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THE CAUSES AND NATURE
OF THE
VASCULAR KIND OF BRONCHOCELE,
AND OF THE
PULSATIONS AND PALPITATIONS TERMED ANÆMIC.

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IN a former communication to the Society (read 7th January), I examined the pathology of that kind of protrusion of the eyeballs and staring eye known as *anæmic exophthalmos*, and which is sometimes associated with bronchocele and palpitations. I then stated the facts and arguments which were opposed to the theory of its anæmic origin, adding at the same time those in favour of the conclusion that the affection is essentially a cerebro-spinal neurosis, and examining all its varieties from this point of view. The questions in physiology, pathology, and practice thus raised, and the collateral conclusions to which my inquiries have led, are so fundamentally important, and the interest expressed by members of the Society in the subject was so great, that I have occupied some of my leisure moments with a further exposition of my views. In the present paper, I follow the arrangement of the kinds of exophthalmos I formerly adopted; but, starting from the doctrines set forth, I propose to point out more particularly the nature and causes of the enlargement of the thyroid gland, and of the vascular thrills, the pulsations, and the violent palpitations, which constitute so striking a portion of the symptoms. I classed the cases of exophthalmos under a new arrangement, as they are, 1. Neuralgic and hysterical; 2. Paroxysmal; 3. Orbital and facial; 4. Cardiac

and cephalic; 5. Thyroidal and cervical; 6. Complicated with uterine diseases, hæmorrhages, rheumatic affections, and degenerations of the cardiac and arterial tissues, with their consequences—dropsies and Bright's disease. I traced the peculiar affection of the eyes to a morbid action of the muscles of both the eyelids and eyeballs, such that the lids were held wide open and the balls protruded; and I pointed out that there was a correlative affection in the drooping lids and retracted eyeballs observed in various diseases of the nervous system. I further showed that the results of recent experimental researches enabled us to trace two kinds of this nervous exophthalmos to two sources of disordered innervation,—one of these local, and dependent on morbid states of the Gasserian ganglion or its cerebral centre; the other more general, and a motor neurosis of the “oculo-spinal” or “ilio-spinal” region of the spinal cord, being that portion which extends from the first cervical to the second dorsal vertebra. I showed further that this spinal kind of exophthalmos was one of the signs of horror, terror, and pain, and, as a symptom, accompanied various cerebral neuroses, as mania and melancholia, mania with epilepsy, and insanity with general paralysis. Two classes of dorsal spinal nerves were shown to be involved in the affection, in accordance with the experiments of Claude Bernard, but both cutaneous, and both belonging to the sympathetic system, viz., the motor nerves of the bloodvessels, on the one hand, and of the cutaneous muscular tissues to which the eyelids and muscles of the eyeballs belong, on the other. I also showed that, looking thus upon the exophthalmos as a spinal neurosis, we could comprehend how it would be associated with other spinal neuroses, by extension of the functional disorder of the cord to contiguous spinal centres, sensory and motor; and that, in short, various hysterical affections associated with it could be thus explained.¹

I shall now proceed to show that the palpitations and pulsations, with the accompanying nervous affections, and the vascular bronchocele, are equally due to disturbance of function of the same “oculo-spinal” region, and of the more extended cerebro-spinal centre of which it forms a part. But I shall also go a step further, and endeavour to indicate how the increased heat and vascular activity which result constitute most important sources of morbid action.

I. *As to the Anatomy of the Bronchocele.*—The affection of the thyroid gland is twofold,—there is enlargement of the gland, and there are purring thrills and greatly increased size and activity of the thyroidal arteries. These two things are not necessarily associated; but since the vascular disturbance commonly coincides with a like state of the vessels of the head and neck, and with greatly increased cardiac action, it may be separated from the enlargement, in so far as the latter is not obviously due to vascular distention, whether paroxysmal or continuous. In addition to the

¹ Ed. Med. Journal, vol. viii. p. 692, Feb. 1863.

vascular and cardiac symptoms, there are, however, others of importance observed to be associated with them and the enlargement of the thyroid, which are either laryngeal or pulmonary, or both, and which indicate an affection of the vagus system. I formerly pointed out cases of paroxysmal exophthalmos, accompanied with sudden enlargement of the thyroid body and suffocative difficulty of breathing, which belong to this class.¹ Hence the necessity of examining the nerves of the thyroid gland in relation to the anatomy of the vagus and of the cardiac motor centre.

