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CEREBRO-SPINAL REFLEX RESPONSE UNDER δ OR θ

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Zoethout says that "Life is a constant change to meet environment". That sentence describes in a few words the functions of the nervous system.

It is generally accepted that the first living thing was a single cell. Whether this cell had its origin on this earth, or whether it was brought here from another celestial body does not particularly interest us here. The thing that does interest us is what happened to it.

Being a single cell, its problem of existence was comparatively simple. It was made up of cytoplasm and a nucleus, its outside or exposed surface was a toughened portion of this cytoplasm and was capable of allowing materials to pass through, food passing in and waste matter, which was the residue of chemical action inside the cell to pass out. The first cell must have had a sort of nervous system, regardless of how simple, otherwise there would not have been the life-spark necessary to cause metabolism.

Gradually as cells were reproduced, and banded themselves together, some of the cells were separated from external environment by other cells. These secluded cells found that something had to be done about it, so they developed a nervous system. This was and is the vegetative nervous system. (At this stage of the game the need for a voluntary nervous system was unnecessary. All these cells needed to do was take on the necessary amount of foods, get rid of the waste, make a few more cells and stay right where they were.)

Students have followed the development, from this stage to the present pretty conclusively, but, as we are interested in the present-day animal we'll just skip along to the human of the present and look at his nervous system.

To carry this out I have come to the conclusion that by following the chapter, "The Central Nervous System and the Six Senses" starting on page 223 of Clendenning's book "The Human Body", both the writer and the listeners will have an easier time.

Quoting from Clendenning, - "No broadly philosophic view of the human organism can fail to assign the central nervous system, the place which is that of the holy of holies. Without it we should be senseless, sightless, soundless, motionless masses of multiplying protoplasm. Everything else about the body is vegetative. Which means like a plant. A plant can neither move nor feel; it's life processes are carried on in response to the most primitive chemical and physical changes in its immediate environment. The central nervous system gives us every contact which we ever possess with the rest of the world; it responds to those contacts in terms of agreement or repulse. In some mysterious manner it furnishes us with every association, every pain, and every delight which we experience throughout our lives. The pain and the delight are linked; they are embodied in the same masses of protoplasm, we could not have one without the other.

"So, while it is not possible to describe it in any detail, we must try in some way to give a brief description of the general manner in which it operates. What I hope to do is to suggest an answer which is fundamental – what is the nature of reflexes. A reflex is a response to a sensation. Therefore, we must first inquire what is a sensation? In order to do so we must take a brief excursion into the field of anatomy of the central nervous system.

"The anatomy of the central nervous system will be understood in its simplest form, I think, by examining a unit of the central nervous system, which is a nerve cell, or a neuron. The typical neuron consists of a large cell-body, with nucleus and cytoplasm. From that cell body a long fiber extends out. This fiber makes connection with some part of the periphery or outer part of the human body – some neurons make connection with a muscle. The fiber is a part of the nerve cell; it connects the cell body with the outer part of the human body – some neurons make connection with a muscle. The fiber is a part of the nerve cell; it connects the cell body with the muscle. Impulses from the cell body travel along the fibre and are transmitted to the muscle; they result in muscular contraction; nervous energy is transformed into muscular energy. This describes a motor neuron. Another cell might be represented with a fiber going out to a different sort of structure to the skin. In this case the impulse would go, not from the cell outward to the peripheral structure, but from the skin inward to the cell, carrying the sensation of feeling. Besides this fibre, traveling from the periphery to the cell body, there is another fibre coming from another part of the cell body and seeming to be lying in space without any connection with anything in particular. This one is prepared to make connections with similar fibres from other nerve cells, receiving an impulse from it and transmitting the impulse along its fibre to the muscle. Still a third type of neuron could be represented. This neuron would have no fibre attached to any peripheral structure. It would be prepared to transmit a nervous impulse from one nerve cell to another. This simple sketch contains the germ of all the functions of the nervous system. Essentially the nervous system consists in myriads of cells of this kind, grouped together in so-called ganglia, each connected by fibres with other nerve cells or with peripheral structures

