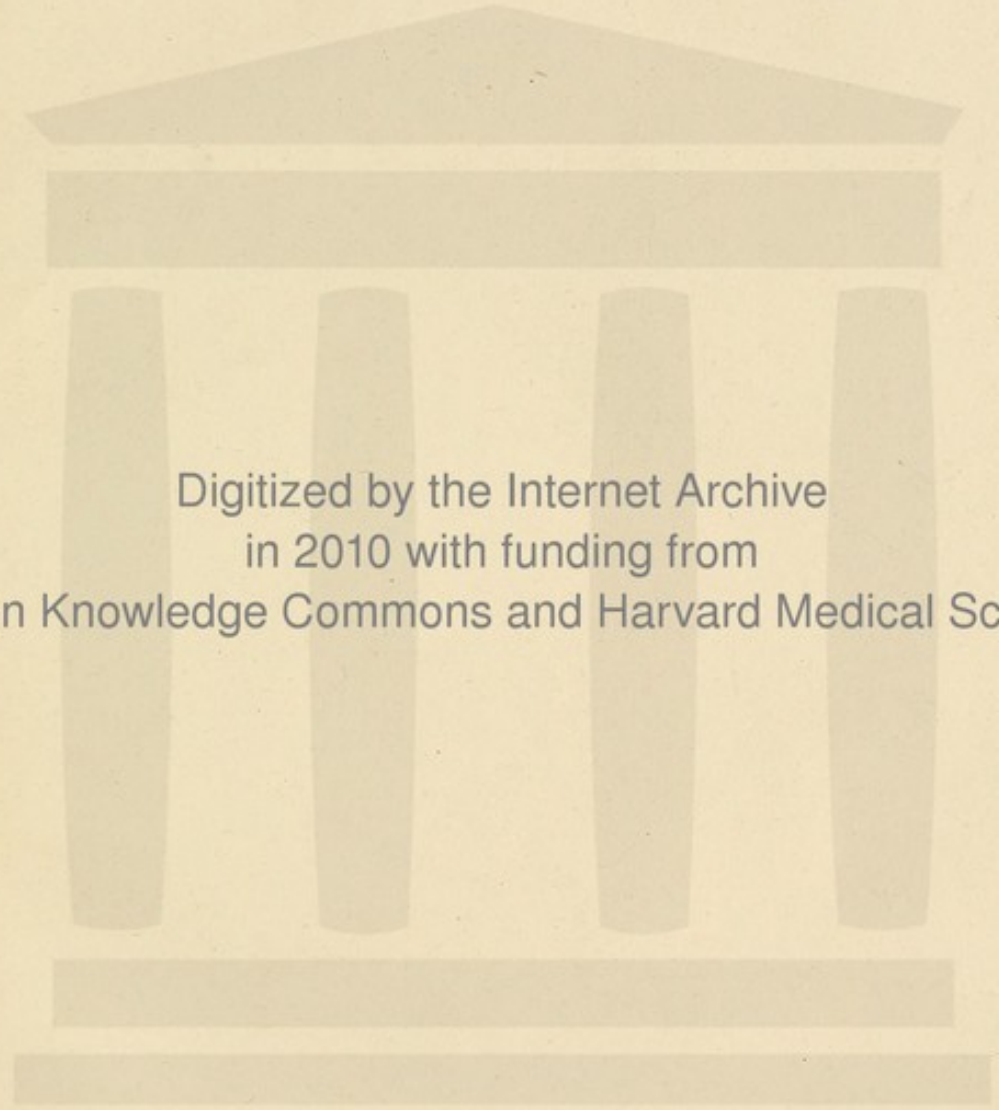
The sympathetic nerve : its relations to disease / by C. V. Chapin.



FISKE FUND PRIZE ESSAY.

1880.

THE

SYMPATHETIC NERVE;

ITS RELATIONS TO DISEASE.

BY

C. V. CHAPIN, M. D.,

HOUSE PHYSICIAN, BELLEVUE HOSPITAL.

PROVIDENCE:
J. A. & R. A. REID, PRINTERS.
1881.

The Trustees of the Fiske Fund, at the annual meeting of the Rhode Island Medical Society, held in Providence, June 9, 1880, announced that they had awarded a premium of Two Hundred Dollars for the best Essay on "The Sympathetic Nerve; its Relations to Disease," to an Essay bearing the motto, "Grenzstrang," and on breaking the seal of the accompanying packet they found the author to be Dr. CHARLES V. CHAPIN, of Providence, R. I.

EDWARD T. CASWELL, M. D., Providence,
GEORGE P. BAKER, M. D., Providence,
CHARLES O'LEARY, M. D., Providence,
Trustees.

CHARLES W. PARSONS, M. D., Providence,
Secretary of the Trustees.

The Sympathetic Nervous System.

Synonyms: —

Sympatheticus magnus, *Nervus Intercostalis* (*Willis*), *Nervus intercostalis magnus*, *Nervus trisplanchnicus* (*Chaussier*), *Rumpfnervensystem* (*Burdach*), *System of organic life*, *System of vegetative life*, *Ganglionic nervous system*, *Grenzstrang* (*German*), *Grand Sympathique* (*French*).

Abbreviations.

Compt. rend.	Comptes rendus de l'Académie des Sciences.
Cbl.	Centralblatt für die medicinischen Wissenschaften.
Deut. Arch.	Deutsches Archiv für klinishe Medicin.
Virch. Arch.	Virchow's Archiv für pathologische Anatomie.
Pflüg. Arch.	Pflüger's Archiv für die gessammte Physiologie.
Gaz. heb.	Gazette hebdomadaire de Médecine et de Chirurgie.
Arch. gén.	Archives générales de Médecine.

Anatomy.

The chief points in regard to the gross anatomy of the sympathetic nervous system, its chain of ganglia, and various plexuses, have been so long recognized and written about that it seems out of place to consider them in an essay like this.

Most excellent descriptions of the general anatomy of the sympathetic may be found in the works of Gray (1), Quain (2), Sappey (3), and especially Henle (4).

The ultimate distribution of the various sympathetic branches in the viscera and organs, over whose functions they preside, will be considered in connection with the physiology of the system much better than it could be by itself. But it may not be amiss, before proceeding to the discussion of the functions and lesions of the sympathetic, to give a brief summary of the various histological elements making up the system.

In regard to the relation of the sympathetic to the cerebro-spinal nerves, three views have been entertained.

The first of these, that of Valentin (5), makes the sympathetic an offshoot or dependent of the cerebro-spinal system, containing no fibres except such as have their centres in the brain and cord.

Another view, though an old one, has been defended by such men of eminence as Bidder (6), and Volkmann (7).

---

1 Gray, Anatomy, Descriptive and Surgical. 2 Quain, Anatomy. 3 Sappey Traité d'Anatomie. 1874. 4 Henle, Nervenlehre. 1876. 5 Valentin, De functioribus nervorum cerebralium et nervi sympathici. 1839. 6 Bidder, Erfahrungen über die functionelle Selbständigkeit des sympathischer Nerven-systems, Müller's Arch. 1844. S. 309. 7 Volkmann, Die Selbständigkeit des sympathischens. Nerven-systems durch anatomische Untersuchungen, nachgewiessen. 1842.

This attributes to the sympathetic a very great degree of independence of action. By its supporters the sympathetic is regarded as almost exclusively the centre of both motion and sensation, for all the vegetative organs of the body.

A third view considers the sympathetic to be made up of fibres, having their origin in the brain and cord, and also of other fibres arising in the cells of the various ganglia. According to this view every sympathetic trunk contains both sympathetic and cerebro-spinal fibres; but, at the same time, not all fibres arising in the ganglia are contained in sympathetic trunks; but some of these join, and run with cerebro-spinal branches. Thus, as Quain suggests, we might, with great propriety, apply the term sympathetic, to all those fibres which have their origin in the ganglia and preside over the functions of organic life, no matter in what trunks they may be found; and the term cerebro-spinal, to all fibres having their origin in the brain and cord.

The ganglia of the sympathetic have branches of communication with each other, and with the cerebro-spinal system, and also branches of distribution to the viscera.

They are invested with a closely adherent envelope of connective tissue, continuous with the sheath of the nerve trunks, and sending septa, supporting the blood vessels, into the interior of the ganglia. To the naked eye they present, on section, simply reddish, gray masses traversed by white nerve fibres.

This gray matter is shown, by the microscope, to consist of nerve fibres and cells. These cells, usually, have only one or two prolongations, and are small in size — varying from $\frac{1}{2500}$ to $\frac{1}{1200}$ of an inch in diameter, Dalton (1), but occasionally larger multipolar cells are found, Schultz.

The cells are enclosed in a capsule, formed of a transparent membrane, with nuclei, and, apparently, continuous with the primitive sheaths of the nerves, Schultz, Key and Retzius (2).

It is possible that the nuclei belong to epithelial cells lining a transparent membrane. The cell itself consists of dark granular matter, containing a clear nucleus and nucleolus.

The fibres, arising from the cell, may be one or more in number; usually two. These are described by Beale as arising on the sur-

---

1 Dalton, Human Physiology. 2 Key and Retzius, Studien in d. Anat. d. Nerven-systems u. d. Bindgewebes.

face of the cell in a spiral manner; but Arnold (1) believes that he can trace them to an origin in the nucleus. When the fibres leave the cell, it has been observed by Beale, Schultz, Key and Retzius, that one fibre runs spirally around the other for a considerable distance in a common sheath, and then separates from it in a sheath of its own.

The nerve trunks of the sympathetic contain both medullated and non-medullated fibres. The former vary from $\frac{1}{1500}$ to $\frac{1}{4500}$ of an inch in diameter; but the most of them are from $\frac{1}{3500}$ to $\frac{1}{4500}$, and present the ordinary characteristics of medullated nerve fibres. The gray fibres are the so-called "pale fibres of Remak;" they are from $\frac{1}{10000}$ to $\frac{1}{5500}$ of an inch in diameter, Flint (2). They are flattened, with regular sharp borders, and present, at different distances, oval nuclei, having about the same diameter as the fibre, and a length of $\frac{1}{1200}$ of an inch. The nuclei are finely granular, and present no nucleoli. For an exhaustive description of the histology of the sympathetic, as indeed of the whole nervous system, there is nothing better than the classical and beautiful work of Key and Retzius.

---

1 Arnold, Virch. Arch. 1875. 2 Flint, Text-Book of Human Physiology.

Physiology.

VASO-MOTOR NERVES.

Though disturbances of the circulation from cutting the cervical sympathetic were first noticed by Petit (1); to Bernard (2), in 1851, belongs the credit of first conclusively showing that the sympathetic exerted an influence on the calibre of the arterioles.

For some time it was believed that these nerve fibres produced, by the muscular contraction which they originated, constriction of the vessels exclusively. But of late years the question has arisen, and been amply discussed, as to whether there are not also vaso-dilator fibres; and some even go so far as to affirm that all vaso-motor fibres are of this latter character.

But whether the vaso-motor nerves be dilators or constrictors, their course and origin has been studied with success.

Brown-Séquard (3) claims that he has demonstrated vaso-motor centres in the cortex; so, also, has Landois; but this is denied by Eulenburg and Guttmann (4), Keussner (5), Hitzig (6), Lepine et Bouchefontaine (7), and Vulpian (8). Schiff concludes that there are some centres in the crura; Vulpian and Philipeaux, in the corpora quadrigemina; Ollivier (9), and Couty (10), in the pons.

Schiff, in 1855, first showed that there were vaso-motor centres in the medulla; so Brown-Séquard, Budge, Bezold, Ludwig u.

---

1 Pourfour du Petit, Mém. de l' Acad. des Sci. 1727, p. 1. 2 Claude Bernard, Compt. Rend. T. xxiv, p. 472; Gaz. Méd. de Paris, 1852, pp. 75 et 256; Rescherches Experimentales sur le Grand Sympathique, Paris, 1854. 3 Brown-Séquard, Arch. de Phys., 2 ser. T. i, No. 6. 4 Eulenburg and Guttmann, Sympathetic System of Nerves. Translation, p. 16. 5 Keussner, Ueber d. vaso-motor. Centra d. Grosshirnrinde. Arch. für Psych. viii. 6 Hitzig, Ditto and Cbl. 1876, No. 18. 7 Lepine et Bouchefontaine, Gaz. heb. 1876, p. 382. 8 Vulpian, Arch. de Phys. 1876, p. 841. 9 Ollivier, Rev. des Sci. Méd. vi, p. 116. 10 Couty. Arch. de Phys. 1875.

Thiery, Kessel u. Stricker (1), and Sobaroff. Owisjannikow (2), and Wood (3), put them in the floor of the fourth ventricle.

That additional centres exist in the cord, has been shown by Lister (4), Goltz (5), Joseph (6), Nussbaum (7), Latschenbergher u. Denhna (8), Stricker (9), Dittmar (10), Pflüger and Vulpian. The latter considers those in the medulla as coordinating centres. The question, as to whether there are local centres scattered along the peripheral branches, or on the walls of the vessels, is not so definitely settled. Arnstein (11), Peschel (12), Huizinga (13), Gergen u. Weber (14), Althaus (15), Dundersand, Gunning, and many others claim their existence; while it is denied by Klebs, Arnold, Beale, Lehman, Bœrwinkel (16), and Henocque (17).

It is certain that there are nerve cells in the cord and medulla, which are capable of acting as centres of reflex action for the vaso-motor nerves, and that from them fibres pass to the arterioles, some by the way of the sympathetic ganglia, and thence through the arterial plexuses; others directly by the spinal or cranial nerves. In the upper part of the body they are contained in the anterior nerve roots; those for the head being at about the level of the third dorsal vertebra, Budge, Waller, Bernard, (18): for the upper extremity, from the first to the seventh dorsal, especially from the third to the seventh, Cyon; for the lower extremity, from the seventh dorsal to the first lumbar vertebræ, Pflüger (19), and Schiff, and some others claim that these latter are chiefly contained in the posterior roots, Bœrwinkel, loc. cit. Brown-Séquard (20), and Stricker (21). Probably there are, in the walls of the vessels, ganglionic cells which are in connection with the nerves above described, and which also receive centripetal sensory nerves, and send motor fibres to the musculature of the vessels.

---

1 Kessel u. Stricker, Sitz. d. Wien. Acad. Bd. 75. Ab. III, S. 83. 2 Owisjannikow, Rev. des Sci. Méd. III, p. 68. 3 Wood, Tenor Lec. No. IV, 1875, Smithsonian Institute. 4 Lister, London. Phil. Trans. 1858, p. 607. 5 Goltz, Pflüg. Arch. Bd. VIII, S. 460. 6 Joseph, Arch. f. Anat. u. Phys. 1879, S. 54. 7 Nussbaum, Pflüg. Arch. Bd. X, S. 374. 8 Latschenbergher u. Denhna, Pflüg. Arch. Bd. XII, S. 157. 9 Stricker, Sitz. d. Wien. Acad. Bd. 75. Ab. III, S. 313. 10 Dittmar, Rev. des Sci. Méd. IV, p. 403. 11 Arnstein u. Meyer, Cbl. 1878. 12 Peschel, Zeitsch. f. pract. Med. 1876, No. 44. 13 Huizinga, Pflüg. Arch. Bd. XI, S. 207. 14 Gergen u. Weber, Pflüg. Arch. Bd. XIII, S. 44. 15 Althaus, Nervous Diseases. 16 Bœrwinkel, Deut. Arch. 1871, S. 141. 17 Henocque, Rev. des Cours. Sci. 1873, p. 88. 18 Bernard, Compt. Rend. 1862, II, pp. 228, 400, 425. Jour. de la Phys. V, p. 33. 19 Pflüger, Allg. Med. Alztg. 1855, No. 68, u. 75. 1856, No. 32. 20 Brown-Séquard, Gaz. Méd. 1856, No. 16, 1723. 21 Stricker, Oest. Med. Jahrb. 1878, H, III, S. 409.

The original idea, that the vaso-motors are purely constrictors, has been adhered to by a number of experimenters, among the most careful of whom are Eulenburg and Guttmann, loc. cit. p. 7et seq. With them agree Putzeys and Tarchanoff (1). Goltz (2) was the first to advocate the existence of vaso-dilator nerves to any extent. He claimed, from his experiments on the sciatic, that that nerve contained dilator fibres; that section of that nerve caused an irritation of these fibres, which produced a corresponding dilatation of vessels and congestion of the part supplied; and that the fall in temperature afterwards was due to the progressive destruction and paralysis of the nerve. He also found that the vessels dilated by directly stimulating the distal portion of the cut nerve. Putzeys and Tarchanoff and Vulpian claim that this was due to a paralysis, the result of over-stimulation. Masius and Vanlair (3) say that the dilators preponderate over the constrictors, while admitting that the latter do really exist. One objection to the theory of dilator nerves is, that its authors claim that there are longitudinal muscular fibres in the vessels' walls; but these have never been demonstrated, except in vessels of the largest size. Grünhagen (4), however, overcomes this objection by his theory that a nerve can act so as to elongate a fibre, as well as to contract it. Those authors who believe in vaso-constrictor nerves exclusively, say that Goltz was led into error by his inaccurate method of measuring temperature by the thermometer. By using the thermo-electric pile these experimenters have determined that section of vaso-motor nerves produces sometimes an immediate, but evanescent, decrease of the vessels' calibre; but that this is always quickly followed by a dilatation, which lasts for hours, or even days and months, and finally gives way to a gradual decrease in size, until the vessels are even smaller than when operated on.

While the existence of the constrictor nerve must not be denied, the greater number of investigators now admit that there are some dilator fibres as well. They were described in the chorda-tympani in 1858, by Bernard, who also found them in the kidneys. Eckhard showed the existence of the nervi-erigentes in the sacral-plexus, in 1863. In 1874 Vulpian (5) found dilators in the

1 Putzeys u. Tarchanoff, Cbl. 1874, No. 41. 2 Goltz, Pflüg. Arch. Bd. IX, S. 174. 3 Masius et Vanlair, Gaz. heb. 1875, p. 633. 4 Grünhagen, Bericht d. Naturforschern-ers zu Köenigsburg, 1877. 5 Vulpian, Gaz. Heb. 1875, p. 105.

glosso-pharyngeals. Schiff (1) has demonstrated them in the superficial petrosal and carotid plexuses and other places. The latter authors, as well as Stricker and Ostroumoff (2), are of the opinion that there are a certain number of dilator fibres scattered, in connection with the constrictors, throughout the body. Among other authors who hold to the double innervation of the blood vessels, are Lepine, Haidenhain and Grützner (3), Frank (4), Kendall and Luchsinger (5), and Bernstein; and it is their opinion that there are cells on the walls of the vessels, or in their vicinity, which receive from the great centres vaso-constrictor fibres, and which also receive other fibres, less numerous than these, which act as inhibitors to them, and which, consequently, are practically vaso-dilators; that fibres go directly from these peripheral ganglia to the walls of the vessels. Thus we have a nervous arrangement throughout the circulatory system, not unlike that found in the heart. A fact which bears strongly on this point is that shown by Dastre and Morat (6); that, after the dilatation caused by section of the cervical sympathetic, we can obtain a hyperdilatation (surdilatation) by strong galvanization. The electric current, ascending to them, destroys by over stimulation the previously unimpaired activity of the peripheral centres.

Besides the direct action of the nervous centres upon the size of the arterioles of a part, we find that there is a constantly occurring change in these vessels, due to some impulse transmitted to the centres by centripetal nerves, and then reflected through the vaso-motors. Rouget (6) and Vulpian find that, in cutting the sciatic, the vessels of the corresponding member on the opposite side contract, and the temperature falls; while the reverse is true of the side operated on. According to Vulpian the contraction is due to reflex, caused by irritation of the sensory fibres of the sciatic, and this results in the contraction of the vessels, not only of the opposite side, but also over a large part of the body. Schüller (7) finds constriction of cerebral vessels, on irritation of the proximal ends of the divided posterior roots of the sciatic, and other spinal

---

1 Schiff, Rev. des Sci. Méd. IX, p. 478. 2 Ostroumoff, Pflüg. Arch. Bd. XII, S. 209. 3 Haidenhain u. Grützner, Pflüg. Arch. Bd. XXI, S. 1 u. 47. 4 Frank, Gaz. Heb. 1876, p. 323. 5 Kendall u. Luchsinger, Pflüg. Arch. Bd. XIII, S. 197. Luchsinger, Pflüg. Arch. Bd. XIV, S. 391. 6 Dastre et Morat, Gaz. Heb. 1876, p. 755. 6 Rouget, Introduction du leçons de M. Brown-Séquard sur la Paralysie des Membres inferieurs, 1864. 7 Schüller, Deut. Arch. 1874, S. 566.

nerves. In general, if the sensory nerves in any part of the body are irritated there results a contraction of vessels, more or less generally, throughout the body, Brown-Séquard and Lombard (1).

But there may also be, in certain cases, dilator reflex as well as constrictor reflex. Snellen (2) and Rouget saw the vessels of the ear of a rabbit dilate on stimulating the central end of the divided cervico-auricular nerve supplying this part, and Callenfels (3) got the same effect by simply pricking the ear. So, on irritating the vagus, we get dilatation of the abdominal vessels by means of dilator fibres in the splanchnics, M. and E. Cyon (4). According to Vulpian (5), any sensory irritation, besides causing a general contraction of vessels, causes a dilatation of the vessels in close proximity to the seat of irritation. Thus we get redness of the skin whenever we apply an electrode, a marked degree of heat or cold, or any other form of local irritation. We may even get a local dilatation, and evanescent erythema from the action of intense light, as that produced by the carbon points of an electric light, even when it is too distant for heat to affect the part, Charcot (6), Faucault (7), and Bouchord (8). So we constantly find, throughout the alimentary and genito-urinary tracts, as well as in the superficial parts, variations in the circulation due to reflex action.

Perhaps in this connection, also, we should refer to the variations of the circulation, which are caused by the emotions, these usually being produced by something external acting on the vaso-motor and cardiac centres through the mind. Some persons have apparently a voluntary control of such acts; as in the case of a friend of mine, who can blush at will. Though apparently volitional, it may, however, be really secondary to rapid mental operations.

Many of these reflex acts, as we have seen, may take place through the spinal nerves; yet there is little doubt but there are also centripetally acting fibres in the sympathetic itself, which can serve the same function. Some of these are sensory in character,

---

1 Brown-Séquard et Lombard, Arch. de Phys. 1868, p. 688. 2 Snellen, De isloed de jennmen op de outstecking, Utrecht, 1857. 3 Callenfels, Zeitsch. f. rat. Med. 1855, Bd. VII, S. 191. 4 M. u. E. Cyon, Cbl. 1866, No. 51. Reicherts Arch. 1867, S. 398. 5 Vulpian, Leçons sur L'appareil vaso-moteur, T. II, p. 243. 6 Charcot, Compt. Rend. de la Soc. de Biol. 1858, IV, p. 63. 7 Faucault, Bulletin de la Soc. de Philomathique, 1856. 8 Bouchord, Rescherches Nouvelles sur la pellagre, 1862.

while others are not true sensory nerves, but rather resemble the nerve of Cyon in the vagus. Thus Brown-Séquard and Remak (1) found that, by irritation of the cardiac plexus, they could produce contraction of vessels, and also dilatation of the iris. Goltz (2), in his "percussion experiment," by striking on the abdominal walls, or on the exposed viscera, obtained, besides an action on the heart, dilatation of the vessels of the abdomen; and Bernstein (3) has shown that the nerve which conveys the centripetal impulse in this case is a small twig accompanying the mesenteric artery, and entering the cord between the third and sixth dorsal vertebræ And all who believe in the existence of peripheral vaso-motor centres, consider also that there are centripetally acting fibres running to them from the walls of the vessels or the surrounding tissues. Hence the centres for the reflex acts are the vaso-motor centres in the brain, in the cord, Putnam (4), Nussbaum and Vulpian, and also on the peripheral nerves, Cunning (5), Weber and Goltz (6).

CEREBRAL CIRCULATION.

