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LUMLEIAN LECTURES
ON THE
PNEUMOGASTRIC NERVE
—
HABERSHON



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LUMLEIAN LECTURES
OF
THE ROYAL COLLEGE OF PHYSICIANS

1876



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ON THE
PATHOLOGY
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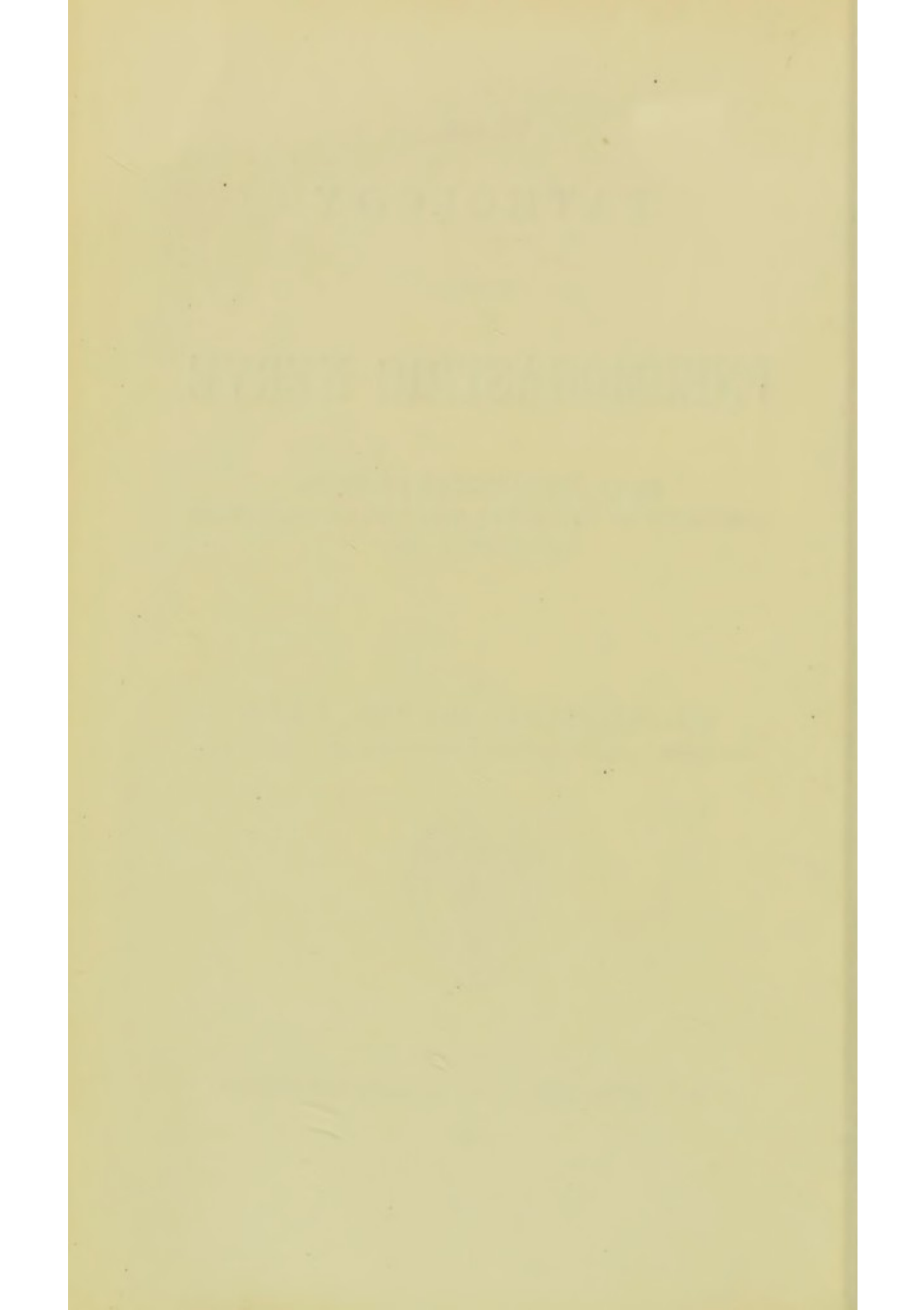
BEING THE LUMLEIAN LECTURES
DELIVERED AT THE ROYAL COLLEGE OF PHYSICIANS
OF LONDON, 1876

BY
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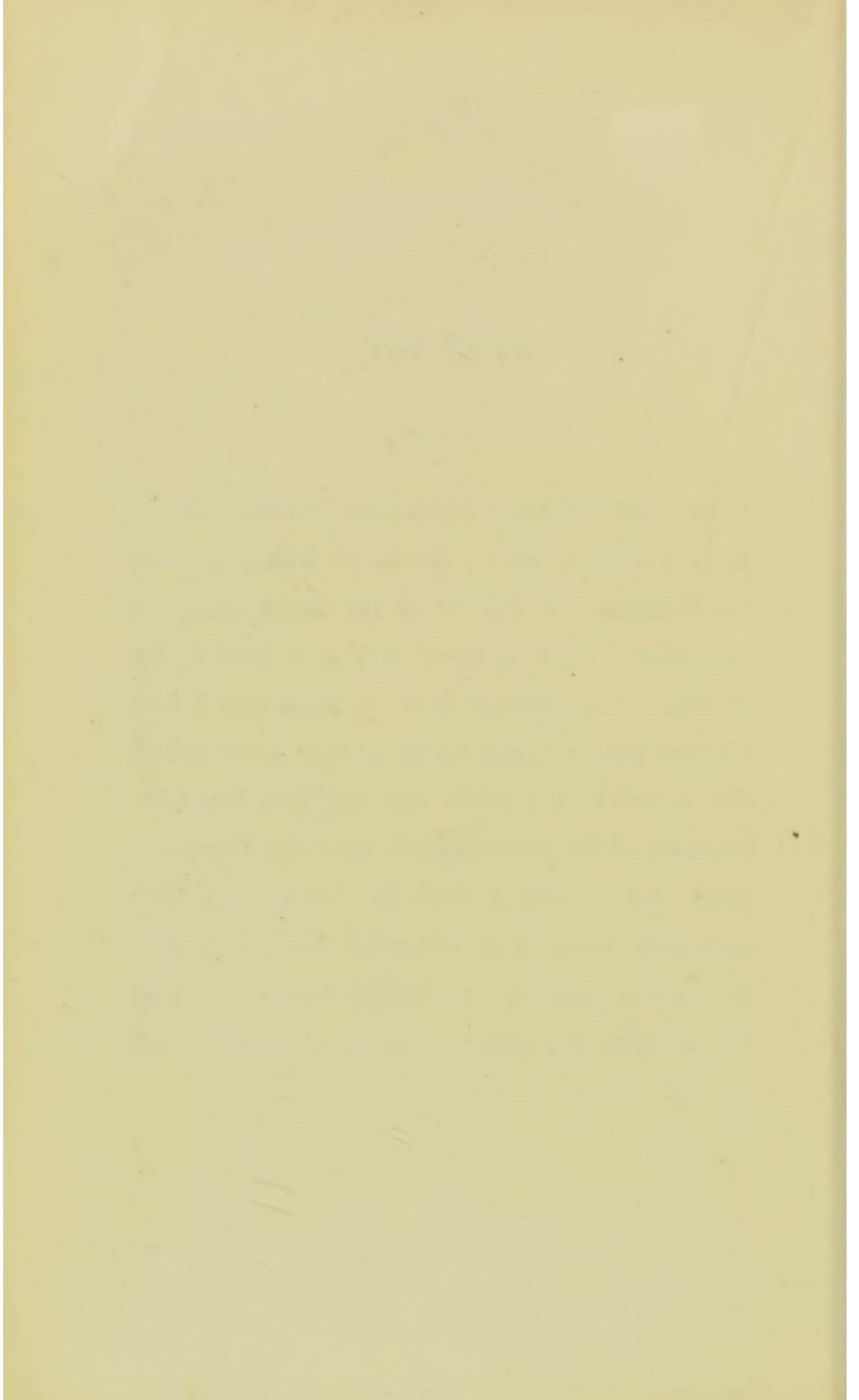
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1877



PREFACE.

HAVING received many expressions of interest in the Lectures which I had the honour of delivering before the President and Fellows of the Royal College of Physicians, I have ventured to present them to the profession in a collected form. I regret that I have not been able to expand the Lectures as I had desired. The subject is a complex one, and it is important, inasmuch as the pneumogastric nerve has relation to every vital function of the body; but although it is necessarily treated in an abbreviated form—for I have only traced some of its leading features—I trust the thoughts may prove suggestive and of practical value.



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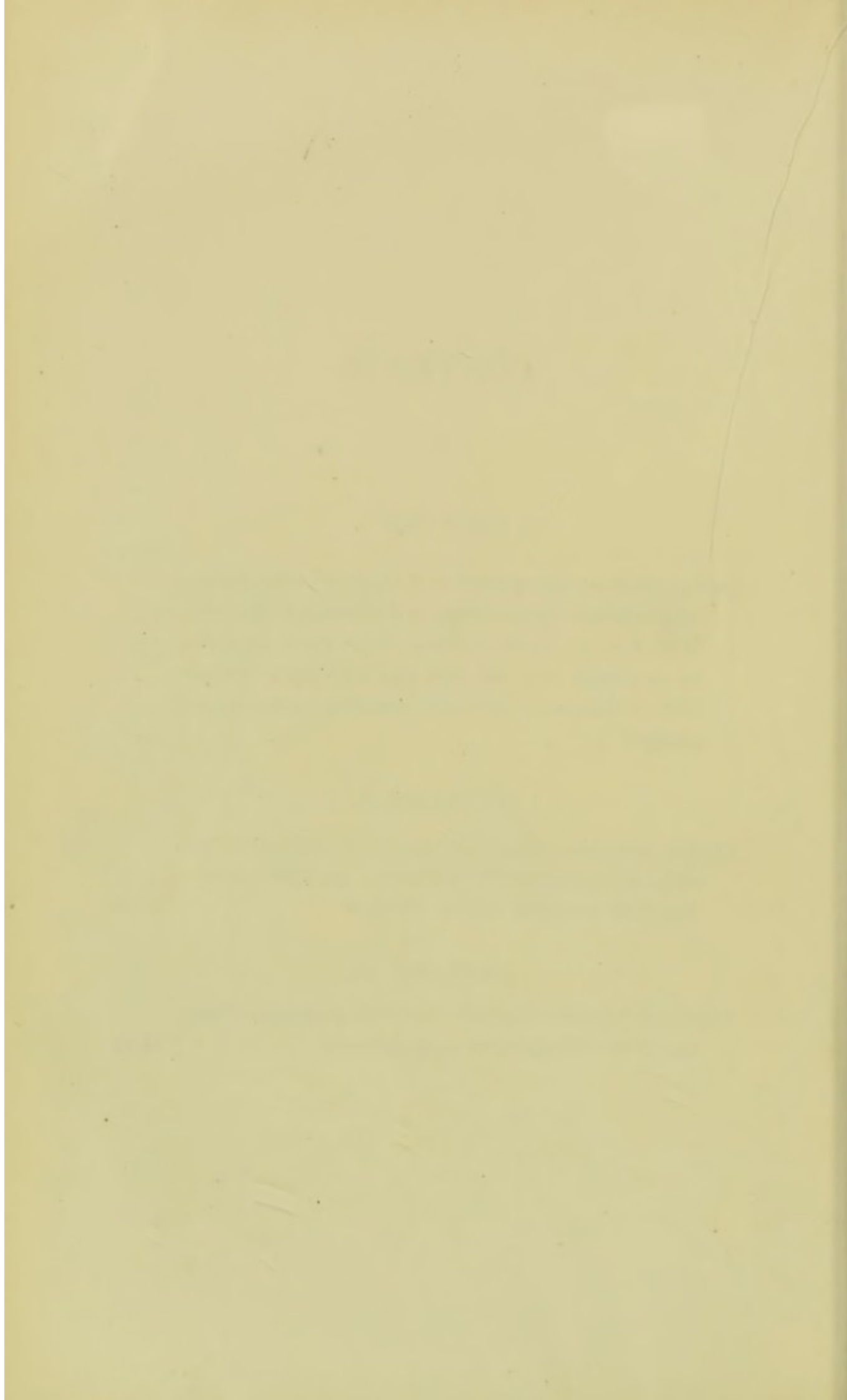
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PATHOLOGY OF THE PNEUMOGASTRIC NERVE



LECTURE I.

ANATOMY AND PHYSIOLOGY—PATHOLOGY OF CERVICAL BRANCHES.

ONE of the most deeply interesting questions in physiological science is, in what manner the harmony of the different animal functions is maintained. The most delicately-adjusted machinery is at work; actions of an entirely different character are performed without interfering the one with the other, and the result is recognised and expressed by the term *health*. The body is a microcosm; and, as in the external world there is harmony in the working of natural forces, so in man's organism there is an adjustment of forces, an even balancing of the living power in its functional integrity, so that, with diversity of operation in the

several parts, there is unity in the complex whole. The light of the sun exerts its silent but irresistible power on the vegetable life of the globe; and the plant, and flower, and tree, grow and thrive as if Nature were alone for them. The chemical force in the plant is in operation, and the physical forces are ever in exercise; but the same light has equal power on animal organism; the heat and life go hand in hand, and move on undisturbed, and chemical and physical and living forces are found in correlative action: but not less powerful is the same influence of the sun upon the physical world, upon the waters of the ocean, in producing evaporation, in determining the currents of the sea, and in regulating the winds. But there is wonderful harmony in the adjustment of these different spheres of operation, the vegetable kingdom with the animal, and these with the physical conditions by which the one and the other can exist and flourish.

The functions of animal life are equally diverse. Respiration is a function separate in itself, to ensure the admission and expulsion of air, for the purification and oxidation of the blood: it has its system of muscles and nerves, and adjustment of force. So also is that of the circulation of the blood, the central organ of which is the heart, a living, active, propulsive engine, by which the vital fluid is propelled both into the lungs and into the whole system. Equally distinct are those of deglutition and digestion, by which food is prepared and dissolved, and then absorbed into the circulatory system. Each of these functions—that of the respira-

tion, that of the circulation, and that of digestion—acts independently, but still in unison. If one or other be disturbed, the whole system is thrown into disorder. Like the apparently complex mechanism of a locomotive engine, the disarrangement of one valve or of one connection will interfere with every part, and bring the power to a stand. In physiology, it is only a small part of the science to study *one* structure and *one* function: each must be taken in its connection with the whole; and so in pathological science. Few diseases can be regarded as strictly local in their character, and the morbid processes in one part are inseparably connected with those which take place in another. The union may be one of structure or of function; the connection may be by means of the supply of blood or the supply of nerves. If we would rightly know the diseases of one organ, we must be acquainted with those which have functional relationship with it. The pneumogastric nerve is a regulating medium, a bond of union between parts which are otherwise dissociated, separate in structure and in function, but united in the healthy working of the body. It holds in check structures which would individually act, but which without it would never harmonise.