"If the bony cavity which encloses the central nervous system were laid open from skull to the tip of the spine, we could see that it is composed essentially of masses of nerve cells called ganglia and of their connections. The ganglia are superimposed on each other, the more complex above, the less complex below. Thus at the bottom is the spinal cord, consisting of relatively simple masses of nerve cells with fibres running upward and downward outside of these nerve cells, the fibres carrying impulses to or from different masses of nerve cells. Above the spinal cord are the medulla oblongata and the cerebellum - - more complex and larger masses of nerve cells, still with cords of fibres running between them to higher and lower centers. Above the cerebellum is the brain, consisting of the large masses of nerve cells, the entire rind of it being a huge collection of nerve ganglia. These are connected together by nerve fibres. Note in this description that we speak of masses of nerve cells, and collections of nerve fibres. Since they are actually of that color, these are distinguished in the ordinary talk and writings of neurologists as gray matter and white matter, the cell masses being gray matter and the fibres white matte.

"In looking at this central nervous system with its bony covering removed another point will catch your attention. Entering it from all parts of the body are nerve fibres. Or rather, if we wish to see it from a penetrating eye acquired after a study of minute anatomy of these fibres, some of them are entering from outside, and some are emerging from it and going out to various parts of the body. If we follow one of these fibres which is entering the central nervous system back to its point of origin, we may discover that it begins in the skin in a flattened-out termination of the nerve fibre, which we will call, as everyone else calls it, an end plate. It is a sensory end plate in the skin, designed for feeling and the nerve which goes from it to the central nervous system is a sensory nerve carrying impulses, in this case, impulses of feeling, from the skin to the great central ganglia. Some of the end plates, designed for special forms of sensation, may be very elaborated, such as the sensory end plate of the optic nerve in the eye, designed for receiving vibrations of light and translating them into impressions of sight.

"If now, continuing our investigations, we follow one of the nerve fibres which originate in the central nervous system and go outward, we find that it terminates in an end plate also. This end-plate is always of simpler character than any sensory end-plate and terminates in a muscle. These are motor end-plates and the nerves of this character are called motor nerves.

“We find, then, that we have two sets of nerves, one set, the sensory nerves carrying impulses from the end organs of sense in the skin and joint surfaces or from special sense organs such as the eye or ear to the central ganglia to the muscles. The impulses which go from the outside in are called afferent impulses; the impulses which go from the inside out are called efferent impulses.

“Is there any other kind of impulse which flows along these fibres besides sensory or motor impulses? Yes, there must be. When a certain nerve is stimulated and a gland begins to secrete, an impulse travels along that nerve fibre, and it is not sensory, and, though it is efferent, it is not motor. Most such impulses, however, relay through the vegetative nervous system. Fibres from all the sympathetic ganglia along the anterior surface of the spine enter the spinal cord, usually by way of the sensory spinal ganglia. So that the old primitive vegetative nervous system, which does all the work of all these somatic functions of the body, is connected with the historically newer center, and if I may use the word in a rhetorical, not a scientific sense in order to make a distinction, the conscious nervous system.