Obviously, the nervous system of the thyroid body must be in relation to its functions, and these in relation to its structure. Now, it belongs to the class of ductless glands; and being made up of two lateral halves, as distinct from each other probably as the kidneys or suprarenal capsules, and only integrated because of their close contiguity to the median line, it is symmetrical, so that the more proper term would be thyroid glands. The fundamental structure, or the element essential to function, consists in clusters of closed vesicles, which contain an albuminous or gelatinous fluid. These clusters are contained in the two lobes or glands symmetrically placed, with a mesian column connecting them, and which divide and subdivide like those of a conglomerate gland. A thin fibrous capsule, continuous with the sheath of the cervical glands, encloses the whole, and each lobe is separated from the others by fibrous septa, which are prolongations of the general capsule. The arteries are in symmetrical pairs, and are inferior and superior. The inferior arise from the subclavian, at a point just opposite to the origin of the vertebrals, which, it must be remembered, supply both the spinal cord and the cerebellum, and posterior lobes of the hemispheres; the superior arise higher up from the external carotid, very near its bifurcation with the internal carotid, which supplies with blood the anterior and middle cerebral lobes. The capillaries form a continuous network, at least throughout each half of the gland. The nerves, like the arteries, are symmetrical, and are supplied from the recurrent and external laryngeal nerves, both being branches of the vagus; but it is most important to observe also that a plexus, derived from the middle cervical ganglion of the sympathetic, proceeds along the *inferior* thyroid arteries, or those derived from the subclavian. The theories as to the functions of the thyroid glands have all, without exception, omitted any reference to its sources of innervation. Dr Parry believed it served as a diverticulum for the blood when the brain is supplied with too much or too forcibly; Mr Simon entertains a like opinion, which he thinks is established by the peculiar relation of the thyroidal arteries, at their point of origin, to the encephalic arteries. And, certainly, their size also favours the hypothesis, for their united capacity is said to be equal to that of the basilar arteries. There is no proof, however, that the mechanical distention of the gland,

¹ Ed. Med. Journal, loc. cit., p. 685.

which at least such a theory implies, ever takes place, and which ought to occur very frequently, if not constantly, under the conditions of the hypothesis. I do not, however, think that a theory founded on the innervation only would be more satisfactory. The thyroid is part of a system of tissues to which the thymus and suprarenal capsules belong, and all which have important developmental if not functional relations with the genetic glands. So that a satisfactory theory should include the relations of the thymus, the thyroid, and the capsules to the ovaria and testes, and of each to the nerve-centres. All I would indicate here is, that such *are* the general relations of the thyroid. Since, however, as to its special nerve-supply, it receives branches from both the vagus and sympathetic, it is in the same group, as to its nerve-centres, with the heart, lungs, and stomach. And since, further, the cervical sympathetic system, with which it is connected, regulates the cerebral and cephalic circulation generally, it participates in the defects of nutrition due to lesions of that system. This is its relation to cretinism. Disease of the gland, as goitre, is, I think, neither a cause nor an effect of that imperfect cerebro-spinal development which is the essence of cretinism, but both seem to be due to a common cause acting upon the cervical sympathetic system, and so deranging the blood-supply in the first instance, and then the proper nutrient activity of the tissues themselves. That the ovaria (and perhaps the testes also) participate in this degeneration, may fairly be inferred from a fact of much practical importance, —namely, that if a woman has a goitre, in countries where cretinism is endemic, and it constantly enlarges, each successive child she bears is more and more cretinous. My friend Dr Morcl, of St Yon, Rouen, has delineated a whole family of six children, in illustration of this fact, in his valuable work on the degenerations of mankind.¹ A case of a woman with bronchocele, who was mother of several children, apparently of weak intellect, is mentioned incidentally by Dr Parry.² A woman, long under my observation with a huge bronchocele, weak in intellect and amaurotic, was the mother of several imbecile and idiotic children. From a consideration of these and other facts, I am inclined to infer that true goitre in a woman, when associated with other signs of degeneration, is indicative of a tendency to such imperfect ovulation or formation of germ-cells that they develop imperfectly, although the ovaria be not diseased in the strict sense of the term, and menstruation and other uterine functions be regular. I say true goitre, for I do not think simple enlargements of the thyroid, for which bronchocele is the more appropriate term, indicate any such tendency.

I shall not examine the questions, how far anæmia is a cause of diseases of the thyroid, or how far they are due to endemic, strumous, and cachectic causes; it is obvious from the considerations advanced

¹ Family of Marie and Joseph X.: *Traité des Dégénérescences l'Espèce Humaine*, plates 4 and 5 of Atlas.

² *Med. Obs. and Inquiries*, p. 125.

that the whole inquiry is one of peculiar difficulty, as indeed has been already amply shown by experience. We can, however, usefully differentiate the bronchoceles anatomically,—that is, according to the tissues of the gland affected, and so restrict our inquiry to one or two kinds. 1. The gland seems to enlarge slightly and diminish in women functionally, very much in the same way as the mammary gland. This is a functional enlargement hardly to be called bronchocele. 2. The bloodvessels and the capillary plexus are excessively developed, or dilated, or have undergone atheromatous or other degeneration, ending in rupture, and allowing of hæmorrhage into the parenchyma. 3. Then there are bronchoceles in which the different structures of the gland are involved. (a) As fibrinous hypertrophy from “exudation,” or plasma-formation. (b) As cystic formations, with melicerous, or fatty, or albuminous, or gelatinous products, evidently involving the structure proper, and termed “spurious colloid.” (c) Fibroid degeneration, or fibrinous exudation, ending in calcification and ossification. The fibrinous capsule and septa seem to be the seat of these changes. Bronchoceles of this kind, although very small, are apt to excite important changes in vocalisation, respiration, and spinal function, from their morbid influence on the branches of the vagus.¹ (d) There may be also waxy degeneration, as I observed in the case of a boy under my care in the Royal Infirmary, who had the right lobe enlarged, and who died of leukæmia, with waxy spleen, liver, and kidneys. It is remarkable that, although bronchocele has been so intimately associated with strumous diseases, both as to causes and symptoms, no scrofulous or tubercular degeneration of the gland seems to have been observed. The nearest approach to scrofulosis, described by anatomists, is observed in the cystic kind of bronchocele, in which the cholesterin and lime-salts, sometimes found within the cysts, seem to constitute the analogue of the “cretified” yellow tubercle.