I have ventured to submit some remarks on the "Pathology of the Pneumogastric Nerve," because there are some questions respecting it which have not received the attention which they deserve, and there are some clinical aspects of disease which are essentially connected with disturbance of the functional integrity

of this nerve. In the animal economy, the pneumogastric nerve stands pre-eminent; the functions of the body with which it is connected are of the greatest importance for the maintenance of life, for it is connected with respiration, with circulation, and with digestion. These three most important functions are guided and controlled by this nerve, and to effect these purposes it is distributed to numerous structures, and its relations are of the most complex kind.

Before speaking of the pathology of the nerve, it will be well to review very briefly its anatomical distribution and its physiological action. The nerve appears at the base of the brain, at the side of the medulla oblongata and at the front part of the restiform body, and behind the olivary. At this part it is in close proximity with the glosso-pharyngeal and with the spinal accessory nerves. The nerve passes through the medulla in the direction of the floor of the fourth ventricle, where several enlargements or nuclei are observed, which are connected with the nerves having origin at this part. The root of the pneumogastric is in the closest relation with the origin of the hypoglossal nerve, the nerve of the tongue; with the fifth nerve, the sensory nerve of the face, and of the orifices of the nose and mouth; with the seventh, that supplies the muscles of the face; with the glosso-pharyngeal, the nerve of the throat; and with the spinal accessory nerve, an important nerve of respiration. There is the most intimate connection between the nerves at this part, the fifth and seventh, the hypoglossal, and the glosso-pharyngeal, spinal

accessory, and pneumogastric nerves. "The fibres of origin of the vagus and glosso-pharyngeal nerves pass through the sensory portion of the fifth."* The beautiful sections made by Lockhart Clarke show the varied unions of the origin of these nerves. The latter author states,† that "the vesicular column that gives origin to the accessory nerve, after reaching the surface of the fourth ventricle as the nucleus of the vagus, sinks beneath the auditory ganglion, and, diminishing in size, becomes part of the nucleus of the glosso-pharyngeal nerve." It is here that the sensory or afferent impressions brought to the centre are reflected by the nerves of motion, which arise at the same part. As the fibres of the pneumogastric emerge from the brain, they pass to the jugular foramen (foramen lacerum basis cranii), where the nerve is surrounded by the same sheath of dura mater as the spinal accessory, and by the same layer of arachnoid membrane, but separated from the glosso-pharyngeal. In the foramen is a ganglionic enlargement; and there are connections, as described by Quain‡ with the facial, with the spinal accessory, with the petrous ganglion of the glosso-pharyngeal, and with the sympathetic nerves. Half an inch lower down is a second ganglion of the pneumogastric, which is said not to include the branches of the spinal accessory sent to join the vagus; but the ganglion communicates not only with that nerve, but with the hypoglossal, the first

* Carpenter's *Physiology*, 7th ed. p. 558.

† *Philos. Trans.* pt. i. 1858.

‡ *Anatomy*, 8th edition, vol. i. p. 559.

two spinal, and with the upper ganglion of the sympathetic. The branches of the spinal accessory sent to join the pneumogastric, after leaving the foramen, may serve to explain the conflicting opinions of physiologists in reference to the motor fibres of the nerve. The spinal accessory nerve is in this way traced to the motor nerve of the larynx and to the palate, and is regarded as controlling the movements connected with vocalisation.

The first branch of the pneumogastric nerve is the *pharyngeal*, and it arises from the upper part of the trunk, and, uniting with branches from the glosso-pharyngeal, the superior laryngeal, and sympathetic, forms the pharyngeal plexus, from which branches are distributed to the muscles and to the mucous membrane of the pharynx.

The *superior laryngeal* is the sensory nerve of the larynx, and is divided into an external branch and an internal. The former branch is of great importance, inasmuch as deglutition and respiration require to be adjusted, otherwise food might more frequently pass into the larynx. It supplies the crico-thyroid muscle, the lower constrictor, and thyroid body, and sends a branch to the pharyngeal plexus. The explanation given by Mr. Hilton in reference to this muscular supply is, that the larynx is prepared for the more delicate contractions due to the supply of branches from the recurrent nerve. The internal laryngeal supplies the mucous membrane of the larynx, the vocal cords, the epiglottis, and the base of the tongue; and it sends filaments to join the recurrent nerve.

The *recurrent* nerve is the motor nerve of the larynx, supplying its muscles, with the exception just mentioned; and it supplies branches to the trachea, the œsophagus, the mucous membrane of the pharynx, and also communicating filaments to the deep cardiac plexuses and to the superior laryngeal. It leaves the trunk of the nerve at the superior opening of the thorax, and then turns upward, passing round the subclavian artery on the right side, and the aorta on the left. The next branches of the pneumogastric are to the cardiac plexus, and then to the pulmonary; afterwards, upon the œsophagus we find the œsophageal plexus—plexus gulæ; thence it passes through the diaphragm into the abdomen. In the abdomen, numerous branches are distributed to the walls of the stomach.* The nerve joins the large sympathetic ganglion, the semilunar; branches may be traced to the liver, to the duodenum, to the ganglion on the vena cava, by which it is brought into connection with the phrenic. This connection of the pneumogastric and phrenic nerves is of great physiological and pathological interest.† The phrenic is distributed to the diaphragm; and afterwards it unites with both the pneumogastric and sympathetic nerve in a ganglion upon the vena cava. The diaphragm is the most important muscle of respiration, and is thus brought into harmonious action with the lungs by means of

* See preparation in the museum of Guy's Hospital.

† See dissection of mine and preparation in the museum of Guy's Hospital.

the pneumogastric. The same muscle has to do with the passage of food through the end of the œsophagus into the stomach—the closing act of deglutition. We find evidence of this connection in the spasmodic action of the diaphragm in hiccough, and we recognise it in the attempt to maintain the greatest quietness in the muscle during acute disease of the abdomen; so also in the intimate connection of disease immediately below the diaphragm with the pleura and the lung above it. In gall-stone and other diseases of that kind, we often find pleuritic disease at the same time. Branches of the pneumogastric also may be traced to the pancreas, to the suprarenal capsule, and to the kidney, beside uniting with the sympathetic branches upon the aorta.

Such is the extensive distribution of the pneumogastric nerve; and, before speaking of the pathology and the morbid conditions due to altered nerve-supply, we must very briefly refer to the physiology of the nerve. The nerve is of a double character, and contains both afferent and efferent fibres. It regulates the *respiratory* function. It is the minute afferent branches from the pulmonary plexus of this nerve that reach the structure of the lung and bronchi; and the impressions there received are transmitted to the brain, and are followed by reflex movements. By its connection with the fifth and seventh nerves, the entrance of air by the mouth is regulated; by means of the hypoglossal, the tongue is adjusted so as not to interfere with the free passage of air; the glosso-pharyngeal and external branch of the superior laryngeal bring the pharynx into right sympa-

thetic action; the internal branches and the recurrent regulate the glottis; and the muscles of respiration supplied by the spinal accessory, the phrenic, and branches of the spinal nerves, complete the respiratory act. The important nerve-centre of this function is at the origin of the pneumogastric at the floor of the fourth ventricle. It is the minute branches of this nerve which, distributed to the bronchial tubes, produce constriction and narrowing of the tubes, so painfully manifested in spasmodic asthma. According to Rosenthal, the superior laryngeal nerve has inhibitory action upon the movements of respiration and upon the diaphragm, and acts centripetally on the brain; and Burkart has shown that the inferior or recurrent nerve exerts similar power.

Another important function which is controlled by the pneumogastric is the process of *deglutition*: the movements of the œsophagus are accelerated, and the cardiac orifice may be closed by it.

Still more important is its influence upon the movements of the *heart*; it controls its movements, and irritation of the nerve retards its action, whilst a strong electric current will stop it in diastole.

The connection of the heart's action with respiration is most important, for the one is essentially dependent upon the other: unless the respiration be performed, the heart will quickly cease, and *vice versâ*. The presence of carbonic acid in the pulmonary capillaries—the venous blood having been impelled by the right side of the heart—and perhaps also the deficiency of oxygen

in the blood, exert their influence on the minute afferent branches of the pneumogastric, and through the medulla lead to the completion of the respiratory movement.

The supply of the pneumogastric to the organs of *digestion* is essential for the right performance of that function. We have already mentioned that the passage of food in the œsophagus is promoted by the pneumogastric, and so also are the movements of the stomach; the nerve contains afferent sensory fibres, and the irritation of these afferent fibres during digestion causes dilatation of the gastric vessels, according to the experiments of Bernard and Rutherford, and in disease these fibres become acutely active. In an instance of ulceration of the stomach, in which the patient suffered intense pain, I found a large branch of the pneumogastric nerve passing across the floor of the ulcer. (Preparation in Guy's museum.) It is probable, also, that the condition of the pylorus is regulated by the same nerve. Most interesting have been the observations made by Claude Bernard in reference to the action of the pneumogastric upon the liver. By experiment he found that a puncture of the floor of the fourth ventricle, at the root of the pneumogastric nerve, disturbed the glyco-genic function of the liver, and produced saccharine urine. These experiments have been repeated, and the observations extended, by our colleague Dr. Pavy; but we will not dwell upon them. The connection of the pneumogastric with the suprarenal capsule, with the renal plexus, and the other portions of the sympathetic nerve of the abdomen with the uterus, etc., leads to the

reflex irritation of the stomach, so frequently observed in diseases affecting those organs.

Numerous experiments have been made by physiologists, illustrating the effect of division of the nerve upon the several organs to which it is distributed. After division, there is loss of sensation in the throat, and foreign substances may pass unheeded into the larynx, a remarkable contrast to the violent spasmodic action produced during the integrity of the nerve ; again, after division, there is loss of power in the throat, and of action in the vocal cord ; the glottis is partially closed ; and, if life be prolonged, the muscles supplied by the divided nerve become wasted ; the action of the heart is impeded, at first it is more frequent, and the force is increased ; the pulse is larger, because there is diminished tension in the vessels ; the lungs lose their sensibility, the movements of the chest-walls are less active, and respiration becomes less frequent, but more deep, till it ceases altogether. The capillaries of the lung become filled with blood ; the lung is deprived of air ; the mucous membrane is congested, and frothy serum exudes into the air-cells ; the nutrition of the part is altered, and inflammatory changes are induced. This inflammation is often found where the pneumogastric is injured by pressure. Where the nerve is divided the cardiac orifice of the stomach does not act, the mucous membrane of the stomach becomes pale, and the secretion is for a time checked, whilst, on irritation of the divided central end of the nerve, the colour is restored. A common effect of irritation of the gastric branches of

the pneumogastric is that vomiting is produced; and, when the nerves are divided, and the peripheral ends are irritated, movements of the stomach are induced (Lauder Brunton); but when these nerves are paralysed vomiting ceases, and the stomach more easily yields to expansive forces, and becomes distended. This condition, we would remark, is very different from those instances in which, from sudden over-distension from gaseous formation and other causes, the muscular coat is unequal to the force required for contraction; the nerve-power is overtaxed, and thereby inoperative.

In considering the diminished power of the pneumogastric in the abdomen, we can scarcely separate its individual action from that in which it is associated with the vaso-motor nerve. In the effects produced by an ordinary bilious attack, or in those consequent on violent vomiting, the afferent fibres of the pneumogastric are in unison with those of the vaso-motor or sympathetic; they are weakened, and the vessels expand; at the same time the cardiac branches sympathise, and the pulse becomes weak and compressible, and the heart's action feeble. After violent vomiting the secreting power of the liver is interfered with, and the motions become exceedingly pale, at the same time that the nervous supply to the lower lobe of the right lung becomes sympathetically affected. This connection is seen, also, in most cases of inflammation of the stomach; but to this we shall again have to refer. The sudden shock of cold water upon the afferent nerves of the stomach may by reflex action stop the heart.

The intimate union of the pneumogastric nerve with branches of the spinal end of the sympathetic nerve may lead to the development of symptoms, as if the branches of the pneumogastric were themselves irritated. We shall subsequently note instances of this reflex action; and a remarkable instance of it is mentioned by Dr. Burdon Sanderson, in reference to the fifth nerve affecting the pneumogastric in the rabbit, by causing the animal to smell ammonia. "The effect is immediate, according to the strength of the ammonia; the heart is arrested in diastole, or the diastolic intervals may be lengthened. Inhalation of chloroform may stop the heart in the same way." This connection of the fifth nerve is of great interest in some diseases; in hydrophobia the whole of the branches of the fifth nerve are in a state of intense irritability; the least breath of cold air, as merely passing the hand near the face, will induce the most intense spasm of the throat; the branches of the superior laryngeal nerve and of the glosso-pharyngeal are at once acted upon, and so are other branches of the pneumogastric nerve. The fifth nerve having acted by its afferent branches upon the medullary centres, reflex action is at once induced. It has been stated that inflammation of the sheath of the nerve has been observed, and also of the cervical nerves at their origin; but these statements require confirmation (Ziemssen's *Encyclopædia of Practical Medicine*). In this terrible disease we have a condition of extreme hyperæsthesia of these cerebral nerves and their centres; whilst conversely in labio-glosso-laryngeal paralysis we

have diminished power of these centres. The seventh nerve is paralysed, and the fifth is weakened; and with these the branches of the superior laryngeal nerve are devoid of sensibility; deglutition is impaired, and becomes a dangerous process, for the natural safeguards are removed. In the clinical wards of Guy's Hospital, during the past session, a man with this disease was admitted under my care; his countenance was expressionless, his tongue had lost its power, and deglutition was so difficult that he was fed by the means of the stomach-pump. To relieve his thirst, however, he made the attempt to swallow a draught of milk; the superior laryngeal nerve had lost its sensibility, and some of the milk passed into the trachea and bronchi. This was quickly followed by a fatal result; and on the *post-mortem* table the milk was found in the respiratory passages. In this case the afferent branches of the pneumogastric failed to excite the sensory centre, and to induce the expulsive efforts of violent cough. The afferent fibres of the fifth were also weakened. We have in this latter disease the opposite condition to that observed in hydrophobia; hyperæsthesia in the one, anæsthesia in the other.