“We must carry our brief anatomical survey of the central nervous system a step further. Let us follow every connection of a single sensory fibre after it leaves the end-plate in the skin. The fibre runs along in a nerve bundle until it reaches its cell, which is in a spinal root ganglion lying just outside the spinal cord. Every nerve cell has at least two fibres, axons and dendrites as they are called, emerging from it, so that from one it can receive, by the other transmit nervous activity. These two fibres in the sensory spinal root ganglion form a T shape, one end of which we have just followed to the cell, the other of which leaves the cell and enters the spinal cord by the posterior nerve root. Here it breaks up in a set of filaments which are in contact with at least a half dozen other filaments coming from other nerve cells. It is important for us to understand what are the connections of the singe sensory nerve cell. One is immediate to a cell in the anterior of motor part of the gray matter of the cord. From this anterior horn cell, a fibre goes out in a nerve to a muscle near that part of the skin in which the sensory end-plate from which we stated is located. Here, then, is an immediate possible nervous response. If that sensory end-plate in the skin were irritated (burned, pinched) the impulse would travel along the sensory nerve, race through the spinal cord level, be transferred to a motor nerve, and a muscle would pluck the irritated spot away from its irritation. The first association, then, is from a spot of sensation in the skin to a spot of muscular response nearby. But the sensory cell has many other connections. It sends long fibres up the spinal cord, which enter the cord at other levels and make sensory and motor connections. The result of this is that if the irritation to the sensory end-plate be strong enough, large areas of the spinal cord will be involved and pain and movement be widespread instead of, as in the first case, simply local. Then a fibre goes upward clear to the medulla oblongata, ending in the nucleus cuneatis, or the nucleus gracilis. From these again a series of connections are made, one fibre going to the cerebellum. Remember these various connections of the cerebellum when we come to consider its special functions. Still other sensory fibres ascend past the cerebellum and go to the brain, some to the lower brain ganglia (the optic thalami, corpora quadrigemina) and some to the cortex of the brain itself, where, if impulses reach to that point they are established in consciousness.

We could follow the motor fibre in the same way we have followed the sensory fibre. The motor fibre arises (the sensory fibre terminates) in a cell in the brain cortex, crosses over to the opposite side of the spinal cord, establishes connections with ganglia in the cerebellum and medulla on the way down, goes through the pyramids, and terminates in connections with cells in the anterior root of the gray matter in the spinal cord. From here it sends out fibres to muscles (or in a few cases to glands).

An outstanding feature of the association of the fibres from the cortex to lower levels is that both the sensory and motor fibres cross over after they relay at the medulla and go to the brain cortex on the opposite side from that of the muscle or skin area in which they originated, so that if the motor area of the cortex of one side of the brain is destroyed, the muscles on the opposite side of the body will be paralyzed.

"We are now in a position to answer the questions concerning nervous activity which we proposed to ourselves. It is unnecessary for you to have followed in detail the various lines of association I have pointed out, but you can from a superficial reading of them see that the central nervous system is essentially a number of masses of nerve-cells connected to each other by a complex set of fibres. The function of the nerve-cells connected to each other by a complex set of fibres. The function of the nerve-cells connected to each other by a complex set of fibres. The function of the nerve-cell is to interpret the impulse brought by the nerve-fibre, and to initiate new impulses to be sent out over other nerve fibres. It is like a telephone exchange system in which the individual telephone is a nerve cell and the wire the nerve fibre; the telephone exchanges are the large ganglia where he impulses or messages are relayed to their appropriate destinations. We may even venture to define nervous activity for the moment as a mass of reflexes or as the translation of one form of nervous impulse into another.

"Here a curious fact comes to notice. If we take a purely sensory nerve, such as the fifth cranial, which goes to the face, out a portion of it between its origin and termination, and replace this out-out strand with a fresh strand of fibres from a purely motor nerve, the nerve fibre will heal up in the course of time. (A nerve fibre will regenerate, provided the nerve cell to which it belongs is intact. A nerve cell once destroyed is destroyed forever). It will take some weeks for nerve tissue regenerates more slowly than any other, but when it gets through, we shall have a sensory nerve with a splice of what was originally motor-nerve tissue in it. Yet the impulses which go along that nerve will always be sensory. The point I am endeavoring to make is that the quality of a nerve impulse depends on the end-plate and the nerve cell, not upon the fibres carrying the impulse.

