

May 12, 1870.

Dr. WILLIAM ALLEN MILLER, Treasurer and Vice-President,  
in the Chair.

THE CROONIAN LECTURE, by AUGUSTUS WALLER, M.D., F.R.S., of Geneva, "On the Results of the Method introduced by the Author of investigating the Nervous System, more especially as applied to the elucidation of the Functions of the Pneumogastric and Sympathetic Nerves." Received May 12, 1870.

(Abstract.)

Dr. Waller commenced by stating that he had been long engaged in the investigation of the nervous system by means of the method which he introduced many years ago. After drawing attention to the importance of the functions of the nervous system as the seat of all the higher faculties which distinguish animals from plants and man from the lower animals, he referred briefly to the general constitution and intimate structure of the nervous system. It is known that after a nerve has been disconnected from the central organs, its medullary part undergoes a series of changes. The tubular medulla, or white substance, is disintegrated and finally converted into dark granular matter. On this alteration the author founded his method of investigation, as it enables the inquirer to distinguish the altered from the sound fibres at any point of their course. Dr. Waller soon applied his method to the study of the sympathetic nerve, and was enabled thereby to clear up a great part of the mystery which hung over the origin and functions of this nerve—a nerve which supplies and presides over some of the most important organs in the body, the liver, the intestines, the womb, and especially the blood-vessels.

In this manner, while associated with Dr. Budge, the author determined the part of the spinal cord termed by them the cilio-spinal region, which, through the part of the sympathetic connected with it, governs the dilating fibres of the iris. In the hands of Prof. C. Bernard, Brown-Sequard, Dr. Waller, and others the results obtained in this inquiry have shown the relation of the spinal cord to the important functions which the sympathetic nerve exercises in regulating the supply of blood in the vessels and, as a consequence, in controlling the general nutrition and temperature of the body.

Dr. Waller next applied his method to the elucidation of the functions of the ganglions or swellings found on the origin of many nerves.

On dividing the roots of the spinal nerves, it was found, after a certain lapse of time, that on the posterior root, which is alone possessed of a ganglion, the central segment remaining in connexion with the spinal cord became disorganized and its elements passed into a state of granular degeneration; whereas in the distal segment remaining in connexion with the gan-

glion the nervous elements retained all their normal structure, evidently showing that continuity with the spinal cord does not prevent it from becoming disorganized, whereas its connexion with the intervertebral ganglion suffices to preserve its integrity of structure.

In the divided anterior root the phenomenon takes place in an exactly inverse manner from the former. For in this instance the central portion connected with the spinal cord retains its normal structure, while the distal part becomes disorganized and reduced to a granular state. We therefore arrive at this conclusion, viz. that the spinal cord confers on the anterior root that unknown vital power whereby its elements resist granular disorganization; whereas for the posterior root, on the contrary, this preservative power is no longer an attribute of the spinal cord, but resides in the ganglion.

The author pointed out the important bearings these results had on pathology—that henceforth in diseases of the spinal cord and of the brain, we had to endeavour in our pathological examinations of these parts to ascertain in each case how far the alterations could be referred to the separation of a part from its trophic centre.

Dr. Waller then referred to his researches on the Pneumogastric and Spinal Accessory Nerves.

If, from among the various nerves of the human body, we were called upon to point out that which has most exercised the patience and ingenuity of anatomists and physiologists, we should at once indicate the vagus. Its distribution to the larynx, the lungs, the heart, and the stomach shows us at a glance the important nature of its functions. At its origin it is formed by roots springing from the medulla oblongata, to which is added afterwards a considerable branch from the accessorius, which joins and mingles with the pure vagus with which its fibres become intimately blended. The problem to be solved, therefore, is the precise functions of each or of either (*i. e.* the accessorius or pure vagus) before their anastomosis.

