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ABSTRACT

The structure and function of the nervous system as it puts us into contact with our environment is described. Section 1 presents a detailed discussion of the structure of the brain, drawing an analogy to a computer, and discusses the sensory input function. The transport system is then explained in a description of the transmission of sensory impulses along the cerebro-spinal neural pathways. The third section, arrival at the brain, discusses reception or processing function in the brain itself. Implications for the diagnosis of neurologically handicapped learners in terms of pinpointing the area of dysfunction are made. A bibliography is included. (CL)

Sister Mary Consilia, O.P.

1. Neurological Organization and Reading

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Introduction

From even a cursory appraisal of the title one would infer that the planners of this session wanted me to discuss the relation which exists between neurological organization and the perceptual-conceptual act of reading. In other words, how the nervous system subserves the learning processes. This undoubtedly is timely in the light of the unlimited number of articles, reports, techniques, and procedures which bring into focus the subject of neurological impairment as one of the possible causes of reading disability. I could not have wished for a more timely title. I will do my best to oblige.

I hope to present for your immediate consideration the structure and function of the nervous system as it puts each of us in contact with our environment. I hope to demonstrate, thereafter, that given poor function, the rational thing to do is to study the structure to see how and where it has broken down. Now as this relates to all learning and in the present limitation of the topic, to reading, it should show us some probable causes of reading disability and what, if any, procedures might be employed to correct or remediate, though I doubt that we will reach the last-named aspect in this paper.

Since the topic is not only intensely interesting, unusually extensive, but vitally important as well, let us get the lecture underway at once.

Part I.

To say neurological organization is to involve the nervous system, the system of nerve cells and neural tracks which puts man in touch with his world and which conducts first into his brain and thence prepared for the mind all knowledge he can acquire. It was not without meaning that the Greek Philosophers long before our age of scientific experimentation proposed that "there is nothing in the mind which was not first in our senses." (Aristotle)

What are the parts of the nervous system? Essentially, the nervous system is comprised of three sub-systems: (1) the central nervous system comprising the brain and the spinal cord (and it is with this that we shall particularly be concerned); secondly, the peripheral system which comprises the cortical and spinal nerves (and because they are input and output systems serving the brain we must be concerned with them also); and thirdly, the visceral and the cerebro-spinal ganglia. Only if you feel the hardness of the seat, the pangs of hunger, or the throbs of a headache, will YOU be concerned with this third system.

Since language, of which reading is a part, involves both INPUT and OUTPUT, I shall differentiate between AFFerent nerve routes and EFFerent nerve routes which spread into almost all parts of the body as the transportation and communication systems into and out of the brain.

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To set the stage for discussion of these systems in relation to learning, let me demonstrate with a few pictures what it would take too many words to say.

As we look at this simple diagram, it shows a peripheral organ, in this case a nerve of the arm which has been activated by external stimulus. The neural impulse is shown being sent on its way for interpretation. This demonstrates the inbound or AFFerent impulse and track.

Here is the junction point where the impulse is transmitted through a synpatic connection to a motor neuron after which it is progagated along an EFFerent neural pathway to the exterior, for example, to a muscle, for response. This might portray the bite of a mosquito and our slapping at it. That would represent a simple S-R arc such as we studied in beginning psychology. A reflex does not go to the brain but only to the spinal cord for interpretation and reaction. This diagram does not, therefore, represent the complexity of the process involved in reading. I doubt that such a process could be represented graphically. But this does have all the essential features of a much longer and infinitely more involved transportation system which might include thousands of individual nerve cells and their axons, and which must transport the neural message all the way to the brain, and ultimately, to a number of different parts of the brain for interpretation, processing, storage,and response.

Here is a more complex neural cluster such as would be involved in any act requiring brain interpretation. I introduce this merely for purposes of contrast with the simple stimulus-Response reflex arc.

THE BRAIN: The What and Why of it

To say simply what the brain is would be to indicate that it is the control center for all specifically human information and reaction. Earlier, I called the nervous system a system of transportation because it carries messages; a system of communication because it receives and understands the messages and, in turn, communicates with the motor transport system in response to the information received..