The same connection of the fifth nerve with the pneumogastric is found in the effect of severe chill or shock from cold; this reflex action is shown in ordinary sneezing, but it is more decided when the power of the pneumogastric is weakened, and severe bronchitis or pneumonia is induced. The shock on the nerve-power of the respiratory organs may be so great that the

patient is in a few hours in a state of the greatest prostration, with dry and brown tongue, resembling advanced fever, but without cough or ordinary external signs of inflammation of the chest. The pneumogastric is almost paralysed; but the first effect was upon the fifth nerve, and a mistake is made in the treatment of these diseases if this connection of the fifth nerve be overlooked. The face should be kept warm, and no draughts of cold air allowed to play upon it. It is quite true that in the perspiration and craving for air in severe pneumonia fanning the face is a temporary relief to the patient; but this is an expression of the exhaustion and of the desire for pure air which the system needs.

We might adduce other instances of the manner in which the pneumogastric nerve is affected by reflex action, but would only here advert to the effect produced upon the centres of the nerve by disturbance on the cerebral aspect of the ganglia. It is powerfully influenced by the emotions and by the passions. The special senses directly influence it; an offensive object, and, still more, a disgusting smell, induce violent retching: sudden alarm at the sight of danger, or the sound that terrifies, at once affects the heart and the respiration, as well as the action of the abdominal viscera supplied by the nerve. The nerve is placed as the custodian of essential vital functions, but it is, as it were, the ready handmaid of the mind and will. We have spoken of its extensive distribution, and each branch of the nerve has, we believe, a definite purpose;

and by its means the throat, the larynx, the lungs and the heart, the stomach, the liver, and other abdominal viscera are brought into the closest union. During health the hidden connections are united in harmonious working; but in disease the jarring of disturbed action spreads its sympathy to all the parts thus linked together. The following laws of action are often observed in the study of clinical medicine.

1. Disease at the origin of the nerve may induce symptoms in any of the peripheral branches; and this reflex state may be one of irritation and hyperæsthesia, or one of diminished power and anæsthesia; the one is spasmodic in character, the other paralytic.

2. Irritation in any set of peripheral branches may produce disturbance in any other part to which the nerve is distributed, or in the centre itself.

3. Alternation of irritation may be induced, at first one set of nerves, then another, becoming implicated. This alternating character of functional diseases is of great clinical interest. We see an irregularity of type and rapidity of recovery which contrast remarkably with the severity of the disease. Spasmodic asthma of the most distressing kind suddenly gives place to disturbance of stomach, this to cerebral symptoms, and these to severe neuralgia. Violent vomiting and marked gastric irritation are followed by loud cough and by loss of voice, indicating that an affection of one set of nerves has given place to change in another set of branches. In general weakness, there is loss of power in all the parts supplied by the nerve, and this

fact is often of great importance in the close of disease. In exhaustion, the voice fails; many patients who are suffering from chronic disease are said to die from the supervention of bronchitis or of pneumonia, when the pulmonary condition is really the expression of exhaustion of the pneumogastric nerve; so, also, when the strength has failed, there is greater liability to affections described as bronchitis and inflammation of the lungs, the power of the respiratory centres being lessened, disturbance of nutrition more readily takes place. Still further, when patients are reduced by chronic disease of the stomach, or of the kidney, similar pulmonary changes may be due to exhaustion; this statement is not opposed by the fact of œdema of the lung and broncho-pneumonia coming on from uræmic poisoning.

A further evidence of exhaustion of the pneumogastric nerve is the loss of appetite, and the diminished power in the stomach to digest food placed in it.

The pneumogastric may be affected as a whole, and the symptoms presented in diabetes are perhaps the best illustrations of this general condition of disease. An interesting paper on this state was published in the *Medical Times* of 1856 by the late Dr. Charles Shearman, on Neurosis of the Pneumogastric Nerve; he drew attention to the depression of spirits, to the loss of memory, the *malaise*, the sense of exhaustion at the stomach, with yawning and sighing, and often with palpitation; to the disturbance of digestion, and, in many instances, to the diabetic condition of the urine:

these symptoms often manifested a periodical character, and, when the condition was early recognised, were amenable to treatment. In true diabetes the branches of the pneumogastric are especially affected, and we find not only the glycogenic function of the liver disturbed, but the other parts supplied by the pneumogastric are involved, the pulmonary nutrition is interfered with, and a chronic pneumonia is often induced; palpitation and disturbance of the heart are common symptoms, and the voice is often altered in character. There is the closest sympathy between the pneumogastric and the sympathetic nerve; hence other common symptoms attending diabetes, such as the impaired nutrition, the red tongue, the dry skin, the altered appetite, the confined state of the bowels, and, at a later period, diarrhoea; and, as to the brain itself, the same sympathy is shown in the melancholia which is often induced. The connection of the pneumogastric branches with the vaso-motor nerve is also seen in that remarkable disease, exophthalmic goitre. With impaired nutrition we find enlargement of the thyroid, protrusion of the eyeballs, and an irritable condition of the heart; and sometimes with a saccharine condition of the urine, as in a young gentleman lately under my care, aged about twenty-three, in whom, with an extremely sensitive condition of nervous system, we had well marked exophthalmic disease with a recurrent glycosuria; the branches of the pneumogastric in him were especially prone to morbid action.

LARYNX.

It may facilitate the right understanding of our subject, if we take the several parts supplied by the nerve in connection with the laws which have been just adduced ; and first as to the larynx. The *larynx* may be affected by spasmodic irritation, or weakened by paralysis ; and each of these may be central in character, or be produced by local or by peripheral causes.

Spasmodic irritation	Central	{	In epilepsy and functional disease of brain
		{	In laryngismus stridulus
		{	In whooping-cough
	Local	{	In catarrh and laryngitis
		{	In croup and diphtheria
		{	In the different forms of ulceration, etc.
		{	In irritation of the uvula
	Peripheral	{	In aneurism pressing on the recurrent nerve
		{	In early phthisis
		{	In heart disease
		{	In enlarged glands
		{	In hysteria
		{	In exhaustion
Paralytic weakness	Central	{	In disease of brain, as apoplexy
		{	In cerebral aphonia
		{	In labio-glosso-laryngeal paralysis
	Local	{	In diphtheria
		{	In aneurism
	Peripheral	{	In pressure on the pneumogastric or recurrent nerve by tumours
		{	In hysterical aphonia

In the paroxysm of an epileptic convulsion, the larynx is spasmodically affected ; but, in this disease, not only are the premonitory symptoms of the most

varied character, but we find that, in the interval between the paroxysms, vague sensations are produced, which are evidently traceable to the same cause. An impression is made upon the nervous system of which the patient alone may be conscious, and one or other branch of the pneumogastric may in this way be involved: either that of the stomach, the heart, the lungs, or the throat. It may be a sense of choking or of dyspnoea, or more severe spasmodic irritation. If the cause be recognised, treatment will be more successful. The following may serve as an instance of this kind of irritation of the pneumogastric nerve. An officer, aged forty-five, who had served some years ago in India, and afterwards in the West Indies and Canada, whilst in India had a fall from his horse, which was attributed to sun-stroke; there was concussion of the brain, and he lost the sense of hearing on the left side, and also the sense of smell. From that time he had become nervous and dyspeptic; he did not suffer from headache, but slept badly, and had morning cough; his pulse was feeble, but otherwise he seemed in good health; his chest was strong, abdomen contracted, urine normal; but he had repeated attacks of "sighing," with sense of choking and distress about the upper part of his chest. He had never contracted any syphilitic disease, and was a water-drinker. In the West Indies he had fever slightly. It was quite evident that this condition was due to functional disturbance of the brain, and the "choking" sensation and sighing to the state of the pneumogastric nerve. Bromide of potassium, with

arsenic and cinchona bark, relieved these unpleasant symptoms.

In an undergraduate, aged nineteen, attacks of the most violent spasm of the throat came on in the following manner. He had previously felt well till he over-fatigued himself with a long walk; the following day he had a paroxysm of difficulty in breathing, and there was a recurrence each day with increasing severity. He would suddenly start up, throwing his arms into the air, the face becoming livid, the eyes staring; he would then, in the wildest manner, force his hand into his mouth, as if to tear something from the throat; after a few minutes, there was the expectoration of thick mucus and a little blood; the attack then gradually subsided. A loud crowing inspiration took place during the paroxysm. The attacks were so severe, that it seemed as if the danger to life were imminent. When seen at 10 p.m., the respiration was 28; pulse, 100; temperature, 100.4° ; the skin perspiring, the throat free from injection; and there was no diphtheritic membrane. The tongue was clean, the bowels confined, the respiration was easy; there was no sibilus and no laryngeal sound produced during ordinary respiration; no rhonchi, nor change in resonance in the chest; the respiration was, however, rather less free than normal at the right base; he could swallow fluids; there was no dysphagia, but great sensibility of the epiglottis. He had no cough; in fact, he was afraid to cough, on account of the throat-spasm. He was ordered a dose of castor-oil, and bromide of potassium, $\mathfrak{D}i$;

tincture of belladonna, ℥x; dilute hydrocyanic acid, ℥ij; and compound tincture of chloroform, ℥x, in water every four hours. He inhaled steam with two drachms of hemlock-juice in it.

About half-past three another severe paroxysm came on, but soon subsided, and the spasms became less frequent. In a few days, he recovered, and there has been no return of laryngeal or other symptoms of disease since—now five years ago. This severe form of disease was spasm of the glottis, and closely resembled the laryngismus stridulus which is more frequently found at an earlier age. It was evident that there was irritation of the pneumogastric nerve, either at its root or of the recurrent laryngeal nerve; it was a neurosis of the larynx, and a condition of hyperæsthesia; but it was due not to any local change in the part, but to an affection of its nerves. This, in fact, is the pathology of laryngismus stridulus; sometimes it is due to mischief at the origin of the nerve, and the spasm of the glottis is a slight convulsion, which may be followed by a more general one, the fingers and the toes being turned in, as in membranous inflammation of the brain; or it may be produced by reflex irritation, as by intestinal affections, or by the pressure of enlarged glands on the recurrent nerve of the neck. In infants, this form of malady may be produced by slight disturbance, as from the teeth, or from the bowels, and an attack, even the first one, may be so severe as to lead to a fatal result.

There is much doubt as to the true pathology of

whooping-cough; according to Dr. Copland, it has its seat in the medulla oblongata; and some speak of it as a neurosis of the pneumogastric nerve; but there can be no doubt that the parts supplied by the pneumogastric are especially affected; the spasmodic condition of the glottis, the urgent dyspnœa and cough, with the closed state of the rima, producing the lividity of the countenance and the long drawn inspiratory sigh; then also the irritability of the chest, often followed by cough and by emphysema, and the great sensibility of the stomach, so that vomiting is very easily induced, show that the whole of the branches of this nerve are exquisitely sensitive. The fact that it is a disease communicable by contagion does not militate against the idea that it is the pneumogastric that is especially affected. The same remedies which are available in relieving spasm of the throat lessen the severity of this disease; and, when the malady becomes more severe, the irritation is prolonged from the origin of the pneumogastric to other nerve-centres, and general convulsion is induced. In measles also, another contagious disease, we find great sensibility of the pulmonary branches of the pneumogastric.

In reference to spasmodic affections of the throat produced by *local* irritation, we have not space to describe them, but would only say that, in all forms of local disease, such as catarrh, laryngitis, croup, diphtheria, strumous or syphilitic or cancerous ulceration, the affection of the mucous membrane very readily induces spasmodic contraction of the muscles of the part, and

this condition aggravates the distress due to the inflammatory disease.

The spasmodic diseases of the larynx which are due to *peripheral* irritation are of a very interesting kind, and we will very briefly advert to them. In many instances of relaxation of the uvula and mischief about the throat, cough and irritation of the epiglottis are due to direct disturbance. The elongated uvula may come into contact with the epiglottis itself; this, however, is not always the case, and the disturbance of the superior laryngeal is reflex.

This reflex disturbance is more decided in aneurismal disease of the aorta and of the large vessels of the neck, which may induce pressure upon the recurrent nerve. At first, this may be mere spasmodic irritation from slight disturbance, and afterwards the disease may lead to paralysis of the part, from long-continued pressure. As the recurrent laryngeal nerve supplies nearly all the muscles of the larynx, spasmodic contraction is easily induced. At first, there is very little affection of the voice, but sudden paroxysmal dyspnoea, which often comes on at night. The patient awakes in great distress, and is unable to get his breath. The distress is sometimes extreme, and this symptom is often one of the most prominent indications of aneurismal disease of the aorta. There may be nothing observable on laryngoscopic examination of the throat; no change in the voice, no affection of the pupil; and the general physical signs of disease may be very imperfectly developed. A case of this kind occurred many years ago in Guy's Hospital,

before, I would say, the laryngoscope was used. The patient was a strong man, without any symptoms of heart disease, but with occasional difficulty in swallowing, and with the paroxysmal distress just mentioned. My former teacher and colleague, Dr. Addison, diagnosed aneurism, although the cesophageal symptoms were more decided than the other indications of disease; and the termination of the case showed the disease to be aneurismal in character. In pressure upon the larynx and trachea from aneurism and tumour, laryngeal spasm greatly aggravate the dyspnœa and distress.

Another form of reflex irritation is that affection of the larynx which is produced by disturbance of the peripheral branches of the pneumogastric in the lung. The voice is changed, and a dry hacking cough, with laryngeal irritation, seems to indicate mischief in the windpipe, but it is really due to reflex irritation. A patient will often describe the mischief as being in the throat itself, when, by careful examination, the commencement of tubercular disease is found in the lung. These instances are, of course, to be distinguished from those in which, at a later stage of chronic phthisis, disease in the larynx and in the vocal cords is induced and ulceration takes place.

Again, in heart disease of an organic kind, we also find reflex irritation of the laryngeal nerves. This state must not be confounded with the urgent dyspnœa which is produced by the disturbed relations of the lungs and heart; thus the blood is unable to pass from the lungs, in consequence of contracted mitral valve, and thereby

the respiratory act is imperfectly and hurriedly performed, and the lung is surcharged with blood. Besides these cases, we have instances of heart disease, whether from valvular disease or weakness, in which sudden laryngeal distress and urgent dyspnoea are produced. This paroxysm often takes place about two or three in the morning; the patient is suddenly roused from sleep, because the respiratory centre does not receive its proper supply of aërated blood; the involuntary muscles of respiration during sleep being unassisted by the muscles of forced respiration, which had served to maintain the balance of the respiration and circulation, are alone insufficient, and, after a time, the need of the system rouses the patient to take a deep inspiration and to supply more oxygen. This explanation will, however, not suffice for many instances in which the patient may be awake, and breathing to the utmost of his capabilities, but still the laryngeal spasm comes on. In other instances of functional disease of the heart, from weakness and from dilatation, we find similar sudden laryngeal spasm produced.