Taking this anatomical arrangement of bronchoceles as a guide, we can evidently exclude from our inquiries into the etiology all but the vascular kind under consideration, and, consequently, all the causes of bronchoceles, whether endemic, cachectic, or diathetic, which consist in degenerations of the proper structure of the gland. In some cases of exophthalmic bronchocele the increased vascular activity is so great as to give the impression, when handled, of distended erectile tissue; but in others of long standing there is degeneration of the vessels and its consequences. When, however, their structural changes are found consecutively to excessive vascular action, as in the dissection recorded by Neumann,² they must be considered

¹ A case of this kind has been recently published. The removal of an osseous nodule from the right thyroid of a young woman, aged twenty-one, cured her of both aphonia and dysphagia, and a spasmodic affection of the arm.—*Brit. Med. Journal*, 29th Nov. 1862.

² *Deutsche Klinik*, 1853, p. 271, quoted by Withusen, *Dublin Med. Press*, 13th July 1859, p. 19.

as the consequences rather than the essentials of the disorder, and occurring under such constitutional conditions as are required for these constitutional degenerations. In the case of Neumann there were observed disease of the aortic valves, with hypertrophy and dilatation; extensive atheromatous change in the aorta and its branches, in the arteries of the brain, and in the ophthalmic and the ciliary arteries; and here and there aneurismal dilatation of the basilar arteries. Such also was the condition of the vessels of the enlarged thyroid. The whole arterial system of the gland was excessively developed; the *inferior* thyroid artery much dilated, in many places aneurismatically, and its coats hard and brittle. The texture of the gland itself was fibrous (fibroid generation), interspersed with small sanguineous extravasations. Of the seven post-mortem examinations quoted by Withusen (of which this is one), all concur in the general character and seat of the structural changes which constitute this kind of bronchocele. They are precisely such as might be expected to result from long-continued hyperæmia of the tissues and vascular tunics, when constitutional causes of degeneration were superadded. Looked at from this point of view, indeed, these cases throw considerable light upon the first stages of atheromatous and other degenerations of the arteries in general.

We may fairly conclude, therefore, that the enlargement of the thyroid in exophthalmic cases is in truth primarily due to a neurosis of the bloodvessels of the organ, like that of the other vessels of the thoracic and cervical region I formerly discussed; and that the dilatations, thrills, and aneurismal murmurs are in all respects analogous to those of the aorta and carotids. They are the result of local changes in the motor functions of the arterial walls. And when we observe that these thyroïdal vascular affections are developed and decline in like manner as the others; and even when there is no exophthalmos and little cardiac disturbance, are still associated with similar head symptoms and arise from similar causes, we may, I think, go a step further and infer that this vascular bronchocele is not only a neurosis, but is of spinal origin. In connexion with these conclusions, I would, however, remark that in future observations of the disease it will be of importance to discriminate those cases in which the vagus system is chiefly implicated, from those in which the vaso-motor is predominantly affected. We have much to learn of both; but the fact that those arteries which receive a special vaso-motor supply were chiefly affected in Neumann's case, viz., the inferior pair, is very significant of a general law of vaso-motor innervation yet to be elucidated by clinical and pathological research.

II. *The Connexion of the Thyroid with the Cervico-dorsal Region.*— I shall now inquire how far the ascertained causes of nervous exophthalmos are also causes of the associated vascular neurosis of the thyroid glands. And, first, as to the emotional causes. The connexion of the "oculo-spinal region," considered as a portion of the

cerebro-spinal centres which subserve to emotions, with the production of exophthalmos, was not difficult to trace, because the muscles of the eye and eyelids are obviously under the direct influence of certain emotions. It is not so with the thyroïdal vessels. No physiologist, I think, has shown any similar connexion between emotional states and the thyroid gland, although there may, and probably is, some such connexion. In my last paper I mentioned a case in which a bronchocele of this kind was probably due to anxiety, and Dr Begbie incidentally makes an interesting observation which proves that its size may be suddenly augmented by horror (or terror) and grief.¹