Anatomists have described nerves following the vessels of the pia-mater, in a plexiform arrangement, and probably supplying the muscular fibres in their walls. Some of these have been traced to the plexus around the vertebral artery, while others are seen to come off from the various cranial nerves. It is generally considered, at the present day, that most of these fibres are contained, primarily, in the sympathetic in the neck. Bernard (7), in 1853, Vulpian (8) and Donders and Callenfells (9), noticed a dilatation of the vessels of one-half of the brain on irritating the cervical sympathetic of that side, and Fischer (10) found an increase in pressure in the meningeal vessels by the same means. So, Nothnagel (11) believes that the cervical sympathetic, and especi-

1 Brown-Séquard u. Remak, Berlin. Klin. Wochsch, 1864, No. 41. 2 Goltz, Cbl. 1864, No. 40. 3 Bernstein, Cbl. 1863, No. 52. 1864, No. 16. 4 Putnam, Reflex contraction of blood vessels. Boston Med. and Sur. Jour. 1870. 5 Cunning, Underzoeking over bloedsbewiging en statis. Utrecht, 1857. 6 Goltz, Bericht. d. Naturforscherners zu Königsburg, 1860, S. 139. 7 Bernard, Compt. Rend. 1853. 8 Vulpian, L'appareil vaso-moteur, T. II, p. 122. 9 Donders u. Callenfells, Meisners, Jahresbericht, 1856, S. 348. 10 Fischer, Deut. Arch. Bd. 19, Bd. 20. 11 Nothnagel, Virch. Arch. Bd. 40, S. 203.

ally its superior ganglion, has a share at least in the innervation of the vessels of the pia-mater. Such an influence is denied by Schultz (1), and Riegel and Jolly (2), but the weight of authority among physiologists, as well as various pathological facts, seem to be against them.

SLEEP.

In 1860 Durham (3), from experimental researches, was led to the conclusion that sleep is due to cerebral anaemia; to a decrease in size of the arteries of the brain. Hammond (4) and Flint (5) agree with him, and so does Cappie (6), as far as the arterial constriction is concerned, but he believes that this state of the arteries causes a venous congestion, and that this is the important factor in the production of sleep. Purkinji (7) thinks sleep is due to the presence of an increased amount of carbonic acid gas in the blood, while Obersteiner (8) and Preyer (9) believe it comes from the retention of other waste products of nervous action in the brain itself.

Vulpian (10), on the other hand, does not believe that sleep is due to a single cause operating alone, like one of those given above, but that it is a very complex state, and that there are required for its induction numberless factors, all the result of continued functional activity of the various parts of the animal organism. However, this view is not held by the majority of writers to-day; it being generally accepted that sleep is the result of a diminished supply of blood to the brain. And, even if we do admit Vulpian's view as to the complex nature of sleep, yet we must certainly grant also that diminution of the cerebral blood supply is one of the necessary elements connected with its causation; that, generally speaking, cerebral anaemia is conducive to sleep; that cerebral congestion is not. In this connection an experiment which I made a short time ago, is of interest. Hearing it suggested that if sleep is dependent on cerebral anaemia, amyl

---

1 Schultz, Petersberger Med. Zeitsch. 1866, XI, S. 122. 2 Riegel u. Jolly, Virch. Arch. Bd. 52, S. 216. 3 Durham, Guy's Hos. Rep. 1860, p. 149. 4 Hammond, Wakefulness and the Physiology of Sleep, Phila. 1869. 5 Flint, Text-book of Human Phys. p. 744. 6 Cappie, Edinb. Med. and Sur. Jour. 1854 and 1859. 7 Purkinji, Wagner's Handwörterbuch der Phys. "Sclaf." 8 Obersteiner, Zeit. f. Phys. Bd. XXIX, Zur Theorie der Schlafs. 9 Preyer, Cbl. 1875, S. 577. 10 Vulpian, L'appareil vasomoteur, T. I.

nitrite, which promotes the circulation in the brain, should waken sleeping persons, I tried it one evening. With the aid of my nurse I very carefully applied a few drops of the drug to the nostrils of ten or twelve patients who were sound asleep, and in every case they awoke in less than one, or at most two, minutes. This was repeated on several evenings and on different patients, but with a uniform result. Lest it might be simply the odor of the drug or its irritation of the fifth nerve, or my presence near the bed, I tried on other occasions bisulphide of carbon and oil of peppermint, but succeeded in awakening not a third of those on whom they were employed. Hence, we conclude that sleep can be induced directly or reflexly, through the sympathetic nerve, which has under its control, partially at least, the vessels of the encephalon.

CARDIAC NERVES.

There are a large number of fibres given off from various portions of the sympathetic nerve and distributed to the heart; and they have been the object of much study and experiment. These investigations have not, however, yielded the most satisfactory results, owing partly to the impossibility of cutting all of these fibres. But it is generally considered that those fibres which pass from the sympathetic to the heart, are its accelerator nerves, and the recent experiments of Baxt. (1) seem to show conclusively that the sympathetic cardiac branches have the power to increase the number of pulsations, while, at the same time, the length of the systole is decreased: this being the reverse of the action of the vagus. This is also the view held by Budge and Donders and V. Bezold (2). According to the latter and Lepine (3), Bechfontaine and Tridon, there are certain spots on the gyri post- and præfrontalis, whose excitation produces the same effect as excitation of the cardiac nerves themselves, and therefore V. Bezold claims that these parts of the encephalon are the cardiac accelerator centres. Others think they are merely vaso-motor centres, and act on the heart secondarily by changing the arterial pressure. Baxt. (loc. cit.) and Stricker and Wagner (4)

1 Baxt., Arch. f. Phys. u. Anat. 1877, SS. 521, 541. 1878, SS. 122, 525. 2 V. Bezold. Untersuchungen über die Innervation des Herzen, 1863. 3 Lepine, Gaz. Méd. 1875, No. 25. 4 Stricker u. Wagner, Sitzung. d. Wein. Acad. Bd. 77, Ab III, S. 103.

believe the centres to be in the cervical portion of the cord, and that the fibres leave the cord, by the rami-communicantes, as far down as the sixth dorsal vertebra; the upper fibres form the superior and middle cardiac nerves, while the lower cervical unite with the thoracic branches, at the annulus Vieussens, and form the inferior cardiac nerves. Some of the thoracic branches, however, join the cardiac plexuses directly. The peripheral ganglia, in the walls of the heart, are also independent motor-centres, as is shown by the fact that by their irritation the heart can be made to contract long after it has been removed from the body. Besides this direct action on the heart, the sympathetic exerts, indirectly, the same influence, by means of the reflex action excited by the depressor nerves of Cyon. Irritation of the central end of this nerve, which is contained in the vagus and its superior laryngual branch, results in an increase in the number, and a decrease in the force of the heart beats. This is accomplished, probably, by the reflex dilatation of the abdominal blood vessels, by the vaso-dilator fibres in the splanchnic nerves, M. and E. Cyon (1). These experiments were conducted on animals, but lately Kriedmann (2) has demonstrated this nerve in man. Some authors also (Aubert and Roever) believe in the existence of so-called "presser" nerves in the vagus and sympathetic, the irritation of which increases the tone reflexively, and which therefore, act in opposition to the depressor nerve of Cyon.

OCULO-PUPILLARY FIBRES.

The fact that the cervical sympathetic exercises a control over the movements of the iris, was first noticed by Petit in 1827. This was again discovered by Biffi (3) in 1846, and soon afterwards became the basis of numerous experiments and observations. By these it has been clearly shown that section of the cervical sympathetic produces contraction of the pupil, and also a sinking in of the cornea and narrowing of the palpebral fissure.

In order to understand these movements it is necessary, first, to study carefully the anatomy of the eye and its appendages, and learn the mechanism of their action. Valentin (4) was the first to

---

1 M. and E. Cyon, Cbl. 1866, No. 32. 2 Kriedmann, Cbl. 1878, S. 193. 3 Biffi, Intorno all' Influenza che hanno sull occhio' i due nervi grande simpatico e vago. Diss Inaug., Paris, 1846. 4 Valentin, Repertorium, Bd. II. S. 257.

describe a dilator muscle in the iris, but constrictor fibres had long been recognized. Arnold (1) distinctly speaks of dilator muscular tissue in the posterior part of the iris, to which are distributed pale nerve fibres. Many others describe the same in man, and even their opponents are forced to admit the existence of a dilator muscle in the lower animals. Among those who deny this muscle in man are, Grünhagen (2), Salkowski (3), Rouget (4), Arlt (5), and Bernard (6). They believe that the dilatation of the iris is due to the contraction of its blood vessels. This is disproved by the fact that the pupils dilate before the vessels contract, and dilate after death. Müller (7) describes a muscle, of unstriped fibre, receiving its nervous supply from the spheno-palatine ganglia, the action of which is to draw the globe of the eye forward; also similar fibres in the lids, which tend to open the palpebral fissure. Sappey (8), describes unstriated fibres in the orbital aponeurosis, which would aid in producing ex-ophthalmus.

The nerve supply to these muscles is derived from the ciliary ganglion, and also, probably, from ganglionic cells situated directly in the iris, Peschel (9), Pause (10), and Arnstein and Meyer (11). The fibres to the constrictor muscles of the iris, as well as to the ciliary muscle of accommodation are derived from the motor branch, which passes to the ganglion from the third nerve, or sometimes from the sixth Adamück (12), or the fifth, Mayer (13). Some say it lies close to the optic nerve without entering the ganglion at all. The fibres to the dilating muscle, Samuel (14), of the eye, appear to come chiefly from the sympathetic, from its superior cervical and first thoracicganglia. Franck (15) says, from the latter some fibres pass, with the vertebral artery, to the brain, and anastosmosing with the carotid plexus, go directly to the ciliary ganglion, while the rest of the oculo-pupillary fibres run in the ascending branches of the superior cervical ganglion to the cranial cavity, and

---

1 Arnold, Virch. Arch. Bd. 36, S. 345. 2 Grünhagen, Virch. Arch. Bd. XXX, S. 481. 3 Salkowski, Meissner's Jahresbericht, 1867. 4 Rouget, Jour. de la Phys. T. III, p. 569 5 Arlt, Arch. f. Ophthal. Bd. XV, S. 294. 6 Bernard, Arch. gen. de Méd. 1862, p. 485. 7 H. Müller, Verhandlungen d. Würzburger Phys. Med. Gesellschaft, 1859, Bd. IX, S. 76 u. S. 244. 8 Sappey, Séance de l'Acad. des Sci. de Paris, 1867. 9 Peschel, Giornalle della R. Acad. di Tarino, 1877. 10 Pause, Arch. f. Ophthal. Bd. XIII, Uber die Nerven der Iris. 11 Arnstein u. Meyer, Cbl. 1878, No. 7. 12 Adamück, Cbl. 1866, S. 561, 1867, S. 433, Cbl. 1870. 13 Mayer, Hermanns' Handbch. d. Phys. Bd. II, S. 239. 14 Samuel, Die tropischen Nerven, S. 61, Leipzig, 1860. 15 Franck, Gaz. des Hôp. 1878, p. 693 et 748.

after giving one branch to the third nerve, join the Gasserion ganglion of the fifth, and are distributed by this nerve to the ciliary ganglion, and thence to the iris; one short nerve containing fibres from the third, and two branches containing fibres from the first division of the fifth. The latter nerve also, probably, has a few constrictor fibres, not derived from the sympathetic, Gradle (1). The vaso-motor nerves of the iris proceed directly from the cervical sympathetic to the ciliary ganglion, by means of the cavernous plexus.

Budge (2) first showed that the constrictor fibres come. by the anterior spinal nerve roots, from that part of the cord extending from the sixth cervical to the second dorsal nerves, and called by him the "centrum cilio-spinale inferius." So, also, he and Bernard placed another, the "centrum cilio-spinale superius," higher up, and Salkowski (3) has asserted that centres must exist above the atlas. The question whether there are fibres connecting these centres with the cerebral cortex is still undecided. It is so believed by Brown-Séquard (4), but is denied by Eulenburg and Guttmann, loc, cit, p. 15. Lepine and Bochefontaine(5) and Vulpian (6), have caused changes in the pupil by irritation and destruction of the gray substance of the hemispheres; but this is probably due to implication of deeper portions of the brain. Hitzig (7) also considers the question very doubtful.

Such being the facts in regard to the anatomy of the pupillary nerve fibres, we can readily understand that section of the cervical sympathetic will produce contraction of the pupil, and irritation of the same will produce dilatation. This experiment has been repeated many times, not only on the lower animals but on the heads of decapitated criminals. And even in the living subject the pupil can be readily made to dilate by "galvanization of the neck," and is due, without doubt, according to the experiments of Eulenberg and Guttmann, Fischer (8), Beard and Rockwell, Landois and Mösler (9), to electrical excitation of the sympathetic. That this pupillary contraction, after section of the sym-

1 Gradle, Chicago Jour. of Nervous and Mental Dis. 1875. 2 Budge, Compt. Rend. T. XXXVI, p. 128. 3 Salkowski, Dissert. Königsburg, 1867. Cbl. 1867, No. 31. 4 Brown-Séquard, Arch. de Phys. 1876. 5 Lepine and Bochefontaine, Gaz. Heb. p. 382. 6 Vulpian, Arch de Phys. 1876, p. 814. 7 Hitzig (Keussner), Arch. f. Phys. VIII, H. 2 S. 432. 8 Fischer, Deut. Arch. Bd. 17, H. 1 and Bd. 20, H. 4. 9 Mösler, (Eulenburg u. Mösler), Cbl. 1868, No. 33.

pathetic, is constantly attended by retraction of the globe of the eye, flattening of the cornea, and narrowing of the palpebral fissure was first pointed out by Bernard (1). It was first noticed, casually, in man by Remak (2) in 1855, and later was demonstrated by Wagner (3) and Müller (4). Schiff, however, considered that the ex-ophthalmus of sympathetic irritation was due to sympathetic influence on the oblique muscles; and Romberg (5) and Remak (6) have ascribed a tonic influence over the voluntary muscles to the sympathetic. Dalton (7) thinks the change in the pupil, palpebral fissure, etc., are due to reflex action, caused by an increased sensitiveness of the retina, due to changes in its circulation.

Besides the direct action of nerves on the size of the pupil, there are several reflex acts that are worthy of notice. In the first place, the pupil contracts on the admission of light to the retina, to a certain extent by a reflex taking place in the anterior tubercles of the corpora quadrigemina, between the optic and motor oculi. But it is also, probably, caused in other ways; for it occurs after the brain is removed, Brown-Séquard (8), and also after death. Janeway, also, recalls a case in which there was blindness with complete atrophy of the optic nerves, and corpora quadrigemina, and yet there was perfect reaction of the pupil to light. Brown-Séquard and Harless (9) think this takes place by a reflex in the ganglionic cells of the iris, the sensory nerves of the iris being directly affected by light. The pupil is dilated reflexively, through the sympathetic, by irritation of sensory or even tactile nerves. This was first noticed by Fontana in 1760, who, also, had the power of voluntary dilatation of the iris. This form of reflex has lately been investigated by Vulpian (10) and Schiff and Foa (11). The absence of any sensory irritation during sleep is considered by Raehlmann and Witkowski (12) the reason for the marked contraction of the pupil during this state. To the same cause is attributed the myosis in various forms of narcosis. It

---

1 Bernard, Compt. Rend. 1862, T. LV, p. 382. 2 Remak, Deut. Klinik. 1855, No. 27, S. 294. 3 Wagner, Verhandlungen des Würzburger Phys. Med. Gesellschaft, Bd. X. S. 11. 4 Müller, Ibidem, S. 49. 5 Romberg, Lehrbuch der Nerven-Krankheiten, 2d Auf. Ab. 3, S. 75. 6 Remak, Deut. Klinik. 1855, No. 27, S. 294. 7 Dalton, Human Phys. p. 588. 8 Brown-Séquard, Compt. Rend. 1847, Jour. de la Phys. T. II, p. 281. 9 Harless, Die Muskalurirritabilität. 10 Vulpian, Gaz. heb. 1878, p. 524. 11 Schiff et Foa, L'Imporziale XIV, 1874, No. 4, Clb. 1876, No. 4. 12 Witkowski u. Raehlmann, Würzburger Verhandl, Oct. 30, 1858, Oct. 29, 1859, Feb. 5, 1859, 1860.

was first noticed in Anæsthesia by Westphal (1), and afterwards studied by Perrin (2), Schiff and Foa, Vibert (3), etc. Labor pains, Hüter, and Raehlmann, and Witkowski, muscular movements, Vigoreux (4), mental excitement, Gratiolet (5), as well as various pathological conditions, to be considered, dilate the pupil through the medium of the sympathetic.

Pourfour du Petit recognized the fact that the vessels of the conjunctiva are supplied by the sympathetic, but Wagner first showed that the vessels in the interior of the eye have the same innervation; this is true of the iris, choroid and retina. The division of the cervical sympathetic causes a diminution of the intra-ocular fissure, ascribed by Wagner to dilatation of vessels. Adamück obtained corresponding results, but determined that the increase of pressure, which he obtained by irritating the sympathetic, to be due to the action of the ciliary muscle, the contraction of the vessels causing a slight decrease in the pressure. Hippel and Grünhagen think that these results depend on the action of the orbital muscles of Müller.

VASO-MOTOR BRANCHES OF THE EAR.

The vessels of the cavity of the tympanum become dilated after division of the cervical sympathetic of the same side. The inference is thus easy, that the variations in the pressure, within the labyrinth, are caused by much the same conditions as those affecting the cranial, or any other part of the circulation within the domain of this nerve.

NASAL MUCOUS MEMBRANE.

It is doubtful whether the secretion of the nasal mucous membrane is affected by the sympathetic. Prevost (6), by electrical irritation of Meckel's ganglion, produced a congested state of the membrane; stimulation of the divided sympathetic, however had not the same effect. Vulpian (7) found that irritation of this

1 Westphal, Virch. Arch. XVII, S. 409. 2 Perrin, "Anæsthesie" Dict. Encycl. de Sci. Méd. 3 Vibert, Jour. de Thérapuet. 1875. 4 Vigoreux, Compt. Rend. 1866. 5 Gratiolet, De la physionomie et des movements de l'espressione, Paris, 1855. 6 Prevost, Meissners Jahresbericht, 1868, S. 327. 7 Vulpian, Arch. de la Phys. 1869.

ganglion was followed by an increased secretion on the corresponding side of the nose.

SECRETION OF TEARS.

Concerning the influence of the sympathetic on the secretion of tears, Herzenstein (1) and Wolferz (2), after carefully watching the effects of irritation, could formulate no definite conclusion; nevertheless, the greater number of the latter's experiments, as well as some made by Vulpian (3), would seem to indicate that the sympathetic does exercise some control over the secretion — a theory with which Demtschenko's (4) results agree. The principal nerve of secretion of the lachrymal gland is derived immediately from the fifth nerve.

SECRETION OF SALIVA.

"Since irritation of the sympathetic nerves, as Claude Bernard (5) first observed, excites contraction of the blood vessels of the glands, retards the circulation through them, and gives a darker appearance to the venous blood, it might seem most natural to unite the vaso-motor with the secretory function, and to trace back the latter to the changes in the filtration pressure of the glandular capillaries;" and though it may be true, that the state of the circulation in a gland can have a marked effect upon its secretion, yet there are certain facts which go to prove that there are always special secretory fibres distributed to the glandular structure. This view, applicable to all secretions in general, has, for obvious reasons, been most thoroughly investigated in connection with the salivary glands. It has been found that the secretion, caused by the irritation of nerves, can be produced in glands through which there is absolutely no circulation; so, when the flow of the secretion, occasioned by nerve irritation, is impeded in the excretory duct, the pressure in it may rise much higher than it is in the sup-

1 Herzenstein, Berträge zur Phys. u. Path. d. Tränenorgane, Berlin, 1868. 2 Wolferz, Experimentelle Untersuchungen über die Innervations-Menge die Tränendrüse, Diss. Dorpat, 1871. 3 Vulpian, L'appareil vaso-moteur, T. I, p. 438. 4 Demtschenko Pflüg. Arch. Bd. VI, S. 191. 5 Bernard, Liquides de l'organisme, T. VI, p. 300, Compt. Rend. 1862, IV, p. 343. Jour. de l'anat. et de la Phys. 1864, p. 311.

plying arteries. Ludwig Pflüger (1), in his investigations, has supported these physiological facts by anatomy. He succeeded in tracing nerves to the neighborhood of glands, where they lose their sheath and the axis-cylinder breaks up into filaments, which are distributed to the epithetial cells lining the secretory follicles.

As regards their nervous supply, the salivary glands receive fibres from both cranial and sympathetic trunks. The submaxillary and sublingual glands are supplied by the chorda-tympani, and the parotid by the small superficial petrosal, Franck (2); the fibres for all these being, at some part of their course, contained in the facial. All these glands also receive fibres from the sympathetic. According to Vulpian (3) the cranial nerves supply the vaso-dilator and the secretory fibres, while the sympathetic contains the vaso-constrictor fibres. But Giannuzi (4) thinks that the sympathetic also contains secretory fibres, and that they arise at the third or fourth dorsal vertebra, in a different space from the vaso-motors.

Haidenhain (5) and Langley (6) also think there are two varieties of secretory fibres, the one in the cranial trunks and the other in the sympathetic; the former for the secretion of the watery elements of the saliva, — "secretory fibres;" the latter for the organic constituents, — "trophic fibres." Joenicke (7), however, denies that this is so in the parotid gland, at least, and says that all of the secretory nerves of this gland are in the petrosal. Eckhard, Nöller, Kölz and Grützner place the intra-cranial centres for these nerves in the floor of the fourth ventricle.

The flow of the saliva, as of the other secretions, can, as we well know, be excited reflexively. Thus it is produced by the sense of taste, by irritation of the gustatory or glosso-pharyngeal, or even by exciting the sense of smell or sight. It may also be excited by the thought of food even, while, on the other hand, great mental anxiety or excitement can markedly decrease the secretion.

---

1 Pflüger, Arch. f. Mik. Anat. Bd. v, S. 193. 2 Franck, Gaz. Heb. 1875, p. 691. 3 Vulpian, L'appareil vaso-moteur, T. I, p. 437. 4 Giannuzi, Lo Sperimentale, 1876. 5 Haidenhain, Pflüg. Arch. Bd. XVII, S. 1. 6 Langley, Jour. of Phys. 1878 and 1879, Vol. I, pp. 96, 339. 7 Joenicke, Pflüg. Arch. Bd. XVII, S. 183.

SECRETION OF URINE.

The kidneys and supra-renal capsules are supplied by numerous branches of the sympathetic, most of these being contained in the splanchnic. Division of them by Knoll (1), Vulpian (2), Bernard (3), and Eckhard (4), produced a dilatation of the vessels of the kidney, and at the same time polyuria and sometimes albuminuria. Bernard says that we get the reverse effect, anæmia of the organs, and diminution in the amount of urine, on section of the vagus. But this is denied by Vulpian, who insists that vaso-constrictor and dilator fibres and the secretory nerves are all contained in the sympathetic. Cyon and Aladoff (5) get the results that Knoll found in his experiments, by cutting the sympathetic at the twelfth dorsal, and Eckhard found the same on removing the lower cervical ganglion. The latter also obtained polyuria by irritating the vermiform lobe of the cerebellum, and Budge and Bernard found a spot of puncture in the floor of the fourth ventricle, not far from that for glycosuria, which caused an increase of urine without sugar. So, too, the pathological facts cited by Lancereux (6) and other authors, would lead us to suppose a cerebral centre for the secretory nerve for the kidneys. The secretory and vaso-constrictor nerves of these organs, as well as those which antagonize their action, are subject to reflex excitation by sensory irritation, especially in various portions of the genito-urinary tract. Thus the irritation of a calculus or the action of cold, can produce a decrease in the secretion of urine.

SECRETION OF SWEAT.

