, 2bR. The lateral space is again less completely filled by the sinistral hand, although it is the "trailer."

Abraham Lincoln

2bL

Abraham Lincoln

2bR

No. 2bL and No. 2bR were written under the same conditions as No. 2aL and No. 2aR, i. e. synchronously without visual attention, but with visual and central attention fixed upon the sinistral movements, the dextral hand being the trailer. The sinistral space again is not filled; the ac-



curacy and perfection of the writing of the sinistral is a little better than in No. 2aL, but the noteworthy fact appears that although the central mechanism of the dextral hand has been the life-long habitually functional one, its natural repugnance, unfitness, etc., is shown when it is deprived of the factor of visual and central attention, the individual letters being generally slovenly formed, the *i* not dotted, etc. It trails worse than the sinistral despite its education.

Abraham Lincoln  
2cL

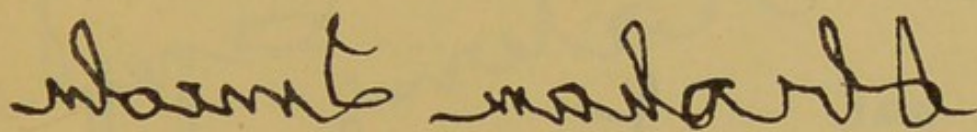
Abraham Lincoln  
2cR

Abraham Lincoln  
2dL

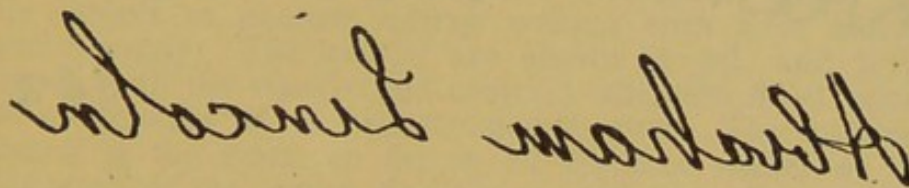
Abraham Lincoln  
2dR

The effect of depriving synchronous bilateral writing of visual attention is shown in 2cL, 2cR, 2dL, and 2dR. In the 2c series central attention was fixed upon the dextral movements, the sinistral hand being the trailer. In the 2d series the central attention is fixed upon the sinistral movements, the dextral hand becoming the trailer. In both cases the sinistral writing is the more condensed laterally. The effect of synchronously carrying on the bilateral movements (without visual attention and only with mental attention) is not so bad upon the sin-

istral as upon the dextral writing, even when the sinistral is the trailer and the dextral has the advantage of central attention. No amount of habit or usage abrogates the primal trend towards lefthandedness or makes the acquired writing expertness of the dextral hand equal to it.



34R.



34L

Series 3 further illustrates the general laws already observed by the condition of mirror writing. No. 3a shows the ability of this subject to write with either hand, alone, and with visual attention directed to the movements. By looking through the paper, back to the eyes, or by the use of a hand mirror, one sees that the mirroring or reversing of the dextral hand is less perfectly and correctly done than with the sinistral mechanism. The subject says of this that with the sinistral hand the reversal is "done easily, rapidly, and automatically," while with the dextral hand it is carried out "with difficulty and slowly."

242 *hand* *mark*

*hand* *mark*

36 R.

The effect of the deprivation of visual attention upon mirror writing shown in 3b series further illustrates the foregoing suggestions. Each is written separately, and by the aid of central attention only. "The right reverses just as badly" as in the case immediately preceding. The sinistral hand does its work far better than the dextral under the disadvantage, and the comparative loss of the sense of direction and space-relation is strikingly manifest. For the first time is shown the tendency, slight in the sinistral hand, marked in the dextral, towards a declination, and a double one, of the two words, from the right to the left, *i. e.* in the direction in which the mirror writing proceeds. The sinistral writing is again the more condensed.

James Mahaffy

3cL

James Mahaffy

3cR

The complications of the problem, as well as of the interest, increase in the remarkable (unique?) ability of this subject to execute mirror writing with both hands synchronously. The results are shown in 3cL and 3cR, written with the visual (and central) attention fixed upon the movements of the sinistromanual pen. The trailing dextral is the worst so far in all respects—either as to formation of the letters, declination, and even overlapping of the lines from right to left, and overrunning of the space both lateral and vertical. The topographic or space-limits are little recognized or observed, and character or individuality of the writing is lost. But here arises the most noteworthy and significant statement of the subject: "I find that I cannot execute what would be the logically preceding series, *i. e.* when the mind is fixed upon the right-hand movements. *They will not go.*" Nature flatly balked and refused to budge. Motion was entirely inhibited with the attempt at two-handed mirror writing when visual attention was fixed upon the dextromanual movements. Such writing could only be carried out when the dextral was the trailing hand. In this case there was, therefore, sufficient perfection of the dextromanual mechanism to trail, that is, to act, and badly, as an automaton, by the aid of the more perfect, though disused initiative of the sinistromanual one. To initiate was impossible when it had to supply subordinate directing force and control to the trailing sinistral hand.