These emotional changes may, however, be fairly attributed to that increased action of the heart which emotions cause; for even by those who view the cardiac affection as a neurosis, beginning with Drs Graves and Stokes, the general vascular activity of the thyroid is believed to be simply a consecutive phenomenon due to the increased action of the heart. But, in truth, there is no very solid ground for this opinion as to what are really mere mechanical results of cardiac action, while it is open to the same objections as the diverticulum theory of the functions of the organ. If violent palpitations, whether organic, nervous, or anæmic, will induce vascular turgescence of the thyroid gland, it ought to be met with in practice much more frequently in connexion with such cases than it is, for they are very common. But this is by no means of common occurrence. I have wholly failed in detecting the slightest enlargement in numerous cases in which palpitation and hæmic murmurs were most striking. On the other hand, this vascular bronchocele will occur with comparatively little disturbance of the heart's action. The theory I suggest refers both classes of disorders of the circulation to a common cause, namely, disturbance of the vaso-motor centres of the cervico-dorsal region, induced by what may be strictly designated "sympathetic" influence.

III. *The Influence of the Reproductive Organs on the Thyroid through the Cervico-dorsal Region.*—And this brings me to the consideration of this common cause. There is one class of facts which points to both a group of vaso-motor centres in the "oculo-spinal" region as the seat of the neurosis, and to a common source of morbid excitation of that spinal centre generally. The connexion of diseases of the thyroid glands with the functional activity of the reproductive organs in women has long been observed, and really affords an important clue to the etiology of this neuro-vascular kind of bronchocele. In stating this, I willingly concur in the opinion expressed by Hasse, that the

¹ "I have under my care at this time a lady, aged 63, who in early life was subject to leucorrhœa. She married when a girl of 15, having then a small, it may be a graceful goitre. She became the mother of a numerous family, and at each of her confinements could remark the augmentation of the thyroid gland. She remarked it more especially on the occasion of a most painful and tragical event in her family, when, in the course of one night, she assures me it nearly doubled in size."—*Contributions to Practical Medicine: Anæmia and its Consequences*, p. 133.

attempts to connect the diseases of the thyroid gland with those of the genital organs have led to no result, although I can hardly endorse Dr Beggie's opinion, that the attempts to connect them with *excitement* of the generative system have entirely failed.¹ There is a remarkable etiological difference between diseases and excitement of the genital organs. Ovarian disease, it is well known, rarely, but ovarian excitement frequently, leads to distant or sympathetic disorders. And even as to the uterine functions this is the rule: ovarian *irritation* will excite menorrhagia, yet this is a rare result of ovarian *disease*. If it can be shown that the female reproductive organs influence physiologically and pathologically the thyroid body through the nervous system, as they influence other organs—the mammæ for example,—and if the channel by which this influence is exercised can be shown to be the cervical, or “oculo-spinal” region, all necessary proof is adduced.

It is not clearly established how far slight enlargement of the thyroid in women as compared with men is a natural state; but, excess in size, as a morbid state, is predominantly seen in them. Of 551 recorded cases of bronchocele treated in this country, in which the sex was mentioned, I find only 26, or less than five per cent., were males,—say 4·7 per cent. Dr Mitchell, Assistant-Commissioner in Lunacy for Scotland, who has investigated the spread of goitre in Scotland, and reports to the effect, that in Nithsdale, its chief focus, from 80 to 90 per cent. of those affected are women.² Males, it is true, are very commonly affected with goitre where cretinism is also endemic; but goitre in males must be considered as an approximation to the feminine constitution, and should be classed with unnatural development of the male mammæ.³ My experience, indeed, has led me to the conclusion that there would be found a larger proportion of cases of mammary enlargement in males, to bronchocele in females, than five per cent., if all enlargements were observed. Bronchocele is therefore a specially feminine affection. That it is specially influenced in them by the state of the ovaria is most certain. It has never come under my notice in impubescent girls or female children except as a congenital disease. When it occurs in male cretins, it is said to be very commonly congenital; but it is rarely, if ever, seen in cretins of either sex (the children of goitrous parents or of cretins) in whom the sexual organs are undeveloped. Increased size of bronchoceles during menstruation and pregnancy is matter of the most common observation.⁴ In two cases lately recorded, an enlargement from fibrinous exudation went on so rapidly during pregnancy as to cause death by suffocation.⁵ There

¹ Op. cit., p. 131.

² British and For. Med.-Chir. Rev., vol. xxix. p. 504.

³ See a lately published portrait of a mammary imbecile under my care in the Royal Infirmary, for jaundice, in Med. Times and Gazette for March 1862.

⁴ See my “Treatise on the Nervous Diseases of Women,” p. 35, for various facts showing the connexion between bronchocele and ovarian function.

⁵ M. Gillot in l'Union Med., Sept. 1860; and Brit. and For. Med. Rev., January 1861.

is no proof whatever that it is *disease* of the ovaria which causes these changes in the thyroid; they are of the same class of changes which occur in other structures influenced by the reproductive glands, and are as physiological, or, more correctly, as dynamical, as the changes induced in the mammæ by ovarian action during menstruation and pregnancy.