The brain might be called a living computer, for in addition to receiving information (which even the eye does), it processes it, knows what it means (which the eye cannot do) and assimilates the information, i. e., compares it to previous experiences and integrates it with the past, when appropriate. There emerges as a result of this activity an ever-increasing fund of knowledge, an ever larger bundle of information, unitary in character, which it stores away for future retrieval.

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Once we said our ABC's by rote. Later, we learned them visually as forms written down. Then we came to know them as related: i. e., as sound to symbol. Our bundle of information was getting larger, more unitary. Still later, we could write the symbol first by copying, and then without the copy. Our hook-up of information was growing. We came, then, to a state of growth where our information could serve still greater needs: we learned to interpret the visual symbol into the auditory ones and then we were reading! Later we spelled; then we took dictation; then we wrote on our own! ! The basic bundle was now ready for the more advanced forms of language which our teachers superimposed upon that basic foundation. All the time, it was the afferent nerves, the brain, the efferent nerves which were serving so magnificiently, even storing away the memory of the input so we could recall how to write the form which we heard first as letter-name and then sound.

All this a man-made computer can do. All this man's brain can do. The brain, too, is a computer: both can process individual data and assimilate and integrate them, both can store and retrieve information, both can work wondrously for us, both can overload, both can break down. One, however, is non-living; the other lives and therefore guarantees to each of us a variety of responses to our environment, the more multiple in proportion as our living brain rises beyond the capacity of other and much simpler brains of lower forms of life.

The brain is a physical organ, tightly compressed, folded over, and literally squashed into one's skull which is its place of residence. Remove it from this place of residence, and, well, you know what!

It is ovoid in shape, spit right down the middle into two hemispheres about whose symmetry or asymmetry arguments abound. It would not weigh much if you put it on a scale but you would be lost without it!

It is estimated that there are at least 92 billion cells in the brain, of which 7 million are in the cortical or outside layers where the highest functions of man are localized; such functions as reading, writing, language, speech, math and the like. Very few people have seven million dollars, so it is hard for us to estimate 92 billion cells in the brain, with 7 million in the cortex alone. Aren't we all very rich with these 7 million brain cells serving our specifically symbolic type of learning which we use every day?

The brain system develops in a hierarchial fashion: first the spinal cord, then the medulla, later the pons, and after that the midbrain and finally the cortex. Let us take a quick view of this since every child we teach will respond well or poorly in relation to the functioning or the non-functioning of this system.

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The growth of the brain (not in size but in function) responds not so much to the element of time as to the kind and degree of stimulation it receives from birth. Two eight year olds sitting side by side could be widely differentiated on the basis of learning achievement. Two factors account for this:

1. the potential programmed into the genetic endowment

2. the opportunity to develop that potential through stimulation, i. e., through USE...through contact with the environment and being stimulated by its unlimited potential for information.

That is why it is said THE BETTER THE BRAIN THE BETTER THE GAIN. Isn't that what Head Start and similar pre-school programs are all about? Isn't that why the movement programs for pre-school and early school children are now being so widely employed? And this is, I believe, the principle of positive early stimulation which Carl Delacato advocates.

This brings us to another facet of our discussion, namely, the relation between the structure of the brain and its function. Parts of a clothes washer lying in a heap on the floor are useless Unless someone gives it structure, i. e., organizes the isolated parts into a unitary thing, no function is to be expected from it. Because it lacks structure, it lacks a suitable arrangement of its parts; it lacks order; its parts (analogous to body organs) are unorganized. It cannot function.

The principle involved is this: STRUCTURE IS FOR FUNCTION.

How a thing is designed and constructed will tell us how it should function. Paradoxically, it can happen in the human computer but nowhere else, (not in machines, for instance) that the reverse can also be stated; namely, that function is for structure. In this reversed form, as applied to the human brain, the meaning is narrower but it is true. It states that in human activity the more the brain (structure) is stimulated, (function) the more the afferent neural tracks are kept busy conveying information to the brain cells, the more richly the brain will be developed. This, of course, is the reason why early stimulation of babies is provided by mobiles, blinking lights, rattles, music sounds, etc. from the earliest days. This, too, is the reason why athletes go into rigid training sessions. They develop through exercise a more powerful body.

