Art. VI. *A brief review of Dr. Marshall Hall's views on an Excito-Motory System of Nerves, by* N. S. Davis, M. D.

[Communicated to the Society.]

Perhaps a correct knowledge of the physiology of no part of the human system is of more practical importance than that of the nervous tissue. For not only is it the seat of many of the most important and dangerous diseases which afflict mankind, but it is the chief instrument by which we gain a knowledge of all other affections. It regulates the motions of the limbs, the attitude of the body, the expression of the countenance; by it we experience sensations of pleasure and pain; and under its influence we give vent to our feelings in articulate sounds. Hence its natural and healthy functions cannot be too carefully studied, nor too well understood; for notwithstanding the brilliant discoveries, and the consequent vast increase of our knowledge concerning the functions of different parts of the nervous tissue, it cannot be denied that the precise functions of many parts are still involved in obscurity. Among those parts requiring further investigation, perhaps none are more important than the respiratory system of Sir C. Bell, or the excito-motory of Marshall Hall, and the nerves of organic or vegetative life. The direct practical bearing of the views of Marshall Hall concerning his excito-motory system, renders a thorough examination of the facts on which those views are professedly based, an object of the first importance.

The direct experiments which demonstrate the excito-motory phenomena are as follows: "A horse was struck with a pole-axe over the anterior lobes of the brain. It fell instantly, as if struck with a thunder-bolt; it was convulsed, and then remained motionless. It shortly began to breathe, and continued to breathe freely by the diaphragm. When lacerated or pricked with a sharp or pointed instrument, as a *pin* or *nail*, on any part of the *face* or surface of the body, it was totally motionless, manifesting no evidence of sensation or volition. When, on the other hand, the *eye-lash* was touched with a *straw*,

the eyelid was forcibly closed by the action of the orbiculars; when the cornea was touched, the eye-ball revolved outward by the action of the *abducens*. When the verge of the anus was touched, the sphincter contracted forcibly. The upper part of the medulla oblongata was now destroyed; there were violent convulsions; the *respiration* ceased, and the eye-lid and eye-ball remained motionless on the application of stimuli."*

From this and similar experiments it is inferred, that the sentient and voluntary functions having been destroyed by the blow of the pole-axe, the contraction of the orbicularis, abducens and sphincter muscles must depend on a distinct system of nerves, having its centre in the medulla oblongata and spinalis. This is the excito-motory system of Hall. It embraces, first, the excitors, viz: the fifth or tri-facial; the pneumogastric; and the posterior spinal nerves. These are distributed to the eye-lid, nostrils, fauces, face, larynx, pharynx, lungs, stomach, anus, cervex vesicæ, cervex uteri, and the general surface of the body. Secondly, the motors, viz: the fourth, sixth, seventh, tenth, or pneumogastric; spinal-accessory; the phrenic; the inferior external respiratory of Bell, and an undefined portion of the spinal nerves. These are distributed to the same part as the excitors, together with the whole muscular system.† The functions of this system are said to be, to regulate the acts of *ingestion* and *egestion;* the functions of respiration, deglutition, defecation, urination, &c. and to give *tone* to the whole muscular system. The extreme branches of the excitors distributed to the mucous membranes, are also supposed by Dr. Hall to constitute the seat of the internal senses, or appetites; and he further attributes to this system of nerves, organic or nutritive functions.‡ These views of Marshall Hall are also embraced by Mr. Aston Key, Dr. Golding Bird, Dr. Bright, Dr. Whiting, and Mr. Grainger, who states that the centre of the system is in a distinct tract of the spinal marrow and medulla oblongata, lying between,

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* Hall on the Nerves, p. 28.
† " " " pp. 25, 26.
‡ " " " p. 46.

and partly enclosed within the sensative and motor columns This minute anatomist alleges that he has verified the existence of this column by actual dissection, and describes it as composed principally of grey substances, sending filaments to the posterior roots of the spinal nerves. These statements are said to be confirmed by the dissections of Samuel Solly, and disproved by those of Mr. Hilton, and many others.* That the spinal marrow contains in its interior more or less of a grey substance resembling the cortical, or cineritious substance of the brain, is not doubted; but that filaments can be distinctly traced from this into the roots of the spinal nerves, I have never been able to prove. And beside the existence of such a column, possessing the functions attributed to it, is directly contradicted by the experiments of Dr. H. H. Smith of Philadelphia;† and also by M. Magendie, Muller, Tiedemann, Dr. J. Reid and others. Indeed if we examine carefully the positions taken by the advocates of a distinct excito-motory apparatus, I think we shall find many of their conclusions unsustained by their premises, or by pathological facts. In the first place, they represent the spinal excitor nerves as distributed to the muscles of the eye; to the *face*, neck, and general surface of the body; while in the horse struck with the pole axe, the application of stimuli to the face, or any part of the surface, produced no effect except on the eye-lashes and verge of the anus. But why should not those branches of the tri-facial or fifth pair distributed to the face, exhibit the excito-motory phenomena as well as those distributed to the orbicularis palpebrarum, if both forme dparts of one and the same system? Or if excitor nerves from the spinal marrow are distributed to the "general surface of the body," why will not pricking or lacerating any portion of this surface produce some effect as well as touching the anus? Again, if the excito-motory system constituted the organic or nutrient nerves for the external parts of the body, as the ganglionic or sympathetic does for the internal, how could it