"Our first task, then, is to inquire what the nature of a nerve impulse is – and here we are met with a philosophical difficulty. We know a great deal about nerve impulses – how fast they travel, what will initiate them, and the physical and chemical environments of the nerve fibres which will hasten or delay them – but we can only guess what the impulses itself is. The guess is that it is "the rapid passage of a wave of chemical decomposition", in the words of Watson, who goes on to say, "If a hair on the skin is touched, it is assumed that the structure and composition of the surface film (surface films must exist between two structures which are in contact) of the axons ending around the hair is altered. The state of electric surface polarization is thus changed and the bio-electric circuit arising between altered and adjoining unaltered regions completes the activation." But after all it is of no consequence what, in its essentials, the impulse is. We do not know what, in its essentials, an electric impulse is, but we do know a great deal about it. About the nerve impulse we know that it can be initiated and sent along a nerve fibre by various agents – electricity, pinching the nerve, chemical substance applied to the nerve. The rate of movement of a nerve – impulse is slow, about thirty meters the first second, varying with the temperature of the fibre and other factors.

"If the total activity of the central nervous system is the sum of its reflexes, we must understand what a reflex is. We have already illustrated one sort. When the skin, say, of the hand accidently comes in contact with a hot stove, the muscles of the arm jerk the hand away. This jerking is done immediately, long before the sensation of pain reaches what I am afraid, in spite of Dr. Watson, I must still call consciousness, and long before there can be any willing to pull the hand away done by the higher physical centers. What happens is that the sensation of burning sweeps along the sensory nerves with such force that before it becomes known in consciousness, it overflows in the spinal cord into the motor nerves at that immediate level causing a muscular response. Reflexes of this simple kind are used by neurologists to test the integrity of the nervous system. When you sit with your legs crossed and the physician taps you on the tendon just below the knee, the muscles in the leg of a normal person contract and cause a jerk of the entire lower leg. This is called the knee reflex, or knee-jerk. It is impossible for anyone to prevent the knee jerk except by keeping all the muscles of his leg so stiff that no additional contraction could occur. A mere complicated reflex is used by the neurologist when he throws a shaft of light into the eye; as soon as this light is on the retina, or sensory organ, the pupil contracts. This is entirely beyond the voluntary control of the individual; no amount of thinking can prevent it. These reflexes are relatively simple. They consist in an impulse applied to sensory and organ, carried by sensory nerves, being transmitted to a motor ganglion and carried by a motor nerve back to its end organ in a muscle, there resulting in a muscular contraction. It is possible, however, to consider nearly all the activities of the nervous system as reflexes. In the more complicated ones, all human organisms will not respond alike. A shout (a sensory auditory impulse) may make an honest man turn around and a thief take to his heels. In both instances there is a muscular response, but conditioned by the kind of life each has led. Sometimes, a sensory impulse is not translated into a muscular response of any kind and we must assume that a reflex of a different character has occurred. In the older days, psychologists called it thinking. The sight of a lovely landscape will arouse an emotion of pleasure. The sound of music will be carried through the auditory nerve to the auditory nerve center in the temporal lobe, then by some process far too mysterious for us to understand, it is related to consciousness and memory.

"In this discussion of reflexes, we have always assumed that the arc is initiated by a sensory impulse. It is logical to inquire, therefore, what the nature of sensation is. There are several kinds of sensation. The old classification used to be that there were five senses. But feeling alone can be subdivided into several groups – that of temperature (the hotness or coldness of an object) of quality) the smoothness, roughness, wetness, dryness, hardness softness of an object), of pressure and shape, and any of these are recorded by quite separate kinds of sensory end-plates. For instance, there are hot and cold nerve-endings in the skin and they are separately and peculiarly distributed. Another sense, that of equilibrium, has a perfectly distinct end organ and its own nerve pathways to the brain. So that the old classification of the five senses goes by the board.