The environment must get into a brain and it must do so by the only possible pathways, namely, the sensory-neural system. The difficulty of getting environmental information into Helen Keller's brain was so monumental that it has provided all of us with a story of courage, patience, determination, exhausting effort, and....success. The things Annie Sullivan made Helen Keller do were done to set up new pathways, and uncommitted areas of her brain were made specific for the functions needed.

Helen Keller would be a good illustration of the principle that neurological organization is affected both by one's genetic pattern AND his environmental INPUT.

The genetic plan of development contributed by nature establishes the forms and limits of structural elaboration of organs, tissues, etc. including, of course, the brain. Environmental factors, on the other hand, act to cause modifications of the genetic plan within those limitations set by the genes. An impoverished environment, deprived of adequate sensory stimulation, results in an impoverished brain whereas a more enriched environment will produce a more ready pupil. Annie Sullivan got the environmental pathways open to Helen Keller and was then able to bring her genetic potential to its fullest realization. We need more Annie Sullivans in our pre-school and in-school programs! The long-debated question, whether nature or nurture produces the better child seems to find its answer more in nurture than in nature.

Some of the reading disabled children whose environment does not sufficiently stimulate the child's sensory systems which then fails to deposit environmental information in the brain, can thus be accounted for.

J. J. Gibson, in his work, The Senses as Perceptual Systems

says: "The whole system of input and output resonates to the external organism."

and, to quote another authority whose books should be read by anyone engaged in stimulating children in the classroom, Dr. Edwin LeWinn, in his book, Neurological Organization, says:

"The genetic code establishes the blue print which determines whether the organism be lion or lobster. It delineates the potencies of the organism for becoming a superior or inferior member of its species, or something in between. The environment determines the extent to which this potential will be achieved."

Let us summarize Part I. of the lecture by giving Dr. LeWinn's capsule definition of neurological organization: He says:

"Neurological organization is the process whereby the organism, subjected to environmental forces, achieves the potential inherent in its genetic endowments. It is a complex of all those factors which contribute to the state of functional neurological capability of the organism.*

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*Op. Cit.

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Part II. The Transport System

As we enter upon part two of the presentation, it should be obvious that inadequacies in one or more factors of structure or function of the brain, including genetic and environmental impairment, will impair neurological organization in its progress towards the full potential of an individual.

It is not too difficult a thing to take a computer apart to see what it is made of; to see the wires, the transistor, the input and output systems, the associating and integrating components, the "memory" and retrieval systems. We might destroy the computer but at least it is possible to study it piecemeal.

It is not so possible to study the analogous systems of the human brain. Were we able to do so, we might find the secret to the auditorially-impaired child, the visually-impaired, the motor deficient child; the child who cannot integrate information; who cannot store and retrieve it.

Much still remains to be learned about these processes so basic to learning because of the prohibitions of direct assault upon the living system. We must draw upon the findings of the neurologists and neural surgeons and do the best we can. Dr. Roberts and Penfield come to mind as having made significant contributions in this area. So, also, Doctors Brain, Chance, Critchley, Eccles, Ransom, Russell and Sherrington.

It is axiomatic that output can be no better than input; hence if the input systems operate weakly or fail to operate at all in their transportation and communications of information, the output will reflect the inadequacy or the paralysis. The child whose body has not acquired grace and facility in gross body movements is likely to have motor problems in the tasks of copying, drawing, reading (in its motor aspect), writing and, in general, fail to achieve good visual-motor coordination.

It is possible that beyond checking the eyes and ears for sight and hearing, the classroom teacher, the school nurse, or psychologist, may overlook the performance of the conveying systems. Parents habitually do so. Let a parent be told that a child is visually or auditorially impaired (meaning, of course, visual or auditory p e r c e p t i o n is poor) and the response will be, "Why, he can't be. We just had his eyes checked (or his ears.)" This shows a misconception of the terms 'sight' and 'vision', sight which takes place in the eye and vision which takes place in the brain. A child with perfect sight (in the eye) can still be visually impaired (in the corresponding perceptual area of the brain).