I believe no anatomist has been able to trace the anatomical connexion between the nerves of the ovaria and the nerve-centres which are influenced by them, whether in health or disease; but I apprehend none doubts that there is such connexion between these organs and the nerve-centres in both the encephalon and spinal cord. The whole mental character is so modified in lower animals by periodic development and atrophy of the genital glands, and by operative removal of them in spaying and castration; and various hysterical monomanias in young women are so clearly dependent upon ovarian sympathies, that there can be no question as to the influence the ovaria exercise upon the functional activity of the cerebral nerve-centres, and this chiefly, it would appear, by exciting the activity of the circulation in them through the vaso-motor system. The same remarks apply to the cutaneous tissues of the head and neck, and to the viscera supplied from the vagus system.¹ I believe for some time to come microscopic research will avail little if it ever can serve much for the elucidation of this central sympathetic anatomy, and we must rely, therefore, upon observation and experimental research. I have generalized the known facts in a work lately published, and differentiated special sympathetic centres in the lumbo-sacral region.²

IV. *Influence of the Reproductive Organs on the Eyelids.*—In special reference, however, to the exophthalmos, I may mention some curious clinical facts I have lately observed, which tend to prove that the genito-urinary system exercises a direct influence on the vascular system of the eyelids; and in so far as we can determine the point, probably through the same "oculo-spinal" region through which the subjacent lids and the muscles of the eyeballs are affected in exophthalmos. It is well known that some males, after venereal congress, and many women at each menstrual period, or when suffering from menorrhagia, manifest a dark livid-looking circle round the eyes. This, as I have found on repeated examination, is due to either a melasma, or more commonly to a change in the capillary circulation of the eyelids. To this latter also belongs the œdema of the eyelids of women with uterine affections, and which I have often also seen in men with affections of the genito-urinary system. A sort of circular puffiness of the eyelids, due to slight œdema of both lids, is very common, indeed, in male children with nocturnal incontinence of urine. The theories of these œdemas of the eyelids are very vague, but I believe they are most commonly attributed to merely local or

¹ See this question fully discussed in my "Treatise of the Nervous Diseases of Women," 1840; and "Mind and Brain," vol. ii. p. 231.

² "Mind and Brain," vol. ii. p. 412.

meechanical causes. There is no doubt whatever that purely local causes acting on the capillaries of a part will induce œdema, but that this is not the explanation of these genito-urinary kinds is easily shown. The œdema, if the eyelids be carefully examined, will usually be found to be symmetrical and exactly co-extensive with the *orbicularis palpebrarum* muscle. Then, in a certain class of cases of Bright's disease, there is probably a condition of the cord in the lumbo-sacral region which impairs in like manner the retaining faculty of the capillaries of the tissues in known relation, as to innervation, with that part of the spinal cord. For, according to my experience, if in a case in which there is œdema of the upper and lower eyelids, it is also found that the lumbo-sacral region is œdematous likewise, or even the serotum or penis only, it will certainly be also found that serum is escaping from the renal capillaries, constituting albuminuria. Much doubt and difficulty have been felt in practice in deciding in what cases of Bright's disease renal stimulants should be administered; in this combination of signs will be found, I think, the best guide, for I have repeatedly ascertained that cantharides, juniper, and the like, may be administered in such cases, not only with safety, but with signal advantage. There are other facts as to local and symmetrical œdemas of the neck and thorax which equally indicate a direct connexion between the reproductive organs and the cervico-dorsal region of the spinal cord; but the whole subject of dropsical effusions and their relations to the vaso-motor system merits special inquiry. I shall only state here that careful clinical observation has satisfied me that œdema and anasarca are much more certainly significant of defect in the activity of the vaso-motor system than in the constitution of the blood.

V. *The Palpitations*.—Having thus traced the affections of the eyelids and eyeball, and of the vascular system of the thyroid to a neurosis of a particular region of the cerebro-spinal cord, it remains to examine the etiology of the violent palpitations which accompany them. It is not easy to separate this inquiry from that into the etiology of the vascular thrills and the increased vascular activity generally, for the heart and bloodvessels constitute one great system, with doubtless their proper guiding and regulating nerve-centres. We may, however, separate the heart as a motor organ from its own coronary arteries and capillaries, from the capillary system in general and from the arterial trunks which arise from it, just as we separate the motor system of the eyes and eyelids from the motor system of their vessels. Now, as to morbid movements of the heart, I have already shown that, more than twenty-three years ago, I traced the class of nervous and hysterical palpitations to a morbid activity of the dorsal portion of the spinal cord;¹ and I believe there never has been serious question as to the channel along which mental changes of an emotional kind influence the heart and capillaries. The most recent of the numer-

¹ A Treatise on the Nervous Diseases of Women. London, 1840, p. 270.