Adamskiewicz (7), Vulpian, Ostroumoff and Luchsinger, have shown that the secretion of sweat is generally, if not always, entirely independent of the state of the cutaneous circulation; and that this, as all other secretions, is presided over by a distinct set of nerves. Though this may be true to a certain extent, yet

---

1 Knoll, Eckhard's Beiträge zur Anat. u. Phys. 1871. 2 Vulpian, L'appareil vaso-moteur, T. I, p. 537. 3 Bernard, Leçons sur les liquides de l'organisme, T. II, p. 162. 4 Eckhard, Beiträge zur anat. u. Phys. 1871. 5 Cyon and Aladoff, Bulletin de L'Acad. Impériale des Sci. de St. Petersburg, 1871, T. XVI, p. 308. 6 Lancereux, De la Polyuria Thése. Paris, 1869. 7 Adamskiewicz, Ueber die "Secretion des Schweisses," 1878.

it is not improbable that the circulation in the sweat glands themselves may be changed so as to affect the secretion without producing any marked variations in the circulation in the skin.

Dupuy d'Alfort was the first to call attention to the fact that section of the cervical sympathetic causes an increase of sweat on the side of the lesion. This was always referred to the circulation, and it is only within a very recent period that the study of sudorific nerves has been carried to any great extent. Kendall, Hermann (1), Luchsinger (2), Nawrocki (3), and Ostroumoff found that galvanization of the distal portion of the cut sciatic in the cat produced an increase of sweat in the paws. Luchsinger says that these nerves are contained in the abdominal sympathetic, and leave the cord by the first four lumbar and last two or three dorsal nerve roots. For the upper extremity they are in the spinal roots of the superior thoracic ganglion. Adamskiewicz believes that, in the cord, these fibres are contained in the anterior cornua, and are transmitted from centres on the surface of the brain. Vulpian (4), on the other hand, claims that only apart are contained in the sympathetic; that a great number are confined wholly to the spinal nerves, the lumbar and first sacral for the lower extremity, and in the brachial plexus for the upper. There are also ganglionic cells situated on the periphery of these nerves. Coyne (5) has traced nerve fibres directly into the secreting cells of the sweat glands. Laffort (6) thinks that the spinal nerves contain the secreting nerves of the sweat glands, and that the sympathetic contains moderator or inhibitory fibres. This seems to be the most reasonable view, as well as that best explaining pathological facts; and many of Vulpian's experiments are by no means contradictory to it. It is quite possible that the inhibitory nerves of Laffort are merely vaso-constrictor nerves.

NERVES OF THE STOMACH AND INTESTINES.

Very little is known in regard to the innervation of the stomach and intestines, either in regard to the blood vessels, the secretory glands, or muscular walls.

---

1 Hermann, Pflüg. Arch. Bd. XVII. S. 291. 2 Luchsinger, Pflüg. Arch. Bd. XVII, S. 310. 3 Nawrocki, Cbl. 1878, No. 40. 4 Vulpian, Gaz. heb. 1878, p. 363, Compt. Rend. 1878, 19 Août, 9 Septembre, 26 Août, 30 Septembre. 5 Coyne, Compt. Rend. 1878, Mai 20. 6 Laffort, L'année Méd. 1878, p. 62.

Schiff and Vulpian (1) have found the splanchnic the vaso-motor nerve of the stomach, and also of the intestines, at least of the small intestine, and it probably serves the same purpose for most of the abdominal viscera. This nerve contains both vaso-constrictor and vaso-dilator fibres, the latter being much more abundant. The centre of these nerves is probably in the brain. After various intra-cranial lesions, vaso-motor disturbances, ulcers, hemorrhages, etc., have been found in the stomach and intestines, Vulpian, Eulenburg and Guttmann (2). The same have been observed after lesions of some of the sympathetic plexuses and nerves, Pincus (3), Adrian (4), Amati (5).

In the stomach and intestines the secretions seem to be carried on only by means of nerves having their centres in the solar and mesenteric plexuses, and in the walls of the viscera, McKendrick (6). This is also supported by pathological facts. Thus, after lesions of the various ganglia, Adrian, Bernard and Lumansky (7) have observed different forms of diarrhœa. The vagus, too, appears to have some influence upon the secretions of the stomach, but it is probably reflex, Lussana and Inzoni (8).

Very little is known in regard to the movements of the stomach, but the motor fibres to this organ are supposed by Flint (9) and Van Braam (10) to be in the vagus; but Flint thinks that they are derived by the anastamoses of this nerve with the sympathetic. The peristaltic movements of the intestines, though automatically excited by the parenchymal ganglia, yet seem capable of receiving accelerating influences from the sympathetic, but not through the splanchnics. The vagus has no influence upon them, Van Braam and McKendrick. According to the latter writer, the accelerating nerves are from the abdominal sympathetic ganglia, while the inhibitory fibres are from the lumbar spinal nerves. The descending colon and rectum receive motor-fibres, according to Nasse (11), from the plexus around the mesenteric artery. The most generally

1 Vulpian, L'appareil vaso-moteur, T. I, p. 443. 2 Eulenburg and Guttmann, Symp. Syst. p. 37. 3 Pincus, Exper. de vi nervi vagi et symp. ad vasa secret. nutrit. tractus intestinalis et renum, Diss. Breslau, 1856. 4 Adrian, Ueber die Functionen des plexus coeliacus u. mesentericus Diss. Giessen. 1861. 5 Amati, Il Raccoglitore, Medico. 1877. Virch. u. Hirsch. Jahresbericht, 1877, Bd. II, S. 142. 6 McKendrick. Brit. Med. Jour. 1876. 7 Lumansky, Zeitsch. f. ration, Med. Bd. XXVIII, S. 259. 8 Lussana et Inzoni, Gaz. heb. 1863, X, 13. 9 Flint, Human Physiology, p. 664. 10 Van Braam, Pflüg. Arch. 1873. Bd. VI, S .266. 11 Nasse, Beiträge zur Phys. d. Darmbewegung, Leipzig, 1860.

received views then, are that the stomach and intestines contain in their parietes, ganglia which send out motor-fibres to the visceral muscles, Budge (1), Kölliker (2), McKendrick, and that these ganglia are stimulated reflexively by fibres running to them from the mucous membrane, Henle (3). Moreover, these ganglia receive other fibres coming from central ganglia in the stomach, through the vagus, and in the intestines through the lumbar cord and sympathetic. The idea of Pflüger's, that the splanchnics are inhibitory nerves of peristalsis for the intestines, is disproved by the experiments of Basch (4), which show that these nerves only secondarily affect the intestinal movement by their action on the circulation in the gut.

NERVES OF THE LIVER.

According to Schiff (5), the vaso-motor nerves of the liver arise in the floor of the fourth ventricle, and in the anterior part of the cord as far down as the fourth and fifth dorsal vertebræ; they then enter the sympathetic and are distributed to the liver.

Section of these nerves produces diabetes, and the explanation by Schiff is, that it produces paralysis and dilatation of the hepatic vessels, and that following this there is an increased change of glycogen to sugar, which is washed out into the general circulation and thence appears in the urine.

Cyon and Aladoff (6) find that these nerves leave the brain in a plexus around the vertebral artery, while some run in the rami-vertebrales of the last cervical ganglion, and that these unite in the ring of Vieussens around the subclavian artery, with branches from the first thoracic. Their further course towards the liver is not well understood. Graefe (7), Hensen and Ploch (8) produced diabetes by section of the splanchnics. Eckhard (9) and Pavy deny this. This discrepancy is due to the different sections of the nerves operated on. Cyon and Aladoff found that

---

1 Budge, Untersuchungen über des Nervensystem, S. 178. Frankfurt. 2 Kölliker, Die Selbstandigkeit u. Abhangigkeit des Sympatischen Nervensystems. 3 Henle, Path. Untersuch. p. 92. 4 Basch, Stricker's Jahrb. 1874, S. 45. 5 Schiff, Jour. de l'Anat. et de la Phys. 1866, p. 354. 6 Cyon and Aladoff, Bulletin de l'Acad. Impériale des Sciences de St. Petersburg, 1870, T. XVI, p. 308. 7 Graefe, Krause Annotationes ad Diabetem, Halle, 1858. 8 Ploch, Ueber den Diabetes, Diss. Giessen. 1863. 9 Eckhard, Beiträge zur Anat. u. Phys. 1867, Bd. IV, S. 3.

while their division high up would cause glycosuria, section of the splanchnic low down, or of the sympathetic between the tenth and twelfth ribs, produces only polyuria. But if the diabetes has been produced before this section, the division of the last has no effect upon it. Eulenburg and Guttmann, loc. cit. p. 39, say, in explanation, that there must be two sets of fibres in the sympathetic and splanchnics, of which the one variety, when paralyzed, produces diabetes, while the other, emerging from the lower portion of the dorsal cord, when paralyzed prevents diabetes. The action of the latter is explained on the ground that they are vaso-constrictor nerves of other organs, and after their section, the blood being directed elsewhere, the afflux of blood to the liver is at its minimum; but if already congested no appreciable change can be effected by their section. To those who believe in the existence of vaso-dilator nerves it would seem a most rational explanation to suppose that the nerves, the section of which gives rise to an inhibitory action over the glycogenic functions, are simply the vaso-dilator nerves of the liver. Of course after these sections there cannot be produced any marked dilatation of the vessels, while if they are already dilated from paralysis of the vaso-constrictors, we should not expect section of the vaso-dilators to have much effect upon them.

Bernard has shown that division of the vagus interferes with the glycogenic function of the liver, and that irritation of its central end increases it. Hence the vagus is the nerve by which the formation of sugar is kept up reflexively.

Bernard, in 1855, first produced diabetes by puncturing the floor of the fourth ventricle. Schiff (1) did the same, and also found sugar in the urine after section of the upper part of the cord, and injuries to the pons, optic thalami and peduncles. Eckhard (2) got the same results after injury to the cerebellum. Certain toxic agents also produce glycosuria. All these causes probably act directly by paralyzing the vaso-motor nerves of the liver, on their centres. Diabetes can also be produced reflexively by irritation of the lower parts of the cord, by ligation of the large vessels, by section of the sciatics, and by various irritations of the vagus.

---

1 Schiff, Untersuchung über Zuckerbildung in der Leber, 1859. 2 Eckhard, Pester. Med-chir. Presse. 1873, No. 7.

All these conditions frequently operate to cause variations in the secretion of the bile, and Vulpian (1) supposes that these are brought about by changes in the hepatic circulation.

NERVES OF THE SPLEEN.

From the experiments of Bulgak (2), it appears that the spleen is supplied by filaments from the great splanchnic nerve on the left side alone. These splenic nerves arise in the anterior roots of the dorsal nerves, from the third to the tenth. They contain motor-fibres, whose irritation causes a contraction of the spleen. These results are entirely in accordance with the experiments of Jaschkowitz (3), who reduced the size of the spleen by irritation of the splenic plexus. He believed this to be due to vasor-motor action. Bochefontaine (4) and Tarchanoff (5) found distention of the spleen after division of the splenic nerves. Bulgak thinks that the splenic nerves contain, besides the centrifugal motor-fibres, centripetal nerves, whose excitation causes contraction of the spleen reflexively.

NERVES OF THE LUNGS.

According to Gerlach (6), the smooth, muscular fibres of the lung are supplied by the vagus. This view is also held by Toeplitz (7), and Stilling (8). According to Remak, there are ganglionic cells in the lung, which receive fibres from both the vagus and the sympathetic.

The vaso-motor fibres of the lung were first conjectured by Wundt (9) to be in the sympathetic, and Brown-Séquard (10) has determined, by experiments on guinea pigs, that they are derived from the first thoracic ganglion, and have a cerebral origin; for both he and Nothnagel have repeatedly noticed pneumonic infiltration and hemorrhages after injuries to the surface of the

1 Vulpian, L'appareil vaso-moteur, T. I, p. 558. 2 Bulgak, Cbl. 1876, No. 33. 3 Jaschkowitz, "Dissertation," Berlin, 1857. 4 Bochefontaine, Brown-Séquard's Arch. T. VI, p. 698. 5 Tarchanoff, Pflüg. Arch, Bd. VIII, S. 97. 6 Gerlach, Arch. f. gesammt, Phys. Bd. XIII, S. 491. 7 Toeplitz, Ueber die Innervation der Bronchialmusculatur Dissert. Königsberg, 1873. 8 Stilling, Brit. Med. Jour. Sept. 1876. 9 Wundt, Müllers, Arch. f. Phys. 1855. 10 Brown-Séquard, Arch. for Sci. and Pract. Med. 1873, p. 148.

brain. Bischofswerder (1) thinks that some of the vaso-motor fibres to the lungs are in the vagus.

NERVES OF THE GENITO-URINARY TRACT.

The walls of the urinary bladder, vesiculæ seminales and urethra, contain ganglia and cells, Darwin (2), which furnish nerves to the smooth muscular fibres, and also receive afferent branches from the lining mucous membrane. They probably also receive nerves, affecting their functional activity, from the great centres, cerebro-spinal and sympathetic.

Budge (3) has shown that most of the direct motor-fibres to the bladder come from the centrum-genito-spinale in the cord, at the level of the fourth lumbar vertebra, through the sacral nerves, while a few pass through the sympathetic in the hypogastric and vesical plexuses. Sokownin (4) believes the same, but thinks there are primary centres in the brain. Besides being controlled by the will, these motor nerves are excited reflexively by irritation of various sensory nerves throughout the body, but particularly, of course, by the sensory nerves of the bladder. So also these nerves are brought into action by various mental states. Thus many persons cannot urinate under certain circumstances, however much they may wish, as is sometimes seen when patients are requested to do so in a clinic; while, on the contrary, certain other circumstances produce the reverse effect, as when a surgeon feels constrained to empty his bladder before an operation, or urination is induced by the noise of running water. These sensory nerves, according to Sokownin, Budge (5), and Giannuzi (6), together with those of the urethra, emerge from the cord with the third and fourth sacral nerves, and join the lumbar portion of the sympathetic and the hypogastric plexus. Others are entirely confined to the sympathetic, without having any connection with the spinal nerves.

Movements of the vesiculæ-seminales follow, according to Budge (7) and Loebe (8), irritation of the trunk of the sympa-

---

1 Bischofswerder, Vagus and Sympathicus, die vaso-motorische nerven der Lunge., Diss. Griefswald, 1875. 2 Darwin. Quart. Jour. of Micros. Sci. 1875. 3 Budge, Zeitsch. of ration, Med. Bd. xi, S. 174. 4 Sokownin Chic. Jour. of Nervous and Mental Dis.,'1874, p. 384. 5 Budge, Arch. f. Phys. 1844, p. 359. 6 Giannuzi, Meissners Jahresbericht, 1863, S. 404. 7 Budge, Meissners Jahresbericht, 1858, S. 585. 8 Loebe, Meissners Jahresbericht, 1865, S. 488.

thetic from the fifth lumbar vertebra downwards. These fibres also arise in the centrum-genito-spinale.

In regard to the uterus opinions vary. Obernier (1), Frankenhäuser (2), Koerner (3), E. Cyon and Schersschewesky (4), think that the hypogastric plexus, and the nerves arising from it, contain nearly all the uterine motor fibres. Schersschewesky, says however, that some of the filaments of the first two sacral nerves are distributed to the muscular tissue of the uterus, but Frankenhäuser thinks that these latter are inhibitory in character. Poincarè (5), from various cases in which the functions of the cord were destroyed, and in which labor proceeded in a normal manner, also thinks that the sympathetic is the chief motor nerve of the uterus. Frankenhäuser suggests a very practical point in this connection: that it is irritation of the hypogastric plexus, and a consequent firm contraction of the uterus, which in cases of post partum hemorrhages, renders so efficacious the "pressure on the abdominal aorta" which we find advised in books on obstetrics. I have, in several instances, been able to excite such contractions by pressing down towards the sacral promontory, but in such a manner as not to impede the circulation in the aorta or iliacs. These uterine motor fibres of the sympathetic have been demonstrated anatomically by Lee (6), and Jobert (7). The centres for these are supposed by these authors to be in the vicinity of the last dorsal, and first four lumbar vertebræ, and perhaps, also, further up in the cord. Osier and Schlesinger (8), claim to have demonstrated such centres in the encephalon.

Nikolsky (9) says that the first sacral nerve transmits a large branch to the hypogastric plexus, and the second a small one; both being destined ultimately, for the walls of the vessels of the penis. Irritation of the first of these branches causes dilatation of the vessels of the corpora cavernosa, and an erection of the organ, while irritation of the smaller branch causes a contraction of the vessels. The large branch is then made up of vaso-dilator nerves, and the

---

1 Obernier, De Nervis uteri, Dissert. Bonn, 1862. 2 Frankenhäuser, Jan'asche Zeitsch. f. Med. u. Naturwissenschaft, 1, 3. 3 Koerner, De nervis uteri, Dissert. Braslau, 1862, Cbl. 1864, No. 2. 4 Schersschewesky, Pflüg. Arch. 1873, S. 349. 5 Poincaré Le systeme nerveux central et la systeme nerveux peripherique, Paris, 1877. 6 Lee, Anatomy of the Nerves of the Uterus. 7 Jobert, Fontarce. Pathol. Clinique du Grand Sympathique, p. 65, Paris. 8 Schlesinger, Stricker's med. Jahrb, 1874. 9 Nikolsky, Ein Beitrag zu Phys. u. Anat. d Nerven errigenten, Arch. f. Anat. u. Phys., 1879.

smaller of vaso-constrictors fibres. His experiments are confirmatory of others made by Eckhard (1), Loeven, (2), Segelus, Budge and Goltz (3). These authors claim that the centre for the nerves of erection, *nervi erigentes*, is in the lumbar cord.

The vessels of the uterus, as well as its muscular fibres, receive their nervous supply chiefly from the hypogastric plexus. It is evident that these nerves have a most important part to play in the congestions of this organ during the acts of ovulation, menstruation and coition. Poincrè would have it believed that the point of departure for the changes accompanying ovulation and menstruation is a reflex impulse transmitted to the cord through the ovarian nerves, and having its origin in the cellular changes of the Graafian follicle. At this time the ovarian vessels become congested, the follicle ruptures, and the fallopian tube adapts itself either by a species of erection or by a contraction of muscular fibres contained in the large ligament. The congestion of the uterus, too, may be due to an active dilatation of the vessels, or else, as Rouget explains it, by a venous stasis due to the contraction of certain muscular fibres over the pampiniform veins.

TROPHIC NERVES.

There are a number of quite constantly occurring disorders of nutrition following various nervous lesions, both central and peripheral, which have induced physiologists to advance the view that there are certain cells and fibres directly presiding over nutrition, and called "trophic cells" and "trophic nerves."

Thus, section of the fifth cranial nerve produces ulcerations and other disorders of nutrition in the various parts which it supplies, especially the mucous membranes. As to whether this influence proceeds from anastomosing fibres of the sympathetic, authorities are divided. Volkman (4), Reid (5), and Valentin (6), and Brown-Séquard find that section of the cervical sympathetic gives the same results. Eulenburg and Guttmann (7), find that it does not;

1 Eckhard, Vulpian, loc. cit. T. I, p. 160. 2 Loeven, Ueber, d. Erweiterung v. Arterien in Folge seiner Nerven-erregung Leipzig. 1866. 3 Goltz, Pflüg, Arch. Bd. VII, S. 346. 4 Volkman, Wagner's Handwörterbuch, II, S. 621. 5 Reid, Phys. Anat. and Path. Researches, Edinb. 1848, p. 296. 6 Valentin, Funct. Nerv. etc., p. 109. 7 Eulenburg and Guttmann, Symp. Syst. p. 23.

and Sinitzin (1), and (Bernard (2), conclude that the sympathetic has exactly the opposite function to this, and that after its section no lesion of the eye, etc., can be produced by section of the trigeminus. Eckhard (3), and Senftleben (4), have repeated these experiments, but with not entirely confirmatory results. After section of the vagus, we get marked "trophic" changes in the lungs, and after section of the sciatic and crural, are frequently found ulcerations of the part supplied, and atrophy of the bones and other tissues of the extremities. Nelaton and Obolensky (5), found marked atrophy of the testicle after section of the spermatic nerves, and Bernard (6). Bidder (7), and Haidenhain (8), had the same result taking place in the sub-maxillary gland after division of the lingual and sympathetic nerves. Schiff and Legros (9), caused a marked decrease in size in the comb of a cock by extirpating the superior cervical ganglion. After section of the sympathetic in the neck, Brown-Séquard (10), and Vulpian (11), have seen atrophy of the brain on the same side. On the other hand, Bidder (12) and Stirling (13) caused hypertrophy of the ear, by cutting the sympathetic, and Schiff found the hair grew much faster on the side of such section. But they always employed very young animals.

Passing to the domain of Pathology, we have

1st. In neuralgias, changes in the nutrition of the hair and skin and in the amount of fat, and also the production of erythema, erysipelas, urticaria, pemphigus, and especially herpes.

2d. Similar results occur in cutting off the connection between the central and peripheral portions of the system.

3d. Trophic changes are found in many lesions of the cord and brain, and in the course of peripheral paralyses.

Most writers are now not disposed to explain these phenomena by the existence of trophic nerves. Mayer (14) thinks that the nutrition of a part is maintained by a certain trophic influence,

---

1 Sinitzin, Cbl. 1871, No. 11. 2 Bernard, Leçon sur la Phys. et Path. du Syst. nerv. 1868, T. II, p. 64. 3 Eckhard, Cbl. 1873, S. 548. 4 Senftleben, Virch. Arch. Bd. LXV, S. 69. 5 Obolensky, Cbl. 1867, S. 497. 6 Bernard, Jour. de la Anat. et Phys. 1864, I, p. 507. 7 Bidder, Arch. f. Anat. u. Phys. 1867, S. 25. 8 Haidenhain, Studien der Phys. Institut. zu Breslau IV, 1868, S. 77. 9 Legros, Les nerfs vaso-moteurs Thèse. Paris. 10 Brown-Séquard, Compt. Rend de la Soc. de Biol. 1872, p. 191. 11 Vulpian L'appareil vaso-moteur, T. II, p. 397. 12 Bidder, Cbl. f. Chir. 1874, No. 7. 13 Stirling, Jour. of Anat. and Phys. Vol X, p. 511. 14 Mayer, Hermann's Phys. Bd. II, Th. I.

which is exerted by the nerves, motor, sensory, or secretory, by which the part is supplied; and that no other nerves of a solely trophic nature are needed. Thus he would attribute to all nerves a "trophic" function, in addition to those which we now look upon them as possessing. Vulpian (1) also adopts this view.

In other ways, also, can the lesions observed on the section of sensory or mixed nerves be explained. When sensation is destroyed in a part, it is no longer under the immediate supervision, so to speak, of the nerve centres; and what perhaps is more important, the channel for the production of reflex alterations in the vessels by which the circulation of the part is regulated, is almost, if not wholly, lost; and lastly, numerous alterations of nutrition are affected by the severance of the vaso-motor nerves themselves, causing permanent changes in the afflux of blood. Nevertheless, there are some authors at the present day, who do not adopt these explanations of the above experimental and clinical phenomena, but require the hypothesis of the trophic nerves. Because, they claim that these are partially transmitted in the sympathetic, and because the vaso-motor fibres of this nerve do really have a considerable influence on nutrition, this brief consideration of the question has been here inserted.

TEMPERATURE.

The heat of the body is due exclusively to the chemical changes which take place in its different tissues in the performance of their various functions. This heat which is constantly being generated, is constantly being lost. 1st. By radiation from the blood, as it passes through the capillaries of the skin and lungs. 2d. By the heat of evaporation which is consumed in the vaporization of the perspiration, and the moisture in the respiratory tract. 3d. A certain amount is lost in the excretions of the body. Of course the amount of heat produced is a very variable quantity, dependent, as it is, on the functional activity of the individual. So, too, is the loss a variable quantity, both because of the changes in the temperature of the surrounding atmosphere, and in the amount of the cutaneous evaporation. Now by what agency are these fac-

1 Vulpian, L'appareil, vaso-moteur, T. II.

tors so coördinated that the temperature of the body remains the same within very narrow limits, no matter how great may be the variation in the different elements?