Getting the Information on the Road

Let us therefore turn our attention to the transport system where very likely some learning failures may be traced; namely, to the cerebro-spinal neural pathways.

This activity begins in the environment, either internal or external, wherever information can be picked up. It is an unending process, restricted to no time of day or night. We shall follow external environmental input to limit our range to manageable space and time.

The peripheral organs, called the end organs, are designed to pick up sensory impulses. From the eye would be transmitted visual matter; from the ear, auditory, and so for all the external senses.

It is easier to detect deficit in the end organs (as the optometrist does) than when it occurs along the neural pathways. Since those tracks are underground, as it were, and analogous to a subway system, they are less easily explored. One can notice at a subway station if a car has its four wheels, or if its coupling is intact, and all moveable parts are conditioned for smooth operating. While we can know that its structure is intact, we do not know whether the rails or pathways from station to station are operating as they should, whether the switches are shifting as required, transporting their burden of steel along its determined route; in other words, whether the system is <u>functioning</u>.

Neither do we know how the transmission of a stimulus in the form of a nerve impulse will be conducted along the almost endless, complex, even congested pathways from eyes or ears until it arrives at the central depot. The kind of transmission along the route of delivery to the brain may be the real villian in a given case. It may be the reason why the brain is not receiving intact images of a visual form which the eyes took in, or intact auditory images of sound which the ears received and started down the neural track to headquarters.

Can it be that this system fails in transmitting images which are adequately seen, heard, felt, even smelt and tasted but that the information arrives at the brain distorted, garbled, a mis-match with reality, so that it does not truly represent reality? Is this the function (or its structure) which brings <u>mis</u>information to the brain instead of information? Is <u>this</u> where the trouble might be when to a child a <u>d</u> becomes a <u>b</u>, or <u>on</u> becomes <u>no</u>? When a child in one or other of his input systems becomes disoriented?

An additional word about the neural tracks will further enlighten us.

Back at the pickup point (eyes, ears, etc., tastes, etc.) the sensory receptors, which in reality are energy transducers, convert one form of energy into another. The conduction of an impulse along the nerve fibers of the afferent network, accompanied by an alteration of the electric potential of the tissues, must enter into the central nervous system where the stimulus is processed. If there is to be reaction or response to this bit of information, the central nervous system must assist in transmitting the response across sensory modalities into the motor system and thereafter there occurs an outbound trip through efferent motor pathways to the environment. This transmodal activity, especially between the visual and the auditory pathways, is frequently not successfully accomplished by the perceptually-handicapped child. To bring about this shunting of neural impulses into appropriate outbound pathways requires untold numbers of central association neurons, of connections and interconnections, of switching from one axon to another,....in all, a somewhat hazardous passage over a far more complicated route than even the New York subway systems.

However, the structure of the neural system has been designed for just such activity. Let us investigate.

A nerve cell and its axon constitutes a neural fiber. At one end of the fiber is the receiving structure and at the opposite end the discharging structure. The discharging structure (dendrites) of one neuron intermingles, (interlaces with) the receiving fibers (brush ends) of the succeeding axon, forming a junction or transmission point known as the synapse. A whole session could be spent with interest and profit on current explorations and discoveries concerning the synaptic connection.

Some investigators into synaptic transmission claim that the forward moving impulse causes an excitor substance to be liberated by the terminals of a preceding axon. This substance excites the second neuron and initiates the nerve impulse in it. Whether this chemical theory or the electric theory of synaptic transmission is the correct one, the end results are the same: namely, that thenerve impulse is not transmitted AS SUCH across the synaptic interval but it serves to excite a new impulse in the next axon along the line.

With rare exceptions each nerve cell receives information directly in the form of impulses from many other nerve cells - often hundreds - and transmits information to a like number. Depending on its threshold of response, a given nerve cell may fire an impulse when stimulated by only a few incoming fibers or it may not fire until stimulated by many incoming fibers. It has long been known that this threshold can be raised or lowered by various factors. Moreover, it was conjectured some 60 years ago that some of the incoming fibers must inhibit the firing of the receiving cell rather than excite it. The conjecture was subsequently confirmed, and the mechanism of the inhibitory effect has now been clarified.