"It is pointed out above that a nerve fibre of a certain kind could be replaced along a part of its length by a fibre of a different kind, yet the impulse would result as if no replacement had been made. In a similar way, theoretically, the fibre of one kind of sensory nerve might be spliced into that of another without changing the quality of the sensation. To be concrete, the fibres of the auditory nerve might be spliced into the optic nerve, and the eye would still do nothing but see, it would not hear. The suggestion is purely theoretical, as the auditory nerve has never been spliced into the optic nerve; the thing would which really happen would be degeneration, as we cannot experiment with these higher sensory organs safely, but the theoretical discussion will serve to make my point, which point is that the quality of a sensation depends upon the sensory end organ where it originates and the reception area in he brain where it terminates. We know this, that if you are in a prize-fight ad you get a bust on the eye, you not feel pain so much as see visions; a person who has a tumor on his auditory nerve does not feel pain, but hears sounds. When we were discussing the effect of cathartics on the mucosa of the inside of the bowel, we said that the nerves were irritated, but that inasmuch as they carried only one sensation, that of pressure, the effect of the continued use of cathartics is simply to produce a sense of fullness. There is a curious disease of the central nervous system, especially affecting the spinal cord, called syringomyelia. In this condition it is found that, over parts of the sin surface, the sensitiveness to tough is retained, but there are lost the sense of heat and the sense of cold. Patients with the disease may lean up against hot stoves and sustain bad burns without feeling any pain. The hot and cold spots on the skin have been carefully worked out; their number on the feet is very large, the number on the sin of the chest very small. Women could never wear evening gowns in the winter if it were not for the latter fact. Other sensations seem to have quite separate nerves - it is probable that pain is carried by special end organs. The tongue, being a modified piece of skin, has developed some special nerve endings, those of taste, and this sense also is divided so that special nerves carry bitter, others sweet, sensations. The tip of the tongue conveys largely sweet tastes, the back, bitter. Other fibres carry specific acid and salty sensations the optic nerve, because it originates in the retina, can carry only sensations of sight. The auditory nerve, because it originates in the sensory end organ of hearing, can carry only sensations of sound. The eye cannot hear and the ear cannot see. We may, therefore, answer the question, "What is the nature of sensation?" by saying that sensation is specific for the nervous end organ originating it, and the ganglia receiving it.

"The integrative action of the nervous system refers to the motor coordination of the body. When you put your leg in walking the muscles on the anterior surfaces contract and at the same time the muscles on the ;posterior surface relax; when the foot reaches the ground, the reverse occurs, the muscles son the back of the leg contracting and the muscles on the front relaxing. These co-coordinative movements are laid down as automatic pathways in the brain and lower centres. The principle holds in the involuntary muscle system also – the law of contrary innervation. When a muscular contraction moves along the intestines, there is a contraction of one place and a relaxation just in front of it at every step in the [progression of the wave. It has to be so, else there is no contraction wave. When the bladder contracts, the sphincter muscle at tis neck relaxes.

"In what part of the nervous system do all these co-ordinative reflexes center? Probably in the cerebellum. We have seen that the cerebellum always receives a relay fibre from the sensory nerves coming from the skin and the joint surfaces and also from the motor nerve centers above in the cerebral cortex. Besides, it receives fibres from the eye centers and the ear centers. Of major importance for its functions, it receives fibres also from the organ of equilibrium, - the semi-circular canals placed near the internal ear, and consisting of three hollow bony rings placed at three levels or in three planes of the body. It is always possible for you to tell even with your eyes closed whether you are standing upright or lying on your back or side. It is doubtful if you can tell whether you are standing on your head, unless you are accustomed to doing so. All these fibres enter the cerebellum and it is a sort of clearing house for skin, muscle, and joint sense, for visual and auditory impressions, and for motor impulses.