*Handwritten cursive text, possibly "Handwritten" and "Handwritten", with "3dZ" written below.*

*Handwritten cursive text, possibly "Handwritten" and "Handwritten", with "3dR" written below.*

When deprived of visual attention, by the aid of central attention alone, synchronous mirror writing, with both hands again repeats and accentuates the preceding conclusions. This is shown in 3dL and 3dR. Again the central attention is fixed upon the left-hand movements; the right is still able to trail, but notice the lateral concentration of the two words deprived of the control of visual attention, the degradation of form of all the letters, almost to indecipherability, the sharp declination of the line-direction from the dextral to the sinistral side, etc. The space-sense or topographic consciousness is nearly lost. The trailing has become so inaccurate and wretched as to be denominated vagrancy. And of course with mental or central attention only fixed upon the dextromanual task there is even a more absolute impossibility than in series 3c of executing any legible or orderly movements whatsoever. "They will not go." But even when deprived of visual attention the central attention upon the sinistral hand is able to make fair copy, and to do much toward helping out the trailing dextral. No amount of use and education could give the dextral mechanism the initiative and effectiveness retained by the thirty-five-year-long disused sinistrocerebral centers.

Abraham Lincoln

4aL

4aR

Abraham Lincoln

The task remained of writing synchronously with both hands, normal style with one hand, mirror style with the other. No 4aL and No. 4aR is the first illustration, made with visual attention fixed upon the dextromanual movements. In this case the dextral hand writes normal style, the sinistral mirror style. The trailing sinistral line climbs a little as it moves onward, but the character, accuracy, etc., are well preserved in both.

Abraham Lincoln

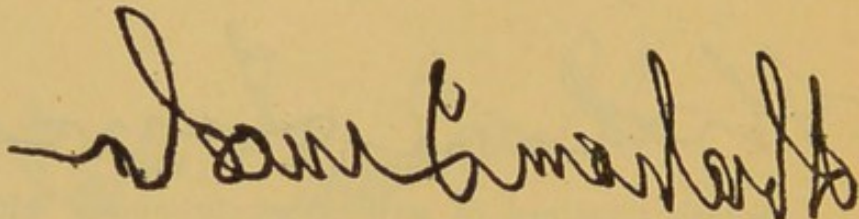
4bL

Abraham Lincoln

4bR.

In Nos. 4bL and 4bR the visual attention is fixed upon the sinistral hand; the dextromanual writing is in normal style, the sinistromanual in mirror style. The writings are

synchronously executed. That of the dextral hand is more incoordinate, tends still more than before to overrun the lateral limits, ascends as it proceeds, etc., but both are easily legible. The superior initiative and controlling power of the dextrocerebral mechanism is re-exemplified.

4cL 

Abraham Lincoln

4cR

Nos. 4cL and 4cR repeat Nos. 4aL and 4aR, with the exception that the movements are deprived of the guidance and control of visual attention. The tasks are synchronous, of both hands, and the central attention in this instance is fixed upon the movements of the dextromanual pen. The dextral hand leads and writes normal style, the sinistral trails and writes mirror style. Both lines decline from a horizontal somewhat as they proceed. Although the mental attention is upon the dextromanual movements, the sinistral hand restricts its work to normal and usual lateral limits, while the difficulty of its task, in originating and controlling the trailer, seems to make the dextral lose the sense of space limits heretofore observed. But even here the legibility of the writing of the sinistromanual trailer is well preserved.

Abraham Lincoln  
42L

Abraham Lincoln  
42R

In Nos. 4dL and 4dR the conditions of the last test are observed, except that the central attention is fixed upon the sinistromanual movements. The level of the lines is better kept; legibility of both writings is good; the lateral limits of space are preserved or exceeded in the same way as in 4cL and 4cR.