At first thought it might seem unimportant for us to discuss this point, but, indeed, the specific difficulty a child may have in learning might be localized in the synaptic connection between one neuron and the succeeding one. If the firing is weak, if it is not sustained, if it is inhibited, what or how much of the original pickup gets through? Does all the information the neuron is carrying get through, or a weaker version of it, or none at all?

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Earlier explanations of neural transmission suggested that the impulse raced along the pathways after the manner of an express train moving with unbroken movement straight ahead from terminal to terminal through the switches as if they did not exist. Since much study has been made on the synaptic connections, it is now believed that the transmission is in the nature of a relay which, though travelling incredibly fast, is required to slow down at every synapse, as the information awaits pick-up by the next axon in the line.

Sir John Eccles writes (in Scientific American, January 1965):

"The electrical impulse that travels along the axon ceases abruptly when it comes to the point where the axon's terminal fibers make contact with another nerve cell.... If the nerve impulse is to continue beyond the synapse, it must be regenerated afresh on the other side. As recently as 15 years ago some physiologists held that transmission at the synapse was predominantly, if not exclusively, an electrical phenomenon. Now, however, there is abundant evidence that transmission is effectuated by the release of specific chemical substances that trigger a regeneration of the impulse."

Could the synapse be the side of the child's breakdown in learning? The answers to these questions seem to belong to the future, but the likelihood seems most probable that difficulty may be expected there.

Part III. Arrival at the Brain

Every movement is FROM somewhere TO somewhere. Movement of neural impulses does not escape the law.

Also, every motion will respond to the degree of force which activates it, whether it be the motion put into a ball by the arm of a child; the motion of a vehicle reacting to the source of its propulsion, or a neural impulse as it responds to a suitable stimulation.

In the situation we are exploring, let us suppose the external excitation was proper and adequate, i. e., the pick-up was flawless. Let us presume, too, that the input was transmitted along the pathways and suffered no blockage or diminution at the synapses. In other words, the transport was without crippling incident. Can it then be anticipated that the discharge of information into the brain will insure reception of knowledge? That delivery and reception will be automatically assured? The answer is NO. Let us look for a moment at the "delivery platform"; namely, the reception areas of the brain.

A quick view of this mapped brain will save us words...and minutes!

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We might ask: Is the brain ready to receive this information?

Is it ready by reason of structural intactness? of functioning?

of organization?

Can the final connection between the pathways and the specific areas of the brain be negotiated without loss of intensity? with sufficient duration on the parts of both the final discharging axon and the receiving area of the brain?

Can the brain process the information? Can it, that is, assimilate it, relate it to previously stored information, associate it wholly; integrate the "bits" coming simultaneously from one or several external sense receptors over multiple pathways so that it contributes to an ever-increasing unit of knowledge?

We must realize that arrival at destination and touchdown can be as hazardous as any point along the route.

Poor reception or poor processing on the part of the brain itself, or even nonreception in a specific area, may account for a child's learning problems. So some pertinent questions might be raised and perhaps the answers to one or all of them may be forthcoming from current and future experimentation. We may then obtain insight into knowing why a child is a disabled learner or reader:

1. Is there delayed maturation in the brain or neural tracks?

2. Is adequate structure there? Are nerves myelinated? healthy? stimulated?

3. Is there dysfunction in the brain or neural pathways?

4. What, specifically, is malfunctioning: motor input or output? visual? auditory? associative functions? memory? integrative? interpretive?

5. If there injury in the brain or neural track?

6. Is there mental capacity for the kind of learning you wish to input?

To some of these questions we already know how to look for the answers. For others, the answer still lies in future research.

What is perhaps frustrating to us teachers is that in our present state of knowledge, we cannot pin-point precisely the area of dysfunction. It may be anywhere: in pickup - transport - delivery, in one, or two, or all three aspects.

