

The tone of the muscular system may be maintained (just as excito-motory acts may be excited) by changes within the cerebro-spinal ganglia; or, in other words, by centric changes. We have a remarkable exemplification of this general principle in those examples of somnambulism in which the individual is perfectly insensible to external impressions. In these the nerves sleep, the brain wakes. But the contrary may happen; the cerebro-spinal ganglia may cease to react so as to induce muscular tone, while the incident excitator nerves are awake. Something like this occurs when certain emotions (as fear) excite such violent nerve changes as to interrupt the action and reaction of the central ganglia on the incident-excitator and reflex-motor nerves. In such an instance as this, muscular tone is not only destroyed, but the contractility of the sphincters is abolished. The action of certain poisons on the central ganglia is precisely analogous. Tartar. emetic, tobacco, &c., by their action on the cerebro-spinal axis, destroy the tone of the muscles, more or less completely.

II. *The diffusion of impressions with reference to reflex cerebro-spinal action.*—When an impression is made on an afferent nerve an instantaneous change takes place in the gray matter of the ganglion in which the nerve terminates, and this is propagated to the roots of the muscular nerves. But it has been generally forgotten that this is not all; a change passes also along the twigs of the sympathetic nerve connected with the ganglion, and so the secreting as well as muscular and sensory structures have an influence communicated to them. In short, a change is effected in all the fibrils entering into the composition of the ganglion. The proofs of this proposition are various: Firstly, it is actually observed to occur in the lower forms of organized matter. Secondly, it has been found by experiment, that the influence of impressions is diffused through a chain of connected ganglia, as for example, when the cord of a frog is subjected to experiment. (Vide Stilling's Researches in Br. and For. Med. Rev. vol. XVII., p. 399, and Propositions 12 and 13, p. 403.) Thirdly, pathological observations agree with the results of vivisection. In analysing a case of paraplegia, following a blow on the neck, and detailed by Dr. W. Budd, Dr. Carpenter makes the important deduction "that all influences from impressions or incident nerves are diffused through the cord." (Principles of Human Physiology, 1st ed. p. 132.) This principle of the diffusion of influence is applicable as well to the encephalic as to the spinal ganglia. The motor track throughout the cerebro-spinal axis is distinctly influenced by every act of volition, and the whole of that axis, whether sensory, motor, or sympathetic, by every emotion. The action of the heart, for example, is accelerated, as is well known, by very slight muscular efforts; the simple act of rising from the recumbent to the upright posture accelerating the pulse. This diffusion of the volitional influence is seen in disease of the motor system; in chorea it produces irregular muscular movements; in epilepsy, the motor excitement resulting will prevent the fit.

That the influences from emotional impressions are diffused through the whole cerebro-spinal axis, is one of the best established facts in physiology. The effect of vivid emotions on the functions of the viscera is instantaneous. The skin, intestines, kidneys, liver, heart, salivary and lachrymal glands, and capillaries of the surface, are notoriously influenced by them: Dr. Erdmann, of Dresden, relates a case in his Medical Observations, of a body whose face, when he was put into a passion, became quite pale on one side and red on the other; and there was an exact boundary along the centre of the face, proving the common union of the sympathetic motor and sensory twigs in the encephalon. The influence of emotions on the hue of the chameleon, and on the colours of certain fishes, strikingly illustrates their operation on the whole system. No class of causes are so influential in exciting convulsions as the emotions, but like the volitional stimulus, the emotional excitement will prevent excito-motory phenomena, and even cure paralysis. Both fear and anger have been known to have this result. It is manifest, too, that the diffusion of the influence of emotional impressions is not limited to the true spinal system, or to the ganglia at the base of the brain, for the exaltation or confusion of the understanding, often amounting to insanity and an abolition of consciousness consequent upon their operation, plainly shows that they not only rouse it, but their influence is diffused through the cerebral hemispheres,—the organs of intellect.