The same symptoms of reflex irritation by pressure upon the recurrent laryngeal nerves may be caused by enlarged glands in the neck or in the upper part of the chest; and, in some instances during early life, the condition is one precisely resembling that of laryngismus stridulus produced by cerebral irritation. In gastric disturbance, an irritable dry cough and perverted sensation of the superior laryngeal nerve may be induced; a tickling in the throat, which the patient can scarcely

distinguish from actual local irritation of the part, or the spasmodic affection may be more decided in character.

In hysteria, the spasmodic affections of the larynx are closely connected with those of the cesophagus; a sense of choking from spasmodic contraction in the latter is associated with difficulty of breathing from spasm of the former. The sensation as of a ball in the throat, the *globus hystericus*, is not limited to the gullet, but extends to the windpipe; there is gasping for breath, with irregularity, and often afterwards hurried respiration.

It is not necessary to dwell further upon these spasmodic laryngeal affections; but we pass on to consider those which are of a *paralytic* character, where there is loss of power or anæsthesia; these also may be divided into those which are of *central* origin, those which are *local* in character, and, lastly, *peripheral*. As to the first, we find loss of power in both recurrent nerves in states of great exhaustion; and when the origin of the *par vagum* has lost its active power, the insensibility of the superior laryngeal nerve may allow food to pass into the larynx, as during syncope, and also towards the close of life: it is of importance to bear this fact in mind, otherwise sudden cessation of life may be produced by laryngeal obstruction. This loss of sensibility is to be remembered in the severe form of disease which has been designated labio-glosso-laryngeal paralysis; and we have already referred to an instance in which the attempt of a patient to swallow milk when the larynx had lost its sensibility led to its sudden passage

into the trachea, and caused death. In this disease, the malady is central; it is at the central origin of the nerve, and probably at the part where the spinal accessory, facial, the hypoglossal, and the par vagum are brought into close relationship at the floor of the fourth ventricle. Trousseau refers the disease to the spinal accessory nerve, and regards the branches of nerve supplied to the larynx as being derived from that nerve, at least as far as the power of speech is concerned; whilst the pneumogastric has especially to do with the respiratory act.

A plumber by trade, aged forty-six, was admitted into Guy's Hospital, under my care, on November 9th, 1874. He had not suffered from lead-poisoning nor from syphilis. Twelve months previously he began to lose the power of mastication, and he had some difficulty in swallowing; there was partial deafness on the left side. The symptoms came on gradually, and steadily increased in severity. The appearance of the patient was very peculiar: the vacant expressionless countenance, with the mouth partially open, was very characteristic of the disease. The symptom which first attracted attention was the diminished power of the muscles of mastication, and this was associated with gradually increasing weakness. At length, one month before admission, he could only take fluid food; the facial nerve was greatly diminished in power, but was not completely paralysed, for he could close the eye and partially distend the cheeks; the mouth was half open. The left auditory was affected, but the

sensory portion of the fifth was unaffected ; for there was no loss of sensation of the face. The appearance of the tongue was most distinctive ; it remained powerless at the floor of the mouth, and the soft palate was motionless. This state led to the most prominent of the symptoms of disease, the inability to swallow or to masticate food properly, and also to pronounce those sounds which require the action of the tongue and of the lips ; deglutition could not be performed, the movements could not be executed, and the attempt was followed by choking ; food reached the edges of the epiglottis, and was violently ejected by the nostrils, and the patient was nearly asphyxiated by the attempt. He coughed up a good deal of phlegm, but he did not seem to have power to clear his throat thoroughly. With the laryngoscope, the vocal cords could be seen to open and close as in health ; still the superior laryngeal nerve did not seem to possess its normal sensibility. He was greatly exhausted when admitted, and, as the paralysis of the hypoglossal was marked, and swallowing could not be performed, it was directed that he should be fed with the stomach-pump ; milk was administered in this way. The following evening, however, he again attempted to swallow ; a few hours afterwards he sank. Some of the milk had passed into the larynx, for white coagula were found in the bronchi. The *post-mortem* examination, very carefully made by Dr. Goodhart, showed that there was a small patch of softening immediately above the right corpus olivare ; the floor of the fourth ventricle was deep in colour ; its

lateral angles and the valve of Vieussens were softened, and there was a minute patch of the same change in the structure of the cerebellum beneath. The right hypoglossal was smaller than the left, and, in the cervical spinal cord, the right anterior horn was softened. The parts affected were the origins of the hypoglossal and facial nerves, but those of the spinal accessory and pneumogastric presented less decided change. It was interesting to find, however, that the recurrent nerve seemed to retain its power over the vocal cords, although the superior laryngeal nerves had diminished sensibility.

In reference to a weakened condition of the vocal cords, or diminished tension, or loss of contractile power, the disease may be of central origin, or it may be of a local or of a reflex character. We often find, in reference to the first, that the disease is in the will; the effort to produce contraction of the cords is not made; the patient speaks in a whisper. A few months ago, a patient of this kind was under my care in Guy's Hospital who had not spoken for two years; there was no evidence of organic disease, and the first application of an electric current to the larynx produced the loudest protestations that she could speak. This state has been called by Romberg psychical aphonia. Sudden nervous shock may also produce this loss of power of the vocal cords. Other weakened conditions of the nerves of this part are due to local disease, to diphtheria, croupous diseases; and even after catarrh, the muscles become weakened, and sympathise in the

inflammatory affection of the mucous membrane. The application of electricity often affords great relief, and, in milder cases, the effort to produce musical notes and to sing, tends to increase the tension of the weakened cords.

Still more interesting are the forms of paralysis of the recurrent nerve and of the vocal cords which are due to reflex action. Any form of pressure upon the recurrent nerve may induce altered nutrition and hoarseness, the consequence of the paralysis; for the recurrent supplies the vocal cords, and, with one exception, the muscles of the larynx. The larynx may be examined by the laryngoscope, which becomes an important help in diagnosis, and the vocal cord may be seen on one or other side to be weakened or powerless. In an interesting paper by Dr. George Johnson in the *Medico-Chirurgical Transactions* of 1875, he shows that, whilst pressure on one recurrent nerve, on the same side, will produce spasmodic action or paralysis, pressure on the trunk of the nerve will cause atrophy or spasmodic action on both sides. Aneurismal disease is perhaps the most frequent cause of this reflex paralysis—reflex in its being produced, not by direct injury of the larynx, but upon it by secondary pressure; not reflex in the sense of an impression being conveyed to the nerve-centre, and then propagated to the affected part. These instances are very different in character from those already described as due to a central cause. Enlarged bronchial glands, cancerous disease, and it is said, pleuritic thickening about tuberculous lungs

will induce this paralysis of the vocal cords by affecting the recurrent nerve.

A very interesting case of this kind was lately under my care in Guy's Hospital. A strong man, aged forty-three, an engineer, who, with the exception of rheumatism, had good health till Christmas; cough then came on, and increased in severity, with dyspnoea, till his admission on February 23rd. His face and neck were swollen and oedematous, the superficial veins of the thorax enlarged; there was complete dulness on the right side of the chest, with absence of respiratory murmur; the signs of thoracic tumour were well marked; the arms became swollen, the dyspnoea increased greatly in severity, and erysipelatous inflammation affected the right arm. The voice was feeble, but was not lost. He died on March 14th. On inspection, a cancerous tumour was found in the anterior mediastinum; it pressed upon the innominate and azygos veins; the right lung was in a sloughing condition; the right pneumogastric was involved, and there was very marked affection of the recurrent on the same side; it was involved in the growth, and, to quote the description of Dr. Fagge, "the larynx was healthy, except the right vocal cord, which was swollen and yellow." The swelling was very decided, and the nutrition was so affected that suppurative changes had commenced; but there was no suppuration about the muscles of the neck. The patient was too ill to bear the use of the laryngoscope.

Many of the instances of reflex paralysis which are

associated with functional disturbance of the uterine organs are closely allied to those which have been referred to as hysterical aphonia.

These varied affections of the larynx may be produced by disease at the origin of the nerve—the pneumogastric—or the disease may be reflex in character, the irritation of one series of nerves affecting other branches, as of the lungs, or of the stomach, or of the larynx; and, lastly, these laryngeal affections may give place to disturbance of the lungs or of the stomach, alternating the one with the other; a patient at one time having aphonia, then spasmodic irritation of the bronchial tubes, or functional disturbance of the digestive organs. In the one case, the attempt should be made to relieve the central mischief; in the second, to lessen the primary source of peripheral disturbance; in the third, to remove the general irritability of the nervous system.

LECTURE II.

THORACIC BRANCHES.

IN this lecture we pass on to the consideration of those pathological changes in the œsophagus, in the lungs, and in the heart, which are connected with disturbances of the par vagum; and we shall find fresh exemplification of the three laws upon which we dwelt in our last lecture.

1. Disease at the central origin of the nerve may induce symptoms of irritation in any other part supplied by the same nerve.

2. Irritation in any set of peripheral branches may produce disturbance in any other part to which the nerve is distributed, or in the centre itself.

3. Alternation of irritation may be produced; at first one set of nerves, then another, becoming implicated.

ÆSOPHAGUS.

The *œsophagus* receives a large supply from the pneumogastric, and the branches of the nerve form a plexus upon it; but, beside these branches direct from the trunk of the nerve, others are derived from

the recurrent nerve, as well as from the sympathetic. This nervous supply is especially concerned with the regulation of the movements of the muscular layers of the canal, for the œsophagus is a mere channel of communication between the pharynx and the stomach. This muscular layer is thrown into a state of spasmodic contraction, from the increased irritability of its nervous supply; or, from exhaustion of nerve-power, it is weakened and paralysed. When the power of the pneumogastric is destroyed, as by division of the nerve, the food is retarded in its passage down the tube. It may be convenient, therefore, to divide the nervous affections of the œsophagus, which have to do with the pneumogastric nerve, into those which are of a spasmodic and those which are paralytic in character; and each of these may be traced to central or to local disease, or they may be produced by peripheral irritation.

Spasmodic Stricture	Central	{ Mania Epilepsy Nervous irritability
	Local	{ Foreign bodies Pressure on the canal by tumours; enlarged glands; aneurism Organic obstruction and ulceration
	Peripheral	{ Hysteria Disease of heart Disease of aorta, and aneurism Flatulence
Paralysis	Central ..	Exhaustion
	Local	Pressure on pneumogastric nerve; aneurism; etc.
	Peripheral	Disease of stomach, etc.

Although the mucous membrane of the œsophagus does

not possess great sensibility, still there are decided sensations produced by the passage of food down the canal, as a sense of heat or of coldness, of fulness and distension, or of severe pain; and sometimes the sensibility is increased, so that patients complain of a sense of soreness, of roughness, or the whole canal is unduly sensitive: at other times this augmented sensibility exists only in the imagination of the patient. The process of deglutition is completed by the passage of food down the œsophagus into the stomach, but food or saliva or other substance must be present to excite the act: a person cannot swallow without something to excite the contraction by reflex irritation. A young gentleman called upon me in great distress, believing that he had organic obstruction in the gullet. During the whole of his journey from Rugby to London he had been trying to swallow, but without success, as he could not complete the act when saliva had already been swallowed. He did not understand the physiological process, and his mind was at once calmed and his fears dissipated when a glass of water was given to him. In some cases of mania, as also in many cases of spasmodic reflex irritation in hysteria, patients believe that there is obstruction, and that there is no passage. Nothing is swallowed, because the attempt is not made: the cerebral centre is at fault. The loudest protestations are made that food will not pass, and the patients will often refuse to make the attempt. The passage of an œsophageal bougie proves that there is no obstruction, and some may be induced to make the attempt after this ope-

ration has once been performed. It is probable that some spasmodic contraction induces the sensation of obstruction. This form of spasmodic affection is a common symptom in many cases of mental disease, and sometimes it is amongst the earliest indications of the malady.

A similar kind of spasmodic obstruction occurs in some cases of epilepsy, and after sun-stroke a sense of choking and obstruction in the throat is produced somewhat similar to globus hystericus, although due not to reflex but to central mischief; and again, in other patients, local spasmodic irritation and contraction of some part of the œsophagus may be produced, which cannot be traced to local disease or to irritation of a reflex kind. For years persons complain of hindrance to the free passage of food where no stricture exists; it may be at the centre of the canal or at its termination. In an instance of this kind a member of our profession was, for a time, in great fear that organic disease existed, and he took his meals alone, on account of the care that he required in getting the food to pass into the stomach; but he found that by taking a deep inspiration the spasmodic contraction, probably near the diaphragm, became relaxed, and the food slipped onwards into the stomach. It must, however, be remembered that all local disease of the œsophagus produces spasmodic contraction from irritation of the part; and that a partial obstruction or narrowing of the canal is often rendered complete from this cause; some, indeed, have believed that

long continued spasmodic contraction may produce thickening of the connective tissue, and lead to organic obstruction. It would be foreign to our purpose here to describe organic obstruction, whether from external disease or pressure of glands, tumours, or aneurism; or from internal thickening of the coats of the canal, as from fibro-cellular growth, from the healing of ulcers, from the deposit of cancerous or other material, further than to remark that spasmodic contraction always plays an important part in the symptoms produced.

The spasmodic contractions which are of a *reflex* character are well known. In the globus hystericus, a sudden sensation as of a ball in the throat and a sense of suffocation are produced; the respiration is disturbed, with sighing and irregular breathing, and the emotional centre, and often the whole of the spinal nerves, are excited to perverted action. Peripheral disturbance of sentient nerves leads to the excitement of the medulla oblongata at the origin of the par vagum; the irregular contraction of fibres of the œsophagus, especially of the circular fibres, leads to this sensation as of a ball in the throat. In many instances there is disordered uterine and ovarian function; whilst in others, from general weakness, the emotional centres of the brain react upon the medulla and its nerves. Very similar sensations are produced by flatulent distension of the stomach and transverse colon; the sensation of weight and oppression at the upper part of the chest is a purely reflex one, and

it is principally due to the pneumogastric, but it is increased by the connection of the upper dorsal nerves with the splanchnic nerves, since the latter have their origin in the dorsal nerves, and pass down to the abdominal viscera. In some cases of heart disease spasmodic irritation of the œsophagus is induced, and it comes on suddenly, with most distressing sense of obstruction. Some refer this reflex action to the branches of the cardiac plexus uniting with the pneumogastric, others to the recurrent nerve which sends a branch to the cardiac plexus, whilst others attribute the sensation to a mechanical cause, the distension of the left auricle, which is in close proximity with the œsophagus. The pathology of these cases of disease is very different, and the simple spasmodic obstruction may be easily mistaken for that which is organic. In the first kind it is important to compel the œsophagus to do its work; in the second, it is equally important to allow it to rest; whilst, in the last, the removal of the peripheral mischief will soon dissipate the spasmodic hindrance.