There is hope, however, in the principle that structure is for function and that good functioning improves structure. This is the greatest argument AGAINST leaving a learning-impaired child unstimulated, untaught. He above all others needs stimulation so that improving function (e. g. exercising him in the employment of reading skills) the brain itself will respond to the multi-faceted stimulation and thus enhance subsequent function.

It says, in brief, that if one teaches to a child's specific disabilities while employing his strengths to counteract his weaknesses, the battle may yet be won!

> In things this is not so. One does not improve the structure of a carpet sweeper by continual use of it; otherwise repair men would be out of work and manufacturers would look for another product.
>
> When one sees that function is failing or has failed or has never been initially educed, then one should suspect the structure. What is wrong? What part is missing? What part doesn't gear with another? What part is too weak? And so we know where the structure is inadequate, under-developed, delayed in maturation, by seeing how it functions. A new bulb; a heavy-duty cord; a twist of a screw; might be all that is needed to enhance the structure of a dishwasher and assure proper functioning.

Farther than that one cannot go in non-human things, but I believe it is different with human beings. The movement proponents, Kephart, Delacato, Getman, all have something in common, both in principle and procedures: they set up programs of training (of function, that is) to bring about improved structure so that function might be performed at its best possible level. Sensory input is for motor output!

It is in this principle that, in my opinion, the Delacato program helps most with under-developed, poorly functioning, and brain-injured children. From a study of a child's functioning to discover which ones are under-performing, and noting the time element in the chronological age of a child when such function should be expected, it is possible to stimulate appropriate areas of the brain (or in case of irreversible injury, adjacent areas) to arouse, to awaken, as it were, areas of the brain improperly functioning and thereby achieve an improved structure which is more aptly developed for appropriate functioning. I have seen children improve under all three types of programs or combinations of them: Getman with his goal of visual competence; Kephart with his movement program for improved perceptual-motor skills; Delacato with his goal of achieving brain readiness through adequate input for overall enriched performance. All three use gross motor movements of creeping, crawling, cross pattern walking. All three use visual training and ocular-motor tasks. All three of these concerned men start where correction is needed. All three work for improvement in function. They differ in this, that only Delacato makes a frontal attack on the brain itself and the pathways which subserve it, by providing stimulation where it has been short-changed. In nature, crawling precedes creeping and prepares for it; creeping precedes walking and conditions for it, and the areas of the brain which program these developmental skills are successive stages in the development of the cortex where symbolic learning takes place. In this sense, I think Delacato offers the greatest promise.

I believe he has the most rational approach to organizing a child neurologically making him ready for learning, be it reading or math or whatever.

Conclusion:

Defective structure is revealed in deficient functioning. So if a child in your class doesn't read (or learn anything, for that matter) properly, explore to see where he is failing to perform, where he is unable to integrate with other new or old learnings for effective operation.

If a child is not performing at expectancy levels, you might ask yourself: Are his visual channels performing adequately? (But do this only after his eyes have been checked.) Are his auditory channels performing adequately? (But only after his hearing has been checked.) Is his trouble in remembering? or in making wholes out of small bits of information (like in doing a puzzle, but with his mind, rather than with his hands and his eyes)? Does he have visual-motor difficulty? How is his Winter Haven? Does he pass the Draw-a-Person test? What about his auditory-vocal performance? Does he speak unclearly? mumble some sounds? neglect endings? mispronounce vowels (aigfor egg)? Does he have discrimination trouble in any modality: that is, can he tell a b from a d, the sound of short i from short e? Is he ready for learning?

What have been his environmental offerings: rich? poor? mediocre? indifferent? How stimulated is he culturally? socially? familial-ly? Does he have body image well developed? Does he know where his body parts are and how they are organized and what they are for? Does he know left from right on himself? on a mirror image of himself? Is he lateralized? Has he developed dominance? Does he know directionality and the terms which express it: up, down, before, behind, beside? Does he have gross body skills: can he run, jump, hop, roll, skip, crawl, walk in cross pattern? Does he know space? himself in space? himself related to things in space? Can he balance himself? How is his head-paper position? How does he grasp his pencil?