Many curious phenomena are singularly illustrative of this diffusion of impressions, and are easily explained by it. Dr. Stilling points out its share in exciting the emotional error and conserva-

tive acts, when disagreeable impressions are made on afferent nerves, (Br. and For. Med. Rev. vol. XVII., p. 139.) The influence of light on the nervous system in maintaining its activity and tone, and preventing sleep, is well known. This influence is subject to the law of diffusion. Jungken was acquainted with two persons who were instantaneous seized with asphyxia if light were excluded, or awoke in a state of suffocation if their taper had gone out. A case of this kind is stated in Dr. Forbes's translation of Laennec. In these instances the incident-excitator impression of light maintained the activity of the respiratory ganglia, prevented them in fact from going to sleep. The diffused influence of light will produce an opposite effect. Obs. 86, in Borden's 'Recherches sur le Pouls,' is that of a very aged female in whom a single ray of the sun or the light of a candle excited an abundant sweat, so that she was obliged to be always in the dark. Many of the phenomena of mesmerism may be explained on the hypothesis of a diffusion of the influence of impression; indeed the theory is as capable of extensive and important applications to therapeutics and hygiene as the excito-motory doctrines.

III. *The substrata of physical phenomena.* The question necessarily arises how is it that when an impression is thus diffused through the cerebro-spinal axis, certain groups of muscles, the contractions of which constitute instinctive, emotional, consensual, and volitional actions, are excited into energy. The answer must be sought in a knowledge of the histological composition of the cerebro-spinal axis, and of the nature of the biochemical changes induced therein, and on the periphery, by the qualities of matter. These adapted acts differ very widely from mere convulsive movements or tetanic spasms, both in their nature and mode of excitement. There is manifestly a mechanism on the periphery from which the sensitive nerves commence, as well as in the centre, appropriate to the inner or ganglionic mechanism. The doctrine of a molecular organization within organized structures, such as that it shall correspond and be appropriate to given stimuli received by appropriate organs, necessarily constitutes the basis of all inquiries into the laws of action in those structures. And there can be no doubt, such is the magnificent uniformity in the immense diversity of creation, that the laws of action of the agent and reagent in vital phenomena, are as definite as those operating on chemical phenomena, could we but effect a sufficiently minute analysis and induction.

It may be useful to state some general principles respecting the ideogenic and kinetic substrata, alluded to as making up the nervous centres. In the first place, it is to be observed that they are as invariably transmissible from parent to offspring as any other portion of the system, and are subject to the same laws of development; they are therefore as much a part of the animal as its nerves or blood-vessels. This proposition must be steadily remembered as an important clue to an explanation of the origin and mode of action of the substrata in the cerebro-spinal axis. Secondly, these ideogenic and kinetic substrata may be modified, as any other organ of the body, by intermixture of species or genera; or new substrata may be formed by the reaction of external stimuli on those already existing; or, in other words, new instincts may be acquired and be transmissible. This proposition is scarcely less important than the preceding. Thirdly, these substrata may be persistent as a part of the organism, and continue to be manifested by acts long after the necessity for those acts, as conservative of the individual or race, has ceased. Fourthly, these substrata may be dormant for a lengthened period from the want of a reagent, and appear extinct, but will reappear so soon as the impressions adapted to their action are received by and conveyed along the afferent nerves. Fifthly, as there is a general development of organised beings, as well as of races, those substrata which are common to all will be the most indestructible in each, and the instinctive acts of which they are the basis, the most decided and permanent.

The illustration of these propositions need not be numerous. The invariable sameness and permanence of the instincts of the hymenoptera among insects is one of many similar examples. The crossing of breeds of domestic animals and the mixed qualities resulting, is a familiar illustration of the second proposition. Many examples of acquired instincts are on record; several of the best authenticated are detailed by Dr. Carpenter in his 'Principles of General and Comparative Physiology,' 1st ed. § 549. The following is an interesting fact of this kind. A troop of cavalry, which had served on the continent, was