"I can best show the way in which the cerebellum accomplishes its functions by an illustration. The golf player is urged by all his instructions to keep his eye on the ball when he is about to try to hit it. Why should this help him? His eyes are about six feet away from the ball, his hands at least three feet. Why should looking at the ball help him to place one tiny space on the face of his club within one sixty-fourth of an inch of the spot on the ball which will send it the farthest and straightest? The answer is: On account of his cerebellum; because his cerebellum, receives fibres from the center of vision in the brain, from the organ of equilibrium, from muscles and tendons of arms and legs and trunk, and from all his joint surfaces. All of these together give him the sense of space and distance, and the muscle sense of steadiness. The cerebellum, also makes connections with the motor centers, sending fibres out to his muscles. This gives him the motor sense of "placement". At no other place are all these functions of sight, equilibrium, feeling, and motion brought together.

"The sense thing happens with a baseball player at bat. He has to see the ball in order to hit it with his bat. And yet why? How does it help him know that the ball at a certain instant of time will be just at the level of his belt at distance of four feet, one and one-quarter inches from his body? If you told him that you would confuse him. Yet the cerebellum makes the ten thousand calculations necessary from him to hit the ball. I will not say with unerring accuracy, because as every schoolboy certainly knows, it is not always hit with unerring accuracy, but at least sufficiently frequently to be astonishing. Athletes need not have very good prefrontal lobes, but they must have good cerebella.

"Patients with disease of the cerebellum, such as a tumor, will stagger, will be dizzy, will be unable to make purposeful movements, or movements that are accurately calculated.

"The motor area of the brain, which initiates voluntary movements, if in the frontal lobe anterior to a large fissure called the Rolandic fissure. If you open an animal's skull and with a very fine electric needle stimulate a very tiny area on the lower part of the convolution anterior to the Rolandic fissure, the animal's thumb will twitch. If a larger needle is used and a larger area stimulated, the entire arm will move. If you progress upwards, the toe will move. If a larger area at the top of the convolution is stimulated, the entire leg will go into spasm. Every time you touch the first spot you touched, the thumb and the thumb only will move. The sensory skin areas are in the region just behind the Rolandic fissure. The centre for vision is in the posterior, or occipital lobe of the brain, The centre for smell; a fascinating syndrome called the uncinate group of fits, consisting of convulsions preceded by a period during which the victim smells a tremendous array of odors, some good, some bad, is associated with tumors in this region.

"The division of labor in the different parts of the central nervous system is of engaging interest, and will repay the wider vista of study which will be found opening in the larger literature of the subject.

If the human body is the most important object of inquiry in man's universe, the human central nervous system is the part of that body which marks him off from all the other animals in that universe.

"Summarizing this account of the structure and functions of the nervous system we may sat that 1. It is made up of a vast number of cells, called neurons; 2. Each neuron consists of a cell-body and a number of fibres; 3. One of the fibres of a great group of neurons enters the cell from an organ of sensation – I the skin, the eye. – and conveys impulses from the external world to the higher centres; 4. Fibres from another great group of cells go out to muscles and glands – nerve impulses going along these group of cells go out to muscles and glands – nerve impulses going along these fibres cause motion of he muscles and secretion in the glands; 5. The other fibres of both these groups of cells and all the fibres of the other neurons make frequent contacts between contiguous cells of the central nervous system; 6. An impulse of one kind – sensation – may be translated into an impulse of another kind – motion – by such contact, the action being called a reflex; 7. The sum of these reflexes constitutes nervous activity; 8. The reflexes may be simple or far too complex for us to grasp – the reflex called consciousness, for instance; 9. The higher centers – those which receive sensations into consciousness, those which initiate motion by volition, which co-ordinate the sensations and motions governing a complex bodily procedure – are strictly localized in certain masses of cells."