1st. What is it that regulates the amount of caloric formed? Some authors, those that believe in the existence of trophic nerves, claim that it is through them that the temperature is secondarily affected. Others, as Bernard (1), describe certain "thermic nerves," whose function is to preside directly over calorification. Bernard believes that these fibres have their origin in the cord and brain, and follow the cerebro-spinal nerves in their distribution; that their excitation increases the amount of heat produced in the tissues supplied, and that their paralysis produces the reverse effect. These are the "nerves of calorification." He also believes that the sympathetic contains fibres, which have an inhibitory action on these nerves of calorification; that their irritation causes a decrease in the amount of animal heat, and their section an increase; and that these fibres are entirely distinct from the vaso-motors. He suggests for them the name of "nerves of refrigeration."

Tscheschichin (2) has a modification of this theory. He thinks that there are no distinct nerves of calorification, but that the intimate nutrition, and consequently heat-producing function of a part, is regulated by an inhibitory, or "moderator centre" in the anterior portion of the encephalon. These ideas, however, do not obtain any general acceptance.

Vulpian (3) believes that the amount of heat produced depends, first, upon the effect which has just been considered, which the cerebro-spinal and other nerves have upon the nutrition of the different parts of the body; second, upon the effect which the amount of blood in a part has on its nutrition, this amount being to a great extent regulated by the vaso-motor nerves.

2d. In regard to the loss of heat, Vulpian says that when the circulation in the skin or lungs is increased, we shall, of course, have an increased loss of heat from these surfaces, and consequently a decrease in the general temperature; while on the other hand, if the blood is driven from the skin to the deep lying organs,

---

1 Bernard, Quoted by Vulpian L'appareil vaso-moteur, T. II, p. 218. 2 Tscheschichin, Reichert's u. Du Bois-Reymond's Arch. 1866. 3 Vulpian L'appareil vaso-moteur, T. II.

the loss of heat is diminished, and at the same time there is an increase of its production in the comparatively congested interior, and so there will be an increase in the general temperature. As the secretion of sweat, which is also under the control of the sympathetic, has a marked effect on the loss of caloric, it is evident that this system, together with the cerebro-spinal, has influence enough to produce all the variations in the general temperature that ever occur, as well as to keep it at its normal standard.

Local variations in temperature are, of course, very readily explained by the heat produced in the part by its functional activity, and dependent on its nervous and vascular supply, and by the amount of heat which is brought to the part by a quickened and increased circulation. That the temperature of a part rises as the vessels dilate is so generally true, that the thermometric method is constantly employed by physiologists as an accurate means of determining the state of the circulation.

It is to the action of the vaso-motor nerves that the changes in temperature are to be attributed which occur after irritation or paralysis of the different portions of the sympathetic.

PIGMENTATION.

Vulpian (1) believes that the sympathetic system innervates the pigment cells of the rete Malpighi. The origin of these fibres is, to a great extent, in the peripheral ganglia, and they are, of course, more or less independent of the cerebro-spinal axis. In his experiments he determined that cutting the sympathetic increases the amount of coloring matter in a part, and that this change takes place markedly in a few hours. He also showed that these results may be obtained entirely independently of the circulation. These views have been confirmed by Herring (2) and Goltz (3).

REFLEX FIBRES.

The motor and sensory fibres of the sympathetic have been fully discussed in the preceding sections, but there are certain other fibres, whose nature has been hinted at, which act as centripetal

1 Vulpian, L'appareil vaso-moteur, T. II, p. 315. 2 Herring, Cbl. 1869, S. 49. 3 Goltz, Rev. des Sci. Méd. 1872, p. 948.

nerves in various reflex acts. But they are not of a true sensory character. They have not been well investigated, yet there is little doubt of their existence, and they may be likened to the nerve of Cyon in the vagus, which exerts reflexively an important influence on the circulation. Of such a character are, probably, certain nerves of the iris, nerves presiding over some of the functions of the genito-urinary tract, the nerves regulating the "automatic" movements of the alimentary canal and its secretions, the centripetal nerves to the peripheral ganglia of the vaso-motor system, and many others of like nature.

Diseases Involving the Sympathetic Nerve.

LESIONS OF THE CERVICAL SYMPATHETIC.

The disturbances in the function of the cervical sympathetic are of two general varieties; those of irritation, and those of paralysis. Nicati (1), in an elaborate essay, has considered these states, and has arranged the phenomena connected with them somewhat as follows: —

I. The symptoms of irritation are precisely similar to those we have noticed in considering the physiology of the nerve. They are: (*a*) spasm of the dilator apparatus of the pupil, mydriasis; (*b*) contraction of Müller's smooth muscular fibres of the orbit, exophthalmus; (*c*) spasm of the smooth muscular fibres of the lids, widening of the palpebral fissure; (*d*) contraction of the vessels of the head and face, with lowering of the temperature, pallor of the skin, and frequently decrease in the amount of perspiration; (*e*) increase in the number of the cardiac pulsations.

II. In paralysis there are, according to Nicati, two stages: —

1. (*a*) We find the reverse of the above oculo-pupillary symptoms, contraction of the pupil, decrease in the size of the palpebral fissure, retraction of the eye in the orbit and a lowering of the intra-ocular tension; (*b*) vascular congestion and an increase in the temperature and the perspiration, but the cardiac symptoms are usually absent.

2. In the second stage of paralysis the oculo-pupillary symptoms usually remain, while the vaso-motor disturbances pass away,

1 Nicati, La paralysie du nerf sympathique cervical, Lausanne, 1873.

sometimes even in a few hours, Vulpian (1). Nicati explains the absence of cardiac symptoms in paralysis, on the ground that it is generally only unilateral, and that one sympathetic is sufficient for the innervation of the heart so far as its normal action is concerned. He believes the decrease of vaso-motor disturbances in the second stage to be due to a secondary atrophy of the capillary vessels. At any rate, it is shown by the experiments of Eulenburg and Guttmann (2), that the hyperæmia soon passes away, while the myosis remains indefinitely. In connection with the decreased blood supply there is sometimes quite marked atrophy of the parts in the second stage of paralysis.

I. Cases of irritation of the sympathetic are much rarer than those of paralysis. In twenty-nine cases analyzed by Poiteau, twenty were of the latter character. Among the causes of irritation are: —

1st. Abscesses in the neck. Several cases of these are mentioned by Ogle (3) and Althaus (4). In one of these the symptoms of irritation alternated with those of paralysis, varying, probably, according to the amount and rapidity of the pus formation. The patient was also troubled greatly by chills. It is possible that these were due to irritation of the vaso-motor centres of the brain, by the hyperæmic condition produced by the paralytic state of the cervical sympathetic.

2d. Pressure of tumors. Demme (5), and Eulenburg and Guttmann, loc. cit., p. 48, had cases of cystic goitre with mydriasis and exophthalmus; and dilatation of the pupil has been noticed in cases of thoracic aneurism by Flint (6), Powell (7), and Walshe (8).

3d. Injuries to the neck. Seeligmüller (9) narrates four cases of this character in which the symptoms of irritation immediately followed an injury. In one of these the vaso-motor phenomena lasted only a few days, but the oculo-pupillary continued five weeks. In the other three cases the oculo-pupillary fibres were the only ones involved, and in one case only was there widening of the palpebral fissure. Eulenburg and Guttmann record the

1 Vulpian, L'appareil vaso-moteur, T. I, p. 142. 2 Eulenburg and Guttmann, Symp. Syst. p. 12. 3 Ogle, Med. Chir. Trans. Vol. XLI, p. 398. 4 Althaus, Med. Chir. Trans. Vol. XLI, p. 398. 5 Demme, Würtzburger Med. Zeitsch, 1862, Bd. III, S. 262. 6 Flint, Clinical Medicine. 7 Powell, Reynold's System of Med. Vol. V, p. 36. 8 Walshe, Diseases of the Heart. 9 Seeligmüller, Arch. f. Psych. Bd. V, S. 835. Deut. Arch. 1877, S. 101.

case of a soldier who had decided dilatation of the pupil after a bullet wound in the neck.

4th. Injury to the spinal cord. In a case of Desormeaux, published by Rendu (1), there was marked pallor of face and dilatation of the pupil accompanying hemorrhagic softening at the level of the fifth cervical vertebra. Similar symptoms were observed by Rosenthal (2) in a stab wound of the neck, in which the knife penetrated the spinal canal, and in a case of dislocation at the fifth cervical, and in one of cancer of the last cervical and first three dorsal vertebræ (3). In a case of caries of the spine, under the observation of Eulenburg and Guttmann, loc. cit., p. 54, there was mydriasis, but no vaso-motor phenomena.

5th. In pleurisy, phthisis, and other diseases in which the pleura may be involved, Seeligmüller (4) thinks that we may have an extension of the inflammation to the superior cervical ganglion, and as a result, irritation of the sympathetic, with pallor of the face and dilatation of the pupil. Later on, newly-formed connective tissue may press upon the nerve and cause its paralysis.

II. Paralysis of the cervical sympathetic may be due: —

1st. To the pressure of tumors; (*a*) glandular swelling, Wellebrandt (5) and Fränkel (6); (*b*) carcinomotous growth, Ogle, Héineke (7), Verneuil (8), and Jewell (9); (*c*) cicatrix in the neck, Ogle and du Moulin (10); (*d*) aneurism, Gairdner (11), Coates, Walshe (12), Powell (13), Flint (14), Bartholow and Clark. In some of these cases the myosis disappeared after ligation of the carotid. (*e*) Abscess, Ogle (15), Kidd, Althaus (16), and Jewell (9). In Jewell's case there was also marked irregularity of the heart's action.

2d. Gunshot wounds. An interesting case of this kind is described by Weir Mitchell (17). A soldier was shot in the neck,

---

1 Rendu, Arch. gén. de Méd. 1868, p. 286-297. 2 Rosenthal, Oest. Zeitsch. f. Pract. Heilkunde, 1866, No. 46. 3 Rosenthal, Diseases of the Nervous System, p. 216. 4 Seeligmüller, Arch. f. Psych. Bd. v, S. 835. Deut. Arch. 1877, S. 101. 5 Wellebrandt, Arch. f. Ophthal. 1855, Bd. I, S. 319. 6 Fränkel, Berl. Klin. Wochsch, 1875, No. 3. 7 Héineke, Greifswalder Med. Beiträge, 1860, Bd. II. 8 Verneuil, Gaz. des Hôp. 1864, 16 avril. 9 Jewell, Chicago Jour. of Nerv. and Ment. Dis. 1874, p. 15. 10 Du Moulin, Bulletin de la Soc. de Méd de Gand. 1872. 11 Gairdner, Edinb. Med. Jour. 1855. 12 Walshe, Diseases of the Heart. 13 Powell, Reynold's System of Med. Vol. v, p. 36. 14 Flint, Clinical Medicine. 15 Ogle, Med. Chir. Trans. Vol. XLI, p. 398. 16 Althaus, Med. Chir. Trans. Vol. XLI, p. 398. 17 Mitchell, Gunshot Wounds and other Injuries of Nerves, Phila. 1864.

on the right side. Ten weeks afterwards the right pupil was much smaller than the left. The eye was somewhat myopic, there was slight ptosis, apparent sinking in of the outer angle, decrease in the apparent size of the eyeball, and redness of the conjunctiva. After exertion the right half of the face was flushed, but while at rest both sides were alike. This was a good example of Nicati's second stage of paralysis. Similar cases have been observed by Kämpf (1), Seeligmüller (2), and Reuling (3).

3d. Injuries to the brachial plexus. Hutchinson (4) first called attention to the fact, that in traumatic lesions of the brachial plexus, the cervical sympathetic is often involved. But it is not nearly so frequent a complication as he would have it believed. Seeligmüller (2) reports four cases: two were in infants, and one was probably injured during birth. In neither were there vaso-motor disturbances. The other two cases were in adults, and were accompanied by the usual symptoms of vaso-motor paralysis. Bœrwinkel (5) reports two cases, and Paget (6) two others.

4th. In various pulmonary affections paralysis of the cervical sympathetic sometimes occurs.

5th. The cervical sympathetic is often involved in spinal diseases and injuries. This complication probably occurs much more frequently than is usually supposed, for it is seldom that this sympathetic element is observed at all in such cases. In 100 cases, collected by Rendu (7), the state of the pupils was noted only in sixteen. Ogle noticed two cases of myosis in diseases of the cord in the neck, and Bœrwinkel (5) has mentioned a paralysis of oculo-pupillary fibres in a case or sclerosis of the medulla. Similar symptoms have been recorded by Rosenthal in cases of caries of the vertebræ (8), and also by Robertson (9), by Budd (10) in injuries, by Brodie (11) in hemorrhage, and by Reid (12) in spinal tumor. Brown-Séquard (13), in his lectures on

---

1 Kämpf, Sitz. d. K. K. Gesellsch. d. Aerzte in Wein, 8 März, 1872. 2 Seeligmüller, Arch. f. Psych. Bd. v, S. 835. Deut. Arch. 1877, S. 101. 3 Reuling, Virginia Med. Monthly, 1875. 4 Hutchinson, Med. Times and Gaz. 1868, p. 584, Brain, Vol. I, p. 1. 5 Bœrwinkel, Deut. Arch. Bd. XIV, S. 545. 6 Paget, Med. Times and Gaz. 1864. 7 Rendu, Arch. gén. de Méd. 1869, p. 286-297. 8 Rosenthal, Diseases of the Nervous System, p. 216. 9 Robertson, Edinb. Med. Jour. Dec. 1869. 10 Budd, Edinb. Med. Jour. Dec. 1869. 11 Brodie, Edinb. Med. Jour. Dec. 1869. 12 Reid, Edinb. Med. Jour. 1841. 13 Brown-Séquard, Spinal Hemiplegia, Lancet, 1868.

spinal hemiplegia, mentions seven cases in which there were symptoms of sympathetic paralysis. Erb (1) says that we may have three forms of vaso-motor disturbance in the course of the nerves affected by spinal lesions. 1st. We may get hyperæmia, which, like all hyperæmias due to vaso-motor paralysis, gradually gives place to ischæmia and all the symptoms connected with it, as pallor, coldness, and atrophy. 2d. We may have a primary ischæmia due to irritation of the vaso-motors; but this is much rarer than the other form. 3d. There is a form of venous congestion due to the loss of arterial tone.

6th. Paralysis of the cervical sympathetic has also been observed in lateral curvature of the spine, Russell (2).

7th. Pressure of enlarged vessels upon the nerves can also give rise to it, Ebstein (3) and Hartmann (4).

8th. Lastly, Otto (5) had a case of "idiopathic" paralysis of the cervical sympathetic. The attacks began with headache, dizziness, vomiting and redness and sweating on the affected side. There was also some mental disturbance. Galvanization of the sympathetic was employed eighteen times, and the patient was cured. Similar cases are also described by Payne (6) and Warner (7), in which the causation was obscure, and Spämer (8) had a case of a young girl, in which the affection was, probably, hereditary, as her mother was affected in the same way before her. Very likely in many of these instances of uncertain etiology we should find, on examination, some of the changes in the structure of the sympathetic ganglia, which have been so carefully studied by Lubimoff (9). Among these are enlargement and dilatation of blood vessels, fatty, granular, and amyloid degenerations of their walls, and an increase of connective tissue among the nerve cells and fibres.

---

1 Erb, Ziemssens. Encycl. Vol. III. 2 Russell, Med. Times and Gazette, 1868, p. 367. 3 Ebstein, Virch. Arch. Bd. LXII, S. 435. 4 Hartmann, De sudoris unius lateris. 5 Otto, Deut. Arch. Bd. II, S. 609, 1877. 6 Payne, Am. Jour. of Med. Sci. 1873, II, p. 486. 7 Warner, Brit. Med. Jour. 1877. 8 Spämer, Zeitsch f. pract. Med. 1877, No. 19, S. 199. 9 Lubimoff, Virch. Arch. Bd. XLI, H. 2, S. 145.

MIGRAINE, OR HEMICRANIA.

This form of headache seems to be dependent on a peculiar dyscrasia, which is often hereditary. It is frequently associated with other neuroses of an hereditary type. The attacks seem to be excited by a great variety of causes, both mental and physical. Among the most common are disorders of digestion, and mental excitement or exhaustion. The pain is very acute, and is, as its name implies, usually limited to one side of the head, though not to any particular region; and it may pass suddenly from one side to another. There is dizziness and vertigo and, sometimes, pallor, sometimes flushing of the face on the affected side. There is occasionally an increased flow of the lachrymal, nasal and oral secretions. The pulse is usually small, and the body is often covered with a profuse perspiration. The vision is often affected, and this has given rise to a sub-division of the disease — Ophthalmic Migraine, by Galzowski (1).

This form is characterized by pain in the eye, and perhaps over the head, and is frequently accompanied by vertigo, and sometimes nausea and vomiting. There is also lachrymation, and redness of the face, and a feeling of formication in the skin of the head and arm, Day (2). Galzowski's four forms of ophthalmic migraine are: 1. Periodic hemiopia. This usually affects the lateral half of the field of vision, but sometimes it is the upper or lower part. It is rarely bilateral. Its duration is from twenty to fifty minutes. 2. Scintillating scotome. This is accompanied by the appearance in the field of vision of spots and wavy or zigzag lines, like the outlines of a fortress. 3. Hemicranial amaurosis. 4. Hemicranial photophobia. No constant changes are found in the retinal vessels. Galzowski, sometimes saw them anæmic, sometimes congested.

Some authors look upon Migraine as a neuralgia of the first division of the fifth nerve. Lebart, Stokes, Anstie, Albutt, and Romberg called it a hyperæsthesia of the brain, thus referring it to the central and not peripheral portion of the system. Laboulbène (3) considers it a neuralgia of the cerebral sympathetic,

1 Galzowski, Arch. gén. de Méd. 1878. 2 Day, "Headaches," p. 153. 3 Laboulbène, Sur les neuralgies viscerales, Thèse. Paris, 1860.

while du Fontarce (1) declares it to be a reflex irritation of the sensory sympathetic fibres of the brain, due to disturbances in that portion of the sympathetic supplying the organs of digestion. Liveing (2) thinks it is not due to any central or peripheral irritation, or to a disturbed circulation, but he believes that in this, as in all periodic neuroses, there is a tendency on the part of the nervous centres to the irregular accumulation and discharge of nerve force. The immediate antecedent of an attack is a condition of unstable equilibrium, and the paroxysm itself is likened unto a storm.

In 1860 Dubois-Reymond (3) was led to believe, from his own experience, that migraine is due to a spasm of the cerebral vessels. He found that during the attack the temporal artery on the affected side was hard and tense, while the face was pale. And he noticed that everything that increased the blood-pressure, greatly increased the pain. The pupil was dilated, and there was pain on pressure over the cilio-spinal centre in the cord. Brunner (4) confirmed all these points, and noticed that with the secondary reddening which occurred in his case, there was contraction of the pupil. The sympathetic in the neck was tender to pressure, and there was a temporary acceleration of the cardiac pulsation. The increased flow of thick saliva noticed by Brunner, Berger (5) and Eulenburg and Guttmann (6), is easily explained on Dubois-Reymond's hypothesis, for, as we have seen, sympathetic irritation produces just such a secretion. Dubois-Reymond explained the pain as due to pressure of the contracting vascular muscles on nerve fibres. Eulenburg and Guttmann, however, believe the pain to be due to the changes in the cerebral circulation, which cause a shock to the sensory nerves of the head. It is well known that sensory nerves are always very easily affected by changes in the circulation, especially if they be rather sudden. There seems to be a certain state of the circulation which keeps the nerves in a proper state of nutrition, or tone, and any change in the amount of blood, whether it be an increase or diminution, it matters little which, acts, as Niemeyer asserts, as a sort of irritant. Brown-Séquard (7) and Althann (8) combat this theory on the ground

1 Du Fontarce, Pathologie clinique du grand sympathique, p. 173. 2 Liveing, Migraine and sick headache. 3 Dubois-Reymond, Arch. f. Anat. u. Phys. 1860, S. 481. 4 Brunner, Petersb. Med. Zeitsch. N. F. Bd. II, 1871, S. 260. 5 Berger, Virch. Arch. LIX, H. 3 u. 4. 1874. 6 Eulenburg and Guttmann, Symp. Syst. p. 59. 7 Brown-Séquard, Jour. de la Phys. 1861. 8 Althann, Beiträge zur Phys. u. Path. der Circulation. Dorpat. 1871.

that such a vascular contraction should cause convulsions. But the experiments of Fischer (1), have shown that we do not, by any means, get convulsions as a necessary consequence of the spasm of cerebral vessels. This form of hemicrania described by Dubois-Reymond is called hemicrania sympathica tonica.

Recently Möllendorf (2) has described an exactly opposite cause for migraine, — namely, a loss of energy in the vaso-motors and a relaxed condition of the vessels causing cerebral congestion. This is called hemicrania neuro-paralytica. It is accompanied by a slow pulse, and the ophthalmoscope shows the vessels of the fundus markedly congested. Eulenburg and Guttmann have observed several such cases, and have noticed among other appearances, a more or less marked contraction of the pupil, decrease in size of the palbebral fissure, and retraction of the eyeball. The ear on the affected side was red, and the temperature in the meatus 2°–4° C. higher. The secretions of the skin were increased, and even unilateral sweating occurred. The slow pulse is to be explained as a result of direct irritation of the vagus from congestion of the medulla. As the vaso-motor centres are also situated here, we can suppose that they, too, are affected, and we can thus account for the small radial pulse observed by Möllendorf, the coldness of the hands and feet, the chills and absence of sweat. This contraction of the arterioles is, at the end of the attack, followed by a relaxation of the vessels, causing an increase of the saliva and urine, a hyperæmia of the liver, and a gradually developed plethora of the abdominal viscera. Morselli (3) describes cases of migraine associated with other symptoms of sympathetic paralysis.

Galzowski thinks that migraine is due to an affection of the sympathetic, sometimes producing contraction and sometimes dilatation of the cerebral vessels. He believes that vascular changes in the optic thalami, corpora quadrigemina, or even in the optic nerve and retina, are the causes of the disorders of vision.

Caffein and quinia are recommended by a great many authors, among others by Galzowski, Bonnall (4) and Bernatzik (5). The latter claims that these drugs act on vaso-motor centres or

---

1 Fischer, Cbl. 1869. 2 Möllendorf, Virch. Arch. f. Path. Anat. Bd. XLI, S. 385. 3 Morselli, Lo'Sperimentale, 1876. 4 Bonnall, Rev. de Méd. et Chir. Charcot. 1878, p. 270. 5 Bernatzik, Wein, Med. Presse, 1867, No. 28.

nerves, thus increasing the arterial tone and diminishing the blood-supply. Another drug, probably acting in the same way, is ergot. Eulenburg and Guttmann, Berger (1), and Woakes(2), have used it with success. These drugs are, of course, indicated in the neuro-paralytic form of the disease. Camphor, cannabis Indica, the bromides, and guarana, are also recommended. Berger was the first to use amyl nitrite in this affection, and it would seem that nothing could be better indicated in the sympathico-tonica form. It has also been used by Vogel and Holst (3), who extol its virtues. But its action is so evanescent that the pain often returns in a short time. It is probable that nitro-glycerine, which seems to have much the same properties as amyl nitrite, only with a more prolonged action, would do better in these cases. Frequently the paralytic form, as indicated by cold surface, and small radial pulse, is markedly benefited by heat to the extremities and by counter-irritation.

Holst was the first to employ electricity for this affection. He employed Brunner's "polar method." One electrode is placed on the sympathetic in the neck, the other is held in the hand. The current is continued two or three minutes, and at first, ten or fifteen elements are used. In the neuro-paralytic form the cathode is placed on the sympathetic, and the current is frequently interrupted. In the other form the anode is placed on the sympathetic, and a continuous current employed. Among those, also, who have employed electricity successfully, are Benedikt (4), Trommhold (5), Fieber (6), Rosenthal (7), Althaus (8), Hache (9), and Colonius (10). In many cases electricity, besides giving temporary relief, if persisted in, results in a permanent cure.

GLAUCOMA.