The *paralytic* affections of the œsophagus are found at the close of other diseases, but these also arise from central, local, or from peripheral disturbance. In general exhaustion, deglutition is slow, because the pneumogastric is in a weakened state, and food may even on this account remain in the œsophagus itself, or it may perhaps pass from the stomach into the lower part of the canal, and produce solution by the action of the gastric fluids; in this way the œsophagus may be

dissolved and even perforated during life. Local pressure upon the pneumogastric nerve, or ulceration, may also destroy its power and paralyse the muscular energy and the sensibility of the canal; and lastly, at the close of some abdominal diseases, as of the stomach and uterus, the power of the œsophagus is lost, and patients are unable to get food into the stomach. In these instances, the condition is one of exhaustion, and of the cessation of living power in the system; and with this loss of sensibility in the œsophageal branches of the nerve, there is only a slight step to the cessation of the more essentially vital act, that of respiration.

LUNGS.

The pathological relations of the pneumogastric nerve with the *lungs* and with *respiration* next demand our attention. The pulmonary plexuses are situated at the root of the lungs; they are connected with the sympathetic and with the cardiac branches of nerves, and are distributed to the minute structures of the lungs; and it has been shown that irritation of the pneumogastric will cause the bronchi to contract. In the morbid processes which are recognised, we may adopt the same arrangement as previously, namely, into those of a spasmodic and into those of a paralytic kind; in the former there is increased irritability of the sentient centre, the respiration is quickened, and there may be violent cough and dyspnœa; in the latter, the respiratory centre is

weakened or paralysed, there may be but little or no cough, and no effect may be produced by irritants ; the respiration is slow, but deep and irregular.

Spasmodic irritation	Central	<ul style="list-style-type: none"> Irritability from exhaustion In fevers, etc. Asthma (spasmodic) Whooping-cough
	Local	<ul style="list-style-type: none"> Hay-asthma Bronchitis Pneumonia Emphysema, etc.
	Peripheral	<ul style="list-style-type: none"> In hysteria, producing hurried breathing, etc. In heart disease, producing cardiac asthma In gastric disease In gout, etc.
Paralysis	Central	<ul style="list-style-type: none"> Respiration slow ; congestion, producing pneumonia and bronchitis Poisoning by opium Apoplexy, etc.
	Local	<ul style="list-style-type: none"> Cold shock, producing bronchitis, pneumonia, often without cough
	Peripheral	<ul style="list-style-type: none"> Patients dying of cancer of stomach, or of uterus, of chronic gastric ulcer, etc., often have pneumonia, which is not due to septic changes

A few words in reference to some of these conditions. With weakness of the system there is increased irritability of the nervous centres, and the centre of respiration is no exception to this rule. In continued fevers, as enteric or typhus, with increasing exhaustion the respiration becomes more hurried, and this is often an unfavourable sign ; the lungs have become engorged with blood at the posterior and more depending parts ; the power of the heart is lessened, and the nervous

energy has become exhausted. In whooping-cough, to which we have previously referred, the principal symptoms are those connected with the throat, but it often happens that severe cough and bronchial complications follow, and in not a few cases emphysema. The mechanical pressure upon the delicate air-cells may have to do with this effect ; but it must be remembered that the par vagum which supplies the larynx also supplies the lung. The nerve-power is lessened, and the nutrition of the lung-tissue interfered with ; and this condition is favourable to the production of emphysema of the lung and its attendant circumstances. There can, I think, be no doubt that true spasmodic asthma may be due to disturbance of the origin of the pneumogastric as well as from peripheral irritation. In true spasmodic asthma, it is remarkable with what suddenness and with what severity the symptoms may come on. The greatest distress of breathing may be produced almost at once, so that the patient is unable to move, but remains with the head thrown back, the eyes full and protruding, the muscles of forced respiration brought into violent exercise, and the countenance, becoming of a livid colour, is covered with profuse perspiration. The attack often comes on at night. If we listen at the chest, scarcely any air is heard to enter ; but some sibilus may be detected ; less and less air is aërated ; the heart becomes feeble, the right side is distended, and but little blood passes to the left side, so that the pulse is necessarily small. The bronchi are spasmodically contracted, and will not

allow air to enter; the branches of the pneumogastric are in a state of extreme irritability; the afferent nerves are intensely excited, and induce corresponding action in the efferent filaments; as, however, the centre becomes narcotised by the imperfectly aërated blood, it relaxes its spasmodic grasp, and, in a quarter to half an hour, a little secretion takes place from the engorged vessels, a small quantity of mucus is discharged, more air gradually enters, and the paroxysm subsides. This state is a most painful one to witness, and is most distressing to the patient. It may be associated, in less severe degree, with diseases of the bronchi and with affections of the heart; but cardiac asthma and bronchitic asthma are very different in regard to the suddenness of the attack and the previous absence of symptoms of organic disease. Various means may be used to quiet this intense spasm, and the most serviceable are the bromide of potassium with the juice of the conium, lobelia and ether, hydrocyanic acid, and stramonium, and narcotics in varied forms; but upon these, and also the means by which the paroxysms may be averted, I must refrain from dwelling.

I was called to see a man, aged twenty-four, some years ago (1870), who had, in the early morning hours, paroxysms of intense dyspnoea. He was, when I saw him in November, sitting up in bed; the respiration was easy, but there were some sibilant *râles*, and prolonged expiratory murmur was heard. He had been out of health for several months, but his attack was of about a week's duration, and came on with sneezing,

with cough and gasping for breath; the heart was irritable, but no *bruit* was heard; the expectoration was frothy, the tongue was clean, the abdomen supple, the pulse compressible, the urine healthy. He was spare; his countenance anxious, and there was much irritability of the whole system. In the following May he had remained free from severe attacks of dyspnœa; he had no asthma, but his heart was irritable and irregular in rhythm, and he had also complained of faintness and flatulence. In October he went to Margate, and his health improved; but he said that he suffered from his stomach. He then took cold, and had his old chest-disturbance; he was, moreover, very nervous, and dwelt upon his ailments. The winter of 1871 he spent at Ramsgate and Margate; his general health was better, but he complained of pain in his head (July, 1872), so that he felt uncertain about himself; his scalp was very sensitive; his breathing was perfectly quiet, and he was free from asthma, but the pulse was irritable. In September he was free from pain in the head, but had nervous twitching and hysterical crying. In November the pulse was very rapid (160), the tongue clean, the appetite tolerable; he had dull headache, and for several months complained of "queer feelings" in his head, afterwards in his mouth and throat. In July, 1873, he had some return of the asthma, and the heart was affected as on a previous occasion. In 1874 he had passed the winter well; but his mind was fretful, "his stomach queer," and there was a threatening of the return of his chest-

symptoms ; still his general health was decidedly improved, and he was able to return to business.

This was at first a well-marked case of spasmodic asthma ; but the irritation of the pulmonary branches of the pneumogastric was followed by disturbance of the heart, then by neuralgia ; afterwards, his nervous system and his brain became disturbed ; then the stomach and digestion were interfered with. It was evident that his malady was connected with the state of the pneumogastric, and there was a remarkable alteration in the part affected : it was the lung at one time, then the heart, then the brain and the stomach. There was no certainty as to which part would be next attacked. The disease was the same, but its manifestation was different ; it was relieved by bromide of potassium, by arsenic, by belladonna, and by tonics, such as steel and quinine. His mother described herself as of a nervous temperament, and his sister died from acute epileptiform disease. We might narrate numerous instances to show this effect on the pulmonary branches of the pneumogastric from central disturbance. It would lead us far beyond the limits of these lectures were we to dwell upon the several forms of spasmodic affection of the bronchial tubes produced by *local* irritation ; and, although we speak of this as produced by local irritation, it must be borne in mind that it is the impression upon the afferent branches in the lungs which is local, as distinguished from those instances in which the irritation is central or traceable to peripheral mischief in the abdomen ; the action upon

the efferent branches is the same in each case. In hay-asthma, the irritant is directly inhaled, whether it be the pollen of grass or other particles ; and, in many inflammatory diseases of the chest—bronchitis, bronchopneumonia, emphysema, etc.—the muscular fibres of the bronchial tubes are excited to spasmodic contraction, and thereby the dyspnœa is increased. It is an important part in the treatment of many of these diseases so to soothe the branches of the par vagum as to lessen the irritation of these bronchial muscular fibres. Very minute doses of morphia, of belladonna, of hemlock, may in this way greatly mitigate the disease, when a large dose, especially of the former, does great injury by narcotising the respiratory centre.

The instances of spasmodic disease which are due to *reflex* irritation are very different both in character and in severity. In the nervous irritability of hysteria or uterine disease, an impression is carried to the medulla oblongata by spinal or sympathetic nerves, and thence by efferent fibres to the lungs, so that the respiration becomes greatly excited. Sometimes these patients may be seen breathing one hundred times a minute or more rapidly, equally in quickness with the pulsations of the heart ; but the disease, though weakening, is comparatively harmless ; it will give place perhaps to irritation of the stomach or neuralgic pain in the head. Very different is the asthma which is due to cardiac disease, especially where there is mitral stenosis, or great dilatation of the left ventricle. The blood is delayed in the pulmonary capillaries, and

the system is deprived of its normal proportion of aërated blood. This disturbance of the balance between the circulatory and respiratory system leads to urgent dyspnœa; but we must not dwell upon this subject. Again, in simple gastric disease, we find that the afferent branches induce disturbance of the origin of the pneumogastric, which is expressed in the pulmonary branches, and there is truth in the assertion that a cough is "stomach cough;" too often, however, the gastric disturbance associated with a dry and hacking cough is itself, as we shall have to mention, the effect of disturbance of pulmonary branches of the pneumogastric by tubercular deposit, and not the cause of the cough. A stomach-cough is a very doubtful symptom in delicate patients, and one that should be watched with extreme care. In gouty subjects, and also in syphilis, in ague, and in remittent fevers, we have modifications of action of the respiratory nerves, and conditions are produced which are very different from ordinary inflammatory disease, and their causes require to be recognised, otherwise they baffle the practitioner in the treatment of them. In this way, iodide of potassium becomes a most important remedy for syphilitic bronchitis, if I may use such an expression, and quinine and arsenic are of great service in the severe asthma that is sometimes observed in aguish districts.

The conditions that are produced by *paralysis* of the pulmonary branches of the *par vagum* closely resemble those observed after experimental division of the nerve. We may take one or two instances to illustrate this fact,

and we would premise by stating that this paralytic condition may be of *central* origin, or it may be due to local or to reflex influence. In reference to the first condition, the medulla oblongata and the origin of the nerve at the floor of the fourth ventricle is directly affected in severe apoplexy, in such cases as ingravescent apoplexy, when a clot has broken into the lateral ventricle, and the blood has passed onwards into the fourth ventricle, or, again, in apoplectic effusion into the pons Varolii. The respiration becomes very slow; one or two deep inspirations are followed by several slight and more shallow ones, then to be compensated for by a full and deep act. The lungs become congested, there is serous effusion into the air-cells, and a form of broncho-pneumonia is produced, if life be prolonged. In poisoning by opium, an almost similar condition is observed. This paralytic state of the pulmonary branches may, however, be the result of a *local* cause, as a severe chill affecting the extreme branches of the par vagum. Scarcely a winter passes—we might say no winter passes by—without many persons thus becoming struck down almost at once, especially in the extremes of life, the aged and the young. Sometimes the attack is spoken of as a mere cold or catarrh, but the shock is so great that the patient is unable to rally, bronchitis or pneumonia is almost at once produced, it may be without cough, and the patient quickly becomes prostrate. In a very few hours patients thus pass away; unless, perchance, by powerful stimulants, such as brandy, ammonia, ether, etc., there is a quick invigoration of

these important nerves and centres. One other reference to this paralytic condition, and in this instance it is due to *reflex* action. It is very common at the close of organic disease of the stomach and of the uterus to find that patients have broncho-pneumonia, and that this appears to exhaust the last spark of life; this condition may be quite independent of septic change and of alteration in the blood, but it is produced by the gradual exhaustion of nerve-power, until, at length, the respiratory act is inefficiently performed, and the least irritation suffices to produce these inflammatory changes in the lung-tissue. Sometimes, by watching the gradual progress by which life is fading away, we may for a short time retard dissolution and prolong life.

HEART.

The most important of the animal functions, that of the circulation, is very directly influenced by the state of its nervous supply. A very large plexus of nerves is formed by the branches of the pneumogastric with those of the sympathetic; these pass down from the neck, and at the arch of the aorta the cardiac plexuses are situated, from which numerous branches pass down to the heart itself. Irritation of the cardiac nerves and of the pneumogastric produces distress and pain, and it has been shown that from the same cause the movements of the heart may be retarded, the diastole may be prolonged, and the pressure in the vessels diminished.

When the nerve is paralysed, as by experimental section, the inhibitory power is taken away, and the heart beats at first with increased force. We find, in pathological investigations, that disease presents us with some symptoms which are due to spasmodic irritation, whilst others may be traced to exhaustion, or paralysis of the nerve.

The spasmodic affections and the paralytic ones also, may be referred to central, to local, or to peripheral causes.