In ordinary circumstances nothing would be more simple than to uncover the nerves and to galvanize each separately, as in the case of an ordinary spinal pair. But here the case is different. In their origin these nerves are so close to the medulla oblongata and the blood-vessels that any such operation is quickly fatal, and the irritation of the minute roots of each nerve in close proximity renders it impossible to obtain any precise results. Professor Bischoff's attempts at division of the roots of the accessorius in the vertebral canal rendered it probable that it gave motor fibres to the vagus which were distributed to the larynx. So far the previsions of Sir Charles Bell were confirmed, who compared the internal branch to the anterior or motor part of a spinal pair, and the true vagus with its ganglion to the posterior root. Professor C. Bernard had, however, succeeded in entirely destroying the power of the accessorius by evulsion of its roots, and had arrived at the conclusion that all the fibres of this nerve are distributed to the laryngeal muscles whose functions are connected with the pro-

duction of vocal sounds, while other fibres from the pure vagus govern certain nutritive or organic functions connected with respiration.

In order to separate the functions of the one from the other, we require to destroy all the fibres of the accessorius and leave the others intact, which has been done most effectually by Dr. Waller's process; first disconnecting the accessorius from the medulla, on Bernard's plan, and afterwards allowing the animal to live sufficiently long for the fatty degeneration to take place, or about seven or eight days. The vagus then being galvanized at every part of its length, it is found impossible to affect either the action of the heart or the stomach, and the only result is to cause slight movements of the larynx.

It is therefore evident that Sir Charles Bell's ideas respecting this nerve are in a great measure demonstrated by this experiment; the only exception being with regard to certain fibres of a motor nature distributed to the larynx, which it may be surmised are derived from some anastomotic source, and therefore not contained in the vagus at its origin. Dr. Waller referred to the recent researches on this subject by Professor Vulpian, MM. Jolliet, Schiff, and Heidenhain, who have confirmed the results above stated.

The Lecturer then proceeded to his observations on the pneumogastric and sympathetic nerves on man in health and in certain affections of the nervous system.

He was first induced to undertake this subject on account of the unsatisfactory results obtained by galvanizing this nerve and the cervical sympathetic on man. In man this operation is frequently resorted to by medical men, but in no case has any one asserted that any of the known symptoms of irritation of those nerves, such as stoppage of the heart's action, dilatation of the pupil or contraction of the vessels, have been produced. The inference is that it is erroneous to suppose that they were in any degree affected by galvanism. By means of mechanical irritation applied over these nerves in the neck, Dr. Waller, in 1862, found that most of the known effects of their irritation, such as dilatation of the pupil &c., can be induced. The principal effects thus induced are nausea, tenderness, or oppression over the præcordia, and stoppage of the heart's action more or less complete; dilatation of the pupil of the same side, and fall of temperature of the cheek and ear, amounting to 2° or 3° Centigrade, as ascertained by one of Geissler's delicate thermometers. All these effects correspond to those produced by galvanism on the denuded nerves. By means of the mechanical irritation of the pneumogastric in cases of vomiting, the vomiting has been instantly stopped, sometimes returning again immediately the irritation was removed; at other times a permanent relief was procured.

He lastly referred to the effects of collapse and syncope produced by the irritation of these nerves. This effect was well known to Aristotle, who attributes it to the compression of the veins, and describes the effects very accurately in the following passage:—

“ὦν ἐπιλαμβανομένων ἐνίοτε ἔξωθεν, ἀνευ πνιγμοῦ καταπίπτουσιν οἱ αἰθρωποι, μετ’ ἀναισθησίας τὰ βλήματα συμβεβληκότες.”

Dr. Waller has frequently observed the same symptoms, viz. the sudden collapse and temporary insensibility; but in general the effects are confined to a state of depression more or less strong, which may be moderated by graduating the degree of irritation applied. He believes that this fact may be taken advantage of and applied as a means of inducing asthenia or debility for the purpose of facilitating certain operations in surgery, such as the reducing of fractures or even hernia, in lieu of the administration of other anæsthetics, such as chloroform or tobacco, which present a certain degree of danger not attending the compression of the vagus. In confirmation of this idea, he cites a case of reduction of the shoulder-joint in this manner:—

