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# ESSAYS

CHIEFLY ON

# THE THEORY OF PAROXYSMAL DISEASES

OF

# THE NERVOUS SYSTEM;

BY

## MARSHALL HALL, M.D. F.R.S.

FELLOW OF THE ROYAL COLLEGE OF PHYSICIANS;
FOREIGN ASSOCIATE OF THE ACADÉMIE ROYALE DE MÉDECINE OF PARIS;
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# CONTENTS.

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## I.

ON THE THEORY OF THE THREATENINGS OF APOPLEXY AND PARALYSIS.

## II.

ON THE THEORY OF PAROXYSMAL INSANITY, AND ITS TREATMENT.

## III.

ON THE TYPES OF DISEASES PRESENTED BY EXPERIMENTS.

## IV.

ON THE EFFECTS OF STRYCHNINE, WITH DEDUCTIONS.

## V.

ON THE THEORY OF DISEASES OF THE NERVES, AND ESPECIALLY OF THE FACIAL.

## VI.

ON THE NECESSITY FOR ALTERNATION IN THE EXCITANTS OF THE SPINAL SYSTEM.

# ESSAY I.

## ON THE

## THEORY OF THE THREATENINGS OF APOPLEXY

## AND PARALYSIS.

———

I PROPOSE, in the present paper, to treat of the theory, prevention, and treatment of paroxysmal apoplexy, or of that form of apoplexy, with its too usual sequel, paralysis, which, arising from causes *distinct,* in the first instance, from *disease* within the head, appears in the form of *threatenings*—the " minæ apoplexiæ " of the classic Heberden. A larger view of apoplexy will be taken at some future period. My present object, though a restricted one, is one of the greatest interest, inasmuch as it is most under the physician's guidance and control.

I have treated, in former numbers of the Lancet[*], and in the first and second of these Essays, of the *convulsive* seizures of infants and adults; it remained for me to show that apoplexy, and mania, and syncope, are also liable to assume a *paroxysmal* form ; and this I purpose to attempt, on the present occasion, in regard to the first of these. Something of this kind I have already described under the title of *cerebral* epilepsy. In the present paper I propose to discuss the subject more fully, and especially to treat of that form of paroxysmal apoplexy, which, if not immediately checked, will speedily issue in the organic, apoplectic and hemiplegic seizure.

No subject in the circle of our medical studies presents an aspect more formidable. The power of the limbs, the intellect, life itself, are equally at stake ; and the texture is

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[*] The Lancet, for 1848, vol. ii, p. 92.

almost as slight as the spider's web, which separates *congestion* from *laceration*, curable from incurable apoplexy. The arterial and the venous textures have ceased, and what remains is that *system of "intermediate"** blood-channels*, which, I believe, I first presented to the consideration of the profession and of physiologists, in a communication ignorantly rejected at the Royal Society, at the instigation and under the direction of a mere biblio-physiologist, to be replaced by official error. Yet in these *methæmatous* channels, these channels for the irrigation of the blood (in the lungs) and, through its means, of the tissues (in the other parts of the body), in the *pneumonic* and *systemic* arrangements, are effected *the* objects of the entire circulation.

But to return to the " minæ apoplexiæ." A patient in apparent health—one of whom Celsus not less beautifully than truly observes, " Si plenior aliquis, et speciosior, et coloratior factus est, suspecta habere bona sua debet,"† is seized with vertigo, confusion of ideas, loss of recollection, perhaps of consciousness, with a tumid, purple flush, and the bystanders instinctively hasten, in alarm, to remove or loosen his cravat. As Heberden observes: " Invadente apoplexia aut paralysi, continuò laxare oportet omnes istas vestium partes, quæ collum cingunt ; id enim nonnunquam his morbis advenientibus adeo tumet, ut ab arctiore quovis vinculo strangulationis periculum instaret."‡ The *paroxysm* is of various intensity—it passes off and is forgotten ; it recurs—recurs again ; at length it remains permament, places the patient's life in jeopardy, or leaves him a cripple !

What is the *theory* of this paroxysm? In what does it consist? Is it a tendency of blood *to* the head and neck? or an impeded flow of blood *from* that region of the body? Is it augmented arterial impulse, interrupted venous return, or both? and in what degree respectively?