This disease consists, according to V. Graefe, of an increase in intra-ocular pressure, this generally depending on an inflamma-

---

1 Berger, Virch. Arch. LIX, H. 3 u. 4, 1874. 2 Woakes, Brit. Med. Jour. 1868, Vol. II, p. 360. 3 Holst, Dorpat. Med. Zeitsch. 1871, Bd. II, S. 261. 4 Benedikt, Elektrotherapie, Wein. 1868. 5 Trommhold Die Migraine u. ihre Heilung durch Elektricität Pest. 1868. 6 Fieber, Compendium der Elektrotherapie Wien. 1869, S. 120. 7 Rosenthal, Handbuch der Diagnostic u. Therapie der Nerven-Krankheiten, Erlangen, 1870. 8 Althaus, Medical Electricity, London, 1873. 9 Hache, Union Méd. 4 oct. 1878. 10 Colonius, Union Méd. T. IX, No. 18, p. 15.

tory condition of the various structures of the eye. Adamück (1) thinks that glaucoma is due to venous congestion, produced by the loss of elasticity in the sclera, the result of inflammation; and that the sympathetic is only thus far involved, that irritation of it is followed by contraction of the arteries and overloading of the veins. Wagner (2) thinks, from observation of two cases of glaucoma, accompanied by neuralgia of the fifth nerve, that the sympathetic may take part in the formation of glaucoma in three ways; 1st. It may be chiefly concerned in the inflammatory process. 2d. It may be irritated by pressure. 3d. It may be excited reflexively by the fifth. Hippel and Grünhagen (3) believe that glaucoma, without inflammation, can be produced directly by the fifth, irritation of which increases the intra-ocular pressure. Grünhagen thinks that the muscles of Müller are involved in this affection. Very few instances of this disease, occurring secondarily to lesions of the sympathetic, are on record. Horner (4), Bœrwinkel (5), Schmidt-Rimpler (6), have observed cases in which there was paralysis of the sympathetic. The latter thinks the influence of the fifth is much greater than that of the sympathetic.

NEURORETINITIS.

Benedikt believes that the sympathetic plays an important rôle in the causation of many local lesions of the encephalon, and that in many of these cases in which we have pathological disturbances removed from the immediate seat of the lesion, the involvement of certain sympathetic fibres has much to do with their occurrence. In this way he explains such phenomena as neuroretinitis, descending atrophy, and engorged pupilla. In these cases he claims that it is entirely unsatisfactory to refer the phenomena to congestion of the retinal vessels from an increase of intra-cranial pressure. It is through the agency of the sympathetic that he explains the secondary affections of the auditory nerve, and other portions of the brain distant from localized lesions.

---

1 Adamück, Determination manumetrique de la presson intra-oculaire, 1866. 2 Wagner, Arch. f. Opthal. 1866. 3 Hippel u. Grünhagen, Zeitsch f. rat. Med. 1866. 4 Horner, Klin. Monatsbl. f. Augenheilkunde, 1869, VII, S. 193. 5 Bœrwinkle, Deut. Arch. 1874, S. 549. 6 Schmidt-Rimpler, Klin. Monatsbl. f. Augenheilkunde, XII, S. 398.

OPHTHALMIA NEUROPARALYTICA.

Walther (1) mentions a case in which there appeared ophthalmia after paralysis of the sympathetic caused by ligation of the carotid. According to the views of some authors, which were considered in the section on physiology, it would not appear unnatural, but from the experiments of Sinitzin we would be led to suppose that paralysis of the sympathetic was really a prophylaxis for ophthalmia.

SYMPATHETIC OPHTHALMIA.

This disease, in which when one eye is affected certain inflammatory symptoms appear in the other eye at varying periods after the invasion of the first, has been believed by some authors to be induced through the agency of the sympathetic. Goldzieher (2) narrates a case of sympathetic ophthalmia in which he made a careful examination of the ciliary nerves. He found them pressed upon by cellular matter, the result of inflammatory action, and he believed this pressure sets up a secondary inflammation in the ganglionic nerves, which proceeds along the sympathetic to the centres in the cord, or brain, and is thence propagated to the corresponding part on the opposite side of the body, just as in the experiments of Niedreck, inflammation of one sciatic was transmitted to the cord, and thence to the sciatic of the other side. Reclus (3), while admitting the possibility of Goldzieher's view, thinks it far more likely that the irritation travels along the fifth nerve than by the circuitous route of the sympathetic, and the cilio-spinal centre in the cord. But granting that this is true, it is not at all improbable that it is the sympathetic fibres of the fifth which are chiefly involved.

HYPERTONY AND HYPOTONY.

Nagel (4), in an article on the vaso-motor neuroses of the eye, describes these two states of intra-ocular tension, the former of increase of the normal tension, the latter of decrease. The latter is

---

1 Walther, v. Graefe's u. Walther's Jour. XXIX, 1840, S. 549. 2 Goldzieher, Klin. Monatsbl. f. Augenheilkunde, Bd. XX, S. 406. 3 Reclus, Sur les ophthalmies sympathiques, Thèse, Paris, 1875. 4 Nagel, Klin. Monatsbl. f. Augenheilkunde, 1873.

by far the most common. He finds it occurring very often in keratitis, and in inflammation of the deeper portions of the eye, and has noticed it in angina pectoris, and other diseases of the sympathetic. It is accompanied by some disorders of refraction (due to falling backward of the lens from decreased tension), contracted pupil and pain. There also often occur a considerable increase of temperature around the eye, swelling of the nose, and unilateral congestion of the face. These symptoms he refers to a paralyzed condition of the vaso-motors of the sympathetic.

UNILATERAL HYPERIDROSIS AND OTHER ANOMALIES OF SWEATING.

This name is applied to sweating of one side, whether it be confined to the face and neck, as it more often is, or whether it affects the whole half of the body. From what is known of the relations of the sympathetic to the secretion of sweat, it is natural that attempts should have been made to show that this hyper-secretion is due to a paralysis of that nerve. Though cases undoubtedly due to this cause occur, they are not at all common. As regards facial hyperidrosis, Verneuil (1), Ogle (2), Otto (3), Nitznadel (4), and Bœrwinkel (5), have each seen one or more cases. Kulz (6) describes two cases occurring with diabetes, in which the increased perspiration was associated with rise of temperature, but no oculo-pupillary symptoms. Several aggravated cases of unilateral sweating are enumerated by Chvostek (7), and Pokroffsky (8), and Eulenburg and Guttmann (9) had under their observation a man who had hyperidrosis of the face, and vaso-motor phenomena, indicating sympathetic paralysis; but with these were associated symptoms of oculo-pupillary irritation. The left cervical sympathetic ganglion was sensitive to pressure; an indication, these authors thought, of chronic inflammation of the nerve. Clark (10), Gairdner (11), and Bartholow (12), mention cases

1 Verneuil, Gaz. des Hôp, 1867. 16 avril. 2 Ogle, Med. Chir. Trans. XLI, p. 398. 3 Otto, Deut. Arch. 1877, Bd. II, S. 435. 4 Nitznadel, Ueber Hyperidrosis u. Anidrosis, Jena. 1867. 5 Bœrwinkel, Arch. f. Klin. Med. Bd. XIV, S. 550. 6 Kulz, Beiträge. Zur. Path. u. Ther. des Diabetes. 1874, SS. 23. u. 27. 7 Chvostek, Wien. Med. Wochsch, 1872, No. 19 u. 20. 8 Pokroffsky, Berl. Klin. Wochsch, 1865, No. 13. 9 Eulenburg and Guttmann, Symp. Syst. p. 57. 10 Clark, Med. Times and Gaz. 1866, p. 367. 11 Gairdner, Edinburgh Med. Jour. 1855. 12 Bartholow, Quart. Jour. of Psych. Med. N. Y. 1869, p. 136.

occurring with other symptoms of paralysis of the sympathetic in connection with aneurism. Mitchell (1) and Jewell (2) have seen unilateral sweating of the face after gunshot injuries in the neck.

Only three cases, however, are on record of autopsies in this affection. In one of them Seguin (3) found no changes. Another, recorded by Ebstein (4), was in a patient affected with angina pectoris. In the examination, the ganglia of the left cervical sympathetic were found filled with dilated and varicose vessels ; and Ebstein explained the sweating as due to the paralyzing pressure exerted by these vessels upon the nervous structures. Morselli (5) had a case associated with other symptoms referable to the sympathetic, in which the nerve on the affected side was the seat of marked degeneration and atrophy.

Ringer (6), Mickle (7), and Bichat, quoted by Debrousse-Latour (8), have seen an abnormal secretion of perspiration on the same side as a hemiplegia, and Mickle has also seen it in a case of chronic pachymeningitis, and he believes that in these cases the sweating is due to a sympathetic paralysis. He follows the views of those who hold to the idea of cerebral centres for the various functions of organic life, and thinks that this paralysis is central, and that there is an affection of both vaso-motor, secretory, and inhibitory fibres. Poincaré and Bonnet (9) also mention similar cases in the insane, and describe lesions of the sympathetic ganglia and nerves. Wood (10) gives two cases of general hyperidrosis in connection with tumors pressing on the solar plexus. In one of these cases the sweating was bilateral only when the patient lay on his back ; when he lay on one side the sweating was confined to that side. But besides these instances, in which it seems only fair to consider the sympathetic as involved in the causation of the affection, there are a great number in which we are not able to do this.

It is a fact only too well known to all practitioners that phthisical patients are usually afflicted, at some part of their disease, with the most exhausting sweats. Fleischmann (11) was the first to

1 Mitchell, Gunshot Wounds, etc., Phil. 1864. 2 Jewell, Chicago Jour. of Nerv. and Ment. Dis. 1874, p. 15. 3 Seguin, Am. Jour. of Med. Sci. Oct. 1872. 4 Ebstein, Virch. Arch. 1879, Bd. LXII, S. 435. 5 Morselli, Lo 'Sperimentale, 1876. 6 Ringer, Practitioner, Dec. 1876. 7 Mickle, Jour. of Mental Dis. 1877-8, p. 196. 8 Debrousse-Latour, Les sueurs locales Thèse. Paris, 1873. 9 Poincaré et Bonnet, Annales Méd. Phys. 1868, p. 185. 10 Wood, Schmidt's Jahrb. 1870, S. 256. 11 Fleischmann, Wien. Med. Presse, 1876, S. 675.

call attention to the fact that this symptom, together with certain vaso-motor disturbances, occurs very constantly on the same side with the pulmonary lesion. Seeligmüller (1) has also observed this fact, and in autopsies has found that the inflamed and thickened pleura had involved the thoracic ganglia and trunk of the sympathetic to such an extent as evidently to destroy its function. I have a number of times observed this unilateral sweating of the head and face in cases of phthisis, but have not had opportunities to verify Seeligmüller's proposition as to its pathology. But it seems more probable that the sweating and flushing which we see in phthisis are not due so often to the direct paralyzing action of a complicating pleuritis, as they are to reflex. I have observed it in several cases where there was no thickening of the parietal pleura, and in cases also where the base of the lung was affected; and all are familiar with the vaso-motor disturbances which are seen in the face in pneumonia. There would seem to be, in these cases, a reflex excitation of the vaso-dilator and secretory nerves, from irritation of the filaments of the vagus distributed in the lungs. A suicide, whom I saw not long ago, is of interest in this connection. He was seen about twenty minutes after he had cut his throat. The incision was just above the larynx, and so deep that the intervertebral substance was cut. The sheath of the carotid was laid open, and one vagus injured, so that the larynx was paralyzed on that side. The sympathetic was uninjured. The corresponding side of the face was covered with a profuse perspiration, while the other side was only moderately moist. The pupils were even, and there was no vaso-motor disturbance noticeable; but the patient was very pale from the loss of blood. The unilateral sympathetic disturbances occurring in pulmonary affections can generally be explained either on the hypothesis of Seeligmüller, or the one given above, and very often when we have the same symptoms on both sides, it will be noticed that both lungs are involved. But of course many cases of general sweating in phthisis in its advanced stages, as well as in other exhausting diseases, are probably due to a general weakness of the whole system, and a lack of tone in the nerve centres presiding over this function.

Among the remedies used to stop these sweats, oxide of zinc,

---

1 Seeligmüller, Deut. Arch. 1877, S. 101.

and the mineral acids have long been employed. Ringer was the first to suggest atropia, which seems especially indicated by its physiological action, and Bartholow introduced it into this country. Thomson wakes up the patient and gives him something to eat, thus, as it were, starting up the nerve centres and infusing new life into them. Lately I have been employing two or three drops of nitrite of amyl internally, and have found it very useful. Ringer also uses one-twentieth of a grain of pilocarpine, and has obtained good results with it when everything else failed.

THE SYMPATHETIC IN HEMIPLEGIA.

Gübler, in 1856, and Brown-Séquard, in 1863, noticed a difference in temperature between the two sides in cases of hemiplegia. Lepine (1), Folet, and Charcot have noticed the same, and the latter has found an increase of from 4° to 9° in the hemiplegic side. Eulenburg (2) has found redness, and decrease of the arterial tension. From the views that have been advanced in regard to the vaso-motor centres in the brain, this is no more than we should be led to look for. So, too, we might expect to note changes in the sweat or other secretions.

In a case carefully recorded by Nothnagel (3), there was, on the paralyzed side, a falling of the upper lid, narrowing of the palpebral fissure (no third nerve paralysis), sinking in of the eye, and myosis. This side was 1° C. warmer than the other, and the secretion of the lachrymal, nasal and salivary glands was increased in amount. Hyperidrosis has been noted in cases of hemiplegia by Ringer and Mickle. The condition of vaso-motor paralysis gives often a somewhat swollen œdematous appearance to the parts. In Ziemssen's encycl., Vol. XII., Nothnagel says that later on in the hemiplegia, the paralysis of the vessels disappears, as Nicati showed it did in lesions of the sympathetic in the neck, and gives place to a reverse condition accompanied by paleness and coldness of the parts.

In a case observed a short time ago, a woman was attacked by convulsions while drunk; she was not seen by a physician

---

1 Lepine, Mém. de la Soc. Biol. 1868. 2 Eulenburg, Berl. Klin. Wochsch. 1868. 3 Nothnagel, Virch. Arch. Bd. 68, S. 26.

for several days, and then no accurate note was made of her condition, though it was said she did not walk as well as usual. When the author saw her, three weeks after the attack, she had been comatose for several hours, and was apparently paralyzed on the right side. The pupil on that side was dilated. The next morning the coma was deeper, and her temperature in the left axilla was 101½°, in the right 101¾°, in the left ear it was 101½°, in the right ear 101¾°, on the left cheek 97½°, on the right 100½°. The right side of the face was much more flushed than the other. At this time the coma was so profound that all the muscles were relaxed alike, and both pupils were dilated. She died in eight hours. On autopsy, a large surface clot was found on the right side of the brain. On thinking over the case, the author was convinced that the side considered not paralyzed was simply partially rigid from the surface irritation, and that this, of course, passed away in the deep coma which followed, while the irritation of the vasomotor centres remained longer, and caused a decrease of temperature on the opposite side to the lesion, instead of an increase on the same side as was first imagined. This was rather an interesting case, as it showed how much care is necessary, sometimes, in order to distinguish the paralyzed side, and it bears out the views of those who hold that all the supposed paralyses on the same side in surface lesions, at least when there is the usual decussation in the medulla, can be explained as mistakes of this sort.

In certain cases of lesion in the pons, medulla, and, perhaps, cerebellum, we may have a great rise of the general temperature, often far greater than could occur from any accompanying intracranial inflammation. Thus, in a case of acute softening of the pons, falling under the observation of the author, the temperature ran up to 110°. The cause of this hyperpyrexia is explained in the same way as that occurring in spinal lesions.

THE SYMPATHETIC IN SPINAL DISEASES.

Besides the localized disturbances seen in various portions of the distribution of the sympathetic in lesions of the cord, there is another frequently-occurring general condition, which is of the greatest interest. This is the rise of temperature, often to a very

great height, which we have in these affections. Brodie (1) was the first to mention a case of this kind, and his experience has been repeated by all who have studied nervous diseases, or have been made familiar with injuries to the spine. The temperature in these cases often begins to rise shortly after the injury, and reaches, in fatal cases, a very high degree. In a case of spinal injury with laceration of the cord, which was brought to Bellevue Hospital while the author was House Physician, the temperature two hours before death was 112°, and it had been rising at the rate of about 1° an hour for the three or four hours preceding. We had no thermometer which would record higher than that, and so do not know how high it was at death. But the most remarkable case on record is that of Teale's (2), in which the temperature remained at 122° for several weeks. The patient probably had some inflammation of the cord, and eventually recovered. How such temperatures are produced through the agency of the nervous system, whether it be due to vaso-motor paralysis, to the failure of the nerves of refrigeration, Bernard (3), or to the inhibitory nerves of Tscheschichin, or to trophic nerves, Charcot (4), and Erb, or to the influence of all the nerves (Vulpian), will be considered elsewhere. Hutchinson (5), Farqueson, Villemin (6), Erb (7), and Fischer (8) state that in a few rare cases of spinal injury, a temperature below that of normal has been seen. This phenomenon has not been well explained, and is worthy of a further study.

VASO-MOTOR DISTURBANCES IN NEURALGIAS.

In neuralgias we very commonly get vascular disturbances along the course of the affected nerve. These may manifest themselves in various ways. Thus we may have merely a redness and tenderness of the skin, or the appearance of an eczema or herpes along the nerve, the latter being the more common, and better known as herpes Zoster or zona. This usually affects the intercostal or lumbar nerves, and begins with a zone of redness, on which there quickly appears a crop of vesicles like those of ordinary herpes. Most writers consider this affection to be of the trophic nerves, and

1 Brodie, Med. Clinic. 1837. 2 Teale, Lancet, 1875. 3 Bernard, Compt. Rend. 1852 et 1853. 4 Charcot, Nervous Diseases. 5 Hutchinson, Arch. de Méd. 1876. 6 Villemin, Gaz. Hôp. 1876. 7 Erb, Ziemssen's Encycl. Vol. XII, p. 128. 8 Fischer, Cbl. 1869.

believe that it consists in their excitation. It is probably due to an inflammation affecting the whole nerve. Erb (1), Charcot (2), Weir Mitchell and Niemeyer (3) adopt this view of referring it to the trophic branches, while Nothnagel thinks it is the vaso-motor fibres that are affected, and it certainly seems as rational to consider it an irritation of the vaso-dilators as it does to call into existence trophic nerves to effect an explanation.

EXOPHTHALMIC GOITRE.

This disease, first mentioned by Pavy in 1825, but first accurately described by Graves in 1835, and Basedow in 1840, consists essentially of three factors. 1st, Exophthalmus; 2d, Goitre; 3d, Cardiac Palpitation, often causing hypertrophy.

These are the prominent and characteristic symptoms which occur in nearly every case; but there are also a number of secondary symptoms, which we find more or less constantly.

Among these are deficient mobility of the upper lid, Graefe (4), which occurs very commonly, partial facial paralysis, and paralysis of both external recti, occurring quite rarely, and ulcerations of the cornea, which Graefe has noticed fourteen times. He has also found sinuosities and dilatations of the retinal veins, and Becker (5) saw pulsation of the retinal arteries. The following sensory and vaso-motor disturbances have been observed; anæsthesias or neuralgias in the course of the fifth, circumscribed vascular dilatations on the integument, unilateral or bilateral redness of the face, Stellwag (6), elevation of temperature, Paul (7), Eulenburg and Guttmann (8), Tessier (9) and Cheadle (10), and œdematous swelling of the face and neck, Stellwag.

Basedow, and more recently Hiffelsheim and Beau, have considered the disease due to a modification of the blood, similar to chlorosis. Piorry and Bouillard believe the symptoms to be due to pressure of the enlarged thyroid upon the vessels of the neck, or upon the sympathetic. Stokes, and others, refer it to hyper-

---

1 Erb. Ziemssen's Encycl. Vol. XII, p. 128. 2 Charcot, Leçons sur les Maladies de la Système Nerveux, p. 136. Jour. de la Phys. 1869. 3 Niemeyer, Text-Book of Prac. Med. Vol. II, p. 419. 4 V. Graefe, Arch. f. Ophthalmol. 1857, S. 292. 5 Becker, Wien. Med. Wochsch. 1873. 6 Stellwag, Wien. Med. Jahrb. 1869. 7 Paul, Berl. Klin. Wochsch. 1865, No. 27. 8 Eulenburg and Guttmann, Symp. Syst. p. 86. 9 Tessier, Trousseau's Clinique Méd. T. II, p. 540. 10 Cheadle, Lancet, 1869, No. 25.

trophy of the heart. But none of these opinions seem to rest on sufficient ground.

Koeben (1) was the first to refer the symptoms of this disease to the sympathetic, and he was quickly followed by Aran (2), Trousseau (3), etc., and at the present day this is the belief of most writers, including Charcot, Friedreich (4), Geigel (5), and Graefe, Rosenthal (6), Poincaré (7), Grasset (8), and Eulenburg and Guttmann.

Now let us take the symptoms one by one, and see if they can be explained as occurring through the agency of the sympathetic. First, the exophthalmus. This is seldom unilateral, generally occurring in both eyes at once, though not with equal intensity. We have seen that just this state of appearance of the eye, with widening of the palpebral fissure, and drawing up of the upper lid, can be produced experimentally by irritation of the cervical sympathetic, thus causing a contraction of the muscles of Müller. But, while we can readily see how exophthalmus may be thus produced, at first it is hard to believe that it can be kept up for any great length of time by such a tetanus of the muscles as there must apparently be. It is, probably, partly dependent on other causes. Thus the enlarged retinal veins show a great engorgement of the posterior part of the orbit, which is of itself sufficient to press the eye forward, as is seen in persons strangled, and in violent muscular efforts. Secondly, exophthalmus may be due to an increase of fat in the orbit, occurring as a result of an increased blood-supply. This fact has been well established by many authors. The immobility of the upper lid, which Graefe considers an important symptom in the early stages, is to be explained by the disturbed innervation of the unstriated muscular fibres found in this part. The ulcerations of the cornea are partly due to the unprotected condition of the eye, and partly to a so-called neuro-paralytic form of ophthalmia, with a dilatation of the conjunctival vessels. From the absence of dilatation of the pupil, which Graefe did not observe once in two hundred cases,

---

1 Köeben, De Exophthalmo a struma cum cordis affectione, Inaug. Diss. Berlin, 1855. 2 Aran, Gaz. heb. 1859, No. 49. 3 Trousseau, Gaz Méd. 1862, p. 474. 4 Friedreich, Lehrbuch der Herzkrankheiten, 1867, S. 312. 5 Geigel, Würzburg. Med. Zeitsch. 1866, Bd. VII, S. 84. 6 Rosenthal, Diseases of the Nervous System, p. 527. 7 Poincaré, Le syst. nerv. cent. et périph. 1877. 8 Grasset, Les Maladies de la Sys. Nerv.

it is to be seen that the pupillary fibres are, for some unknown reason, not involved.

The enlargement of the thyroid, which attends Graves' Disease, from the rapidity of its appearance, from the softness of the swelling, from the pulsation of the thyroid arteries, and from the great and rapid variation in the size of the tumor according to the action of the heart, it is natural to conclude, is chiefly due to a dilatation of the blood vessels, Naumann (1), Banks (2), Fournier and Ollivier (3), and Eulenburg and Guttmann. That such a condition can be due to an abnormal state of the vaso-motor fibres in the sympathetic is in every way possible. In the same manner can be explained the rise in temperature, Paul (4), Cheadle (5), and Tessier (6), the redness of the face, and other vaso-motor symptoms that have been observed. Eulenburg and Guttmann explain them on the ground that the vaso-constrictor fibres, which they believe are the only ones governing the movements of the vessels, are in a state of paralysis, and they say that the excited state of the ocular fibres, and the paralytic state of the vaso-motor fibres are due to the fact that they each arise from centres distant from one another, and that these centres are, at the same time, differently affected. But Rosenthal (7) and others, who believe in the distribution of dilator fibres to all the vessels, claim that it is irritation of these, rather than paralysis of the vaso-constrictors, which causes the vascular engorgement.