Abraham Lincoln  
52L

Abraham Lincoln  
52R

In Nos. 5aL and 5aR the sinistral hand writes normal style and the dextral writes mirror style synchronously. Visual attention is permitted and fixes the sinistromanual movements, which climb a little, but which result is legible writing. But the associated ones of the trailing dextral hand become almost illegible and have lost nearly all sense of orderly topographic consciousness. As in the 3c series



the subject again explains that "it will not go with the visual attention fixed on the right-hand movements." The stint was found impossible. And of the greatest significance is the further statement that "this form of reversal was always the least satisfactory, and is not now so good as it used to be." Later, upon request, Miss K. writes: "Some time before I was twenty I discovered that I could do this reverse writing, and since then I have occasionally amused my friends by doing it, but very seldom. Until I did this for you it is surely five years since I last tried it. I did not notice the inability to do this particular specimen less well until I tried it this time for you. I have no specimens written in the past." The coordination of the two cerebral hemispheres is therefore losing an acquired function or aspect, and reverting to a desirable and natural singleness or monolaterality. Confusion, awkwardness, inhibition, indecision, or imperfection of function must follow decision or action initiated or controlled by centers cooperating from different sides of the cerebrum.

Abraham Lincoln

56L

Abraham Lincoln

56R

The limit of illegibility and loss of the sense of spacial relations is shown in Nos. 56L and 56R, written under the conditions imposed in 5a, except that the sinistromanual movements were deprived of the help of visual attention. Of course it was again wholly impossible to write anything whatever when the mental attention was fixed upon the dextromanual writing movements.

of the mechanism of vision, and of motility, is thus evident, and there cannot be foresight and plan except there is a foreseer and a planner. Mentality, therefore, preceded and created structure. The mind, the life, the brain, the eye, made their tools.

Again, the appearance of slight righthandedness is five months after birth, and its perfectibility goes on throughout life. This particular differentiation of function is dependent upon attention, and is a matter of education. But there can be no attention without an attender. In sensation-making, in conscious willing to act, in choosing to use one hand rather than the other, we reach beyond the limit of automatonism or of mechanism *per se*, and come to the hand upon the lever of the engine, *i.e.* upon the something beyond the machine—in a word, upon the metaphysical. If there is a control or force, called attention, that can be transferred from one side of the brain at will, and markedly change the functions of one side or the other, then there is something outside of and above the individual mechanisms and centers which is not a part of them, and which uses them as tools. A player on the piano is something different from the piano itself. The player upon the cerebral piano transfers his attention to one side or other of the keyboard of the brain. The fact of attention, transferred at will to one part or another, and choosing at pleasure not only the music to play, but the parts of the keyboard on which to play, playing better with one hand or the other—all this demonstrates that there is a mechanism, a material, neurological mechanism, but also that the player is something other and different, placed over it, a mental somewhat not bound up with it, not explainable as the action of the nervous system *per se*, but using that mechanism as an instrument. The psychology that is monistic, that

denies life, that denies the fundamental distinction and existence of a machine and a machinist, is *ab initio* unscientific.

Moreover, cerebral tumors and traumatism and physiological experiment have absolutely proved that the adult, central, or cerebral mechanisms of memory, of language, of writing, of speech, etc., are located in one side of the brain, that opposite the writing hand. In the righthanded the left half-brain is therefore preeminently the seat of the mind. The mechanisms that give the man external validity, that intermediate him with useful objectivity, are one-sided. But this one-sided differentiation is acquired, and is subject to progressive perfection throughout life. The machine is becoming more and more perfect. Dividing the machine in two parts of the brain is degradation, is against progress, and the inevitable differentiation of function. "Ambidexterity"-mongering is the most absurd silliness.

Note that there is no discoverable difference of microscopic structure between the corresponding unused brain-tissue on one side, and that in the cerebral speech-center much used on the other. And note again that the choice is open to the attentior or will to elect in infancy either side to work from, and thus to make the individual either righthanded or lefthanded. Observe also that as about 96 per cent. of people now are righthanded, the supposed "laws of heredity" are put utterly out of court so far as pertains to the number of the lefthanded. Every lefthanded person must have had millions of righthanded ancestors for every one that was lefthanded.

Not to be omitted, too, is that with all the actual or possible education of the left cerebral center in the righthanded (or of the right in the lefthanded), there is a poorly cooperating observing or reversing, or mirroring mechanism of the other side which

can be brought into use by the attention. The psyche is, therefore, again demonstrated to be something more than the mechanism. It plays at will upon the mechanism. It plays badly, if you please but the mechanism does not play itself! Attention is merely the name we give the metaphysical player, the cerebral engine cannot run itself, or the piano play itself any more than could the locomotive or the musical machine. In depriving one hand or one center of the attention, we make the other an automatic "trailer" (as I have called it), working by means of the commissural fibers between the two oppositely-placed centers, but working badly, largely without the sense of direction, form, topography, etc. The attention, therefore, adds all-important elements to the mechanism. Psychology can no longer ignore pathology, or aberrant physiology.