What are the *causes* of this paroxysm, and what their mode of operation? Is emotion a principal cause, and does it act *directly* on the spinal system, inducing abnormal muscular actions in the neck, impeding the return of blood along the

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* See Voigt, Berres, &c.
† Lib. ii. cap. i. sect. i.
‡ Cap lxix. De Paralysi et Apoplexia.

jugular and vertebral veins? Or, do a certain class of irrita-tions act in a *reflex* manner on the same muscles, and through their influence on the same vessels? Are the tissues of the head abnormally and pathologically in the condition of the erectile tissues, without the physiological structural defences of the latter? And if such be the *theory*, what are the proper and effectual remedial measures? and what promptitude in the administration of them is equal to the emergency?—that is, what ought the bystanders to do before the physician can arrive, and what is it our own office to accomplish? We have but to recal the painful case of Mr. Lockley, journeying on the railroad with the late Sir Henry Halford, and suddenly involved in an apoplectic paroxysm, to realize the difficult, responsible, and, indeed, overwhelming circumstances of such a case. In such circumstances precisely, what could have been *instantly* done to save the patient?

*All* this can readily be understood when viewed by the light shed upon the subject by the discovery of THE SPINAL SYSTEM,—a discovery, of the influence of which on medical science and art, however great already*, we have still but a glimpse, yet rejected in its turn by the Royal Society;—a proceeding to which its Fellows and the Profession have hitherto most ignobly submitted!

### § 1. *The Tissues of the Head and Neck Erectile*

The whole region of the head and neck, with the ence-phalon, and the several organs of mind, of sense, and of motion, is doubtless made up of tissues which may be compared to the erectile.

The eye becomes erect when we *look* earnestly and in-tently. If we attempt to read whilst walking and meeting the wind, it speedily becomes suffused with tears; no such effect being observed when, in similar circumstances, we do not urge the organ into intenseness of action. For this reason the oculist desires the patient affected with ophthalmia not to use the affected, or even the unaffected eye.

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* I have great pleasure in referring to the labours of Dr. W. Tyler Smith, set forth in his Lectures on Obstetrics, now publishing in the Lancet, and afford-ing a brilliant example of this influence and of successful medical enquiry.

It is the loss of this erectile power which constitutes the presbyotic state of vision. Aged people become long-sighted, the eye not becoming sufficiently prominent for distinct vision at short distances.

The condition of accurate adjustment of the eye is one of erection, and connected with the action of certain muscles.

Doubtless the ear is affected in a similar manner, and the difference between merely hearing and listening intently, is one of erection of the organ, dependent, like that of the eye, on the action of muscular tissue.

It would be out of place here to say more on this subject, but I cannot resist the temptation to make one remark. Many deaf persons remain deaf from the want of the *habit* of listening, by which the power itself is lost ; just as some persons are found to hear when driving along in a carriage, though deaf in ordinary circumstances, the act of listening being induced. The slightly deaf person should be exercised in listening—in inducing erection of the tissues of the ear.

In a similar manner, the senses of touch, smell, and taste, may be improved, as is well shown in cases of persons who use those senses to supply the wants of others which are lost. All are aware of the singular effect on the tissues of the mouth, on the action of the salivary glands, and of their ducts in propelling the saliva, in the act of mastication, and even from the view, or idea, of savoury food.

So of the brain and its connected tissues. When the powers of the mind are intensely concentrated, the circulation in this region is augmented, and its vessels distended, congested. In the strife for the senior wranglership, the student sits for hours at his subject with a wet towel wound round his head, to moderate the excessive fulness of its vessels.

But great as is the effect of *attention*, that of the various *emotions* is infinitely greater. We have only to watch the effects of shame and of anger, the former so attractive, the latter so repulsive, both so extraordinary, as denoting the action of the muscular system of the neck, and distending the veins, and thence those vessels which, situated between the capillary branches of the arteries, and the capillary roots of these veins, may be justly denominated the *intermediate* vessels or canals of the tissues—the real vessels of those

tissues, the rest being but *machinery* for the movements of the blood.