The increased action of the heart may also be explained as due to irritation of the cervical sympathetic, for we have seen that one function of this nerve is to increase the number and force of the cardiac pulsations. Eulenburg and Guttmann think that it is not a constant state of excitement of the sympathetic which causes these symptoms, but rather a state of paralysis by which the coronary arteries are dilated, and the parenchymal ganglia of the heart irritated by an increased supply of blood; a view which is extremely theoretical. So far as autopsies go in indicating a sympathetic origin for this disease, Eulenburg and Guttmann record nine cases in which lesions of the cervical portion of this nerve

---

1 Naumann, Deut. Klin. 1853, No. 24. 2 Banks, Dublin Hos. Gaz. 1855, No. 9. 3 Fournier and Ollivier, Union Méd. 1868, p. 95. 4 Paul, Berl. Klin. Wochsch, 1865. No. 27. 5 Cheadle, Lancet, 1869, No. 25. 6 Tessier, Trousseau's Clinique Méd. T. II, p. 540. 7 Rosenthal, Diseases of the Nervous System, p. 527.

were found, and lately Smith (1) has mentioned another of the same sort. In opposition to these, there are only four recorded cases in which the sympathetic was examined and no lesions found.

In treatment, digitalis has always been considered to have much value. Smith, Meryon, Friedreich, and Janeway have used it with success. Another agent is galvanism, which is employed for a few minutes each day, with the positive pole in the mastoid fossa, the negative over the upper cervical ganglion. It is advocated by Dusch, Eulenburg and Guttmann, Chvostek (2), Meyer (3), and D'Ancona (4). Janeway has greatly benefited several cases in this manner, and has also obtained permanent cures. He believes that the good result is due to excitation of the vagus, thus antagonizing the irritating influence of the diseased sympathetic.

ANGINA PECTORIS.

This disease was first described by Heberden, in 1768. It is, according to Eulenburg and Guttmann, not by any means a simple disease in its pathology, but is a "compound senso-motor neurosis." The chief symptoms are the well-known pain and distress in the præcordia, the pain frequently extending over the left side and arm, and a feeling of great dread and anxiety. The motor symptoms are variously described; sometimes the heart's action is nearly normal, sometimes increased in force and associated with a full pulse, at other times decreased in force, and associated with palpitation and a small, quick pulse. Often, too, when the heart appears to be acting vigorously, its real force is slight, as evinced by the low tension of the radial pulse, Brunton (5). Eichwald (6) has observed that in one and the same patient, and even at different periods of one attack, we may have these varying conditions of cardiac action. Accompanying this disturbed state of the heart, there is often great dyspnœa and change in the frequency of respiration, following secondarily the changes in the circulation.

Angina pectoris shows a marked tendency to occur in certain

---

1 Smith, Med. Times and Gaz. 1879. 2 Chvostek, Wien. Med. Presse, 1869, No. 19, 1871, No. 41, 1872, No. 23. 3 Meyer, Berl. Klin. Wochensch. 1872, No. 39. 4 D'Ancona, Independente et Annales de la soc. Méd. chir. de Liege, 1878. 5 Brunton, Lancet, 1867, July. 6 Eichwald, Würzburg Med. Zeitsch. 1863, Bd. IV, S. 49.

organic lesions of the heart and aorta, such as insufficiency or stenosis of the aortic valves, or an atheromatous state of the aorta itself, and of the coronary arteries. These changes in the coronary arteries have been said to be the cause of the attack, but this is disproved by the frequency with which such lesions occur without angina, and also by the number of cases of angina that occur with no lesion at all. The nervous supply of the heart is from so extensive an origin, and it is so difficult to decide accurately in regard to the function of each set of nerves, that a clear understanding of the participation of these nerves in this affection is well-nigh impossible. But from the great number of sympathetic filaments contained in the cardiac plexuses, and from the marked influence which they have upon the heart, it is natural to attempt to refer to these nerves, some, at least, of the symptoms of this affection.

In the first place, Goltz (1) has shown that the sympathetic nerves of the heart contain sensory fibres. Moreover, the analogy in the character of the pain of angina pectoris with that which is caused by irritation of other parts of the sympathetic, as in colic of the intestines, of the gall ducts, or the ureters, would lead us to suppose it might be of sympathetic origin. Why this pain should be transmitted from the præcordia over the chest and into the arm, is quite difficult to explain; but probably the numerous anastomoses between the sympathetic and the spinal nerves have much to do with it.

As regards the disturbance in the cardiac pulsations in angina pectoris, we may suppose that it is brought about either by the motor ganglia in the walls of the organ itself, or else in the sympathetic nerve, or perhaps in the vagus. The activity of the cardiac ganglia may be increased by abnormal resistance to the circulation, as in valvular lesions and atheroma of the aorta, by an inadequate supply of blood, as in disease of the coronary arteries, or by the ganglia themselves becoming involved in disease of the heart itself, as in myocarditis, or fatty changes. Eichwald has supposed that in cases in which, at first, there is a full, slow, hard pulse, there is an irritable state of the vagus; while in cases of rapid, intermittent pulse, there is rather a semi-paralytic state.

---

1 Goltz, Virch. Arch. 1863, Bd. 26, S. 1.

Then there is a certain form of angina occurring with diseases of the abdominal viscera, which we may consider as a reflex neurosis of the vagus, from its similarity to the results of the experiments of Goltz. From what we have learned of the origin of cardiac motor nerves, we can readily understand how disturbances in the functions of the cervical sympathetic can directly cause the state of the heart's action occurring in this disease.

The sympathetic may also produce cardiac disturbances in another way. By the excitation or paralysis of the vaso-motor filaments throughout the body, a state of arterial spasm or relaxation may be produced, which can, secondarily, powerfully affect the heart by altering suddenly the blood-pressure and amount of work the heart has to do. Cohen (1) long ago advanced the theory, that certain cases of angina pectoris are connected with the vaso-motor nerves. Later, Landois (2) and Nothnagel (3) described an angina pectoris vaso-motoria, which they referred to a general arterial spasm, often produced reflexively, especially by exposure to cold. It is accompanied by marked pallor, lividity, and coldness of the extremities. It is successfully combatted by warm applications and friction.

PALPITATION OF THE HEART.

This condition, though not generally specifically treated of, is one of the most common, and gives to the patient the greatest distress and anxiety, and to the physician the greatest opportunity often for successful treatment and useful advice. An increase in the number of the cardiac pulsations, and irregularity of their rhythm occurs continuously and constantly in exophthalmic goitre. Such a condition is brought about, temporarily, by violent emotions, as anger, fear, etc. It is also the result of exhaustion, deficient nutrition, excessive venery, and the abuse of alcohol, tobacco, tea, coffee, etc. It occurs in certain morbid conditions, as chlorosis, and anæmia, and in most cachexias, and with various neuroses, and as a result of indigestion. It is found, therefore, more frequently in women, especially the weak and hysterical.

Physiology would lead us to look for the cause of this disturbed

1 Cohen, Arch. gén de Méd. 1863, T. II, p. 564 et 636. 2 Landois, Greifswald. med. Beiträge, II. Bd. 1864, S. 161. 3 Nothnagel, Arch. f. klin. Med. 1867, Bd. III, S. 309. II, S. 173.

heart's action in an irritable state of the sympathetic motor nerves; and the præcordial pain and distress which so often accompany it are due, doubtless, to secondary participation of the sensory nerves of this organ. This view is supported by the fact that Seeligmüller has noticed in several such cases a dilatation of the left pupil, on which side we may suppose the nerve to be affected.

But, as in the case of angina pectoris we noticed an indirect influence of the sympathetic by means of its vaso-motor fibres upon the heart's action, so we may have it in this condition.

In the treatment of cardiac palpitations we must, of course, first attend to the general health of the patient, exercise, diet, etc. The morale, too, must not be neglected, and all the means employed which are used to train and guide hysterical patients. But at the same time we often find medication of great value. Hydrocyanic acid, the bromides, the anti-spasmodics, digitalis, etc., are often employed. Galvanization of the neck, also, is of a good deal of value.

VISCERAL NEURALGIAS.

As we have seen that the abdominal and pelvic viscera, and perhaps those of the thorax, are supplied, in part at least, with nerves of sensation through the medium of the sympathetic, it is evident that it is proper to consider the painful affections of these organs, commonly spoken of as neuralgias, as affections of the sympathetic. That these do not differ essentially from other neuralgias is shown by the fact, that they are often caused by the same conditions; such as perverted nutrition, malarial, gouty, or other "blood-poisons," and a perverted blood-supply. They also occur in connection with neuralgias of the cerebro-spinal nerves; those of one alternating with those of the other, Laboulbène (1). As the pain of neuralgias of spinal origin is often increased by increased muscular action, so we find the pain of visceral neuralgias made worse by the increased functional activity of the organs. Thus enteralgia is increased by digestion, ovarian neuralgia by menstruation, and vesical by the voiding of urine. The pain of these affections is not confined to such well-marked limits as

1 Laboulbène, Sur les Névralgies Viscèrales, Thèse, Paris, 1860.

it is in neuralgias of the cerebro-spinal nerves, for the distribution of the sympathetic fibres is not so accurately defined as is that of the former.

I. Neuralgias of the Solar Plexus.

Autenreith and Romberg (1) have included under this name certain painful affections, presumably of the stomach, occurring in the epigastric region, and which they consider to be distinct from ordinary gastralgia, which is an affection of the vagus. With regard to the diagnostic symptoms of this neuralgia, Romberg says: "The feeling of weakness accompanying the pain, the sensation " of coldness of which the patient often complains, the disturbed " circulation, anxious look and feeling of impending dissolution, are " pathognomonic." He believes the cardialgia sometimes accompanying intermittent fever, and mentioned by Borsieri (2), to be due to implication of the solar plexus. Wittmaack (3) supports Romberg's ideas, and adds as further diagnostic points, that cardialgia does not occur so frequently in young persons, is less often associated with menstrual disorders, and does not last so long as gastralgia. Valz, in one case of cœliac neuralgia, found the nerves pressed upon by cancer of the pancreas. Bamberger (4) and Henoch (5) do not believe in the occurrence of this affection, but think that every form of gastralgia is due to implication of the vagus. Eulenburg and Guttmann agree with them.

II. Neuralgia of the Hypogastric Plexus.

This form of neuralgia also was first noticed by Romberg, who describes it as consisting of painful sensations in the lower part of the abdomen and pelvis, and even running into the thighs. It appears much more often in women than in men, as we would naturally suppose, and is most frequent in hysterical girls at about the age of puberty. It is, of course, often due to disorders of the circulation, and so occurs in dysmenorrhœa, the neuralgic, or ovarian variety, and in the other sex we find it associated with

---

1 Romberg, Lehrbuch der Nervenkrankheiten. 2 Borsieri, Inst. med. pract. I, p. 235. 3 Wittmaack, Path. u. Ther. de Sensibilitätsneurosen, 1861, S. 242. 4 Bamberger, Virch. spec. Path. u. Ther. Bd. VI, Ab. I, S. 168. 5 Henoch, Klinik d. Unterleibskrankheiten, Bd. II, S. 184.

hemorrhoids — the so-called hemorrhoidal colic. It occurs also with cancer, fibroma, and other uterine tumors, and in certain cases of what is called irritable bladder. We have also in men a neuralgia of the urethra. Gooch (1) describes what he calls an irritable uterus, others, uterine neuralgia. Cohen (2) thinks that, in these cases, there is primarily an ilio-lumbar neuralgia, and that this causes secondarily vaso-motor neuroses of the uterus and other pelvic organs.

III. Neuralgia of the Spermatic Plexus.

The spermatic plexus can be the seat of a neuralgia, which Sir Astley Cooper describes under the name of irritable testicle. Hasse and Romberg believe that this is due to an enlargement of the veins of the parenchyma of the testicle. As in the analagous case of uterine neuralgia, Cohen believes this form is primarily in a spinal branch, and he locates it in the genito-crural, and this causes secondary changes in the circulation.

IV. Neuralgia of the Mesenteric Plexus.

Enteralgia, or neuralgia of the intestines, is either single or sporadic, or else due to various blood dyscrasias, as malaria, gout, or to chronic lead poisoning. There is also a certain form of endemic colic, colic of Poitou, Madrid, Cayenne, etc , which is very similar to lead colic. The ordinary forms of colic are due to indigestion, and to various morbid states of the blood, as above mentioned. In these conditions, according to Romberg, the activity of the sympathetic is in an exalted state. Ordinarily, he says, sensory impressions are conveyed from the walls of the intestines to the sympathetic ganglia, and are reflected to motor, or secretory nerves without producing conscious impressions; but in enteralgia, there being a hyperæsthetic condition, the sensory impressions are conducted beyond the ganglia through the posterior nerve roots and the cord, to the cerebral centres, and we become conscious of pain. Colic is often accompanied by irregular and spasmodic contrac-

1 Gooch. Diseases peculiar to Women, London, 1831, p. 299. 2 Cohen, Névroses vaso-motrices, Arch. gén. 1863, T. II.

tions of the intestines, and often by constipation. These various effects are doubtless produced by the reflex activity of the motor and vaso-motor nerves caused by the sensory irritation. The reason that the bowels are sometimes contracted and sometimes relaxed, is because there are two factors at work. The one is the reflex excitation of the direct motor-nerves, the other is the excitation of the vaso-motor nerves running in the splanchnics, which, by diminishing the blood-supply, act as inhibitory nerves of peristalsis. The pallor of the skin, the small, hard pulse, which are so generally associated with severe colic, are doubtless due to reflex excitation of the vaso-motor nerves, as is common in pain generally, and also of the vagus as it occurred in the percussion experiment of Goltz. Häen, Vanstrostwyk, Rangue, Andral, and Grisolle believe that the lead colic is due primarily to lesions of the sympathetic. Astruc and Sauvages believe that it is of purely spinal origin, but as the sympathetic nerves are now known to have, to a large extent, such an origin themselves, it does not at all follow that they are not the ones immediately involved in the disease. Tanquerel des Planches (1), who had abundant opportunities for studying colica pictonum, was firmly convinced that lesions should be sought for exclusively in the sympathetic, and he narrates a case in which there was marked enlargement of a number of the abdominal ganglia. So Kussmaul and Maier (2), in a patient with lead poisoning, who died during an attack of colic, found the ganglia of the abdominal sympathetic enlarged and indurated, there being a marked increase of connective tissue. In this connection it may be mentioned that Segond (3) found the same conditions in several cases of endemic colic at Cayenne. In regard to the spastic contraction of the intestines, and other concomitant symptoms of lead colic, such as vomiting, painful micturation and dragging up of the testicle, they have usually been regarded merely as reflex acts. But Eulenburg and Guttmann very naturally object to so loose an employment of the word reflex, and suggest that, in case of lead colic, which they consider both as a sensory and motor neurosis, there is a simultaneous action of the lead upon both the motor and sensory fibres. Moreover, the lead is de-

1 Tanquerel des Planches, Traité des Maladies de Plomb, Paris, 1839. 2 Kussmaul u. Maier, Deut. Arch. 1872, Bd. IX, S. 284. 3 Segond, Essai sur la névralgie du grand sympathique, Paris, 1837.

posited in the tissue of the muscles themselves, and this may lead directly to the spasm. This is probably the cause of the cramps in the abdominal muscles, which it would be difficult to explain as occurring reflexively.

ANÆSTHESIAS OF THE SYMPATHETIC.

In contradistinction to the hyperæsthesias of the sympathetic which we have been considering under the name of neuralgias, anæsthesias have been written about. Very little, however, is claimed to be known about them by any one. Eulenburg and Guttmann doubt the existence of such affections very strongly. When it is acknowledged, they say, that the perception of sensation in the sympathetic is extremely small, and confined entirely to the indefinite form called *common sensation*, how can we believe that there can be a diminution of this sensibility at all appreciable by our consciousness. To claim the existence of anæsthesias from the absence of reflex actions, besides stretching the definition of the word, is absurd; for we might have the interrupting trouble situated in the ganglionic cells, where the reflex takes place, or in the motor apparatus itself, while the sensory nerves remained intact.

PERITONISMUS.

Under the name of peritonismus, Gubler (1) has described a set of symptoms which are connected with morbid conditions of the peritoneum. Among these he notices pain, meteorismus in its various degrees, hiccough, vomiting, small and rapid pulse, cyanosis, lowering of the temperature, decrease in the amount of urine and alteration of its character, and cerebral symptoms of anxiety, and depression of all the mental powers.

This is a picture of what occurs only too frequently in connection with lesions of the peritoneum and the viscera covered by it. Thus we see it in connection with peritonitis, even when it is circumscribed. It occurs on opening the abdominal cavity, and when gas or air is admitted, long before inflammation could set in. It occurs from the presence of irritants in the cavity, and even from such unirritating substances as water or blood. It occurs when there

1 Gubler, Jour. de thér. 1876 et 1877.

is some injury to even a small portion of the peritoneal covering of the intestines — especially the small intestine — as in strangulated hernia, intussusception, volvulus, and other forms of obstruction, and lastly we have it suddenly developed in connection with typhoid, cholera, and even certain forms of dyspepsia. In these latter cases the morbid process, whatever it may be, though not at first affecting the peritoneal covering of the intestines, is yet in such close proximity to it, that the peritoneal nerves are markedly affected.

Gubler supposes that these symptoms are produced by the agency of the sympathetic fibres of the peritoneum. The sensory fibres of this membrane coming from the sympathetic, he believes are readily affected by certain forms of irritation, and then by reflex action the sympathetic supply to the various organs, as the muscularis mucosæ, the contractile coats of the vessels of the brain, the intestines, the kidneys, and the whole body, and also the nerves of the heart, are powerfully affected; thus producing the aggregate of the symptoms that he designates by the name of peritonismus. The well-known fact that these symptoms are much more likely to appear in the well and strong than in the weak and sickly Gubler explains on the ground that in the former the functional activity of the nervous system, especially of the sympathetic, is much greater than in the latter, and hence they are more ready to be affected by irritation of the peripheral nerves and to reflect such excitation along the centrifugal motor branches.

NERVOUS ILEUS.

The older authors were in the habit of describing, under this name, a spasmodic closure of the intestine, accompanied by stercoraceous vomiting, and the other symptoms of organic stricture of the intestinal canal. Jaccoud narrates a case of this kind occurring in his hospital practice. The case was kept closely under watch by himself and his interne Dieulafoy, so that there was no possibility of deception. There was complete constipation, considerable meteorismus, and vomiting not merely of stercoraceous material, but of cylindrical pieces of fæces, evidently from the large intestine. Under the action of belladonna, cam-

phor and castor, this ceased on the eighth day. Not long afterwards the patient died of typhoid fever, and the autopsy showed no organic changes which could account for the intestinal obstruction. The ileo-coecal valve was normal. Thus it was proved that nervous ileus does occur, that antiperistaltic action of the intestines is real, and that under such circumstances the ileo-coecal valve does not offer an obstacle to the upward movement of the contents of the large intestine. Jaccoud says this affection occurs almost exclusively among hysterical women, and this is not to be wondered at when we remember how often sympathetic disturbances are seen in this class of patients. That it sometimes occurs in men is shown by the case of Axenfeld, quoted by du Fontarce, p. 207. The remedies, of course, are the anti-spasmodics, and drugs tending to depress the sympathetic, the most important of which is atropia.

DIARRHŒA.

That the character of the evacuations from the bowels can be influenced, to a certain extent by the sympathetic, has been shown by the experiments of Adrian, Lumansky, Bernard, and Budge, some of which were referred to in our consideration of the nerves of the intestines. They found that after injury or extirpation of the cœliac ganglia, or solar plexus, there frequently appeared diarrhœas and intestinal hemorrhages. This result may be brought about partly through the agency of the nerves of peristalsis, partly through those governing secretion, and partly through the vaso-motor nerves. Vulpian is of the opinion that in the experiments above named the fluidity of the passages was due to a paralysis of the inhibitory nerves of secretion. It is through a reflex affection of the circulation through the sympathetic nerves that diarrhœas result from exposure to cold, or from severe injuries, such as large superficial burns. Vulpian supposes that the diarrhœa of enteritis is due to reflex action, and to the same cause may be attributed that of dentition and emotional disturbances.

DIABETES MELLITUS.

According to Lauder Brunton (1), the causes of diabetes mellitus are as follows: —

1 Brunton, Reynolds' System of Medicine, Vol. v, p. 381.

I. Increased formation of sugar, due to, (*a*) rapid digestion of starch and sugar; (*b*) failure of the glycogenic function of the liver and muscles; (*c*) increased transformation of glycogen into sugar.

II. Lessened combustion of sugar, caused by, (*a*) insufficiency of ferment which would convert it into lactic acid; (*b*) altered quality of sugar, enabling it to resist the action of the ferment; (*c*) diminished circulation through the muscles.

On glancing over these causes it is evident that the nervous system may, in various ways, be the means by which the pathological condition of glycosuria is produced.

First, the failure of the glycogenic function of the liver may be due to a dilatation of the hepatic vessels, and an increased rapidity of flow through them, not giving time enough for the transformation of the sugary products of digestion into glycogen. The sugar thus passes unaltered into the general circulation, and gives rise to diabetes. This is one cause of those intermittent forms of the disease which are observed as occurring after meals, and which, if the meals are frequent enough, become continuous, but remittent. The dilatation in these cases is probably confined to the portal vein. Of course by a proper regulation of the diet this form can be readily cured.

Secondly, the increased transformation of the stored-up glycogen back into sugar may be due to a larger proportion of ferment, or to an increased circulation through the organ. This last may be brought about either by increase of the arterial pressure, or by a dilatation of the vessels of the liver, especially of the hepatic artery, Cyon and Aladoff (1). It is plainly by means of the vaso-motor nerves that these conditions are produced. Dilatation of the hepatic vessels, which stands in immediate causative relation to the appearance of sugar in the urine may be due,

(*a*) To paralysis of the vaso-constrictor nerves going to this organ. The origin and course of these nerves has been fully considered elsewhere. As it was shown that diabetes could be produced experimentally in animals by injuring various parts of the encephalon and thus affecting the vaso-motor centres here situated, so we find numerous cases recorded where diabetes was evi-

1 Cyon and Aladoff, Bullet. de l'Acad. Impériale des Sci. de St. Petersb. T. XVI, p. 308.

dently due to lesions of the cerebro-spinal centres. They have been mentioned by Pavy, Grisolle, Szokalski (1), Fanconneau, Dufreson (2), and many others. Fritz (3), Goolden (4), and Fischer (5) have published lists of such cases. The latter found diabetes, following cerebral lesions, twenty-one times, and traumatisms of other parts of the body twenty-two times. We also noticed under hyperidrosis cases in which supposed paralysis of the sympathetic was accompanied by diabetes.

(*b*) The vessels of the liver may be made to dilate and the production of sugar increased reflexively by irritation of the vagus and other sensory nerves, as is shown by the experiments of Bernard, before mentioned.

Not only can the vagus be irritated along its main trunk, but excitation of its terminations produces the same effects, as was shown by Schiff's sticking a needle into the liver, Pavy stimulating it by electricity, and Harley (6) by injecting alcohol into the portal vein. It has not been shown experimentally that irritation of the other branches of distribution has the same effect, but it is assumed by Brunton. He attributes to this cause the glycosuria observed in intestinal irritation, and after the inhalation of amyl nitrite, and the various anæsthetics, the latter irritating the pulmonary branches of the vagus. It is possible this may be the manner in which asthma produces sugar in the urine, and the reason that we sometimes find it associated with phthisis and pertussis. As regards the irritation of other sensory nerves, Braun (7) says that in certain cases of neuralgia of the sciatic, sugar has been found in the urine. The way in which mental acts operate to modify the functions of the nervous system is not much understood, but perhaps it comes under reflex better than elsewhere. At any rate, it is well known that mental emotions are not an infrequent cause of glycosuria, Roberts (8).

