

nerve impulses producing them (in nerve centers through which they pass) act directly upon certain efferent (or out-going) nerves, whose function it is to produce musculo-motor action in the body; this resultant action taking place before the conscious mind has had time to direct it.

A study of the cortex of the brain, which is the seat of all consciousness including memory, self-consciousness, and volition, reveals a wonderful mechanism for co-ordinating and relating our sense impressions and musculo-motor action; for instance, the sense of violin playing has its seat in close proximity to the musculo-motor center which controls the motion of the arms; in other words, the place where the final recording of an external impulse takes place is close to and always associated with impulse terminals of a similar nature and at the same time with those nerve cells which can enable the individual to further the action required for the proper development of an accomplishment.

In addition to the foregoing, which has to do principally with the conscious action of the mind, we find a wonderful control of the bodily functions by the brain, which keeps the various organs in harmonious relationship with each other. When, for instance, the environmental conditions demand heavy muscular action on the part of the individual, and there is a waste of muscular tissue and a demand for its removal, the nerve which accelerates the heart action is stimulated and increased circulation results, enabling the blood to carry material for restoring the body tissues to their normal condition and carrying away waste products. At the same time that the heart is accelerated, the lungs are caused to increase their rate of respiration through stimulation of the nerve accelerating the motion of the diaphragm. Many other things too numerous to mention occur simultaneously, such as the operation of the sweat glands to assist the organs of elimination to carry off the waste products, etc.; but enough has been stated to illustrate the point I wish to make, namely, that the whole unity of action is made possible only because of the marvelous control exercised over the body by the nervous system. It is only when this control is lost, through disease or injury, that the unity of action and consequent definiteness of purpose upon which progress depends is impaired.

In order to understand the reason for the simplicity and wonderful unity of the nervous system in spite of its apparent infinite complexity, it is necessary to describe its three great subdivisions:

The *sympathetic system*.

The *spinal system*.

The *cortical system*.

Take first the sympathetic system, which is the seat of those almost entirely automatic functions over which the conscious mind has only very indirect control. This consists principally of the efferent (or out-going) nerve cells, whose bodies are collected into ganglia, or groups, located outside of the spinal cord, principally in the head and in the body cavities. For instance, the nerves which stimulate the growth of the hair, the finger-nails, and even the growth of the body itself; the vaso-constrictor and vaso-dilator nerves controlling the contraction and expansion of the blood vessels; the nerves controlling the beating of the heart and thousands of other functions are all a part of the *sympathetic nervous system*. This is so designed that it constantly reminds and, in a sense, releases the forces required to keep the routine work necessary to our preservation in motion.

Next let us take the *spinal system*, which is located inside of and protected by the backbone. This is the seat of those semi-automatic functions over which the brain has a direct and constant control. These functions—such, for instance, as walking or breathing—after once being set in motion by the will, acting through the brain, or conscious mind, are kept in motion by the nerves in the *spinal cord* without the conscious effort of the individual. It is also the seat of the so-called "reflex, muscular action," which causes the body to act involuntarily for its own protection, when necessary.

The fundamental difference between the subconsciousness of the *sympathetic system* and the subconsciousness of the *spinal system* is that the stimulating nerve power of the latter is more or less directly under the control of the conscious will, while the *sympathetic system* performs its work independently of it.

Finally, let us describe the *cortical system*, which is really an outgrowth of the spinal system, surmounting it, co-ordinating and controlling its action. The upper portion, or cortex of the brain, is the seat of the memory, where all the sensory impressions from every portion of the body are brought by the afferent (of in-going) nerve paths, and from which originate the efferent (or out-going) impulses, which keep the body, functioning properly in accordance with its environment. The will, having the power to recall and use the stored-up records in the brain, can, by means of communicating nerve fibres in the cortex, direct the organism through its outgoing nerves to useful efforts of progressive accomplishment.

Having described the functions of the three main divisions of the nervous system, it now remains to sketch briefly the relationship of each to each other.

The *sympathetic nervous system* is connected, through what the anatomist calls, the "preganglionic nerves" with the brain and spinal cord and comprises the outlying efferent (or out-going) nerve cells, through which the impulses from the central nervous system finally reach the involuntary muscles and glands; the spinal cord connections coming out between the spinal vertebrae, and the direct brain connections being made through the cranial nerves coming down from the cortex direct. The so-called sympathetic nerve cells are connected into ganglia (or groups) located as before mentioned in the head and body cavities. The various nerve plexes, such as the pulmonary and the solar, are also a part of the *sympathetic system*, and the connections into these ganglia and plexes, coming from both the cranial nerves and the spinal nerves, complete the cycle which produces a harmonious working together of the parts and a continuous correcting or complementing action.

I could go on almost indefinitely with illustrations of this nature, but enough have been given to bring out the point I wish to make, namely, that the human body is an organization of many elements (and I might say of many personalities, for each cell has individuality of its own, and many can live outside of the body itself), all working together in harmony, under the direction of the will, acting through the nervous system.