Whatever may affect any erectile tissue, may affect the circulation of the head and neck. This is doubtless principally effected through the special muscular system of this region, and especially that part of this system which influences the larynx, and that which, by compressing the veins, induces fulness and congestion of their roots, and of the vessels which, in the normal and unimpeded circulation, empty themselves into them. These muscles are in a remarkable degree under the influence of emotion and of the excitants of reflex action. Remoter causes which influence the condition of the veins of the head and neck are, affections of the heart, its dilatation and disease of its valves, and affections of the respiration. To these topics I shall have to revert in the following section, my present object being to treat of the head and neck as purely erectile organs or regions; and of the causes which, influencing the muscular and circulatory systems in such organs and regions, induce the various physiological and pathological conditions observed in them; and especially of those forms of the latter which are periodical or paroxysmal.

Of these last, even apoplexy and hemiplegia, and other forms of paralysis, are examples. The threatenings of apoplexy, the transient forms of paralysis, are of this character, and constitute an object of medical study of the most intense interest, inasmuch as the *prevention* of incurable, or imperfectly curable disease, too often ageing the young, and crippling the aged, depends upon it.

§ 2. *Force of the Heart; Effect of Impeded Venous Circulation.*

The power of the heart, by which the blood is propelled to the most distant parts of the animal frame, through the intermediate system of vessels, and returned by the veins, and runs through a second circulation in the liver, must be immense.

This power is *seen*, if we watch its effect in moving the foot bodily at each systole, when the artery of the ham is laid over the knee, in sitting crossed-legged.

It is also seen in the degree of resistance offered by the

erectile tissues—a resistance which may be viewed as measuring, as it were, the power of the heart; for the phenomenon consists in impediment to the return of venous blood merely, the power and action of the heart being normal—a fact full of physiological interest and instruction.

Experiments which I made in 1830 illustrate the same principle. Let the circulation in the web of a large and vigorous frog be displayed under the microscope, and let a ligature be applied gently round the limb; the circulation, which was a uniform flow of blood before, now becomes pulsatory, with more or less of retardation or interruption at each systole of the heart, the veins and the intermediate vessels being distended, and the circulation in them more or less stagnant according to the degree of tightness of the ligature. Eventually the intermediate blood-channels become full, distended, irregular in diameter, ruptured even—the miniature living picture of the state of the cerebral tissue in apoplexy! The limb itself bocomes livid and tumid.

Beautiful is the scene when the lung of the toad is similarly placed under the microscope—it is like a flood of gold! And as it is difficult, perhaps impossible, to remove all impediment to the flow of blood, this flood is beautifully pulsatory, the entire lung being moved obviously at each systole of the heart —such is its power!

In these experiments, as in sphagiasmus or impeded venous circulation in the neck and head, we retrace the powerful effect of the systole of the heart in the throb of the enlarged artery, the veins and the intermediate vessels being distended by the rush of blood impeded in the former.

The physician should contemplate this scene of living physiology and pathology. It represents the normal phenomena of the erectile tissues, and the abnormal condition in sphagiasmus and paroxysmal apoplexy.

Now let us imagine the jugular and vertebral veins of the neck compressed by the platysma myoides, the cleido-mastoid, the omo-hyoid, muscles, &c. The effect of emotion, or of reflex action, impeded circulation, distension of the veins, congestion of the intermediate blood-channels, tumefaction and venous lividity of the features, and of the conjunctiva, and a similar condition of the encephalic tissues, take place, with the varied

cerebral, visual, and auditory symptoms—paroxysmal apo-plexy. How happy if it proceed no further!

This compression of the veins of the neck is various, and quite special in different cases. Contraction of the platysma myoides, for example, affects the external jugular chiefly : a more gentle, but more general action of the muscles of the neck leads to more general compression of the veins, and sleep ; a more specific action induces blushing, which may be limited to the cheeks, or diffused over the head, face, neck, and bosom ; a fit of anger is not only a " furor brevis," but it is a brief and violent sphagiasmus with cerebral action and congestion ; compression more sustained and complete leads to cerebral congestion and all its formidable symptoms—loss of memory or of consciousness, drowsiness, stupor, coma, &c.