Now, what is this "Attention"? As before, the question can be answered only genetically. The brain comes out to see, but only succeeds in really seeing with some comparative degree of accuracy at about five or six months after birth. *And this is precisely the date at which righthandedness, or the reverse, appears.* In about 96 per cent. of infants the right eye is the better-seeing eye, and thus compels the right hand to work with it. Thus, vision is the father of action, of righthanded action, and righteyedness is bound up as a precedent, synchronous, and causal factor of righthandedness. The writing illustrations above given show that spacial relations are created and definitized by "ocular attention." Direction, location, measurement—all topographical factors, are thus products of vision. But a secondary product has been evolved, its working illustrated in the writing illustrations, which may be called psychic or mental attention. It is plainly a derivative or product of ocular attention

because it can only exist separately when the visual attention is not upon a (usually) moving object. With the eye closed it may be brought into existence, but its derivative nature is again evidenced by its imperfection of work, the lack of direction, of accuracy of topographical qualities, etc. With the active vision renounced, it may even be turned upon sensations not visually derived, such as of sounds, odors, tastes, etc., but all sounds at least are topographical and directional; pain and touch are of the localized parts of the body, or again spacial in nature, and even taste is located in the mouth. The brain did not make out of its own substance the peripheral organs of hearing, taste, touch, etc.; the eye alone is brain-substance told off to a special mental and cerebral duty which was prevented by a nontransparent skull.

The execution of a compositely-formed resolve requiring first of all vision, then possibly other sensational stimuli, but always memory, *i.e.* the stored results of all previous coordinated activities, words, speech, etc., can issue in swift and decisive act only through the placing of all the most directly inter-mediating cerebral centers in the closest possible contiguity in one side of the brain. If one is right-handed his centers for writing, speech, and memory must be on the left side. Upon the same side, therefore, must be the visual and other centers which furnish the chief data for the compositely-formed act. If one or more important data must come from centers in the opposite half-brain, delay at least must ensue, and other doubts and inaccuracies also. Hence the all-necessary concentrations of the chief organs and functions in one side of the brain. The organist plays on several banks of keys, and with pedals, uses scores of stops, reads five staves of music, etc., that is, he really plays on many organs at once. But

his banks of keys and stops must not be located on different sides of the church, or even beyond the reach of his arms. The two cerebral cortical hemispheres are indeed somewhat connected by commissural fibers, but poorly so at best, as our trailing handwriting shows. Biologically, the safety and success of the human organism has always depended upon the most intimate, accurate, and swift coordination of many factors and cortical centers in order to issue in resolve and action. Such coordination could not take place if the cortical centers furnishing the necessary data for action were divided equally between the two cerebral hemispheres.

The difficulty of understanding the nature and origin of mirror-writing has come from the fact of looking at it as the result first of a pathological state of mind or nerve action, and secondly as the work of a finished or completed mechanism. Pathology has nothing to do with the matter; it is physiological and natural, due to the action and degree of attention, and it is also a product of education, habit, or development. Soltmann, Erlenmeyer, Marinesco, Sollier, and others look upon it as a pathological, and as a finished and presented fact. Others, Buchwald, Durand, Vogt, Nicolle, and Halipré, Meige, Bernard, Ballet, Figuera, etc., hold it to be normal of the left hand in the righthanded, sometimes even in the lefthanded. In 77 deaf mutes Soltmann found 35 per cent. wrote mirror-style with the left, and he concludes that "the more educated the person the less he will fall into mirror-writing with the left hand." This is the reverse of the truth, and nothing is said as to the fundamental condition—the fact of precedent lefthandedness, either continued or overcome, and of mixed types.

A simple device would have put all such errors to rout and would have shown the truth. The diffi-

culty in writing in the manner habitually chosen is forgotten; it is an art, slowly and laboriously acquired, and always poorly executed, this writing on a table or a flat surface in front, and with the body craned to the left to see with the right eye the writing which is being executed. (By the left eye in the lefthanded, of course.) And also there is a universal neglect of the direction in which the hand is commanded to write. If one writes mirror-style he must write towards the body with the right hand, and away from it with the left. This is demonstrated by the plan here proposed: Place the surface upon which the writing is to be done upright—a solidly fixed sheet of plate-glass is best—the edge at right angles to the face and almost against the nose and forehead; attach sheets of quadrille paper upon either side by clamps. Thus is avoided the great difficulties the imagination and eyes have in projecting outward the image or seeing the writing which is being executed. The skewed, indirect, absurd-angled, reversed, and illogical writing posture is avoided, and the upright sheet of glass is as if the two-sided mirror were placed between the two cerebral halves. The writer should be one innocent of all such experiments, *i.e.* not used to put his educated consciousness or attention through any “tricks” or tasks; a pencil should be in each hand, the points on the sides opposite to each other. Neither eye can now be used if the pencils are started within a few inches of the eyes, so that the eyes may be closed, and the experiments will be all the better for the free working of the attention on the surfaces directly in front of the eyes. Synchronous writing under these circumstances will, in the righthanded, always show normal style with the right hand, and mirror-style with the left—or the reverse in the case of the untampered-with lefthanded. Fix the atten-