Spasmodic irritation Angina ..	{	Central ..	{	Nervous shock
			{	Renal disease (?)
		Local		Diseased coronary arteries
		Peripheral		Gout, etc.
Paralysis	{	Central ..		Apoplexy
		Local		Pericardial effusion, carditis, etc.
		Peripheral	{	Acute disease of the abdomen, peritonitis, etc.
				Cold in the stomach, or a sudden blow

It is not necessary to do more than very briefly to refer to these conditions. The cardiac distress which is produced by nervous shock is an instance of the action of the cerebrum and the emotional centres upon the origin of the pneumogastric, and thus upon the lungs and heart. The effect is due in a greater degree to the pneumogastric than to the sympathetic nerve; although, in all cardiac affections, the action of the vaso-motor nerve is exceedingly important. Altered nerve-supply is the cause of the great distress in many organic diseases of the heart; the afferent fibres of the cardiac branches of the pneumogastric are closely united with the sympathetic in the cardiac plexus, and by the

effluent fibres from the pneumogastric centre the respiration becomes affected as well as the action of the heart. Whilst saying this, we would not overlook the mechanical interference with the heart in disease of the valves, in dilatation, and in disordered states of the muscular walls of the heart. In renal disease, attacks of severe angina come on where there is chronic disease of the gland, as in the small granular kidney, but many considerations must be borne in mind in reference to this disease; there are degeneration of the minute capillary vessels and altered tension of the arteries, the muscular coat of the ventricles is hypertrophied, the blood is changed in character, and the respiratory centres are affected by this impure blood. At the same time, also, that the afferent nerves convey impression from the pneumogastric branch to the kidney and renal plexus of nerves, the branches of the sympathetic nerve connected with the vessels also affect the same nerve-centres. The action of the cardiac ganglia upon the heart is also a more *direct* source of disturbance in these cases. The same remarks apply to those instances of angina pectoris where the coronary vessels are extensively diseased, and also to those in which gouty disease has led to degenerative change without the production of renal disease and albuminuria. These patients complain of distress at the chest, there is breathlessness on exertion, or on going up stairs, it may be with a sense of choking, and with a dry cough; at night, however, especially after the first sleep, the patient awakes in great distress at the heart, with irregular fluttering

movements, palpitation, and inability to get the breath. The paroxysm soon subsides, but it greatly alarms and distresses. Sometimes, when the disease is more severe, the distress at the chest, the pain, or rather the "breast-pang," occurs after very slight exertion. On the most careful physical examination, no abnormal sound may be heard; but there is evidently disturbance of the function of the heart. There is inhibitory action of the nerves of the heart, and the pneumogastric is at fault. The suffering complained of is that of agonising fear of death, unless the heart recovers its power; but, in other cases, it is intense darting pain through the left side in the direction of the heart. To stimulate the heart to increased action, by ether, and by diffusible stimulants, as ammonia, may be of value when they can be resorted to.

It is interesting to find in some of these instances of gouty disease affecting sometimes the heart, and sometimes the kidneys, that the hepatic function is also disturbed and a transient glycosuria is induced; it would seem that other branches of the pneumogastric besides those to the thoracic viscera are involved, and this condition of sugar in the urine, although decided in quantity, may be the more easily overlooked, from the comparatively low specific gravity of the urine. It is well known that in gouty disease, with chronic affection of the kidney, the urine is often of a low specific gravity, and sugar may be present, whilst the urine only attains a density of 1,015 to 1,020, or a little more. This state is important to be recognised, for it has an

essential bearing both upon the progress and the treatment of the disease; and, if it be overlooked, the malady may make rapid and downward progress.

Some have referred the sudden cessation of the heart's action during the administration of chloroform to this inhibitory action of the pneumogastric, and they state that the heart would act more efficiently if this restraining force were removed by the full narcotic action upon the centre of the nerve.*

The pathological states produced by severe apoplectic effusions are of great interest in connection with the pneumogastric. We have already referred to the slow and irregular breathing which is observed when a clot of blood in the fourth ventricle directly interferes with the origin of the nerve, but the effect is also shown upon the heart; the restraining power is removed, it is partially *paralysed*, and the heart beats with increased force. It is, however, in many of these cases, that the vessels are diseased and the left ventricle hypertrophied. A *sense* of exhaustion and *apparent* weakness of the heart's action is often complained of by the patients suffering from cerebral oppression. The weakness is *imaginary* rather than real, and we find that such patients will try sometimes to relieve their state by freely partaking of wine and similar stimulants, which augment rather than palliate their condition. A gentleman who had suffered from exposure on the West

* See an interesting communication on this subject by Dr. Lauder Brunton in the *British Medical Journal*.

Coast of Africa, which had caused sun-stroke, etc., was found taking a glass of champagne every two hours to relieve his "debility;" but the disease was more effectually removed by spare diet and by smart action upon the bowels.

In pericardiac effusion and in inflammatory carditis, the heart's action is diminished in power, and there is exhaustion of the nerve-supply. This is especially connected with the condition of the sympathetic nerve and with the cardiac ganglia; the pneumogastric nerve, is, however, affected, for we find that the respiration is quickened, and the whole of the parts supplied by the pneumogastric sympathise; the voice is feeble, and the digestion is impaired. This is one of the diseases in which it is of great importance, whilst we recognise the local, not to forget the general condition of the patient, to try to lessen the local affection, but to sustain the exhausted functional activity of this, the most important nerve of animal life.

The ganglionic nerve-supply of the stomach and abdomen is in intimate relation with the cardiac plexus. The pneumogastric nerve, although it is especially distributed to the muscular coat of the stomach, is also in the closest connection with both the peritoneal and the mucous layers. In acute diseases of the mucous membrane of the stomach, as in poisoning by arsenic, the heart's action becomes extremely feeble, and the pulse compressible, and the same is true in acute peritonitis; the collapse of the patient is an expression of this intimate relationship. Witness the almost

instantaneous effect of a perforating ulcer producing acute peritonitis: the heart's power at once fails, the patient becomes cold and almost pulseless; the eye sunken and the extremities cold; the cardiac plexus and the pneumogastric of the heart at once sympathise with the solar plexus and the pneumogastric branches of the abdomen—the afferent branches of the latter, in their action on the medullary centre, cause reflex action on both pulmonary and cardiac nerves.

In many other affections of the gastric mucous membrane, this reflex action on the heart is recognised, in ordinary stomach disturbance, as a bilious attack; the nerve-power is weakened by irritation of the mucous membrane, perhaps the sympathetic nerve is exhausted, the vessels dilated, and we thus find a sense of exhaustion produced, with feebleness of the heart's action; too often, when this state is produced by the irritation of alcoholic stimulants, the patient seeks to relieve the symptom by a fresh dose of the stimulant, and thereby increases and perpetuates the disease. The constant repetition of this process of exhaustion and renewed overstimulation leads to the most disastrous results, in causing chronic disease of the stomach and of the liver, with disorder of the nervous system. It is of no avail to attempt to relieve the weakened power of the heart, and exhausted nervous energy, if the patient persist even in moderate potations of alcohol; and, as a rule, it is the better plan at once to cease from all alcoholic stimulant; the stomach and the

heart will then recover in a great degree their former energy and strength.

A sudden blow upon the epigastrium has been known at once to stop the heart's action and to produce instant death, and with almost equal power a shock from cold will stop the action of the heart ; these, also, are instances of reflex action affecting the heart from peripheral disturbance.

We have thus brought before your notice pathological conditions of a very diverse character affecting the branches of the pneumogastric nerve supplied to the thoracic viscera. To mistake those which arise from a central origin, as if from a local cause, is to misunderstand the whole character of the disease ; so, also, if we refer those which are produced by peripheral disturbance to mere irritation in the parts only affected by reflex action, we fail to relieve the symptoms, because the treatment is misdirected, and therefore unavailing.

LECTURE III.

ABDOMINAL BRANCHES.

THE pneumogastric nerve in the abdomen is brought into the closest relationship with the solar plexus and semilunar ganglia of the sympathetic nerve, and it is very difficult to separate the pathological changes incident to the one from those which have their origin in the other. The par vagum reaches not only to the stomach but to the liver, to the duodenum, to the suprarenal capsules, and to the kidney; and it unites with the phrenic nerve as the branches of the latter pass through the diaphragm. Although the pneumogastric is especially distributed to the muscular coats of the stomach, and regulates its movements, still it has sentient branches, and when these are irritated pain is produced; neuralgic pain at the stomach may be due to disturbance of this nerve as well as of the sympathetic nerve. Romberg describes gastrodynia neuralgia as due to hyperæsthesia of the pneumogastric nerve, and neuralgia cæliaca as traceable to hyperæsthesia of the solar plexus. Irritation of the nerve will

not only produce pain and muscular contraction, as hour-glass contraction, but vomiting, and this of several kinds; as well as altered secretion, and sometimes perverted sensation, as craving appetite. When the nerve is weakened or paralysed, another set of symptoms is observed, and we have loss of appetite, anorexia, and distension of the stomach. It will be a convenient method to consider those conditions in which we have increased irritability or spasmodic action, as shown by pain, neuralgia, hour-glass contraction, or vomiting; and, secondly, those in which there is diminished power or paralysis, in which we find anorexia or distension; and each of these may be traced to central, local, or peripheral causes.

Spasmodic vomiting	Central ..	Concussion of brain
		Acute cerebral disease
		Abscess in the brain
		Tumour in the brain
		Tubercle in the brain
		Apoplexy
	Local	Over-anxiety and distress
		Epilepsy
		Persistent irritability of stomach
		Inflammation of mucous membrane
		Ulceration
		Cancerous disease
	Peripheral	Phthisis; tubercle in the lung
		Disease of heart
		Uterine disease
		Ovarian disease
		Chlorosis; hysterical vomiting
		Renal disease; disease of suprarenal capsule
		Hepatic disease
		Intestinal disease
		Peritoneal, etc.

Spasmodic pains, etc.	Central ..	{	Perverted appetite; excessive craving
			Neuralgia
	Local	{	Hour-glass contraction
			Ulceration, etc.
			Organic disease
	Peripheral		Cardiac disease
Paralysis Anorexia Distension	Central ..	{	Distension from exhaustion and nervous shock
			Anorexia
	Local	{	Rapid fermentation, causing distension
			Distension from obstruction
			Distension from peritonitis
	Peripheral	{	„ „ abscess
			„ „ empyema

The *vomiting* produced by cerebral disease is often of the most decided character, and it is of the greatest importance that the nature of the malady should be correctly understood. To treat the stomach while the irritation is at the cerebral extremity of the nerve, is often the greatest injury to the patient. The bilious attacks of early life are very frequently to be traced to cerebral disease, and are too often overlooked till the true character of the disease is unmistakably indicated. It is not, however, every form of acute disease of the brain which induces this irritation of the pneumogastric nerve, but especially those cases where the base of the brain or the floor of the fourth ventricle is implicated. In an instance of acute meningeal inflammation in a muscular young man in Guy's Hospital, the stomach was so exquisitely sensitive that if water, milk, or any fluid were swallowed, it was at once ejected with such violence that it was projected beyond the foot of the bed. After death there was found a collection of pus in the meninges of the brain,

directly pressing upon the pneumogastric nerve at its exit from the brain-substance at the medulla.

In *tumours* of the brain, especially at the cerebellum, the vomiting is often of the most marked character; it comes on independently of food, the tongue may be clean, and the bowels in a normal condition, but still food is rejected at irregular intervals, and especially in the morning; sometimes several days may elapse between the periods of vomiting. At times this is the prominent symptom of commencing disease of the brain, but in other cases vomiting is associated with severe pain, and with affection of other nerves, as the optic and olfactory; with giddiness and intolerance of sound, or with epileptiform convulsion. I have narrated a deeply interesting case of this kind in the *Guy's Hospital Reports of 1874*, and, in the last clinical session under my care, a child, about twelve years of age, was admitted quite amaurotic with one eye, and with the other she could only distinguish day from night. The symptoms had come on a month previously, with severe vomiting and pain in the head; the pupils were widely dilated, but there were no febrile symptoms. The condition appeared to indicate organic disease of the brain, such as tumour, and the prognosis was a very unfavourable one; but, under the steady use of perchloride of mercury with iodide of potassium, the symptoms entirely disappeared. The vomiting had ceased previously, but the amaurosis gradually lessened, at first in one eye, then in the other; and she was seen to be amusing herself, then nursing a

doll, and soon afterwards an infant patient in the ward.

It is scarcely needful to refer to the vomiting, which is one of the earliest, although most insidious, symptoms of *tuberculosis* of the brain and its meninges in early life. It is often ascribed to a bilious attack, till severe convulsion comes on, or the child has severe pain in the head, or is noticed to become listless and indifferent to its ordinary amusements; as effusion takes place, and coma comes on, this irritable condition of the stomach ceases, but it is often reproduced if the recumbent position of the patient be changed. The pupils, at first small and irregular, become dilated and insensible; the abdomen is often contracted; the respiration is also irregular and sighing, and the skin sensitive to cold. The capillaries, losing their tonicity, easily yield to sudden pressure or blow, and again become overcharged—the *tache cérébrale*. This irritable condition of the stomach, however, does not always exist in tuberculosis, for many instances of tuberculosis occur in adults where vomiting is absent. These cases closely resemble enteric or typhus fever, and are only recognised by close observation of the temperature and general symptoms.

The same action upon the pneumogastric is observed in *direct injury* to the brain, as in severe concussion, and it is a noticeable symptom in ingravescent apoplexy; a minute vessel gives way in the brain, and the first effects are those of sudden disturbance, as in concussion, severe pain in the head, faintness and pallor,

with vomiting ; then, as reaction follows, further effusion of blood takes place, and the worst symptoms of apoplectic effusion into the brain are produced. It is the greatest mistake, and often very disastrous, to treat this faintness with ardent spirits ; to stimulate the action of the heart increases the subsequent effusion ; and that which might be only a partial injury of brain-tissue is thus rendered destructive of most important organs. The apoplectic clot breaks through into the lateral ventricle, and, reaching to the fourth ventricle, exerts direct pressure upon the origin of the respiratory and other nerves.

Disturbance of the cerebral centre of the pneumogastric may be produced by *over-anxiety of mind and distress*. A junior partner in a large commercial house had vomiting every morning ; he had no pain at the stomach, the tongue was clean, the bowels regular or relaxed, the pulse compressible ; there were no intemperate habits or dissipation to induce this morning sickness ; the meal was taken, but in a very short space of time rejected. It was evident that the irritability of the stomach was not due to disease of that organ ; and, on making inquiry, it was found that the patient had had a fall from his horse some time previously, and the fear was entertained that organic disease of the brain had commenced. Mercantile collapse came at length, the heavy clouds of disaster broke, and when a more healthy state of money affairs was obtained, then the cerebral disquietude also ceased.

Again, we find the same irritation of the stomach

produced by *epilepsy* and commencing *insanity*. The epileptic paroxysm may entirely cease, but may be replaced by attacks of nausea and vomiting, with epileptic vertigo. It is difficult to define the precise condition of brain in these cases. The cerebral disturbance, whether anæmia or other atonic change, is sufficient to produce, not a loss of consciousness, but a transient affection of the pneumogastric nerve; in the same manner, some epileptics will describe a sensation passing over them without loss of consciousness, sometimes affecting sight, sometimes the hearing, or general sensation; in these cases, it is at the cerebral origin of the pneumogastric that the gastric disorder originates.

These symptoms are sometimes very peculiar, and the following may be taken as an example. A gentleman, aged forty-nine, whose father was epileptic, was brought to me by his medical attendant. The patient was nervous and dyspeptic, and troubled with flatulence; he had a choking sensation as if he could not swallow, and became very uneasy. The heart's action was occasionally irregular; the pulse was compressible and irritable, but there was no evidence of any organic disease; the tongue was pale and flabby, and he complained of pain at the back of the head; the countenance was not expressive of distress, but the patient said the pain was intense. It was evident that the branches of the pneumogastric were especially affected, and that the malady was connected with disorder of the nervous system, and did not arise from organic mischief. It was not one, but several branches of the nerve that were

involved ; and sometimes one, sometimes another, was affected.