From this cause I have also observed, and most carefully observed, transient delirium, mania, spasm, paralysis, in cases which I propose to detail hereafter.

Other causes of abnormal circulation in the head and neck exist. Diseases of the heart itself, of which *one*, hypertrophy, augments the flow of the arterial blood, and of which *all* induce impeded circulation along the veins—a fact of far greater moment,—have their influence in inducing the apoplectic state. But it must be remembered, that the influence of disease of the heart in inducing impeded venous circulation, is a remote effect, through the pulmonary circulation. It is a part of the subject of the *arrière circulation*, which I have elsewhere treated at some length*.

No one can have witnessed the violent efforts of the stam-merer without feeling that the sphagiasmus induced must be attended with risk ; and accordingly, derangement of the nervous centres, but epilepsy, rather than apoplexy, has been traced to the influence of this cause. I was recently consulted by a medical gentleman, who traced this connection both in himself and in a patient for whom he had, in his turn, been consulted, and in whose case he had naturally taken a deep and sympathizing interest.

A similar but more permanent influence is exerted by

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* See the Gulstonian Lectures for 1842, p. 48.

every kind of dyspnœa, but especially by severe asthma, in which *expiration* is so apt to be prolonged and difficult.

But none of these latter causes of impeded venous circulation is of such influence as the sphagiasmus induced by contraction of the muscles of the neck. Of this event, hitherto unrecognised in pathology, the exciting causes, as I believe I have already stated, are emotion, and especially the emotions, the hopes and fears, of the Stock-Exchange and of the sick-room; and various kinds of irritation, gastric, intestinal, uterine, &c. the sources of reflex action, especially the first. Hence the *paroxysmal* character of the apoplectic seizure, to which I now desire to draw especial attention.

### § 3.  *Further Observations on the Circulation in the Neck and Head.*

The difference between augmented flow of blood along the arteries, and its impeded return by the veins, on the *intermediate* blood channels and organs, is extreme.

The most violent *exercise,* as in running, the respiration being free and proportionately accelerated, only suffuses the face with florid blood, freely circulating; violent *effort,* on the contrary, as in lifting, in which respiration is arrested by closure of the larynx, induces a purple tumefaction of the tissues of the face and neck, from impeded flow and stagnation of venous blood. It is the difference between *augmented* and *impeded* arterial venous circulation.

There is a great difference, too, between the *degrees* of impediment to the return of venous blood: the violent muscular efforts in ordinary vomiting, fits of coughing, &c. fill the tissues of the face with venous blood; but still more violent acts of vomiting, the efforts of parturition, the convulsions of epilepsy, actually cause the thin parietes of the blood-channels of the face to yield, and induce minute *ecchymoses,* seen in the eyelids and on the temples.

Let the impediment to the reflux of the venous blood be greater still, and especially more specifically of the veins of the neck, and we cannot be surprised at the occurrence of loss of consciousness—cerebral epilepsy, if transient; apoplexy, if more permanent—with or without cerebral *ecchymoses.*

A tumour, or ligature, or spasmodic action of the muscles, compressing the veins of the neck, produces this effect.

Much, too, depends on the degree of suddenness of this compression. In diseases of the heart, we observe the features tumid with venous blood, without apoplexy, which may, however, occur eventually gradually. But the sudden compression of the veins of the neck, from the action of the platysma myoides, the omo-hyoid muscle, &c. induces the apoplectic state instantly.

This apoplectic state may consist of mere congestion, and is then transient; or of ecchymoses or rupture, with laceration of the brain, and is then persistent and hemiplegic; or if the attack of mere congestion be often repeated, effusion of serum may take place from the internal surfaces of the cerebrum.

A further difference may consist in the difference of the vein or veins affected: the jugular seems to be in more immediate connexion with the cerebrum; the vertebral with the medulla oblongata; at least, I think this probable.

It is extremely interesting to observe the influence of impeded or arrested flow of blood in the veins upon the *arteries*. I have already alluded to the experiment of applying a ligature on the inferior extremity of the frog, in which this is *seen* under the microscope. The phenomenon deserves to be noted more particularly.