* See a Report of the Proceedings of the Physical Society, Guy's Hospital, 1838.

† Amer. Jour. Med. Sciences for 1837, No. 40.

ever happen that the external parts of the body should be tolerably well formed in the fœtus, while the whole medulla oblongata and medulla spinalis, and of course the whole centre of the excito-motory system, were wanting?" And further, if the tri-facial or fifth pair are nutritive nerves, why does not the destruction of them at their roots prevent the future nourishment of the face? True, it has been asserted on the authority of M. Magendie, that the destruction of the fifth nerves within the cranium destroyed the eye, from want of nutrition; but this assertion has been abundantly disproved by a great variety of cases and experiments.* That the excito-motory apparatus is the seat of the internal senses, seems to be equally devoid of proof; for if we admit that the ganglionic or sympathetic system of nerves presides over the organic and nutritive functions, we should conclude, *a priori*, that the wants of the organs would be primarily indicated by these nerves, and consequently that in them are seated the internal senses. That the sense of hunger and thirst are not seated in those branches of the par-vagum or pneumogastric distributed to the stomach, is fully proved by the experiments of Dr. Reid, who states that animals often live several days after both the par-vagum and recurrents are cut, with no other inconvenience than a very slow and laborious respiration. He further states, that the functions of the digestive organs and absorbents continued to be performed in a regular and healthy manner.† Another proposition of Dr. Hall is, that the excito-motory system gives tone to the muscles, and is the seat of nearly all our spasmodic and convulsive diseases; but to suppose the numerous instances of convulsions from disease of some portions of the brain, to be caused only by pressure on or extension of the disease to the alleged centre of the excito-motory system, is to imagine what cannot be easily demonstrated. Besides, the morbid appearances of the spinal marrow in cases of tetanus are by no means generally seated in the central excito-motory column described by Mr. Grainger. Indeed, if contraction of

* London Medical Gazette, February. 1840.

† Report of the Proceedings of the Medical Section of the British Association of Science, 1838.

the muscles in voluntary motions are induced by the nerves of voluntary motion, under the influence of the natural stimulus of the will, what simpler process of reasoning can be imagined, than to infer that irregular, spasmodic, or involuntary motions would be induced by the same nerves under the influence of unnatural stimuli, or irritation. And instead of this sytem giving *tone* to the muscles, we think facts will warrant the conclusion, that this quality of the muscular fibre depends entirely upon another cause, viz. the presence of well oxygenated or arterial blood; else why does not contraction of the orbicularis palpebrarum, and other excito-motory phenomena, take place after the lungs are deprived of oxygen, or in a state of asphyxia? If the foregoing objections to the views of Marshall Hall are well founded; if his excito-motory system of nerves neither control the functions of nutrition in the external parts, nor form the seat of the internal senses, nor give rise to ordinary convulsions and spasmodic diseases; then is it reduced to nothing more nor less than the respiratory system of Sir C. Bell.

There seem to have been two grand errors in the investigations of Hall and his followers. The first consisted in not duly considering the structure and functions of the internal ganglionic or organic nervous system; the second in forgetting the experiments which prove the centre of the nerves of sensation and voluntary motion to exist in the medulla oblongata, and the consequent possibility of exciting contraction of the voluntary muscles, after the cerebral functions had been removed.

Having devoted some attention to the anatomy and physiology of the *organic* system of nerves, I am not only inclined to favor the views of Miller and Breschet, but think that future observations will show it to consist, like the sentient and voluntary system, of two sets; one for organic sensibility, including the internal senses; the other, sanguineous, intestinal and organic motions. The first are distributed in the mucous membranes, the internal coat of the heart and arteries, where it receives the stimulus of oxygenated or arterial blood, &c. The latter are distributed to the muscles of organic or vegeta-