In another, a gentleman aged forty-two, whose brother died of phthisis, had attacks of intense nausea, which came on every two or three months during seven years ; the attacks, he said, amounted to " agony." He had a distressed countenance, and a sense of fulness of the head ; the appetite was poor, and the bowels confined ; there was aching, or rather increased sensitiveness, in the spine ; the abdomen was relaxed, and nothing abnormal could be felt. The recti sometimes became rigid ; the urine was of specific gravity 1,020, and was free from albumen and from sugar. This patient was relieved by the injection of morphia, but more effectually by strengthening the nervous system. Sometimes nervous twitchings came on in these patients, as if a slight epileptiform convulsion ; in others, the excessive irritability of the stomach is followed by melancholia.

Closely connected with these instances are others of *persistent irritation* of the mucous membrane of the stomach ; the vomiting is constant, and continues every day year after year, till the patient is emaciated to the last degree. These cases are different from the irritable stomach which is found in hysteria, in chlorosis, and in uterine disease—the hysterical stomach, as it has been called ; to these we shall have to refer presently. At first, there may have been some local or peripheral disturbance, some dysmenorrhœa, or affection of that kind, to originate the disease, but that soon subsides, and leaves a condition of great nervous exhaustion ;

still the symptoms may be worse during menstruation, because the weakness is greater. The food is rejected from the stomach almost at once, it may be without pain; but, in many instances, there is soreness at the scrobiculus cordis; there is no hæmorrhage, or only of the slightest kind; mucus is rejected, and patients often refer to this as the cause of the disease. The tongue is clean, or nearly so; the bowels are inactive; neuralgic headache is also complained of. In many cases these patients are said to have organic disease of the stomach, ulceration, or even malignant disease; the reduction of strength may be extreme; and ordinary remedies fail to lessen the irritation. It will generally be found that those remedies are most effective which lessen nerve-exhaustion; and few are better than very small doses of ammonio-citrate of iron, alone or given in a state of effervescence; sometimes nux vomica does good, and even arsenical compounds may be used with advantage, and we may remark *en passant* that it is of great importance to give some kind of vegetable food. Mistakes are often made in the entire abstinence from vegetables for lengthened periods; the system becomes weakened thereby, and I have seen severe scurvy produced.

It would occupy too much time to enter into the general symptoms of *diseases of the stomach*, but we may remark that vomiting is a common symptom of inflammation of this organ, both when the disease is acute and when less severe in character, but that although the vomiting may be exceedingly severe, there

may be no pain as long as the mucous membrane only is affected. Even in acute poisoning, as by arsenic, pain may be absent at the stomach, except the soreness from continual vomiting; and in the gastritis from chronic poisoning by alcohol, excessive irritability is a constant symptom, with craving for cold drinks, but only slight tenderness of the stomach itself. It is in ulceration of the stomach that pain is such a common symptom, and it is associated with the vomiting of food; pain comes on, both at the scrobiculus cordis and through to the back, soon after the food reaches the stomach, and is only relieved by the passage of food into the pylorus, or by vomiting. These patients will often produce sickness by putting the finger into the throat, in order to spare themselves the pain of digestion. In one instance, in which the patient with chronic ulcer of the stomach gradually sank from exhaustion, I found a large branch of pneumogastric nerve passing across the floor of the ulcer: we have previously referred to this in speaking of the physiology of the nerve. In cancerous diseases, also, vomiting and pain are common symptoms; but the former may be entirely absent if the œsophageal and pyloric orifices be free from obstruction.

In reference to those instances which are more strictly reflex in character and produced by disturbance of *peripheral nerves*, there are some most interesting illustrations in ordinary practice. The irritation of the *pulmonary* branches of the pneumogastric is a common cause of disturbance of the stomach, and constant

vomiting is often produced. It is true that, in the early stages of phthisis, there are often dyspeptic symptoms, a dislike of fatty food, and an impairment of digestion ; tenderness at the scrobiculus cordis, furred or patchy condition of the tongue, and irregular action of the bowels ; but these symptoms are less decided than the vomiting to which we refer. The irritation of the stomach is then the prominent symptom ; all food is rejected, the tongue may be furred, and, unless the chest be examined with care, the true nature of the malady is overlooked. The state of the stomach may lead to a cough, but the " stomach-cough " of early phthisis is a most treacherous symptom, and equally so the vomiting to which we refer. It will often be found that when the disease in the chest, the tubercular deposit, and pneumonic and degenerative changes have advanced, the vomiting suddenly ceases, but only to reveal disease of the lung, which has made insidious progress during the time when treatment of the thoracic disease might have been most efficacious. This subsidence of the gastric symptoms often takes place on the occurrence of acute pneumonia or of acute pleurisy. The chest should be carefully examined, and the thermometric temperature recorded in these instances ; and, if we can quiet the disturbance of the pulmonary branches of the pneumogastric, the gastric mischief will cease.

In disease of the *heart* of an organic kind, with obstruction, the stomach is affected by the mechanical

hindrance to the blood; the right side of the heart being engorged, the liver is also distended, and with it the branches of the portal system of veins. In this way the coronary veins of the stomach are filled; there is profuse secretion of mucus, gastric catarrh with its attendant symptoms of flatulence, pain, distress, and sometimes hæmorrhagic erosion. We do not refer to this condition, troublesome as it is, but to one of still more serious import, namely, severe vomiting; we have this occurring in mitral stenosis, as well as in dilatation of the heart. It would seem that the cardiac nerves of the pneumogastric and sympathetic induce this reflex action upon the gastric nerves—perhaps the connection of the pneumogastric with the phrenic on the large hepatic vein may be the source of this connection. The vomiting thus coming on at the later stage is often the precursor of a fatal termination.

The vomiting which is produced by *uterine disease* and by pregnancy is too well known to need even mention, but that which is a symptom of early *ovarian disease* is often overlooked. There may be no pain in the region of the ovary, no enlargement there, and the gastric symptoms may be so decided as to mislead experienced practitioners. I was called to see a lady in consultation who had vomiting a few hours after food; the vomiting was not constant, but irregular; still the emaciation was decided and progressive, the abdomen was not distended, it was free from pain, and the pylorus could be felt. This led to the opinion of organic disease at that part; the irregularity of the

vomiting, however, induced me to believe that this might not be the case, and I could not consent to the decided opinion of malignant disease being present. This lady was about fifty-five years of age, and menstruation had ceased for several years. She went into the country, and, whilst there, all the gastric symptoms ceased, but the abdomen began to swell; she returned to town with evident symptoms of ovarian dropsy. The fluid was drawn off by paracentesis abdominis, and afterwards a large ovarian cyst was successfully removed. Very similar are those cases of gastric trouble in young married people, where conception has not taken place, but where there is reflex action and sympathetic disturbance from ovarian and uterine irritation of the pneumogastric nerve. These instances are often misunderstood, because menstruation continues regularly, and it may be, without pain. The gastric branches in this way become exceedingly irritable, and vomiting is a troublesome and harassing symptom; sometimes it is almost constant, at other times only on slight nervous excitement or over-fatigue; the excitement of going into company, or of mixing in society, may be quite sufficient to bring on severe vomiting. Of the same kind is the troublesome vomiting present in young people, with scanty or disordered menstruation and chlorosis. The food is rejected at once, almost as soon as it reaches the stomach, but without much distress; there may be scarcely any pain, and some of these patients appear to be plump and well

nourished. This condition has been aptly called the "hysterical stomach," and certainly the condition is one of functional irritability. Some food is retained, for the body is not wasted; the bowels are generally confined; the pulse irritable; the abdomen often fairly distended; with this state there are other indications of nervous excitement. The determination of the patient may do an immense deal to restrain this condition, and in a young hospital patient the cure was effected by the nurse refusing to bring anything into which she could vomit. The occupation of the mind, fresh air, chalybeate tonics, free action on the bowels by aloetic and assafoetida purgatives often relieve this state. The steel may be given with advantage in a state of effervescence; in other instances, however, it is necessary to allow the stomach to rest entirely, and to feed the patient by nutrient injections. If the uterine and ovarian functions be disordered, these must, if possible, be rectified; and in the instances of married women, to which we have referred, it is often of great value to lessen pelvic irritation by opiate suppositories. It is of little use to treat one symptom while the cause of disturbance remains.

There are many other causes of *peripheral* disturbance of the pneumogastric nerve in the abdomen which we can only mention. Thus, in consequence of its connection with the duodenum, and with the liver and gall-bladder, we find vomiting a common symptom of many diseases of these organs. The same may be said of the kidney; a branch of the pneumogastric

may be traced to the renal plexus, and the sympathy of the kidney with the stomach is due to this nervous connection as much as to the disordered secretion and altered blood. This alteration of the blood and gastric juice does not account for the vomiting and gastric disturbance which we have in calculus and some other renal affections. The function of the suprarenal capsules is still unknown, but the symptoms of a disease of this structure were well brought out in the learned lectures delivered by Dr. Greenhow last year. It is interesting to note the very large supply of nerves distributed to this organ, and the connection of the pneumogastric with it, as explanatory of the violent vomiting, which is a prominent symptom of disease of the suprarenal capsule.

The vomiting in *peritonitis* is *reflex* in character, so also in those instances in which mechanical obstruction produces similar symptoms; but on these we need not dwell.

We pass on to consider *pain* and perverted sensation connected with the stomach as expressive of pathological change in the pneumogastric nerve. These changes may be traced to central disturbance, or to local or peripheral mischief. It is well known that in some conditions of mania patients swallow the strangest substances; but, without any disturbance of the mind, we may find the appetite perverted; sometimes an excessive craving is produced, with gnawing pain at the stomach; the appetite is not satisfied, but the pain is relieved by food. These instances occur without any alteration in the

urine and without the presence of any sugar. These patients are often spare and cachectic, nervous and irritable, and the disease is one of disordered nerve-function. So also is the intense neuralgic pain which sometimes comes on at the stomach quite unconnected with organic disease, but often due to disturbance of the uterine function, as we have mentioned in connection with vomiting. The pain is often very severe, and in young and weakened subjects the pain may be intense; but if the attention of the patient be completely absorbed, the pain is forgotten; it comes on at irregular intervals, with or without vomiting, and not necessarily in connection with food; there may be great demonstration of pain when the hand is placed on the abdomen; but, by careful manipulation, it is found that the pain is not deeply seated; there is no real tenderness, the bowels are generally confined, flatulence is often present, and menstruation is disturbed.

We believe that we justly refer these cases to the state of the pneumogastric on account of the alternating manner in which other branches of the nerve become affected, although there can be no doubt that the whole nervous system is disordered. The diagnosis of these cases is sometimes extremely difficult; the fear is of ulceration of the stomach; but, by careful examination, it is found that there is an irregularity of the symptoms which we do not find in organic disease, the pain is not especially after food, and the symptoms are increased by the sympathising attention of friends; vomiting can be controlled, and the pain disappears if the

attention be thoroughly absorbed. Steel medicine is often of service, given in one of the milder forms or in effervescence; bromide of potassium, valerianate of zinc, and assafoetida, are beneficial; and also bismuth with alkalies. Sometimes the pain is so severe that the hypodermic injection of morphia is of great value. It is very desirable that these patients should not be allowed to remain in bed and to brood over their malady. Fresh air, and even horse-exercise, greatly promote restoration to health. A young lady, aged sixteen, tall and thin, and of delicate constitution, had suffered from neuralgia in the face, but otherwise had enjoyed good health. About the beginning of May she took cold, and soon afterwards was seized with severe pain in the region of the stomach towards the right side, about the pyloric region, and at the scrobiculus cordis. She was free from headache and from cough, and there was no evidence of any disease about the lungs or the heart; there was no vomiting till the later period of the complaint, and no evidence of gastric hæmorrhage either in the matter vomited or in the motions. There was no disease of the spine; the abdomen was contracted; and, although she complained of pain on superficial pressure at the scrobiculus cordis, there was no consciousness of pain when the attention was absorbed. The pain came on in severe paroxysms, and it was accompanied with great demonstration of suffering, but was not aggravated by food; the tongue was white, the bowels were confined, the motions were pale and clayey, menstruation was scanty. The urine

was of specific gravity 1,020, and for a few days contained a trace of albumen; this, however, soon ceased; and there was no irritability of the bladder nor pain in the loins, no blood in the urine, no symptom of renal calculus nor of renal disease. The pulse was rapid, sometimes 140 to 150 per minute. The temperature varied from 98.4° to 100° . The bowels were very confined, and required strong aperients to act upon them. This state was continued for several weeks, and was unrelieved by bismuth, bromide of potassium, steel, etc.; every medicine appeared to aggravate the pain. The hypodermic injection of morphia by Mr. C. Hunter offered great relief, and certainly promoted recovery. Still, the symptoms persisted week after week; irritability of the stomach came on, but it was observed that, by a strong effort of the will, the patient could both take food and retain it. She was not allowed to remain in bed, but was dressed and taken out in a carriage; every effort was made to prevent her mind from dwelling upon her own weak state of health and upon her pain; she was then allowed to take horse exercise, and the pain soon afterwards entirely ceased.

The diagnosis of this case was at first obscure; the presence of albuminous urine suggested the idea that she had renal calculus, but there was no evidence of persistent renal irritation, and the trace of albumen soon subsided; although menstruation was scanty, there was no proof of any ovarian disease; again, the fear of gastric ulcer was present to our minds,

but the pain was irregular in its onset ; it was not increased by food, and for many days there was no vomiting, and sometimes the symptoms entirely ceased. Neither was there anything to indicate spinal disease, for the fresh air in carriage and horse exercise relieved the suffering. It was evident that, as the general strength failed, the nervous system became more irritable, and the pain increased. The disease was due to the state of the nervous supply of the stomach, and it is probable that spasmodic contraction of the muscular coats took place. The vaso-motor nerve of the abdomen was affected, but it was manifest that the pneumogastric was especially implicated. The case was different from what has been described as hysterical stomach, in which food is quickly rejected, but it was a severe case of functional gastralgia. If the patient had been allowed to brood over her suffering, and to abstain from nourishment, the disease would have persisted, or might have terminated fatally. This spasmodic pain is, however, not confined to young and delicate women ; it is found in men of mature age, and in some instances leads to a fatal result. The pain is severe and paroxysmal, and somewhat resembles that of gall-stone. In a gentleman between sixty and seventy years of age, this form of gastric affection terminated fatally ; but, after death, no organic disease of the stomach, pylorus, liver, or gall-bladder could be detected. The symptoms suggest also the idea of aneurism, disease of the spine, etc. Hour-glass contraction of the stomach has sometimes been found in these cases without any evidence

of ulceration. Again, severe neuralgic pain at the stomach comes on in organic disease of the heart, quite independently of mere flatulence or congestion of the mucous membrane. The continuance of these attacks of pain, and their recurrence almost at the same period of the day, indicate that they do not arise from thrombosis, and they come on unconnected with food.