To elaborate just a little, there are three classes of nerves – as given by Halliburton:

1. Efferent nerve fibres
2. Afferent nerve fibres
3. Inter-central nerve fibres

Efferent or motor nerves carry impulses from the central nervous system to other parts of the body. A list of classes of efferent nerves is as follows:

a. Motor
b. Accelerator
c. Inhibitory
d. Secretory
e. Trophic

a. Motor nerves. Some of these go to voluntary muscles; others to in-voluntary muscles, such as the vaso-motor nerves which supply the muscular tissue in the walls of the arteries.

b. Accelerator nerves are those which produce an increase in the rate of rhythmical action. An instance of these is seen in the sympathetic nerves which supply the heart.

c. Inhibitory nerves are these which cause a slowing in the rate of rhythmical action, or it may be its complete cessation. Inhibitory nerves are found supplying many kinds of involuntary muscles; a very typical instance is found in the inhibitory fibres of the heart which are contained within the trunk of the vagus nerve.

d. Secretory nerves are found supplying many secreting glands such as the salivary glands, gastric glands, and sweat lands. The impulse which travels down a secretory nerve stimulates accretion in the gland which it supplies.

e. Trophic nerves are those which control the nutrition of the parts they supply.

2. Afferent nerves are those which carry impulses from other parts to the central nervous system. The impulse may or may not be brought to the conscious mind. If the stimulation is great enough, we are conscious of it, otherwise it is taken care of by either ignoring it or by some action of the involuntary nervous system, as in the case of in the alimentary tract, where stimuli to the various parts of this are carried to the proper centers causing action, either muscular or glandular.

3. Inter-central nerve fibres are those which connect nerve centers togethers; they connect different parts of the brain, and of the cord to one another.

What has already been read is in no way an attempt to fully describe the nervous system. It has been intended only to repeat a few of the actions and methods of which we should be more or less familiar when we experiment in stimulating or inhibiting impulses.

The task assigned me was to note the results of the filters δ and θ on the patellar reflex, but as this reflex is only one of the many, and is bound to be related to others in its response to stimulation, I have tried to show that reflex actions are of extreme importance. As Clendenning points out, if it were not for reflex actions we would surely die.

I have tried to find what happens when a nerve's excitability is increased or decreased. I have not been able to find it in books so far, so I called on an M.D. He is a very old friend and one of the most successful surgeons in our part of the state. I tried to tell him what I wanted. I asked him what happened when the transmitting ability of a nerve was altered, he said he didn't know, except the end result. I asked him what he would prescribe for a person who had been under a terrific mental strain for a period of time and was suffering from "nerves and insomnia." He answered that he could tell me that but that he couldn't answer the next question, which he guessed rightly to be, "What happens?"

The above paragraph is an explanation of why it has been impossible for me to say what happens or should happen when δ or θ are given.

Dr. Spitler suggested the move camera and we used five people.

a. Syntonic type, male age 22
b. Asthenic Type, male age 25
c. Pyknic type male age 39
d. Pyknic-Syntonic type male age 37
e. Asthenic type female, age 20

We made first exposures, taking the reflex about five times on each subject to get an average. Then for five consecutive days gave Syntonic treatments of δ or θ as indicated by the type. Then made exposures as before. The results as follows:

A. Asthenic, jerk before Syntonics 5 ½; after Syntonics 3 "

B. Syntonic, jerk before Syntonics 5 ½"; after Syntonics 3 ½"

C. Pyknic, jerk before Syntonics 6; after Syntonics 10"

D. Pyknic-Syntonic, jerk before Syntonics 1", after Syntonics 2"

These measurements are those of the greatest jerk out of the five times taken on each person.

The pyknic above, whose jerk increased four inches, had some stimulation two nights before. He had been one of a crowd at a cockfight when the place was stuck up by five men with shotguns and machine guns.

It is next to impossible to strike the knee exactly at the same place and with the same force each time.

There are a great many things that may alter the results, as heat, time of day, external stimulation, etc.

It is my opinion that to bet anything like an intelligent report on this particular result of /syntonics, it would be necessary to make the tests over a period of time and have a pretty definite knowledge of all conditions hat might alter the results.