tion of the righthanded upon his lefthand writing, and command it to write normal, and compel the right to make some movements; it will make attempts, at least, at mirror-style. The higher the expertness and mental culture the more certain will be such results. On the table before us vision, and that imagined vision we call central attention (with peripheral vision abrogated), controls or tries to control, but has so many difficulties that it has falsified and confused all experimentation. The left tries to write as does the right. My device removes confusing factors and conditions, and proves that everybody normally writes mirror-style with the trailing-hand, but dependent upon the all-controlling factor of the direction of the writing, and upon general education, imaginativeness, skill, habit, the development of central attention, etc. Sign-language, warfare, etc., first originated the habit of righteyedness and so of its resultant righthandedness, and this necessitated the location of the speech center in the left half-brain. The particular incidence, now, in a certain child, of righthandedness or lefthandedness, depends upon which is the better seeing eye, when arm-and-hand motion arise and are coordinated with the function of the precedent and governing eye. Heredity has nothing to do with the matter directly, and only indirectly, in making the right eye the better seeing eye in infancy, and when the habit is established. In about 96 per cent. the right is the better seeing eye. If it is desired to make a lefthanded babe normally righthanded, the process must be begun in the earliest stages, and by means of giving the right eye the better function. This may now be held impossible, although atropine in the left eye of the child with begining lefthandedness might possibly be efficacious. *Let no one attempt it!* Pathology follows almost inevitably any



interference with Nature's institution of handedness, right or left, however early it may have begun. For the mixed type is far worse, and usually ends in more suffering than if lefthandedness were of the pure type.

In two-handed mirror-writing, and in the work of the trailing hand, there is more than a suggestive hint, there is an intimate glance permitted into the mechanics of the construction or connections of the two-sided brain. It also comes out in the often-described experiment of writing with one, and then with the other hand upon paper while looking at the figure being made in a mirror set at right angles vertically in front. In a righthanded person the making of a square or triangle with the dextral hand is possible and comparatively easy, but on attempting the same trick with the sinistral hand, without forethought and quickly, the direction will be ludicrously reversed. Now, synchronous two-handed writing, by the righthanded, is easier and more commonly possible if the left writes mirror-style and the other normal style. The commissural fibers, the pattern-making threads, between the two opposed cerebral mechanisms, let us say between the two patterned or figured cloths, seem therefore to run from the "face," or "right" side of one, to the "back," "wrong," or "seamy" side of the other. Changing the analogy to that of two mirrors, the face of the mirror on one side of the brain reflects and normalizes the figure of the obverse or back side of the mirror on the opposite side of the brain. The mirror or cloth erected in the left brain of the dextromanual fronts consciousness and its figures are normal, while that in the trailing side is mirror-writing, or is the "seamy," "wrong" side of the cloth. In reference to the eyes, besides the evident facts termed righteyedness and lefteyedness, one of

an equal or greater importance comes into view, which I have called *dominance*. Usually and normally a righthanded person is righteyed, and a lefthanded one is lefteyed. That is, the right eye is normally the dominant one in the righthanded, and the left eye in the lefthanded. A simple test, one of many, of dominance, is easily made and thoroughly convincing. Hold the pencil or finger upright a foot from the eyes in the median line and observe the image it makes on the opposite wall; closing the left eye results in no movement of the image on the wall, but closing the right or dominant eye throws the left eye into hitherto disused or non-selected function, and the image "jumps" suddenly to the right. The demonstration of the dominance of the right is thus apparent; the mind must not be confused in action by two differently-placed images, and has learned to ignore the one and rely upon the other. And it ignores the least reliable and least accurate or useful image, which is the left in the dextral. Correspondingly, of course, the choice is reversed in the lefthanded person. And it is as evident that a high degree of ametropia, squint, amblyopia, or other disease, of the naturally dominant eye, would transfer the dominance to the eye of the other side. In such cases the mind and entire organism is morbidized, decision and action are confused, delayed or inhibited reflexes are necessitated, stuttering and halting speech or thought appears, etc. This is because the right eye of the four-footed animalian phylum has controlled the motion and placing of the right front foot, guarded the right side of the body, etc., and primarily established the great law that cooperating cerebral centers must be in the same cerebral hemisphere to render decision and action the most exact and quick. Contiguity of these centers insures accu-

racy and celerity, while the location of one or more centers in the opposite hemisphere demands the intermediation of commissural nerves between the two halves, with which pathology arises. These morbid results are painfully evident in the sudden loss in adult life, of the dominant eye, or the more expert hand. To the observant they are equally evident in those naturally and healthily lefthanded persons made morbid by the morbid "ambidexterity" sillies. These persons put Nature to the foolish task of creating a second set of subdominant or equidominant cerebral centers where, according to God and common sense, one was not only sufficient, but infinitely better. In such cases the dominance of one eye is done away with and an equidominance or alternate dominance is established. Two images of the pencil on the wall are seen, and neither is unconsciously to be ignored.