If we tie a ligature round the frog's leg, the web being spread under the microscope, we instantly see the whole circulation, which was equable, or nearly so, before, become pulsatory. If we tie the ligature a little more tightly, the globules of blood are observed to oscillate even, in the arteries, and to proceed and to retrograde, at each systole and diastole of the heart. The intermediate vessels, meantime, become distended with blood, and even dilated in their diameter. So, in sphagiasmus, the carotid and temporal arteries *throb*, whilst the tissues of the face and neck, and even of the chest, become tumid, and purple with venous blood; the patient complaining that his cravat is tight; that he is giddy, and in danger of falling; or oblivious; or incapable of mental effort or attention; or dozy, falling asleep over his book, and even over his writing.

It seems probable that the mere compression of the veins

of the neck may sometimes be partial—greater on one side of the neck, or on one vessel, than the other, or others ; and that in this manner partial congestion may occur, and induce, more or less, temporary hemiplegic paralysis.   One patient, the subject of epilepsy, had in the first instance attacks of transient hemiplegia !   In like manner, the epileptic seizure frequently affects one side more than the other ; whilst the apoplectic is frequently conjoined with more or less of partial convulsive affection—so allied are these diseases.

The influence of indigestible, and therefore irritating food, of constipation, as causing—and of sleep especially, and of posture, and of repletion of the stomach or bowels, as augmenting—this venous congestion, will be obvious to every one.

As to efforts unattended by closure of the larynx, as the rapid ascent of a hill, they have no tendency to produce apoplexy, or extremely little.   It is not accelerated arterial circulation, but impeded venous circulation, which is the source of danger.

It is because they do not act by inducing sphagiasmus specifically, but more generally on the venous system, that efforts, which even imply closure of the larynx, whether voluntary, as in lifting, or involuntary, as in vomiting, do not, in general, lead to the apoplectic seizure.

The paroxysm of epilepsy, on the other hand, frequently, nay, generally, issues in an apoplectic state, and, occasionally, in a more or less transient hemiplegia.

## § 4. *The Anatomy of the Neck.*

There is nothing more wonderful in physiology—all wonderful as that science is throughout—than the fact, that artery, vein, and nerve, should be imbedded in the very midst of the powerful muscles of the head and neck, and yet should remain uncrushed by their varied actions.   The head is supported, raised, moved in every direction, in every position of the body, by these muscles, the large veins of the neck are surrounded by them, and yet sustain no injurious pressure : nay, this is still true, even if an enormous weight be carried upon the head.   So accurately are the action and reaction of this system of muscles accomplished !

It is when the balance between their action is broken,—

when their action is abnormal, irregular, inordinate, unsystematic, that the sphagiasmus, to which I have so frequently adverted, is produced, with all its dire consequences on the circulation of the cerebrum and of the medulla oblongata. Let the omo-hyoid and other muscles of the anterior part of the neck be suddenly and spasmodically contracted, for example, as an effort of emotion, or of reflex action, and the compression of the jugular vein will be the immediate consequence, with all the subsequent links of that chain of morbid results. The vertebral veins are, in like manner, crushed by the powerful muscles arranged along the posterior part of this important region; cerebral and spinal congestion, apoplexy or epilepsy, ensue.

Meanwhile, the countenance is tumefied, and affected with pale or purple lividity, the sign and index of the condition of the circulation within the head and neck, and of the nervous centres; the neck is swollen, too, and the condition of the larynx, pharynx, and adjacent tissues, is such as to lead to stertor, and rattle in the breathing, and imperfect deglutition, whilst the acts of respiration themselves cease to be rhythmic and equally sustained—a fact which presents the true index to the degree of danger.

My readers will readily understand how important, in the pathology of these cases, is an accurate knowledge of the *Anatomy of the Neck*, and especially of its muscles and its veins, its arteries and its nerves. It is the most important of *medical regions*, and I purpose to dissect it most carefully.