ous experimental researches which have been instituted to determine the sources of the motor force of the heart are those of Professor Von Bezold of Jena, who thinks he has discovered a special motor centre for the heart, situated in the medulla oblongata, the motor fibres of which leave the cord between the seventh cervical and the fifth dorsal vertebræ, pass through the inferior cervical and superior dorsal ganglia of the sympathetic, and enter the thorax at the middle and lower cardiac nerves. It is in reflex relation with sensory cerebro-spinal fibres. Von Bezold's researches further tend to prove, that from this centre three-fourths of the whole power of the heart are derived, and that by abnormal irritation of it the energy of the cardiac contractions may be increased to six times the force which irritation of the cardiac ganglia induces. It also appears that this is a cerebral and emotional centre, for he found that the heart's action was increased whenever the animal he was experimenting on attempted considerable movement, although the attempts were not successful in consequence of paralysis caused by woorara. And to this centre he refers the augmentation of the heart's action consecutive to sudden emotion, as terror, fright,¹ etc. Although these experimental researches need to be confirmed before being fully accepted, they are so much in accordance with the deductions to be drawn from the facts of medical psychology, physiology, and pathology, that the general conclusion may be safely admitted, viz., that there is a cerebro-spinal motor centre for the heart, and that its nerves are connected with the sympathetic ganglia in the cervico-dorsal region. The connexion of the heart with the "oculo-spinal region" may, therefore, be assumed as proved, and the violent palpitations which accompany the exophthalmos and the vascular bronchocele are seen to be part of the same cerebro-spinal neurosis.

VI. *The Thrills and Pulsations*.—These conclusions do not, however, explain the morbid activity of the arteries and of the capillary circulation as well of the head and neck as of the thyroid gland, and which is seen also in the upper extremities in certain cases; as in the case of Elizabeth Camidge, referred to in my last communication, in whom, from time to time, the fingers and thumb of the right hand presented a mottled livid appearance, and there was an aching pain along the arm, while at other times the left hand became purple, and a deep-red blush extended along the forearm.² In the recent experimental researches of Schiff,³ we have, however, a clue to the explanation of these capillary or vaso-motor phenomena as distinguished from the purely cardiac. These are so much in accordance with numerous clinical facts, that in my systematic course I have constituted the affections of the vaso-motor system a distinct

¹ See *Med. Times and Gaz.*, Oct. 1862, p. 365, and *Wiener Med. Wochenschrift*, Dec. 20, 1862. Professor Von Bezold is said to be one of the most distinguished pupils of Professor Dubois-Reymond.

² *Ed. Med. Journal*, Feb. 1863, p. 686.

³ *Comptes Rendus*, tom. lv. p. 462-64.

group of neuroses in which a distinct series of cerebro-spinal centres are involved, to be termed the central vaso-motor system. Through these centres, I conceive the distribution of the blood is regulated by action on the capillaries in particular organs and tissues, and especially in particular portions of the encephalon, just as particular muscles and groups of muscles are acted on by the motor centres proper. In the spinal cord there appear to be vaso-motor centres of this kind, with their appropriate afferent or sensory nerves. Hence a well-marked group of cutaneous symmetrical neuroses manifested as capillary lesions, with or without neuralgia, and variously characterized by symmetrical melasma, redness, pallor, œdema, lividity (as in the case of Camidge), effusive inflammations (of which herpes zoster is the type), sweats, and nervous or hysterical hæmorrhages. The recent experiments of Schiff, on the special relations of the vaso-motor system, tend to prove that even the upper and lower limbs have each their own proper vaso-motor centres, in and through which the distribution of the blood and the evolution of heat in them are regulated. Whatever may be the conclusion as to particular experiments, the general conclusion that the capillary circulation is influenced through cerebro-spinal vaso-motor centres by vascular and calorific nerves is one of the most certain facts in physiology and pathology.

VII. *Heat the Proximate Cause of Nervous and Anæmic Palpitations, Pulsations, and Thrills.*—Now, although it be admitted as a fact that the vaso-motor nerves and nerve-centres are disordered in these cases of palpitations and pulsations, the mere fact gives us no clue as to how they are produced. The experimental physiologists vary in their opinions; but Claude Bernard, Brown-Séquard, and others, concentrating their attention on the increased heat and vascularity which certainly result from certain lesions of the sympathetic, have endeavoured to explain them by a very simple, but, I suspect, too plausible a series of theories. They say that the injury of the sympathetic causes paralysis of the motor tissue of the arteries, that in consequence of this paralysis the arteries dilate, and then, in consequence of their dilatation, they admit a larger quantity of blood; upon which there follows not only the increased vascularity (which may be admitted), but also the increased production of heat. Now, it is not only doubtful whether this be the true order of events, but doubtful whether the paralysis of the arteries (supposing it to take place) is the sole cause of the other phenomena. In the first place, although it is most certainly established that these results do follow injury of the sympathetic or vaso-motor nerves of a part, yet they occur only on the same side as the nerves operated on; on the opposite side the converse takes place; consequently, if this state be paralysis on one side, it must be the opposite to paralysis on the other. Further, the arteries of the affected side do not, in fact, seem to be paralyzed, if by the term be meant a loss of motor or contractile power in the vascular fibrils, for Claude Bernard found the small arteries situate in the muscles of the shoulder were pulsating