Almost the sole method and means by which we come into large and intellectual relations with the world are the results of vision. The total contributions of all the other senses compose but a fractional part of the ocular ones. Intellect itself is little more than epitomized ancestral visual experience. Nearly all our thinking is in images, pictures of things seen, and even the most scientific, even the most abstract and metaphysical intellectual processes are only seemingly amorphous; they are really like the crystalline coal-measures of ancestral and personal visual experiences. The difficulty is to draw the line between the inherited and the individual parts. The "*tabula rasa*" of the infant mind is by no means blank, but its inheritances are necessarily abstract, and are vivified and definitized by the daily millionfold personal, *i.e.* chiefly retinal, images poured among the ancestral carbon strata awaiting the touch of reality to awaken them to living light and heat. A truer

analogy presents in language the fused and packed epitome and record, the composite photograph, in fact, of racial experience. Nearer far to his personality than any other or all other products of Man's being here, the most immaterial, most spiritual record of his existence, is his language. And languages are almost wholly the records of things seen. The greatest deed of mankind is the creation of the alphabet; so arduous was it in fact that only one alphabet has been evolved in and for the whole world. All are at one in the conclusion that this alphabet is the *sine qua non* of intellectual development and of the condition we call civilization. Well, the alphabet, as all know, is made up of the conventionalized pictures, ideographs, eye-made images and photographs of objective scenes and things. The seeing of things correctly is the foundation and condition of knowing things rightly and truly—*i.e.* of civilized living and scientific thinking. Conversely, the seeing things badly and distortedly, *i.e.* ametropically and with optic morbidity, is the source to-day of more suffering and improper living than all other pathogenetic factors combined. In all past time the composite of millions of ancestral visual experiences have been forming what we call mind, intellect, and memory. The elimination of the visually unfit has made the present-day heir of all the ages the product of predominatingly and relatively perfect eyes. Civilization adds an amazing acuteness to the present tragedy when an ametropic organism comes in bitterest personal clash with the inherited datum of all past experience. "Eyestrain" is thus usually the greatest misfortune which can happen to a civilized "near-worker." It morbidizes mind and body and is wrecking numberless lives all about us. Some day medicine will be aroused to the amazing reach of this awful truth, and in that

day medicine, and especially psychiatry and neuropathology, will be revolutionized.

One may go further and say that not only is human life and civilization itself the quintessence of summarized visual experience, but the very development and evolution of biological forms above the lowest has been dependent upon vision. *Ubi motus ibi visus est* is the key of most higher organic evolution. Food and defense have always depended upon vision and perfection of vision, and the development of more perfect vision has been the forerunning means of the production of more perfect forms. The Darwinian exclusion of the unfit has been largely the exclusion of the visually unfit, and the survival of the fittest has been the survival of those possessing the best ocular mechanism. No task in organofaction has been so difficult of achievement and of healthy preservation as that of making the most perfect ocular mechanism.

One of the most inscrutable and important powers of the psyche is attention, but is it not almost entirely a product of visual function? In the congenitally blind and exaggeratedly ametropic the same truth comes to clearness. The inherited or epitomized experiences of the ancestry have operated in them, and in all of us, to beget the secondary and acquired kind of attention which we have in varying degree, and which may be called mental, intellectual, or central—that coming to view with deprivation of visual attention. It is inaccurate and imperfect, especially topographically, as our illustrations, even from a highly cultivated mind, show. The fundamental distinction has not been emphasized that visual attention depends largely and chiefly upon the following of the objectively moving thing with the eyes, or what amounts to the same thing, upon movements of the eyes to reestablish sensitiveness