(*c*) Glycosuria is produced also by rise of the arterial pressure, and this in turn is due, sometimes, to the action of the vaso-motors. It is to the changes in the blood-pressure that we find sugar in the urine in convulsions of various kinds, Michea, Reynoso and

---

1 Szokalski, L'Union. Méd. 1853. 2 Dufreson, L'Union. Méd. 1849. 3 Fritz, Gaz. heb. 1869. 4 Goolden, Lancet, 1854. 5 Fischer, Arch. de Méd. 1862. 6 Harley, Brit. and Foreign Quart. Rev. 1857. 7 Braun, Lehrbuch der Balneotherapie Berl. S. 343. 8 Roberts, Urinary and Renal Diseases, p. 228.

Roberts; with impeded respiration, after exposure to cold, Roberts; with cholera and chills, Burdel de Vierzon. In these cases, from the carbonic acid in the blood, from the toxic element of the disease, or from the action of cold, the vaso-motor centres are stimulated, and there follows a rise in the arterial tension.

DIABETES INSIPIDUS.

This disease was first distinguished from glycosuria by Willis (1). It consists simply in an increased flow of urine of low specific gravity, but otherwise normal, except that the aggregate of solids is somewhat greater than in health. It is rational and in harmony with physiological experiment to believe, that this great excretion of water by the kidneys is due to the dilatation of their vessels and a hyperæmia of the organs. This view is borne out by the few autopsies that have been made, for in most of these the kidneys have been found hyperæmic, and there was marked degeneration of the glandular tissue. That this vascular dilatation may be due to nervous influence is shown by the fact, that injury or section of the splanchnics in the lower part of their course, after the hepatic nerves have left them, or of the solar plexus, or of the renal nerves themselves, causes an increase in the amount of urine, but there is no sugar in it as we get on section of the higher parts of the sympathetic. As we have diabetes mellitus after puncture of the floor of the fourth ventricle, so we have diabetes insipidus after injury to the floor of this cavity, only the spot of injury is not precisely the same as for the former affection. We have, in fact, then, two sets of nerves connected with the production of diabetes; the one consists of the vaso-motor nerves of the liver, the other of those of the kidneys. These nerves arise at nearly the same spot in the floor of the fourth ventricle, and are intimately associated for a part of their course. An injury to both centres, or to the united trunks of the nerves, will cause glycosuria; an injury to the nerves of the kidneys will cause polyuria; and instances are cited by Poincaré (2), in which the amount of urine has remained normal, but it has contained a considerable amount of sugar. In these cases it is probable that merely the vaso-motor nerves of the liver are involved.

---

1 Willis, Urinary Diseases. 2 Poincaré, Le sys. nerv. central et périphérique, 1877.

Such being the pathology of the affection, we are not surprised to find that it has oftentimes a nervous origin. In thirty-seven cases cited by Roberts, nine accompanied cerebral diseases, six followed blows on the head, eight were after falls, five were due to intemperance, five to cold, five occurred after fevers, three were due to hereditary influence, one to exposure to the sun's rays. Among the cerebral lesions are lacerations, tubercle and parasites. Klebs and Munk (1) found atrophy of the semilunar ganglia, and Lubimoff (2) found sclerosis of the same. Brunton believes that the cases occurring after exposure to cold and after excessive drinking are due to the excessive work thrown upon the kidneys. There is sometimes a diminution of the salivary and other secretions, sometimes an increase. In the former case it is probably due to an abstraction of water from the system, this also being the cause of the polydipsia. In the latter case the increase of saliva is due to the fact that the centres for this secretion are also in the fourth ventricle, not far from those for the urine.

Roberts, in an appendix, gives a number of cases in which there was marked polyuria, but in which there was also a small amount of sugar, and inconstant in its occurrence; thus illustrating the close relation between the two forms of diabetes. Two of these cases reported by Fischer, followed fracture of the skull; another was examined post-mortem by Luys (3), and in the floor of the fourth ventricle were found marked changes, and in Roberts' case there was a large intra-cranial hemorrhage.

In the treatment of this affection J. Franck considered large doses of nitrite of potash as a specific. In France, camphor and valerian have been used, — the latter especially with marked success. Ergot. morphia, and atropia are also employed. The latter seems to be a very rational remedy, and the author has been very successful in its use. Siedel (4) has employed electricity, using the constant current for five months, daily. One pole was placed on the loins near the spine, the other pressed deeply into the corresponding hypochondrium. In three weeks there was a falling off of from 5,900 c.c. to 2,300. Erb (5) also greatly benefited a case by the constant current applied to the spine a few minutes each day.

---

1 Klebs u. Munk, Tagebl. der Naturforscher-versammlung zu Innsbruck, 1869, S. 113. 2 Lubimoff, Virch. Arch. Bd. XLI. 3 Luys, Gaz des Hôp. 1861. 4 Siedel, Schmidt's Jarhb. Bd. 130, S. 97. 5 Erb, Med. Times and Gaz. 1868, Vol. I, p. 327.

ADDISON'S DISEASE.

The peculiar symptomatology which is characteristic of this disease, was first described by Thomas Addison (1). The clinical signs are a deposit of dark bronze colored pigment in the rete Malpighi, more rarely in the internal organs; symptoms of irritation of the intestinal canal, vomiting, abdominal pain, etc.; great muscular weakness, and anæmia, almost always terminating in death. Addison claimed that the cause of all these was degeneration of the supra-renal capsules.

Physiologists soon began to experiment, to show how this set of symptoms could be brought about by lesions of these organs. Brown-Séquard found that their extirpation was followed by speedy death, and in a few cases he discovered traces of pigment in the blood. Gratiolet (2), Philippeaux (3), Berruti and Perusino (4), Harley (5), Chatelain (6), and Schiff (7) have refuted these experiments, and have found that both in animals with a pigmented skin and in albinos there was no increase of pigment in the skin and internal organs. Induced by these negative results, and even before physiologists had shown that the function of the supra-renal capsules had been over-estimated, pathologists ascribed the disease to another source, and claimed that the ganglia and plexuses of the abdominal sympathetic are the parts immediately concerned. This view evidently originated from a recognition of the rich nerve supply of the capsules, and the close and numerous connections which they have with the neighboring plexuses. Besides, as Rosenthal (8) remarks, the clinical symptoms of Addison's disease are evidences of an affection of the nervous system. Under this category come the frequent headache, vertigo, syncope and neuralgias, and later on, dyspepsia, vomiting, diarrhœa, etc. The convulsions which sometimes occur are purely the results of cerebral anæmia; the same anæmia of the nerve-centres which ultimately ends in cachexia, exhaustion, somno-

---

1 Addison, On the Constitutional and Local Effects of Disease of the Supra-renal Capsules, London, 1855. 2 Gratiolet, Compt. Rend. 1856, T. XLIII, p. 468. 3 Philippeaux, Compt. Rend. 1856, T. XLIII, pp. 964 et. 1155: T. XLIV, p. 396. 4 Berruti u. Perusino, Constatt's Jahresbericht, 1857, IV, S. 265. 5 Harley, Brit. and For. Med. chir. Rev. 1855, Vol. XXI, pp. 204 and 498. 6 Chatelain, De la peau bronzée, Thèse Strasbourg, 1859. 7 Schiff, L'Union Méd. 1853, No. 61, p. 346. 8 Rosenthal, Diseases of the Nervous System.

lence, and death. Schmidt, of Rotterdam (1), was the first to adopt this view of the sympathetic origin of Addison's disease. It is now accepted by a great majority of writers, among whom may be mentioned Risel, Jaccoud (2), Martineaux (3), and Greenhow (4), and is favorably considered by Rosenthal, and Eulenburg and Guttmann.

In thirty-two autopsies collected by the latter authors, in which the sympathetic was examined, twenty cases showed lesions of these nerves, and twelve showed them intact. Among the changes found were œdema and enlargement of the cœliac plexuses and sympathetic nerves, Munro (5), Recklinghausen (6); fatty degeneration of the semi-lunar ganglia and solar plexus, Queckett, Meinhardt (7), Bartsch (8), and Southey (9); atrophy of the abdominal sympathetic and solar plexus, Schmidt (1) and Van Andel (10); hypertrophy of the solar plexus, semi-lunar ganglia and efferent nerves, Virchow (11), Greenhow (12), Wolff (13), and Burresi (14); advanced degeneration of the same, Sanderson (15), and a purulent softening starting from the capsules, Fränkel (16).

While it is supposed that these lesions are the immediate cause of the symptoms of Addison's disease, it is by no means claimed that they do not very frequently occur secondarily to changes in the capsules. According to Risel the disease consists of a paralysis of the abdominal sympathetic from the propagation of an inflammation starting in the supra-renal capsules; this giving rise to a general anæmia, on account of the statis of the blood in the abdominal viscera. The pain and vomiting may be explained as due to the participation of the gastric plexus, the diarrhœa to an affection of the mesenteric plexus, the headache, vertigo, and neuralgias to the general anæmia, the syncope, which is sometimes fatal, to the reflex excitation of the vagus through the cœliac

---

1 Schmidt, Arch. f. d. holländ. Beiträge, Bd. II, S. 166. 2 Jaccoud, Traité de la Path. Interne. 3 Martineaux, de la maladie d'Addison, Paris 1864. 4 Greenhow, Lancet, 1875, Vol. I, p. 327, 361, 395, 429, 463, 532. 5 Munro, Assoc. Med. Jour. 1856, p. 848. 6 Recklinghausen, Deut. Klin. 1864, No. 8, p. 78. 7 Meinhardt, Wien. med. Presse, 1876, No. 1–4 u. 7–9. 8 Bartsch, De Morbo Addisonii Dis. Königsburg, 1867. 9 Southey, Path. Soc. London, Dec. 1871. 10 Van Andel, Nederl. Tijdschr. v. Geneesk. VI, S. 200, 1862. 11 Virchow, Virch. Arch. 1875. 12 Greenhow, Path. Trans. Vol. XVII, p. 307. 13 Wolff, Berl. Klin. Wochsch. 1869. 14 Burresi, Lo 'Sperimentale XXV, p. 522, 1870. 15 Sanderson, Med. Times and Gaz. 1868, Oct. 31st. 16 Fränkel, Ein Fall. v. Addis. Krankheit, Dis. Berl. 1870.

plexus. The experiments of Vulpian, showing pigmentation after section of the sympathetic, would seem to shed some light upon the origin of the bronze coloration.

ERYTHROMELALGIA.

Mitchell describes, under this name, a disease of which he himself observed some half-dozen cases, and of which he quotes as many more. It generally occurs in persons who have just recovered from some severe sickness, and the first thing that is noticed is pain in the foot. It is situated more frequently in the ball of the great toe than anywhere else, and is always very accurately limited. Sometimes there are several of these painful spots. They are always extremely tender on pressure. Very soon after they attract the attention of the patient they become red and slightly swollen, the redness always being increased by exercise. The pain and distress is so great that the patient is obliged to give up active life. Exercise and the application of heat always increase the severity of the symptoms, and it is relieved by cold and rest, the redness at such times passing away. Mitchell believes that this disease is primarily an affection of the sensory nerves, and that these, acting reflexively through the vaso-motor centres in the central nervous system, produce, by means of the vaso-motor nerves of the part, a vascular dilatation, which greatly increases the severity of the symptoms, and tends to prolong the disease indefinitely. He, however, thinks that it may sometimes be primarily an affection of the vaso-motor centres.

LOCAL ASPHYXIA AND GANGRENE OF THE EXTREMITIES.

In the disease which Raymond (1) designates by this name, the fingers and hands are the parts generally affected; but it often extends to the feet, and sometimes to the extremities of the nose and ears. The parts become pale and numb, but there are also often quite severe neuralgic pains, which give the patient a great deal of trouble. The temperature sinks, and the surface presents a somewhat cyanotic appearance, though often it is mottled with

1 Raymond, Asphyxia locale et gangréne symetrique des extremitès Thèse, Paris. 1862, No. 36.

spots of red. Anything which is prejudicial to the circulation, — as for instance, heart lesions, with which it is often associated,—makes matters much worse. Some cases have these symptoms only at irregular intervals, and they seem to be brought on often by exposure to cold, mental emotion, etc., McBride (1). Other cases have the symptoms constantly, but advance no further, and either remain stationary or else slowly recover. In the more unfavorable cases the circulation becomes more and more feeble, and nutrition is correspondingly less and less. The skin often becomes covered with reddish blisters; later it is dry, shrivelled, and feels like parchment, and becomes of a dark brown or black color, in fact gives all the signs of ordinary dry gangrene, which in truth it is. Sometimes, however, instead of becoming gangrenous the parts retain their vitality, but become much atrophied, Vaillaud (2).

From this history of the disease it has been supposed that it is due to a constriction of the vessels of the part. While Weber and a few others believe that the vessels themselves are primarily involved. Durosier, Raymond (3), Vulpian (4), Fischer, Poincaré (5), and Fontarce (6), think the disease is strictly nervous in its character, and seated in the vaso-motor filaments, the contraction of the vessels being due to an irritation of the nerves distributed to their muscular coat. Sometimes this is apparently reflex in its nature, as in McBride's case. At other times the lesion appears to be a central one, and involves the vaso-motor centres in the cerebro-spinal axis. Vulpian and Poincaré believe it is in the cord; the latter placing it in the so-called "vascular columns of Clark." Vaillaud mentions a case occurring in a soldier who had some localized tenderness along the lower part of the cervical spine, associated with a little fever. The symptoms in this case were more on the left than the right side, and later on this side become somewhat paralyzed. McBride's case also had some spinal disease. Raymond, however, puts the centres affected in the cerebellum, and it is quite probable, indeed, that the localities affected are not always the same — for we have seen the wide distribution of the centres for vaso-motor nerves.

---

1 McBride, Med. Rec. 1878. 2 Vaillaud. Rec. de mém. des méd. milit. 1877. 3 Raymond, Asphyxia locale et gangrène symetrique des extremités Thèse, Paris, 1862, No. 36. 4 Vulpian, L'appareil vaso-moteur. 5 Poincaré, Le syst. nerv. cent. et périph. 1877. 6 Fontarce, Le grand sympathique.

Very little can be done in the way of treatment, except to meet the symptoms as they occur with local measures. Mills (1) employed electricity along the spine and the nerves of the affected extremity, but found that it merely served to decrease the temperature much more.

SCLERODERMA.

This was first described by Thirial (2) in 1847. It is generally symmetrical, appearing equally on both sides of the body, and the extremities are the first and most markedly affected. Vidal (3) divides its course into two stages: first, a stage of marked vascular disturbance, in which the parts become cold, cyanosed, and often covered with a profuse perspiration. This is succeeded by the second stage, in which the nutrition of the part is interfered with, the skin is dryer and becomes very hard, tense, and solid, as if it had been frozen, and generally presents marked pigmentation. Blachez (4) makes a second intermediate stage between the other two, which is characterized by œdema, but Vidal says this is often wanting.

Forget believed it to be a chorionitis, but he is not supported by other writers. Duhring (5) claims there are no signs of an inflammatory process, but there is a simple increase of pigment in the rete Malpighi, and of connective tissue in the chorion. Kaposi (6) believes that the vessels have most to do with the causation. Emminghaus (7), Lepine (8), and Lagennge (9), Viaud (10), Lamanche (11), and Budin (12) have found it in connection with one-sided facial atrophy. Vidal, considering the prominent part which the vessels must play in it, its symmetrical appearance and its origin, beginning like local asphyxia, thinks without doubt that the disease is primarily an affection of the vasomotor centres in the anterior columns of the cord, and he believes also that his views are confirmed by Charcot and Luys, who found sclerosis of this part in an autopsy they made in a case of sclero-

1 Mills, Am. Jour. 1878, II, p. 431. 2 Thirial, L'Union Méd. 1847. 3 Vidal, L'Union Méd. 1879, Compt. Rend. de la soc. Méd. des Hôp, 1879. 4 Blachez, Compt. Rend. de la Soc. Méd. des Hôp. 1878. 5 Duhring, Diseases of the Skin, p. 361. 6 Kaposi, Würzburg, med. Wochsch. Bd. III, S. 119. 7 Emminghaus, Deut. Arch. XI. 8 Lepine, Soc. de la Biol. 1873. 9 Lagennge, Thèse, Paris, 1874. 10 Viaud, Thèse, Paris, 1876. 11 Lamanche, Thèse, Montpelier, 1876. 12 Budin, Soc. Anat. 1873.

derma. This also is the view adopted by Grasset (1). He thinks that scleroderma is closely allied to facial hemiatrophy, and suggests that these two affections should be called, respectively, general scleroderma and facial scleroderma. It is a rare disease, four cases only having been observed in this country.

PROGRESSIVE FACIAL HEMIATROPHY.

Its synonyms are: prosopodysmorphia, Bergson, neurotic facial atrophy, Samuel, aplasie lamineuse progressive, Lande, and scleroderma, Grasset. It was first described by Romberg (2). The side of the face which is involved becomes thin, tense, hard and pale, the features are "drawn," there is no perspiration and no flushing even on violent exertion, and the secretion of sweat is sometimes diminished. This, too, is a rare disease, and like the one just considered, only four cases have been observed in this country — by Robinson (3), Hammond, Draper and Bannister.

Bitot, Lande, and Gintrac (4) believe that it is primarily a disease of the tissues themselves, but even Lande admits that there may be a participation in it of the nerves of nutrition. Romberg, Samuel, Fremy (5) and Berger say it is a disease of the sympathetic, but place it in the trophic fibres. Stilling believes it is the vaso-motor fibres that are affected, especially those that are distributed with the fifth nerve. This view is supported by Bœrwinkel, who, in one case at least, claimed that the spheno-palatine ganglion was the original seat of the lesion, and also Nicati, who has found atrophy of one-half of the face after paralysis of the sympathetic on that side. Brunner and Seeligmüller have seen cases in which this disease was associated with all the other symptoms of sympathetic excitation, and they consequently claim that this is the cause. Eulenburg and Guttmann think there is little doubt that, in facial hemiatrophy, the vaso-motor fibres in the fifth nerve are affected to a marked degree, even if their diseased condition does not stand as the immediate cause of the affection. These authors have employed electricity, but with no avail.

---

1 Grasset, Les maladies de syst. nerv. 2 Romberg, Klin. Ergebnisse, 1846. 3 Robinson, Am. Jour. 1878, II, p. 437. 4 Gintrac, "La Face," Nouv. Dict. de Méd. et Chir. pract. 5 Fremy, L'Etude critique de la trop-neurosis facial, Thèse, Paris, 1872.

FEVER.

By fever we mean simply an increase above the normal standard of temperature of the body. As regards the accompanying symptoms in the various organs, and the changes which the high temperature may produce, though of the greatest interest to the pathologist and the practitioner, they would be out of place in this connection. We will here consider merely the causes of an elevated temperature.

Fever may be divided into three general varieties: —

1. Fever of purely nervous origin, as that which occurs with certain lesions of the great centres.

2. Symptomatic fever, that in which the rise in the general temperature is preceded by a local inflammatory process.

3. Fever occurring in connection with morbid conditions of the blood.

In the section on physiology we have studied temperature sufficiently to appreciate that the rise in it depends upon the relation between the production and loss of caloric. The mechanism of the loss we have fully considered, and it remains to study further the various methods by which the production of heat is regulated, and what influence the nervous system may have upon it.

Traube (1) believed that the mechanism governing the loss of heat was the only one involved, and fever was merely due to a diminished cutaneous circulation. This was speedily refuted by Auerbach (2), Liebermeister (3), Immermann (4), Leyden (5), Baerensprung and Michal, for we very frequently have a great increase in temperature with a marked dilatation of the peripheral vessels. Marey (6) modified Traube's theory by showing that increased chemical action and production of heat was also an element in fever, but he laid too little stress on this all-important point.

Though the temperature may be markedly affected by the variations in the loss of heat, yet the great element in any febrile disease is, primarily, an increase in the amount of heat produced,

1 Traube, Allgm. med. Centralzeit, 1863, No. 52-54 u. 102. 2 Auerbach, Deut. Klin. 1864, No. 22 u. 23. 3 Liebermeister, Prag. Vierteljahrschrift, 1865. 4 Immermann, Deut. Klin. 1865, No. 1 u. 4. 5 Leyden, Deut. Arch. 1869. 6 Marey, Phys. méd. de la circulation du sang. Paris, 1863.

due entirely to an increased activity of tissue metamorphosis throughout the body. Now we can have this exaggerated action brought about in two ways: 1st, By the direct action on the tissues of some abnormal element in the blood. 2d, By the intervention of the nervous system. In the case of fevers of nervous origin of course the latter influence is the only one involved. In fevers due to local inflammations, we may have the rise in temperature due, in the first place, to the increased formation of heat in the inflamed part. But Billroth, Simon, Weber and others, have shown that in these cases the general temperature is higher than the local inflammation can raise it, and Huffert found that in superficial inflammations the affected part sometimes shows a lower temperature than is found in the rectum or axilla. Hence it follows that the local lesion must affect the general nutrition of the body either by means of the blood or the nerves. In the fevers of the so-called blood-poisonings we may, in a like manner, have the poison, whatever it may be, acting directly on the tissues, or indirectly through the intervention of the nerves, or we may have both these elements at work at once. At least this is the view held by a great majority of the writers of the present day, many of whom will be mentioned below. Some, however, deny that the nerves have any share in producing fever. They hold what is called the humoral theory, and think that in all cases fever is produced by the action of abnormal circulating fluid upon all the constituents of the body. Among these are Guerin, Verneuil and Gassilin. Now, by what mechanism is it that the nerves are enabled to affect the chemistry of the body.

1. It is conceded by nearly every one, and is especially dwelt upon by Vulpian (1), that dilatation of the vessels through the influence of the vaso-motor nerves, and an increased flow of blood through a part, can accelerate the molecular changes and raise the temperature. This is one reason for the rapid rise in temperature during the chill of an intermittent, the spasm of the cutaneous vessels sending the blood to the internal organs and greatly increasing the internal combustion.

2. Those authors who believe in the existence of trophic cells

---

1 Vulpian, Leçons sur l'appareil vaso-moteur, T. II.

and nerves, such as Charcot, Brown-Séquard and Weir Mitchell, of course explain the tissue changes as taking place through their agency, an increased excitability of these nerves producing more active chemical changes; in a word, they consider fever as a general inflammation, an exaggeration of nutrition.

3. Bernard (1), following out his theory of two sets of thermic nerves, believes fever to be due to a paralysis of the "nerves of refrigeration," which he believes are contained among the fibres of the sympathetic.

4. Tscheschichin (2), not adopting the idea of calorific nerves, but believing in the existence of a "moderator centre," affecting the heat-producing function and existing high up in the encephalon, thinks that fever is due to a paralysis of nerves running out from this centre to the tissues, and called by him "inhibitory nerves of calorification." This view is adopted by Wood (3). But these authors have many strong opponents; and many elaborate experiments have been made by Bruck and Günter (4), Pochoy (5), Naunyn and Quincke (6), Riegel (7), Vulpian and Murri (8).

5. Vulpian and Mayer (9), not believing in distinct trophic nerves, but thinking that the nutrition is kept up by a certain trophic influence exerted by all the nerves, motor, sensory and secretory, claim that it is simply an alteration in this function of the nerves, which reacts upon the nutrition, causing a febrile movement.

Such being the explanations of the action of the nerve-centres in producing increase of temperature, let us briefly consider the mechanism by which this result is brought about in the three varieties of fevers that were spoken of at the beginning of the section.