more strongly after removal of the superior thoracic ganglion, and the blood more abundant in the tissues and redder than in health.¹ And when he cut the arteries in the two ears of a rabbit in which he had divided the cervical sympathetic on one side, and produced the ordinary phenomena of increased heat and redness, the blood flowed from the arteries of the injured side in jets double and even triple the size of those of the unaffected side. That this is the condition of the great arteries in a typical case of vascular pulsations and thrills, is, I think, clear from all the phenomena observed. It is thus, in fact, and thus only, that we can explain the pulsations themselves, the vibratory thrills, and the souffles. Further, it is certain that increased heat and increased vascularity do not necessarily go together, as is shown by both observation and experiment. When the Gasserian or trigeminal ganglion is diseased or injured, there is equally increased redness of the eye, but then there is therewith diminished production of heat. And further, while, after lesions of the sympathetic, the nutrition of the tissues goes on as usual with increased vascularity, the opposite result is seen in lesions of the fifth, and defective nutrition takes place. In a dog in which Professor Claude Bernard extirpated the superior cervical ganglion, the side of the head experimented upon remained of a higher temperature than the other for a year and a half, or so long as the animal was kept alive; while if the Gasserian ganglion be extirpated, necrosis of the cornea, and inflammation and bursting of the eyeball, follow in a few days.² And in all these purely nervous palpitations and pulsations there is what is seen in extirpation of the sympathetic ganglion, viz., greatly increased heat of the head, face, and neck, and long-continued cardiac and arterial disturbance, without structural change or defective nutrition. It is only in certain constitutions that rheumatic and gouty affections of structure of the heart and arteries complicate the disease either previously or consecutively. But granting that the increased vascularity and heat is the result of induced paralysis of the *capillaries*, does it follow that the increased force of the *arterial* pulsations is due to the same cause? I think we cannot admit this with our present conclusions as to the results of paralysis of nerves of motor structures, and must look elsewhere for an explanation. Now, I apprehend that these pulsations are really due to the heat which is generated in the arterial tissues themselves, and which would be evolved in increased amount if the vaso-motor nerves of the vasa-vasorum are implicated, which it is clear from all the phenomena is what happens. And this view of the cause of the increased arterial action accords with all our experience of the influence of heat on living tissues. We know it is the stimulus to animal and plant activity alike, and that, without it, vital processes can neither be begun nor continue. And we know, too, that

¹ Comptes Rendus, tom. lv. p. 308.

² In a copy of a drawing from Landmann, "*De Morbo Cerebri Oculique Singulare*," handed round the meeting, this result of structural disease of the ganglion was very strikingly shown.

it most especially and certainly excites the activity of the heart and bloodvessels. When applied to the cutaneous surface under ordinary circumstances, we see that increased vascularity is the direct result. Even the heat produced by simple friction will cause it.¹ When heat is applied in excess to the lungs and body generally, the congestive phenomena known as sun-stroke arise. That analogous results must follow in the class of cases under consideration seems a necessary conclusion, for the heat is generated within the very tissues of the contractile vascular walls, and so comes into as direct contact with them as with the cutaneous vessels when it is applied to the surface of the body. Professor Claude Bernard found in his experiments on the cervical sympathetic, that the deeper tissues of the head of the animal experimented on, as, for example, the cerebral substance and membranes, were hotter as well as the cutaneous surface; nay, even the blood itself became hotter after it had circulated through that side of the head. This was proved by placing a thermometer in each jugular vein.² It follows, therefore, from all these various yet harmonized facts, that in those cases in which the increased heat and vascular action is of centric origin and yet local, there is a lesion of the vaso-motor nerves which gives rise to the evolution of heat in the first instance, but that the locally developed pulsations are really due to the heat thus locally developed, which raises the temperature both of the arterial tissues and of the blood circulating through them, and thereby excites them to that increased activity known as throbbing, pulsations, and the like. In local inflammations from injuries, it does not follow, however, that there is vaso-motor paralysis locally, because the heat evolved from the injured tissues may be, and, I think, is the cause of the increased vascularity, and the local pulsations or throbings, either directly or reflexly.

VIII. *Influence of Heat on the Heart.*—These views are still more interesting when applied to the heart. I am not aware that experimental researches have proved that the local production of heat follows upon lesion of the vaso-motor nerves of the heart, and that, consequently, its tissues are thus rendered hotter than natural; but since the law has been demonstrated in regard to the skin, limbs, and brain, we may fairly infer that the cardiac structures are no exception to the general rule. And it seems certain that the blood is hotter. Now such increased temperature of the heart, or of the blood circulating through it, would sufficiently explain the increased cardiac activity in the class of nervous palpitations, for it is capable of proof that heat is one of the most direct and powerful stimulants to the heart's action. Any one may verify this fact on a frog's heart. When removed from the body of the animal, it palpitates for a while after removal, and then is still; but the palpitation may be re-excited either by placing the organ in warm water, or dropping a drop or two upon it. Further,

¹ I think it is Schiff who explains the increased vascularity which follows on friction by reflex action; this theory of the action of heat does not, however, militate against the notion.

² *Leçons sur la Physiologie et la Pathologie du Système Nerveux*, tom. ii. p. 493.