of the retina. Absolutely persistent gazing at an immovable point quickly results in inability to see it. The moving object rivets the attention, and so long as it is visually fixed mental or central attention and visual attention are fused into unity. There is no possibility, except possibly by training, of attentively observing a moving thing like the pen-point or the letters being made by it, while at the same time mutually and continuously attentive to another train of thought, memory, or objective happening. The bimanual writer may write the same letters and words synchronously, but not different words. This is simply because the eye cannot see different words being written. As all students have agreed, consciousness or attention is like a simple stream of sand passing through the constricted part of the hour-glass. The attention of an expert organ player, playing with feet, two hands, pulling stops, reading several lines of notes, varying the expression, etc., each second, seems almost to contradict the validity of the hour-glass comparison. It appears to be a widely spread-out rain of attention, different from the more primitive and naive or hour-glass kind of the rest of us. But even this is due, I believe, to an acquired ability of perceiving and acting upon the perimacular and more peripherally placed images of the retina. Most of us actually use and attend to the macular image, and the retina beyond is used only to call the attention of the eyes to an object not really or perfectly visualized and perceived, but which by ocular motion is at once brought upon the macula and then clearly perceived. Watching an organ-player read and play new music shows one that he has a staring and indefinite expression, which argues a large field of vision and attention, filled with many objects, all held in a synchronous, graded, and differing clearness of at-

tention, impossible to do except after long education and practice. And this extension of visual attention to the images of the notes, keys, etc., located farther and farther beyond the macula, requires that they shall be visually and essentially correlated. The broadening of attention to multiple objects, the holding in synchronous unity seemingly discrete streams of objects and influences, seems, therefore, a matter of education, not of primary endowment, of progressive development and widening, instead of abrogation of the single-current, and depends primarily and wholly upon the ocular extension of the synchronous recognizability of correlated images falling farther than usual beyond the macula.

The visual central (or mental) attention is separable from the peripheral visual attention only when peripheral visual attention is abrogated. That this central attention is derived from the visual is its pale, possibly ludicrously, inexact reflex, is apparent, even without the striking demonstrations shown in the writing illustrations given herewith. It is essentially of the nature of a *pis aller*, reminding one of the pathetic almost incoherent falsetto of the acquired speech of the deaf mute. By long cultivation it gains precision in the mind of the orator, musician, etc., but the extramacular education of the retinas lies at the foundation of the proficiency.

The origin of right-handedness and lefthandedness I have elsewhere set forth in detail, but must here epitomize. There is no reason to suspect even the most vague or far-away beginnings in animals. So long as the four feet are used for locomotion there could be no lateral differentiation of function. I have watched for it in squirrels that use their front paws to hold nuts, cats that strike at insects in the air, or play with wounded mice, and in many other animals, but I am sure that to neither paw is pref-

erence assigned. There is thus probably no dominance of either eye in animals. Even in the monkeys and gorillas, who of all animals most use the forepaws as hands, one catches no suggestion of preferential use or superior expertness in the dextral or sinistral side. (My very intelligent dog, trained to "shake hands" with his right paw, lost his right eye, and after that he always offered the left paw.) But in the lowest human savages all over the world choice or greater expertness of one hand is as clearly present as in civilized races. No savages, however, are so near animalian conditions as to exhibit its differentiating origins. Fixed in all our military and social customs, and living at the base of language itself are two facts which solve the riddle and make clear whence and how right-handedness arose. In all tribes and countries since man used implements of offense and defence, the sinistral or cardiac side was protected by the shield and the sinistral hand was called the shield-hand, as the dextral was called the spear-hand. Next to fighting and synchronous with it was the need of barter, and the fundamental condition of bartering was counting with the low numbers, one to ten. The fingers of the free or dextral hand were of course first used, and all fingers are to-day called digits, as are the figures themselves, and the basis of our numberings is the decimal or ten-fingered system. The tally-stick, notched or numbered, is the record of the digits held in the air. Every drill and action of the soldier from Xenophon to West Point is dextral in every detail. The dominance of the right eye is shown in firing from the right shoulder and sighting with the right eye. I have two patients, lefthanded in every respect, who have been taught to fire their guns from the right shoulder; but of course they are lefteyed, and they de-



press the right eye below the level of the gun, and sight with the dominant left eye. Rightfootedness, less differentiated of course, must follow righthandedness and righteyedness, so that all soldiers (and free masons, too) must step off with the left foot first, *i.e.* the spring must be made with the right. The loss of the right hand, or right eye, mutilations, etc., very common in barbaric times, would help to account for the preservation of the present four per cent. of lefthanded people.