If any one wishes to inquire into the forces which have led up to the individual development of mankind, he will find himself at once plunged into the realm of psychology and mental philosophy. I can heartily recommend such a course as immensely profitable and of practical value.

The five important facts, however, that have to do with the subject in hand are:

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1st. That the human body is such a wonderful organization because it is the product of the forces of creation, acting through millions of years of evolution.

2d. That its capacity for progress depends upon the maintenance of the unity resulting from this creative evolution and upon a conscious recognition of this unity.

3d. That this unity would not have been possible without the development of the nervous system.

4th. That the conscious intelligent progress made by mankind could not have reached its present level until in the process of evolution a mechanism had been built up in the nervous system itself capable of recording the various impressions which the senses are constantly receiving.

5th. That the recording of past events, with the power of consciously recalling them for the solution of problems immediately confronting it, is absolutely essential to its development.

Now, what I want to point out is that inasmuch as man's progress depends upon the perfect co-ordination of his forces to produce unity of action, we have no right to expect an industrial organization to make progress (which it must do as a unit) without the establishment of a conscious co-ordinating mechanism similar to the nervous system in the human body.

Is it not a fact, then, that the success of scientific management, properly applied, is due to its action in building up the individuality of the organization? I think there is not the slightest doubt on this point, nor is there any doubt that the failure of some organizations to put their business on a scientific basis has been caused largely by the fact that they have not used the mechanism of scientific management for the purpose of perfecting its unity.

I am personally very familiar with one large, flourishing establishment, which has no less than one hundred recording and one hundred indicating instruments, representing twenty or more different kinds of sensory impressions, such as temperatures, pressures, colors, gas compositions, liquid densities, liquid levels, etc., all required in order to maintain uniformity of product and economy of operation.

Recognizing, then, these various recording devices and instruments which come in direct contact with the work as the end organs of newly acquired senses, we must conduct the impulses resulting from the instrumental contacts through suitable channels to the place where all things affecting the organization are recorded.

We must have, in other words, an organization, memory, which is entirely apart and separate from the memory of the various individuals of the plant. It is only by having such a place of record, where all things affecting the organization as a unit can be recorded, that a proper perspective can be obtained.

A gradual development of such a memory by the addition of new senses will tremendously accelerate the rate at which the organization will progress, just as in the individual the addition of new concepts to the brain tremendously increases its reasoning power.

In designing the recording mechanism, or plant memory, it is best to use graphical methods in order that comparisons may be easily made. Figures, if must be remembered, are static, while curves show tendencies.

By the use of graphical records, things affecting each other can be brought in close relationship, enabling those whose

business it is to control the manufacturing process to see at a glance what action is necessary on their part to produce the best results, not only with respect to their own department, but with respect to the whole plant.

If I had time, I would like to describe to you in detail a chart room containing over 1,400 separate plotted records, all used to record the operations of a single plant. These charts are so arranged and grouped as to be instantly and at all times available for study by those directing the organization's activities. This department is the plant memory and corresponds to the third and last acquired great subdivision of the human nervous system—the brain.

Having described the memory part of the organization as corresponding to the cerebrum of the brain, let us now consider the part corresponding to the spinal cord, which is the seat of what we will call the vital or intelligent subconscious action. In our industrial organizations this corresponds to the control by the department heads and foremen, who are constantly directing and setting in motion corrective forces tending to keep the organization functioning properly. This is analogous to what the anatomist calls "reflex action."

Now, in the average organization, much of the work is done in this manner without direction from the central conscious mind. There being no plant memory, this is the only way it can act and progress is necessarily extremely slow, as it is, for instance, in the insect world where the spinal system is not surmounted by a brain.

As the co-ordinating effect of a brain, however, enables the spinal cord to do much better work, so does the addition of a plant memory tremendously aid by intensifying the subconscious action; as, for instance, when it acts through its executive branch to stimulate the creative energy of the foreman, sub-foreman, and even individuals, by giving them a record of the performance of their work and by making comparisons with others. By this means a spirit of emulation is built up which makes each man desire to do good work of his own free will. The urge comes from within instead of from without. The result of having this spirit permeate the organization means an entire reversal of the old order of things, where the chief executive uses his creative force to make his department heads carry on their work and they in turn pass the impulse along to their foremen and so on until it reaches the last man in the organization, where it is felt very faintly indeed.

The new order carried out to its ultimate point means that each man in the organization is interested because those above him have had brains enough to furnish him with the means of recording his progress. He then feels that he is creating something and is happy. His foreman, being released from the tedious work of making his men work against their will, finds stimulation in directing the forces he feels flowing upward for him to direct. As a consequence, he becomes creative in his work.

The department head has the same experience and finally the chief executive finds himself directing the forces looking to him for leadership and he himself becomes creative and no longer wears himself out by trying to drive his own creative force into the men in his organization, thereby depleting his own supply.

Finally, let us take that part of the organization corresponding to the *Sympathetic Nervous System*, for it has a very important place in our scheme of rounding out the organization's individuality. Much of the organization's activity must become automatic, otherwise our capacity to acquire new accomplishments will be greatly limited. Man's prog-