We have especially spoken of those cases in which there is spasmodic or other irritation of the par vagum producing pain or vomiting, but have now to turn to that condition in which there is *diminished power*, and in which we find (1) *anorexia* and (2) *dilatation of the stomach*; here, also, we have states which may be due to central disturbance, or be caused by local or by peripheral mischief.

The mere loss of appetite may be a symptom of febrile excitement, or it may be due to varied causes; but in the cases to which we refer, and which have been graphically described by Sir William Gull as "*anorexia nervosa*," the appetite fails, food is not taken, and the body wastes to an extreme degree, the countenance has a distressed appearance, the eyes are sunken, the cheeks hollow, and the whole system is impoverished: the body has fed upon itself, and all superfluous fat has become absorbed. This condition may be entirely due to the state of the brain, and the disease has been correctly described as one affecting the will. Some of these instances are cases of religious melancholia. One admitted under my care into Guy's Hospital appeared like a case of enteric

fever, in the dry and brown tongue and in the expression of the countenance; there was, however, no febrile disturbance, and the symptoms had extended over several years; the young patient completely recovered when made to swallow milk and other food. In another case of extreme emaciation in a man, aged fifty, also admitted into Guy's, the patient had symptoms which had been attributed to organic disease of the œsophagus; he stated that he was unable to swallow, but it was soon found that the disease was in the will; he would not make the attempt, and when fed by the stomach-pump he soon recovered. Some months after leaving the hospital, his mind completely broke down, and symptoms of mania were developed. These cases are frequently found in asylums for the treatment of mental disease, and may necessitate the introduction of food for months, and even for years, by means of the stomach-pump or nasal tube.

There is, however, another class of cases in which the *anorexia comes on after gastralgia*; the patients, often young women, state that food produces severe pain, and gradually less and less of it is taken; the strength necessarily fails, and the digestion, as a consequence, becomes also more feeble, and in proportion as the strength fails the nervous susceptibility increases. Some of these patients become completely blanched, thin, and weak, and for months may have taken very little more than bread and water. Many of them rapidly recover, partly from the use of chalybeate medicines, but still more when they can be induced to

persevere with food, although pain is produced; the patient is more willing to make the effort when assured that the suffering is temporary, and that it will subside as strength is regained. As regards the diet, although we are often told that milk disagrees, it is well to use it in one or other form; it is important also to vary the dietary, and to give vegetable or fruit; and in most cases of this kind good draught ale or porter is much to be preferred as a stimulant, when that is necessary, to any form of ardent spirit or wine.

Another condition, due to a weakened state of the pneumogastric nerve, is *dilatation* or *distension* of the stomach. In a healthy state the stomach contracts upon its contents, and by its vermicular action facilitates the movements and churning of those contents, by which their thorough mixture with the gastric juice is promoted, their solution accomplished, and the resulting fluid propelled onwards through the pyloric valve. The pneumogastric nerve regulates these movements, and when it is paralysed these movements are more feeble, and distension readily takes place. Great distension, occurs, however, from several causes; it may arise from an exhausted state of the nervous supply, both of the pneumogastric, as mentioned by Traube, and also of the vaso-motor nerve. In these instances no peristalsis of the stomach is observed, for the muscle is weakened; this form of distension may be due to long fasting, or to hysteria, or to nervous shock. The distension produces distress and breathlessness, from pressure upon the diaphragm, sometimes severe pain

at the stomach and through to the spine, or across the upper part of the chest. It would seem that long continued vomiting may induce this form of nervous exhaustion; and it has been recognised in diseases of the brain and spinal cord, in typhus, in cholera, and in puerperal fever; again, the fulness of the stomach sometimes occurs in phthisis, and the flaccid condition in which the stomach is found after death, may be due to this gradual exhaustion of the pneumogastric nerve.

In reference to the forms of distension due to local change in the stomach itself, we have those which are consequent on obstruction at the pylorus, and those in which sudden formation of gas and enormous distension render the muscular coats powerless to contract, and so cause paralysis. We have just referred to paralysis causing distension; but in these cases the distension causes the paralysis. It is at the pylorus that the muscular fibre, especially the circular coat, has its fullest development. When there is any obstruction at this part, particularly if it be gradual at its origin, the muscular coat becomes proportionately increased; and, when the muscular contraction is unable to overcome the hindrance then dilatation takes place, and gradually attains an enormous size. Bamberger quotes a case in which ninety pounds of fluid filled the stomach. As the muscular coat endeavours to overcome obstruction, peristaltic movement may be observed through the abdominal wall; a small quantity of food or of water

taken into the stomach may suffice to produce this contraction.

But the sudden formation of gas from fermentation or other cause may lead to enormous distension. The dilatation is then so great that the very distension is the cause of the paralysis, as just mentioned. Attention was drawn to this condition of distension by Sir William Gull many years ago, in a case under his care, in which the stomach filled the abdomen, and thus led to a fatal result. It has also been well described by my colleague Dr. Hilton Fagge, in a communication to the *Guy's Hospital Reports* of 1872. The form of abdomen is peculiar in this kind of distension; it is full in the left hypochondrium, but hollow in the epigastric space, the curve of the upper portion of the stomach being dragged obliquely downwards, and the pylorus being situated low down on the right side or near the pubes; whilst the greater curvature of the stomach describes an arc from the left hypochondrium following the curve of the abdomen. The distension may resemble an urinary bladder, or hydatid cyst, or distended colon. It is partially resonant; but, on percussion, a splashing sound may be produced from the admixture of air and fluid.

This state may come on suddenly, or it may be very gradual; in a lady under my care the symptoms have extended over eighteen months; and sometimes great relief is afforded by removing the contents of the stomach, and thereby allowing the distended viscus to contract.

In other cases it would appear that branches of the sympathetic nerve, by their connection with the pneumogastric and by reflex action, lead to this weakened condition of the muscular fibre of the stomach; thus we find it in peritonitis, and in a remarkable case recorded by Dr. Fagge, it was due to abscess behind the ascending colon opening into the duodenum. In other cases empyema has been the apparent cause of the exhaustion and distension. However induced the condition is one which indicates weakness of the pneumogastric nerve, and of the muscular coat of the stomach to which it is supplied.

The function of the *liver* is a complex one; it has to do not only with the secretion of bile, but it is intimately associated with the maintenance of the healthy blood condition, and it possesses a glycogenic function as described by Claude Bernard, and still further developed by the experiments of my colleague Dr. Pavy. It is not our intention to dwell upon these subjects; but the action of the pneumogastric upon the liver is of the greatest interest; branches of this nerve may be traced in unison with the vaso-motor to the fissure of the liver, and into its substance; and it is also closely connected with the phrenic in the ganglion upon the vena cava. The glycogenic function of the liver, as well as the secretion of bile, may be greatly affected by the condition of its nervous supply, and it is well known that puncture of the root of the nerve at the floor of the fourth ventricle produces a saccharine condition of the urine, so also division of the sympa-

thetic nerve in the neck; this change in the urine may be referred to the altered blood-supply in the pneumogastric, affecting the lungs and the heart; but this hypothesis does not satisfactorily explain the symptoms, and the nerve appears to have a more direct action upon the secreting structure of the liver than can be explained in this way, for there are many and decided changes in the state of the circulation of the liver connected with heart disease which do not produce glycosuria. We find many instances of transient glycosuria from functional disease of the liver, especially where the nervous system is implicated; and the instances of almost sudden jaundice being produced by severe nervous shock are notorious, and have often been recorded. In one of my hospital patients, a poor washerwoman, jaundice was at once produced when she found that the clothes she was engaged to wash had taken fire whilst hanging up to dry; and, again, it is well known that acute yellow atrophy of the liver is often connected with great mental depression. In these instances, the influence of the pneumogastric nerve is inseparably associated with that of the great nerve of organic life, the vaso-motor or sympathetic.

The connection of the pneumogastric nerve with the hepatic function is shown in the gastric symptoms which are produced by many morbid changes in the liver and bile ducts; the stomach is irritated, and vomiting is one of the common indications of hepatic disturbance. It is true that the same exciting cause of

the disease of the liver may also act upon the mucous membrane of the stomach, but this cannot be said of those instances in which the passage of a gall stone produces excessive vomiting.

Again, the pneumogastric nerve not only supplies the stomach, and sends nervous filaments to the liver, but branches may also be traced to the first portion of the duodenum. It is this portion which is in the closest functional relationship with the stomach, and also with the liver. Irritation in this part of the intestinal tract from the pylorus to the opening of the bile ducts may, we believe, be the cause of spasmodic contraction of the bile ducts, and cause, not only vomiting but also jaundice. These symptoms are sometimes mistaken for acute yellow atrophy of the liver.

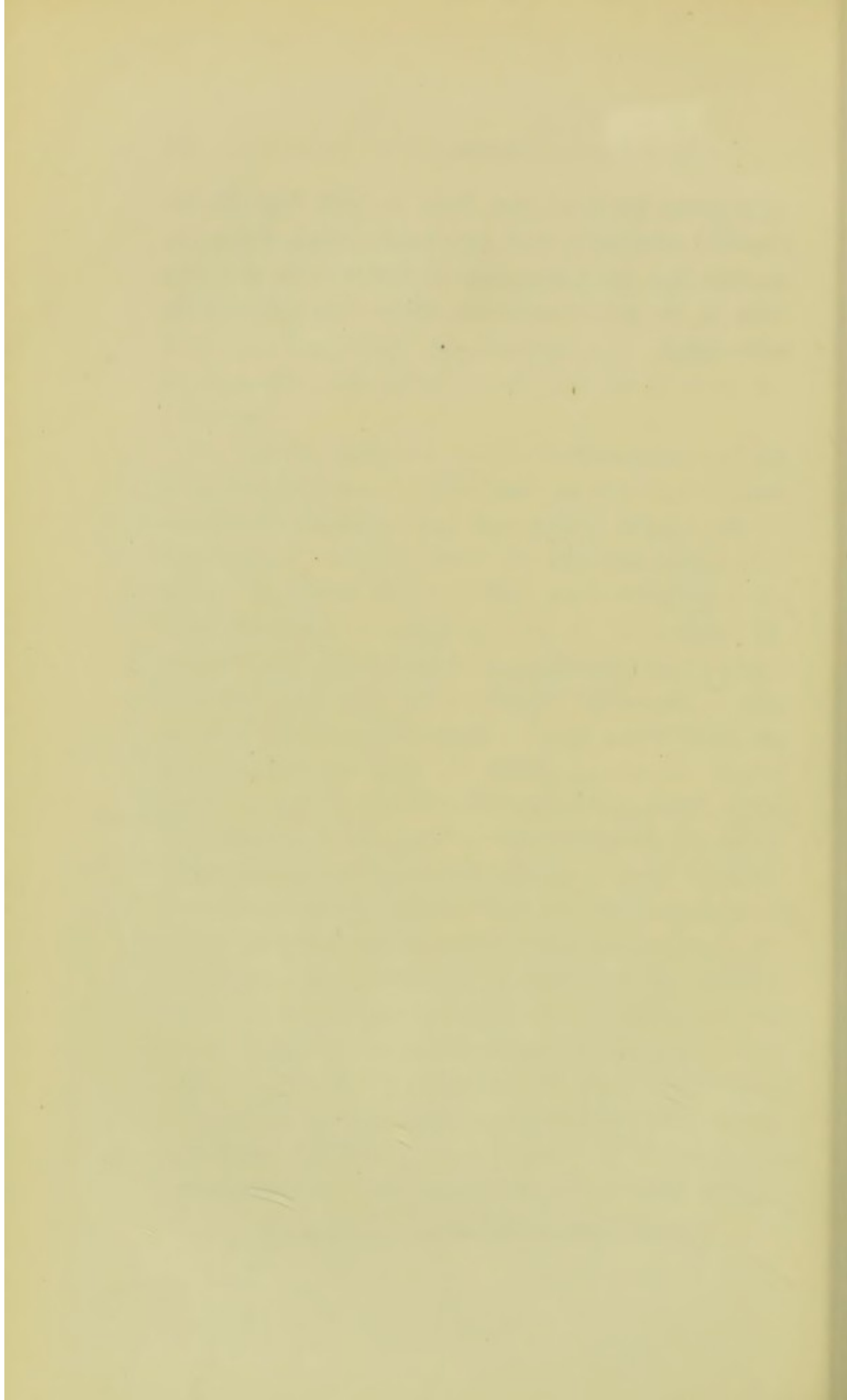
It is doubtful how far the pneumogastric is concerned in the production of the cardiac symptoms that are due to indigestion and to hepatic disease; in an ordinary "bilious attack" the irritation of the stomach is followed by faintness and by sallowness, by bilious vomiting, and general distress. It may be that the vaso-motor nerve becomes exhausted from prolonged irritation, and that this is followed by sympathy with the cardiac branches, but the pneumogastric is also implicated.

The pancreas is also supplied by the same nerve; and we doubt not that the regulation of its functional activity is influenced by this nerve, as well as by the

vaso-motor. We are not acquainted, however, with any direct action upon the pancreas from experiments made upon the pneumogastric; nor, in examinations after death, where the nerve has been implicated, have we been able to discover any change that demonstrates the influence of this nerve upon the pancreas.

To describe fully the pathological conditions of the pneumogastric nerve would lead us into each branch of clinical medicine, and into nearly every organ of the body, if we considered its wide-spread ramifications. As succinctly as possible we have reviewed its more important connections, and, as we noticed the several structures immediately controlled by it, we have seen that each one may be directly influenced by mischief at the cerebral centre. Those parts which are most remote are often the first to express the central disease; it may be, that the restraining power being less effective in the more remote structures, the irritability consequent on morbid change is more manifest. In ordinary hemiplegia, we find the extreme muscles of the limb the last to recover their power; so in the pathological symptoms due to disease at the cerebral centre of the pneumogastric, the branches to the stomach and to the abdominal viscera are often especially disturbed. Equally do we find that disease affecting one group of nerves may manifest reflex action upon those supplied to other organs. That restraining power which in health controls the functional activity

of separate parts of the body is best seen in its beautiful adaptation and beneficent design, when we contrast the quiet harmony of health with the disorder in the whole economy when that restraint is taken away.



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