Because the underlying and governing condition why the man must be generally dextral, or generally sinistral, is the evident necessity that the centers governing a coordinated set of functions, must be located in the same cerebral hemisphere. To make any important act precise, purposive, harmoniously, and rapidly effective, several interacting and fusing cerebral centers must conjoin their functions: Vision, the chief of all, must present the problem, determine the spacial or topographical relations, etc.; hearing, smell, taxis, etc., may or may not enter into the matter as auxiliaries; memory of past facts, stored chiefly in the same side of the brain, undoubtedly is called upon for other data (and memory is almost entirely a gallery of stored photographs made by the eye!)—then judgment and decision, working upon the data gathered from all subordinates, issues in the word which is the seal of volition, and in act which is reality or the incorporation of the psyche in objective sense and effect, in the materiality, beyond cancellation or change. The essence of the matter is, therefore, were the chief of the contributing centers creating word and act divided between the two cerebral hemispheres, the certainty and celerity of the word and act would be lessened by the difficulty and delay consequent upon fusing the products of these remotely placed

and poorly united centers. Hence the law that the better expertness of the chief dextral organs requires that the other cooperating organs, also more expert, must also be upon the dextral side. And *vice versa* of sinistral expertness. The centers of all organs contributing to the composite terminal act must be in the same cerebral hemisphere. All physiology and pathology show that the speech center, a single organ, can be and is located in only one side of the brain, sinistrocerebral in the righthanded, and that the hand which executes the writing act, the most intellectual of all acts, dominates the location of the speech center in the opposite half-brain. The "ambidextral" societies, the mothers and school teachers, who would martyrize children naturally lefthanded by compelling them to learn an equal expertness of the right hand, are the most blunderful of stupid persons. No person ever was or ever can be made equally expert with both hands, and every attempt results in tragedy for the patient. To carry out the egregious plan thoroughly, flutes, half the violins, carpenters' and mechanics' tools, etc., and half the pianos should be made for the dextral "ambidextralists," and half for the sinistral "ambidextralists." All musicians should play half the time lefthanded and half righthanded on reversed piano keyboards, reversely strung violins, etc.; all carpenters and mechanics should work one day righthanded and the next lefthanded, with suitable tools; all soldiers drill lefthanded and leftfooted one day, and the reverse the ensuing day, etc., etc. What a world it would be if those who are wiser than God and Nature had their way!

Were it so, all laws and customs as to the "Rule of the Road" would have to be changed so that carriages, foot-passengers, etc., should pass half the time to the left and half to the right. All double-

track railroads would then order trains to pass one day to the right and the next to the left, and their locomotive engineers would then sit half the time on the right side of their cabs, and the other half on the left side. It took a whole generation time of experiments and mechanics to learn that the engineer must stand or sit on the right side of his engine or cab in order that he could look ahead with his right or dominant eye only, and without sticking his entire head out, as he would have to do if he sat or stood on the left side. The railroad men never learned why this is so, do not know why to-day, and to make the desirable change in two American left-passing double-track railroads, while it would finally avoid expense and accidents, would cost at once many millions of dollars. Thousands of years ago knights and men fighting on foot or horseback had to approach and pass each other on the left in order to strike or spear each other with the right hand while the shield-hand held the shield or the reins. The railway engineer, civil or locomotive, does not know that the knight was his righthanded and righteyed progenitor and endower.

A flood of light is thrown upon history, sociology, and medicine, especially upon psychology, neurology, and psychiatry, by lefthandedness and its sequels. Of every million born at least 30,000, probably more, are naturally lefthanded, so that in the United States there are nearly 3,000,000, and in the world over 45,000,000, thus handicapped. An indefinite proportion of these have been, or are being doubly cursed by the efforts of the foolish parent or teachers to make them righthanded. Sad suggestions and illustrations of the baleful results of the work of these improvers of Nature exist in such simple facts as that *right*, which should mean only dextral or righthanded, has come to mean good,

moral, advisable; and *left*, or sinistral, has become sinister, awkward, unlucky, to be avoided, both person and thing. *Dexterity* and *dextrousness*, properly meaning only *dextrality*, have become synonymous with expertness and exceptional proficiency, whereas everybody knows that the lefthanded person, if purely so, is as cunning of hand as the righthanded. Even the superstition of the "evil eye"—the nondominant one—teaches the same lesson. In all ages, and now surely, there are everywhere strange and unaccountable cases of "failure in life," "peculiar," "odd," "awkward" folk, cranks of a hundred types, misfits, stutterers, and all that. What a light the misplacement of the cerebral center for speech and writing, or its pernicious double placing and maleducation and crippling by "ambidextralists," throws upon the origin and fate of many stutterers, and upon many of the "hopelessly stupid," the laggards in school! How many of the medieval court jesters and the derided, the townfools, the kyphotics, and cripples were the products of the "sinister" superstition of the righthanded tyrants? And how many of the morbid-minded and insane?

Incidental and accidental results of the study of these cases would solve many problems and mysteries of medicine, and surely of psychology. Pathology is physiology gone astray. The thoroughgoing study of individual cases of aberrant neurology will be found to illumine many of the dark places of mental and moral genesis, function, and law.

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