The abnormal action of the muscles of the neck is frequently quite obvious, especially in epilepsy, in which, from the inordinate action of those muscles, the head is violently distorted and twisted, and drawn into every frightful position; the eyes glare, and their axes are diverted, whilst every feature of the face is shockingly disfigured. In apoplexy, this action of the muscles is less marked, but still obvious enough to the careful observer. It must be remembered that some of the muscles involved in this question are, with the principal veins compressed by them, *deeply seated*. The effects of this compression are therefore observable chiefly in the *arrière circulation* of the intermediate blood-channels, and in the arteries which, in their turn, lead to them. The cheeks and

the conjunctivæ are suffused with stagnant serous blood. If the precise cause be obscure, so is that of its effects.

### § 5. *Affections of the Cerebrum and of the Medulla Oblongata.*

As apoplexy is, generally speaking, an affection principally of the cerebrum, epilepsy is an affection of the medulla oblongata; the one is an affection of the organ the seat of *intellect ;* the other of the seat of the *excito-motor power*, and, if I may so express myself, of the most complex and vital portion of that power. Both are, however, frequently involved in both cases: apoplexy becomes complicated with stertor, difficulty of deglutition, vomiting, convulsion, &c.; epilepsy, with coma and delirium.

There is one case especially, both of apoplexy and epilepsy, to which I would beg to draw special attention; it is that marked by pallor or pale lividity and faintishness, nausea and vomiting, affections of the heart and stomach through the medium of the medulla oblongata and the pneumogastric nerve. Such an affection is *sea-sickness*, about which I propose to write hereafter.

Cerebrum and medulla oblongata; the heart, the respiration, the stomach; how variously are these affected in apoplexy alone! and what a study is this for the physiologist, yes, and for the practical physician! and how plainly is physiology the one basis of the art of medicine! What a bright beam of light is thrown on the subject by this one saying—apoplexy (and mania) are affections of the cerebrum, primarily; epilepsy is an affection of the medulla oblongata; to which I may add, incidentally, that chorea, hysteria, stammering, the shaking palsy, &c. are affections of the seat or seats of action of the *emotions.* Let us only *observe* and *think* well!

### § 6. *The Relations between the various Paroxysmal Nervous Affections.*

Nothing is so common—nothing is viewed as of such trifling import—as the seizure termed " sick-headache." Yet I have known sick-headache issue in paroxysmal attacks of a very serious nature, both apoplectic and epileptic.

Sickness, cold perspiration, pale or purple lividity, with

collapse or tumidity of the features, as syncope, or the apoplectic state, may prevail, and, with symptoms *almost* apoplectic or epileptic or maniacal or syncopic, or with vomiting or relaxed sphincters of the skin, constitute a *peculiar* form of seizure.

How often is the apoplectic seizure marked by sickness and vomiting !

How often have we convulsive affections in the apoplectic seizure, and how constantly is the apoplectic state left by the epileptic convulsion !

How often would the prompt use of a feather, to induce vomiting, and of a stimulant enema, ward off the apoplectic and the hemiplegic attack !

And especially how often would *due* attention to sick-headache, and similar warning affections, ward off the more formidable attacks of *apoplexy* or of *epilepsy*—yes, and of *mania !*

How important is the whole of this topic to the physician and to the patient !

Our attention has been too much and too long engrossed with researches into the mere gross morbid anatomy, the effects of diseased action. I now make an effort to place what may be designated morbid physiology, or *living* pathology, before my professional brethren, tracing the varied links of the formidable chain.

I believe the profession have still to pursue this subject, as the public have still to learn the vital importance of a regulated state of the emotions, and of a *due* attention to the diet, the intestinal canal, and to the uterine functions. Vague notions exist of the importance of these topics, yet mankind go on partaking of the most indigestible meals, neglecting a loaded and disordered intestine, and altogether reckless of the general susceptibility of the nervous system, and of the local irritation and cause of morbid reflex actions during the flow of the catamenia, or at the catamenial periods when that flow is suspended. Yet do I daily witness the apoplectic, the convulsive, the maniacal condition, if not the actual seizure, dependent on these causes, severally or combined.