I. Nervous form. In a great number of wasting diseases of a non-inflammatory type, but in which there is great depression, such as certain cases of tumor of the brain, not including those which act by paralyzing the centrifugal nerves in the lower part of the encephalon — in malignant growths in various parts of

---

1 Bernard, Rev. des cours scient. 1871-1872. 2 Tscheschichin, Reicherts u. Dubois-Reymond's Arch. 1866. 3 Wood, Toner Lect. No. 4, 1875, Smithsonian Inst. 4 Bruck u. Günter, Pflüg. Arch. 1870, S. 578. 5 Pochoy, Rèchercheś experimentales sur les centres des temperature, Th. Paris, 1870. 6 Naunyn u. Quincke, Reicherts u. Dubois-Reymond's Arch. 1869. 7 Riegel, Pflüg. Arch. 1871-1872, S. 629. 8 Murri, Sulla teoria della febre Florence. 9 Mayer, Herman's Phys. Bd. II, Th. I.

the body, in various cachectic conditions, in leucocythæmia, etc., there is often, towards the last, when the patient has become excessively debilitated, a marked and often rapid increase of temperature. Thus, in a case of leucocythæmia which the author observed, the temperature, which had remained normal till a short time before death, rapidly ran up in the last few hours to 108°. Every one has observed the same thing in cerebral tumor, and in tumors of the abdominal organs. Vulpian explains this, on the supposition that the nerve centres suffer in the general depression, their energy is lost, and they can no longer control the nutrition of the tissues within its proper limits, and hence a more rapid metamorphosis takes place, accompanied by the rise of temperature. The temperature in sunstroke, which continues to rise to a great height, even after the patient is subjected to the most vigorous anti-pyretic measures, is doubtless due to the overwhelming influence of the external heat upon the cerebral centres. Then we have lesions of the brain and cord, affecting, apparently, not the ganglia themselves, but the centrifugal fibres as they pass downwards towards their peripheral distribution. Among such are hemorrhages, or other lesions of the pons and medulla, and apoplexies, injuries and inflammation of the cord. The cases which have been more particularly mentioned in connection with cerebral and spinal diseases are typical samples of fever caused solely by affections of the nervous system.

II. Symptomatic fever. We have this form of fever due to some peripheral irritation, either a local inflammation, or by some other irritation of the afferent nerves. There was recently, in the wards of Bellevue Hospital, a boy who had a chill once a week, accompanied by a fever ranging up to 105°. He had never had intermittent, and quinia had no effect in checking the paroxysm. Finally it was thought it might be due to the painful irritation of a contracting cicatrix in his hand, and it was found, on the removal of the cicatrix, that the attacks ceased. Redard (1), Haidenhain (2), Mantegazza (3), and Howarth (4) say that the irritation of sensory nerves produces a decrease of temperature, but this is denied by Riegel (5). At any rate, it is certain that

1 Redard, Arch. gén. T. XIX. 2 Haidenhain, Pflüg. Arch. 1870, S. 504. 3 Mantegazza, De la azione del dolore sulla calorificazione et sui moti del cuore. 4 Howarth, Cbl. 1870. 5 Riegel, Pflüg. Arch. 1871-1872, S. 629.

irritation of these, or at least of some kind of afferent nerves, is followed often by a febrile state. So also Lister, Chaffaud (1), Lereboullet (2), Bernard, and Lucas-Championiére (3) have shown that this form of fever is due, partly at least, to a reflex irritation of peripheral nerves, though, of course, an altered character of the blood may be a factor, as is claimed by Billroth (4).

III. In the essential fevers, those due to a morbid condition of the blood, as septicæmia, pyæmia, diphtheria, the exanthemata, etc., we probably have the toxic principle, whatever it may be, acting directly on the tissues themselves, and also on the nerve centres, depressing them and acting, secondarily, through their vaso-motor, trophic, or thermic branches distributed in the sympathetic. But we must remember that most of the theories of the relation of nerves to temperature are merely theories, and have little basis in either physiological or pathological data, and, as Jaccoud remarks, we really know little more about fever than did Hippocrates.

CHILLS.

In this connection it will not be uninteresting to notice chills, which, though not forming a necessary part of a fever, are yet very frequently connected with it. A chill is really a spasm of the superficial vessels by which the blood is driven to the centre of the body, and a subjective feeling of intense cold produced by the transitory anæmia of the skin. This spasm must evidently be central in its origin, and is due to exaggerated activity of the vaso-motor centres. This may sometimes be entirely reflex, as in case of a chill following the passage of a sound, or it may be due to the direct action of some toxic element upon the centres, as in intermittent, or there may be some doubt about the manner in which it is brought about, as in the chill of pneumonia. Chills are rare—as is well-known—in children, their place being taken often by convulsions. This, too, would point towards their nervous origin, for in children it is the motor centres for the voluntary muscles,

1 Chaffaud, De la fiévre traumatique Thèse, Paris, 1873. 2 Lereboullet, Fiévre Dict. Encycl. T. II. 3 Lucas-Championiére, De la fiévre traumatique Thèse, Paris, 1872. 4 Billroth, Arch. f. Klin. Chir. Bd. VI, S. 442.

and not for the innervation of the blood vessels, which are involved.

It was from a knowledge of the fact that pilocarpine increases the cutaneous circulation and brings on perspiration, that it was first employed by Griswold (1) to arrest chills. Any other drug which exercises a marked influence on the circulation, or in any way affects the great nervous centres, so as to change or alter the direction of their action, will frequently have precisely the same effect. Thus, inhalation of amyl nitrite, large doses of chloroform internally, hypodermics of carbolic acid, and various other substances, and even water, will often speedily stop the most severe chills. Even water given by the mouth, through the imagination, will produce the same result.

INFLAMMATION.

While the researches of Virchow and Conheim have shown that vascular dilatation does not stand in true causative relation to inflammation, and that this condition really consists in a perverted nutrition of the cellular elements themselves, yet this dilatation is always coincident with inflammation, and indeed forms a necessary part of it, and consequently is therapeutically of the greatest importance. Without an increased supply of blood to the part, the exaggerated nutrition, or inflammation, could not go on; and to this hyperæmia are due the four great characteristics of inflammation, which are as truly such to-day as they were in the days of Hippocrates: "*Rubor, tumor cum dolore et calore.*" We have seen how any irritation which is capable of exciting inflammatory action in a tissue always produces a dilatation of arterioles in the immediate neighborhood of its application, and it is only by such a dilatation that the inflammation can proceed. Consequently any therapeutic measures which constrict the vessels and reduce the hyperæmia prove of the greatest value. Thus, when the inflammatory changes have not gone too far, we can often at once relieve the symptoms by applying cold to the part, thus contracting the vessels. But a long-continued use of this agent produces an after relaxation, so that we have had recourse to another agent,

1 Griswold, Med. Rec. 1879.

namely, heat in the form of hot water, which, no matter how long its application is continued, tends to keep up an anæmic condition. This probably acts through the peripheral centres in the walls of the blood-vessels. The application of hot water is very extensive in surgery; being used for sprains, contusions, wounds, fractures, and in all cases where inflammation of cellular tissue must be combatted, or guarded against, and in gynæcology we have no more useful agent in congestions and inflammations of the vaginal and uterine tissue than frequently repeated hot-water douches.

ŒDEMA.

Œdema is due to two general causes. The one is an altered character of the blood, and the other is a more or less disordered state of the circulation, by which the return of the circulating fluid from a part is interfered with. The blood is brought to a part by the arteries, and it is returned by means of both veins and lymphatics. While it is probable that the latter do play an appreciable part in causing certain œdemas, yet in general their influence is very much less than that of the arteries and veins. From the fact that the calibre of these vessels, and consequently the tension of the blood in them, is under the control of nervous filaments, it is easy to see that these fibres may have considerable influence in producing that tension of the vessels and stagnation of the return circulation which is directly causative of œdema.

That these theoretical considerations are supported by facts, is illustrated by the experiments of Ranvier (1), who found that by ligating the femoral vein the circulation was not enough interfered with to give rise to any transudations, but after section of the nerves supplying the vessels the flow became so much more retarded that œdema soon appeared. Boddært (2) performed similar experiments, with like results, in other parts of the body, and they have also been verified by Duval and Vulpian (3).

Œdema has been observed after injuries to nerves by Moguet, Hamilton, Mitchell, Malgaigne, and others, as was noticed in other parts of this essay; in conjunction with neuralgias, by Vul-

1 Ranvier, Récherches experimentales sur la production, de l'œdème. compt. rend. 1869. 2 Boddært, Notes sur la path. du goître ophthalmique. Gand, 1872. 3. Vulpian, L'appareil vaso-moteur.

pian and Poincaré (1), and in certain hemiplegias and other paralyses by Rosenthal (2), Laycock, and others. We also have reflex œdemas after injuries to nerves and exposure to cold. Vulpian, and Rathery (3) have shown how the œdema, as well as the congestion of inflammations, is due, in part at least, to the action of the vaso-motors.

PSEUDO-MUSCULAR HYPERTROPHY.

This disease, which consists in a proliferation of the interstitial tissue of muscles, followed by a decrease in size of the muscular fibres, and a granular degeneration of the same, is referred to various causes. Spielmann (4), Gower (5), and Friedreichs believe it is a myopathic affection; Duchenne (6) and Stoffela (7) think it is of cerebral origin. Barth (8) and Martini (9) found changes in the cord and nerves, but believe them to be secondary. Griesinger (10) assumes that it is a disease of the vaso-motor nerves, and Benedikt (11) classes it among the tropho-neuroses, and believes some of his cases to be due to a paralysis of the sympathetic. Berger (12), Meryon, and Seeligmüller hold the same view, and Brigidi (13) has found lesions of the sympathetic in a case in which he had an autopsy. Vulpian also has found sympathetic changes. Therapeutically, Benedikt thought he obtained a good result by galvanizing the sympathetic. Chvostek (14), and Berger (12), and Eulenburg and Guttmann (15) did not get much good from it.

PROGRESSIVE MUSCULAR ATROPHY.

Aran (16) and Cruveilhier (17) were the first to give this disease a name, and a clear description, but Charles Bell (18), much earlier, narrated several cases of it and refers its origin to the sympathetic.

---

1 Poincaré, Le syst. nerv. 2 Rosenthal, Nervous Diseases. 3 Rathery, Pothogonie de l'œdème. Paris, 1872, Thèse. 4 Spielmann, Gaz. Méd. de Strasbourg, 1862. No. 5, p. 85. 5 Gower, Lancet, July 26, 1879. 6 Duchenne, L'Electrisation localisée, 2d Ed. 1861, p. 331. 7 Stoffela, Zeitsch. der Gesellsch. der Aerzte, Wien. 1865. H. 1, S. 85. 8 Barth, Arch. der Heilkunde, 1871, No. 48 and 39. 9 Martini, Jour. des Sci. Méd. 1871. 10 Griesinger, Arch. der Heilkunde, 1864, S. 171. 11 Benedikt, Elektrotherapie. Wien. 1869, S. 186. 12 Berger, Deut. Arch. 1872, Bd. IX, S. 363. 13 Brigidi, L'Imparziale, 1878. 14 Chvostek, Oest. Zeitsch. f. pract. Heilkunde, 1871, Nos. 38 u. 40. 15 Eulenburg and Guttmann, Symp. Syst. p. 84. 16 Aran, Arch. gén. T. XXIV. 17 Cruveilhier, Arch. gén. 1853. 18 Bell, Phys. and Path. Investigations in regard to the Nervous System, 1832.

Ever since then its primary pathological condition has been a subject of sharp dispute. Some authors believe that it is of a myopathic origin, that it is in the beginning an inflammatory process resulting in the proliferation of connective tissue, and secondarily contraction of this presses the muscular fibres and causes their atrophy. Among the supporters of this view are Arnt, Meryon, Wachsmuth, Oppenheimer, Hasse and Roberts. On the other hand, Cruveilhier, Valentiner, Fromman, Virchow, Charcot, Clarke, Hayem, Duchenne and Rosenthal, place its starting point in the central nervous system, usually in the cord.

In the autopsies made by these authors, sometimes there was found degeneration of the anterior roots, sometimes of the anterior horns and central gray matter, and sometimes of the posterior columns. These are the views that are most generally accepted at the present day.

A list of the autopsies in which these lesions have been found is given by Rosenthal. Schneevoght (1) was the first to call attention to the possibility of the sympathetic being involved. He found, besides the lesions in the cord, certain degenerative changes in the cervical and thoracic sympathetic. Jaccoud (2) made autopsies in two cases in which the sympathetic showed marked fibro-fatty changes, and the whole cervical part was transformed into a cord of connective tissue. He believes that the disease begins in this part of the sympathetic, and proceeds thence centripetally to the rami-communicantes and the anterior roots, and centrifugally along the peripheral nerves. Swarzenski noticed an atrophy of the cervical trunk and upper ganglion, and Duminil fibro-fatty changes in the same parts. Sefanini (3) has also lately recorded a case in which there were sympathetic lesions. These make, in all, six cases in which on autopsy the sympathetic was found to be involved. In most cases the sympathetic has not been examined; but in sixteen it has been, by good observers, and pronounced intact. On the other hand, we have some symptoms connected with the disease which would lead us to refer it, more or less, to the sympathetic. Voisin (4) had a case in which the left arm was first affected, then the right. At first, the left pupil was smaller, the

---

1 Schneevoght, Niederl. Lancet, 1854, p. 218. 2 Jaccoud, Bullet. de la Soc. Méd. des Hôp. 1865, L'Union Méd. 1865, Leçons du Clinique Méd. p. 361. 3 Sefanini, Arch. fer le Sci. Méd. 1878. 4 Voisin, Gaz. Heb. 1863, No. 37.

eye sunken, and the sight dim. Then the other eye was affected in the same way. Menjaud (1) had the same symptoms, only better developed. It will be seen that these are the same which follow division of the sympathetic in the neck. Bœrwinkel (2), Bergman, and Rosenthal (p. 286), also report similar cases, but these symptoms are not at all constant in the disease. Schneevoght was the only one of those who record oculo-pupillary symptoms, who found the sympathetic involved on autopsy. While experimenting in a case of progressive muscular atrophy, Remak (3) discovered what he called "diplegic contractions." By putting the positive electrode in the submaxillary fossa, and the negative on or below the fifth cervical vertebra, he produced convulsive movements of the opposite side. He explained these as of a reflex nature, and produced through the superior cervical ganglion; and he regarded progressive muscular atrophy as a disease of the sympathetic, or of that and the cord together. Meyer (4) and Drissen (5) gave these movements the same explanation. Eulenburg and Guttmann, however, think that though reflex, their origin must be sought for in the centres in the cord and medulla.

From the facts set forth it is evident that no definite conclusion can be reached in regard to the primary lesion in progressive muscular atrophy. The question as to what part the sympathetic plays in this, as in the preceding disease, is still a debated one. In regard to treatment, Nesemann has found galvanization of the sympathetic produce a temporary improvement. So Remak, Benedikt, Meyer, Erb, and others have also obtained favorable results; but Rosenthal and Eulenburg and Guttmann have never seen much good follow it.

LOCOMOTOR ATAXIA.

Duchenne (6) has stated that in a certain number of cases of this disease the cervical sympathetic must be regarded as its starting point. This he infers from the frequent occurrence of the well-

1 Menjaud, Gaz. des Hôp. 1866, No. 3. 2 Bœrwinkel, Prag. Vierteljahrsch. f. pract. Heilk. 1858, S. 133. 3 Remak, Oest. Zeitsch. f. pract. Heilkunde, 1862, S. 1 u. 29. 4 Meyer, Die Elektricität in ihrer Anwendung auf practische Medicin, 1868, S. 219. 5 Drissen, quoted by Meyer above, p. 219. 6 Duchenne, Gaz. heb. 1864, Nos. 8 et 10.

known oculo-pupillary symptoms, and from the various vaso-motor disturbances on the face and elsewhere. He believes that the sympathetic is only functionally affected, and that as a result of this there is a neuro-paralytic state of the vessels of the posterior columns, resulting finally in the changes found here on autopsy. The sudden attacks of pain in the bladder and rectum, and the disorders of the genital functions are also regarded by Duchenne as functional disturbances of the sympathetic in its abdominal plexuses. The sympathetic has been carefully examined in this affection by Carrè, Westphal, and Vulpian (1), and no lesion found, but of course this would not be expected if Duchenne's view of a functional disturbance be a correct one. Rosenthal (2) says that the symptoms above mentioned are due to an affection of the centres in the cord from which the sympathetic fibres arise; the centrum cilio-spinale superius and inferius, the centrum genito-spinale, and the vaso-motor centres scattered along the whole length of the cord.

HYSTERIA.

According to Rosenthal, hysteria is a disease of an essentially central nature. He locates it chiefly in the cord. There is a state of exalted activity of the centres, motor, sensory, and especially those for reflex action. It is to this altered reflex that most of the motor disturbances are to be referred. The varying locality and rapid change in all the phenomena are to be explained on the ground that varying areas of the cord are affected at different times, and that in most of these cases the disturbance, whatever it may be, is a purely functional one. The hyperæsthesias and anæsthesias are due very largely to changes in the circulation of that portion of the cutaneous surface involved, such changes being under the control of the vaso-motor nerves. When these nerves contract the vessels, anæmia and anæsthesia result; when they dilate, we have hyperæmia and hyperæsthesia. Rosenthal has noticed this in his cases, and has found the temperature 3° C. below normal in the anæsthetic region.

---

1 Vulpian, Arch. de Phys. 1869, II, p. 221. 2 Rosenthal, Nervous Diseases, p. 249.

Besides this indirect action of the vaso-motors, we have in hysteria a number of symptoms that are immediately referable to them. The flashes of heat and cold, so common in this disorder, and usually accompanied by dilatation or contraction of the vessel, belong to this category. So does hysterical fever, of which Rosenthal has collected seven cases, and Briguet twenty. It usually begins with a chill, and is followed by heat and congestion. The patient loses her appetite, has a dry tongue and skin, and often becomes delirious. But the sensation of heat is purely subjective, for the thermometer indicates no rise of temperature in the axilla. Increase of the salivary secretion is a rare symptom, and is due to reflex irritation of the nerves governing the secretion and having their origin in the medulla. There is much more frequently a similar irritation of the vaso-motor centres for the kidneys, which lie near by, resulting in the voiding of a large amount of clear urine of a comparatively low specific gravity.

EPILEPSY.

Sir Astley Cooper (1) made the first experiments in regard to the nature of epilepsy, and showed that attacks of this character could be determined by cutting off, to a considerable extent, the blood-supply to the brain. Twenty years later Kussmaul and Tenner (2) repeated these experiments, and showed that it was the motor centres behind the thalami optici which were irritated by the cutting off of the blood-supply, thus causing epileptiform convulsions.

Benedikt (3), accepting this view, believes "that the epileptic attack is caused by a sudden spasm of the vessels, and presents the most complete analogy to neuralgic attacks; only that the irritation affects chiefly the vaso-motor nerves, and so leads directly to anæmia of the brain." He also believes that the hippocampus major, designated by Meynert as the part affected in epileptic seizures, is a vaso-motor centre.

Nothnagel and Loven, believing that the cervical sympathetic

---

1 Astley Cooper, Guy's Hos. Rep. 1836, p. 465. 2 Kussmaul u. Tenner, Moleschott's Untersuch. Bd. II, S. 248. 3 Benedikt, Allg. Wien. med. Zeit. 1870, Nos. 35 u. 36.

has a certain control over the arteries of the brain, think this nerve plays an important part in bringing on an attack. This is especially true in those cases of epilepsy in which there does not seem to be any central lesion, but in which the paroxysms are induced by some peripheral action,— that is, are reflex.

Rosenthal (1) accepts this view, and gives cases occurring after sexual irritation. Billroth and Schaffer had cases due to sciatica. It also happens in connection with various forms of uterine irritation, and from cicatricial contractions, foreign bodies, parasites, and neuromata. Levinstein (2) has published two cases in which epileptic attacks followed the carrying of heavy loads.

REFLEX PARALYSIS.

In connection with certain diseases of an organic or functional character, affecting the internal organs, especially the alimentary canal in the young, and the genito-urinary tract in adults, there not unfrequently occur paralyses, which have received the name of reflex.

Romberg, Stanley, and Graves call these "motor-paralyses, due to a suspension of the sensory influence of the fibres of the sympathetic system." According to Brown-Séquard, they result from an irritation of the organs involved, with a secondary contraction of the vessels of the cord and atrophy of the corresponding parts. Gull and Tiesler are of the opinion that the paralyses are due often to a propagation of peripheral irritation to the spinal cord.

Remak explains them on the ground that the voluntary muscles throughout the body are under a tonic influence proceeding from the sympathetic, and thinks that the reflex action causing these paralyses is confined wholly to the sympathetic. Jaccoud has expressed the opinion that the peripheral irritation, whatever it may be, produces an exhaustion of the spinal centres, and lastly, Levisson believes the paralysis to be due to an arrest of the functions of the motor nerve-centres, in consequence of excessive irritation of sensory fibres.

Whichever of these theories may be the correct one, the fact that

---

1 Rosenthal, Nervous Diseases, p. 249. 2 Levinstein, Deut. Klin. Oct. 1867.

the viscera, the irritation of which can produce paralysis reflexively, are supplied with both motor and sensory fibres through the sympathetic, gives sufficient reasons for referring to reflex paralysis in this connection.

PATHOLOGICAL CHANGES IN THE SYMPATHETIC IN SOME INFECTIOUS AND OTHER DISEASES.

In this section will be grouped together some observations on changes in the sympathetic, to which no reference could be made in the former part of the essay. Petrow (1) was the first who described lesions of this portion of the nervous system in constitutional syphilis, and his observations were afterwards corroborated by Virchow. In all the cases which Petrow examined to substantiate his views, he found lesions of the s ympathetic, both in the nerves themselves and in the connective tissue. In the first, there were colloid and pigmentary degenerations, and increased size and proliferation of the endothelium surrounding the nerve cells. In the connective tissue there was hyperplasia and sclerosis. Soon afterwards, Pio Foa (2) found various changes occurring quite constantly in such diseases as syphilis, leucocythæmia, tuberculosis, cardiac and infectious diseases. Among these changes were fibrous atrophy, hyperæmia, sclerosis, pigmentary, fatty, and amyloid degeneration, the accumulation of colorless blood-corpuscles, and the presence of micrococci in the blood-vessels. Giovanni (3), as well as the last-named author, and also Seeligmüller (4), have noticed the participation of the sympathetic in organic cardiac diseases. The most common symptom is contraction of the pupil, which Giovanni believes to be due to venous stasis in the neighborhood of the cervical sympathetic, and his view has been confirmed by autopsies. Lastly, Köster (5) reports two cases of sun-stroke, in which there was congestion, and also hemorrhage in the ganglia of the cervical sympathetic, and also in the vagi.

---

1 Petrow, Virch. Arch. 1873, Bd. 57, p. 121. 2 Pio Foa, Bologna, 1874, Sull' Anatomia del gran simpatico. 3 Giovanni, "Annali univ. Tebbr." 1875, p. 246. 4 Seeligmüller, Deut. Arch. 1877, S. 101. 6 Köster, " Berlin, Klin. Wochsch." 1875, No. 34.

INDEX.

ERRATA.

Page 8. Line fifth from bottom, for "Bouchefontaine" read "Bochefontaine."
Page 9. Line sixteenth from bottom, for "replex" read "reflex."
Page 13. Line third from top, for "cardiac" read "cœliac."
Page 14. Line third from bottom of footnote, for "Sclaf" read "Schlaf."
Page 15. Line eighth from bottom, for "Bechefontaine" read "Bochefontaine."
Page 16. Line thirteenth from bottom, for "presser" read "pressor."
Page 18. Line first from top, for "Gasserion" read "Gasserian."
Page 19. Line ninth from top, for "change" read "changes."
Page 20. Line first from top, for "Anæsthesia" read "anæsthesia." Line twelfth from top, for "fissure" read "pressure." Line second from top of footnote, for "Thérapuet" read "Therapeut."
Page 21. Line first of footnote, for "Berträge" read "Beiträge."
Page 22. Line fifth from top, for "epithetial" read "epithelial."
Page 24. Line thirteenth from bottom, omit "in."
Page 25. Line sixth from top, for "of" read "for."
Page 26. Line second of footnote, for "Sympatischen" read "Sympathischen."
Page 27. Line fourth from bottom, for "on" read "or."
Page 31. Line ninth from top, for "Poincrè" read "Poincaré." Line third from bottom, for "Volkman" read "Volkmann."
Page 39. Line tenth from bottom, for "carcinomotous" read "carcinomatous."
Page 80. Line fourteenth from bottom, for "samples" read "examples;" and line eleventh from bottom, omit "by."