C., a journeyman baker of powerful athletic frame, dislocated the head of the humerus beneath the clavicle by a fall down stairs. While the man was lying on the bed some unavailing attempts were made to reduce the luxation by Dr. Waller himself, Dr. Prevost, and Dr. Julliard. Dr. Julliard, whose patient he was, sent for some chloroform to facilitate the operation by inducing anæsthesia. In the meantime Dr. Waller proposed to make another attempt with the assistance of the compression of the vagus. After removing the pillows at the head and arranging the patient more comfortably, Dr. Waller stood at the head of the bed to apply compression on both sides, while Dr. Julliard and Dr. Prevost performed extension and counter extension. At the end of about two or three minutes, just when the carotids had ceased to be felt beating beneath the fingers, a sudden click indicated the return of the bone into its cavity.

The Lecturer concluded with the following words:—“In terminating his lecture, I cannot refrain from urging on your attention that, if much has been already accomplished by means of this method, there still remains a vast field of inquiry unexplored before us. The nervous system, central and peripheral, is an immense and intricate series of nerve-tubes and of ganglion-cells, and by the method I have laid before you we have already recognized in these elements a great degree of mutual dependence. Within these limits are contained the organic substratum of all that is most noble in our being, of all that elevates the animal above the plant, and that gives man preeminence over the animal. No one can doubt the importance of a thorough knowledge of this system for the efficient treatment of the diseases that affect it. And it may be reasonably hoped that the full development of the method here especially referred to, combined with other modes of investigation, will materially contribute to gain for us a greater insight into the nature of this so highly endowed part of our organism.

“Much that is at present required is a combined and methodical application of the powers and knowledge which we possess; something, in fact, resembling that which has been done by mapping out the surface of our satellite in separate small compartments, each of which is assigned to a

different observer. I cannot help entertaining the hope that something of the sort will sooner or later be undertaken with regard to the investigation of the whole nervous system."

*May 19, 1870.*

General Sir EDWARD SABINE, K.C.B., President, in the Chair.

The following communications were read :—

I. "A Ninth Memoir on Quantics." By Prof. CAYLEY, F.R.S.

Received April 7, 1870.

(Abstract.)

It was shown not long ago by Prof. Gordan that the number of the irreducible covariants of a binary quantic of any order is finite (see his memoir "*Beweis das jede Covariante und Invariante einer binären Form eine ganze Function mit numerischen Coefficienten einer endlichen Anzahl solcher Formen ist*," *Crelle*, t. 69 (1869), Memoir dated 8 June 1868), and in particular that for a binary quantic the number of irreducible covariants (including the quantic and the invariants) is = 23, and that for a binary sextic the number is = 26. From the theory given in my "Second Memoir on Quantics," *Phil. Trans.* 1856, I derived the conclusion, which as it now appears was erroneous, that for a binary quintic the number of irreducible covariants was infinite. The theory requires, in fact, a modification, by reason that certain linear relations, which I had assumed to be independent, are really not independent, but, on the contrary, linearly connected together: the interconnexion in question does not occur in regard to the quadric, cubic, or quartic; and for these cases respectively the theory is true as it stands; for the quintic the interconnexion first presents itself in regard to the degree 8 in the coefficients, and order 14 in the variables; viz. the theory gives correctly the number of covariants of any degree not exceeding 7, and also those of the degree 8, and order less than 14; but for the order 14 the theory as it stands gives a non-existent irreducible covariant  $(a, . .)^8(x, y)^{14}$ ; viz. we have, according to the theory,  $5 = (10 - 6) + 1$ , that is, of the form in question there are 10 composite covariants connected by 6 syzygies, and therefore equivalent to  $10 - 6 = 4$  asyzygetic covariants; but the number of asyzygetic covariants being = 5, there is left, according to the theory, 1 irreducible covariant of the form in question. The fact is that the 6 syzygies being interconnected and equivalent to 5 independent syzygies only, the composite covariants are equivalent to  $10 - 5 = 5$ , the full number of the asyzygetic covariants. And similarly the theory as it stands gives a non-existent irreducible covariant  $(a, . .)^8(x, y)^{20}$ . The theory being thus in error, by reason that it