In this manner paroxysmal apoplexy, epilepsy, mania is produced, emotion or local irritation inducing direct or reflex spasmodic affection, and this, in its turn, a morbid condition

of the circulation through the cerebrum or medulla oblongata, through compression of the jugular or vertebral veins, and consequent cerebral or spinal irritation or congestion, and their effects. Many are at this moment paralytic, or subject to seizures of epilepsy, or are immured in an asylum for the insane, whose dire misfortune might have been prevented by *due* and timely, and *sufficient* and sufficiently sustained attention to avoid or avert the causes of their calamity, when it wore the treacherous aspect of an insignificant malady, as sick-headache.

The *slightest* symptom or symptoms should be instantly and strictly attended to. One patient may be affected with a rigid temporal artery, another with superficial veins of the neck " as large as the finger," a third with a sense of tension of the integument of the head, a fourth with a livid flushing, a fifth with the sense as of a tight cravat round the neck; others have headache, vertigo, momentary confusion or oblivion, or sickishness, or faintishness, or a sense of numbness, or spasmodic affection, as *warnings, before* the more formidable *paroxysm* of apoplexy, or epilepsy, or mania occurs.

Amongst the premonitory symptoms, none is more frequent than numbness in the ring and little fingers.

The physician should carefully and habitually examine the condition of *the temporal artery*, of the *conjunctiva*, and of *the veins of the neck*, in all these cases.

### § 7. *Extract from Dr. Abercrombie.*

We are now prepared, I believe, to understand the following remarks of Dr. Abercrombie, which, though rather long for a quotation, I must, from their importance, give entire:

" The most simple illustration of the apoplectic state is derived from those cases in which it is distinctly traced to an external cause, and ceases when that cause is removed. A boy, mentioned by Zitzilius, had drawn his neckcloth remarkably tight, and was whipping his top, stooping and rising alternately, when, after a short time, he fell down apoplectic. The neckcloth being unloosed, and blood being drawn from the jugular vein, he speedily recovered. Strangulation, when the neck is not dislocated, appears to be simple apoplexy. A

man brought after execution to Sauvages, was recovered by three bleedings, and sat up and talked, his breathing and deglutition being natural. After a short time the part of his neck where the cord had been applied began to swell, so as evidently to impede the circulation in the veins of the neck ; he then became drowsy, his pulse and respiration slow, without dyspnœa, and in a few hours he died apoplectic. A woman mentioned by Wepfer, recovered after execution under the same treatment. After her recovery, she was for some time affected with vertigo, which subsided gradually. To cases such as these we may add the numerous examples in which persons fall down suddenly in a state of perfect apoplexy, and very speedily recover under the appropriate treatment without retaining any trace of so formidable a malady.

" *The apoplectic attack, as it occurs in such examples as these, must be supposed to depend upon a cause which acts simply upon the circulating system of the brain, producing there a derangement which takes place speedily, and is often almost as speedily removed. What the precise nature of that derangement may be, is a point of the utmost difficulty to determine, and, perhaps, we have no data upon which it can be determined by legitimate induction. The subject leads to speculations of a very interesting kind ; but it must be confessed that they are in themselves in a great measure hypothetical, and that their application to the phenomena of apoplexy is also conjectural in a very great degree.* They may be worthy of some attention, but must be kept entirely distinct from our present course of inquiry, in prosecuting which I shall now take a general view of the principal varieties of symptoms which occur in the attack of apoplexy.

" The apoplectic attack is generally preceded by symptoms indicating some derangement of the circulation in the brain. The most remarkable of these are the following :—headache, giddiness, sense of weight and fulness in the head, violent pulsation of the arteries, and confused noises in the ears. These symptoms are often accompanied by epistaxis, which may give a partial and temporary relief; by loss of recollection, and incoherent talking, resembling slight intoxication ; by affections of the sight, double vision, and temporary blindness; by drowsiness, and lethargic tendency. We also frequently

observe indistinct articulation, and other partial paralytic affections. These are sometimes confined to one limb or a part of a limb; sometimes affect the eyelids, producing inability either to shut the eye or to open it; and frequently impair the muscles of the face, producing a slight distortion of the mouth. These symptoms, and others of a similar kind, mark the tendency to the apoplectic state, and often appear for a considerable time before the attack actually takes place. The attack itself occurs chiefly under three distinct forms, which it is of importance to distinguish from each other.