These are some of the things that neurological organization is concerned with. These are things which, when performed properly, render a child ready for learning, any kind of learning, but specifically for symbolic learnings as in writing, reading, math. Tests are available to determine these things.

Various studies have shown that the ability of the organism to absorb, to integrate, to organize and store information arein proportion to the rate of development of the central nervous system. Webb in his "The Organism of Behavior" etc. shows the special importance of early experiences for the development of perceptual and intellectual skills.

Let us not forget our psychology courses:

Sensation is the basis of perception

Perception is the foundation of conception

Conception is the mental ability to read and comprehend what is read

Neurological Organization is the <u>condito</u> <u>sine</u> <u>qua</u> <u>non</u> of the three processes.

<u>Summary</u>

Let us summarize the more important principles we have discussed:

1. It is a principle of neurological structure and organization that no function can evolve unless there is structural equivalent available to it. Consequently, functional aberrations will reflect parallel structural abnormality in an individual.

2. Prior to birth, the genetic thrust is the more powerful; subsequently, the environmental factors act to cause modifications of the plan, - impoverished or enriched, as the case may be.

3. The ability of the organism to absorb, to integrate, organize and store information is in proportion to the rate of development of the central nervous system.

4. The processes of association and integration sum up a child's current learning. Deprivation of experience can therefore be readily understood to exert a deterrent to learning. Nature may have conferred on an individual all the structure needed to function adequately, yet the extent to which the function is operable will depend upon the opportunity to operate.

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"It is a matter of common knowledge," says D. Krech* "that environmental factors, inadequate family unit, ghetto existence, undernourishment, poor health, and the like are capable to producing structural aberrations during pregnancy, during birth, and during the post-natal period...The anatomy and chemistry of the brain and the learning ability of the individual can be changed by the psychological richness of the environment... The ability to adapt to environment and to learn from their environment advances as the brain becomes increasingly organized."

Keith E. Beery** notes that sub-cortical integration may be faulty and failure to achieve neurological organization because of inconsistencies of corticle transmission or because of insufficient stimulation.

5. Mere environmental opportunity for sensory intake without appropriate motor participation of the organism disrupts the unity of sensory-motor relationships. Held and Heim write *** "Normal visually guided actions cannot be accomplished... when although given opportunity for visual intake, they are at the same time deprived of other sensory stimuli, especially the kinesthetic factors in locomotion," This is the reason for the motor perceptual programs which are being employed increasingly for organizing poor readers and preventing problems at the pre-school, kindergarten and first grade levels.

6. Transmodal activity is frequently not successfully accomplished by the perceptually-handicapped child.

7. Perception may be impaired because of the brain's unreadiness to receive incoming information adequately or because of dysfunction along the neural pathways or poor stimulation of the receptor cells.

8. Sensation, perception and conception are three differing functions of the human person and they should be carefully distinguished one from the other, though their relatedness and inter-dependence must be understood by the teacher.

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*D. Krech, "Behavior, Brain, Bio-Chemistry, in SCIENCE 51:858:1966

** Keith E. Beery, in <u>Visual Motor Integration</u> monograph

*** Richard M. Held, a lecture given at a M. I. T. Alumni Seminar Session on "The Mind of Man"

As I close, we must all be thinking: WHAT CAN I DO ABOUT IT? What can I do about the child unready for learning who nonetheless sits among his peers as if he were performing? The answer must be sought in an ongoing quest for understanding, in wide reading, in developing ingenious plans for teaching that child, in trial-and-error experiments on our part, and in willingness to become involved. We must for always and everywhere be concerned with this type child and leave no stone unturned in seeking and developing help to assist him. Above and beyond all else, UNDERSTAND HIM; because he does not understand himself!

Let me say, a little facetiously that with billions of cells and miles of conduction pathways, unnumbered junctions and alternate routes, the nervous system had better be organized lest we taste smells; hear sights; smell sounds; touch tastes, or activate our arm muscles when we want to walk. Ninety-two billion cells in which to store knowledge, seven million of them for use in reading and writing, - what wealth we all have!

Use them, every last cell of them, for the disabled reader, for the non-learning child!

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