M. Calliburcès has demonstrated experimentally the like influence of heat upon the frog's heart when undetached from the body, and ascertained that the rapidity of the palpitations increased with increase of temperature. He also found that the application of heat to the frog's feet had the like effect as when applied to the heart, and that the palpitations thus excited were not due to the influence of the nervous system, or of the respiratory movements, or to physical conditions of the vessels. And hence the conclusion, that heat can excite the heart's action locally, and maintain that activity, and thus influence not only the number but the quality of the cardiac contractions.¹ There are on record other facts of a like kind; as, for example, the fact that a sturgeon's heart, hung up to dry in the sun, will beat until it has lost its moisture: but these I will not enumerate. All that I need say here is, that as the heart will beat, independently of the nerves, out of the body, under the stimulus of heat, we may fairly infer that it will beat, under the same stimulus, within the body, when its vaso-motor nerves are in a paralyzed or enfeebled condition, and heat is produced as one of the results of that condition.

IX. *Deduction from Practical Facts.*—Therapeutics also contributes its share of proof. In the particular kind of bronchocele under consideration, cooling means have been successfully applied empirically by various practitioners. The case recorded by Flajani illustrates the difference between theory and practice. He believed the thyroid gland was the seat of the malady, and that an acrid humour deposited there was the cause. "Such being the nature of the disease (I quote from Dr Begbie's translation), the indication for cure must consist in effecting the resolution of the deposited (or stagnant) humour. For this purpose, cold compresses saturated with a solution of sal-ammoniac or vinegar and water were applied, and after the employment of this application for twenty days, there was a very visible diminution of the tumour; it had fallen to less than a third of its former bulk,—the patient, moreover, breathed with greater ease." This solution is one of the old surgical "refrigerants." In another case, ice applied to the tumour was of signal service. If, however, we extend this doctrine of the local production and stimulant action on the heart and vessels of heat to other diseases in which increased cardiac and vascular action and a higher temperature go together, as in the great group of diseases known as fevers and inflammations, we have not only the largest possible proof of its truth, but a strikingly simple explanation of the *modus operandi* of cold affusions, cool air, ice, cold applications, evaporating lotions, and all the varied cooling remedies so long and so beneficially used in febrile and inflammatory affections, and at the same time a guide to the proper use of them.

X. *Relations to Neuroses, Fevers, Inflammations, and Anæmia.*—Nor as to the great questions of general pathology into which morbid heat and vascular activity enter as principal elements is this doctrine

¹ Professor Claude Bernard, in op. cit., tom. ii. p. 395-403.

less applicable ; and, perhaps, the most satisfactory and conclusive proof of the truth and value of these views is to be found in these applications of them, for they thus enable us to understand better the relations of a great variety of phenomena of this class, and so reconcile numerous diserepancies and contradictions, and correct many errors. That rapid eremaeausis of the tissues, and the consequent production of heat, and therewith the increased vascularity which constitute the essential morbid phenomena, is obviously but an exaggeration of a natural state, common to all hot-blooded animals. If it take place within the cerebro-spinal axis, or in particular portions of that axis, then there result the varieties of *neuroses* which are said to be due to "irritation" and not to "inflammation," and which are predominantly characterized by exaggerations of function ; if within the heart and large vessels, nervous pulsations and palpitation. But if the morbid state involve the blood itself, as well as the vaso-motor system, then a very important additional element in causation is introduced ; for if, on the one hand, it be certain that the varying states of that system increase or diminish the eremaeausis of the tissues and the production of heat, so it is equally certain that the condition of the blood, as the nutrient fluid from whence the materials are drawn which keep up the eremaeausis will deeply influence it likewise, and therewith these conditions of the tissues themselves which are structural according to the varying constitution of the blood. And this is what occurs in anæmia, fevers, and inflammations. If a certain kind of blood-defect concur with a local vaso-motor defect, involving chiefly the heart and large vessels, the two states are the factors which constitute conjointly the cause of *anæmic* pulsations, palpitations, and thrills. Here the state of the blood may be considered as the antecedent or predisposing cause. If, however, the two conditions be general and due to specific causes, then arise the phenomena of specific fevers ; or, if the general vaso-motor defect be also localized and restricted to an organ or tissue, then arise the phenomena of specific inflammations. In the increased temperature and vascular activity of hæmorrhagic anæmia there is a difference of cause as to the state of the blood and the structural changes that result in inflammation, but an analogous result as to the evolution of heat and its consequences. In the eremaeausis and evolution of heat and muscular force observed after death, there is a manifestation of the ebbing life of the tissues alone in persons who have died, more rapidly as to the general system than as to the tissues ; or else who had before death that condition of the sympathetic system in virtue of which there is a restriction upon the process of eremaeausis, and which death removes. In life there is a continual change in the direction of decomposition, but there is also as continual recomposition ; in death, decomposition is not alternated with recomposition, and so ends "life's fitful fever."

On these points I need not, however, dwell, as the practical applications of these principles will be obvious to every practitioner.