" In the first form of the attack, the patient falls down suddenly, deprived of sense and motion, and lies like a person in a deep sleep; his face generally flushed, his breathing stertorous; his pulse full, and not frequent; sometimes below the natural standard. *In some cases convulsion occurs ; in others, rigid contraction of the muscles of the extremities ; and sometimes contraction of the muscles of the one side, with relaxation of the other.* In this state of profound stupor the patient may die after various intervals, from a few minutes to several days; or he may recover perfectly, without any bad consequence of the attack remaining ; or he may recover from the coma with paralysis of one side. This paralysis may disappear in a few days, or it may subside gradually, or it may be permanent. Other functions, as the speech, may be affected in the same manner, being speedily or gradually recovered, or permanently lost; and recovery from the apoplectic attack is sometimes accompanied by loss of sight.

" The second form of the disease begins with a sudden attack of pain in the head ; *the patient becomes pale, sick, and faint ; generally vomits, and frequently, though not always, falls down in a state resembling syncope ; the face pale, the body cold, and the pulse very feeble. This is sometimes accompanied by slight convulsions.* In other cases he does not fall down, the sudden attack of pain being only accompanied by slight and transient loss of recollection. In both cases he generally recovers in a few minutes from the first effects of the attack, is quite sensible, and able to walk, but continues to complain of head-ache; after a certain interval, which may vary from a few minutes to several hours, he becomes oppressed, forgetful, and incoherent, and then sinks into coma, from which he never

recovers. In some cases, paralysis of one side occurs; but in others, and, I think, the greater proportion of this class, no paralysis is observed.

"In the third form, the patient is suddenly deprived of the power of one side of the body, and of speech, without stupor; or if the first attack be accompanied by a degree of stupor, this soon disappears; he seems sensible of his situation, and endeavours to express his feelings by signs. In the farther progress of this form of the disease, great variety occurs. In some cases it passes gradually into apoplexy, perhaps after a few hours; in others, under the proper treatment, the patient speedily and entirely recovers. In many cases, the recovery is gradual, and it is only at the end of several weeks or months that the complaint is removed. In another variety, the patient recovers so far as to be able to speak indistinctly, and to walk, dragging his leg by a painful effort; and, after this, makes no farther improvement. He may continue in this state for years, and be cut off by a fresh attack, or may die of some other disease, without any recurrence of the symptoms in his head. In a fifth variety, the patient neither recovers, nor becomes apoplectic; he is confined to bed, speechless and paralytic, but in possession of his other faculties, and dies gradually exhausted, without apoplexy, several weeks or months after the attack."

Of this remarkable passage, of which I have taken the liberty to insert a part in italics, the following is, I believe, the explanation:—

The tissues of the neck, face, and head are subject to influences similar to those which affect the erectile tissues. The former, like the latter, become tumid by certain emotions, as shame, anger, &c. and collapsed by others, as fear, anxiety, &c.

Shame and anger suffuse and tumefy the countenance, the eyes, the cheeks, the forehead, the neck, and even the integuments of the thorax, distending the capillary vessels. A fit of anger, and especially of suppressed anger, has passed into an attack of apoplexy! Sphagiasmus has existed in such a degree as to over-distend, or even to induce yielding or rupture of the capillary canals.

What certain emotions effect, is effected too by a loaded

C

condition of the stomach. The tissues of the face and neck are affected with capillary or venous congestion, and the patient—for such he is—becomes affected with a sort of sub-apoplexy—dozing, or rather sleeping, heavily, and with stertor.

As the effect of emotion in one case, and of excited reflex action in the other, the muscles of the neck are brought to contract on the veins of the neck, (and as in epilepsy it is chiefly the veins returning from the medulla oblongata, so it is in the threatening of apoplexy those which return the blood from the cerebrum and cerebellum), and the sub-apoplectic state is induced.

But it is, as I have stated, the agitation of speculations in commerce which most conduces to dangerous congestion of the cerebral vessels, and the danger of the apoplectic or paralytic attack of epilepsy, and of others of *this Class* of diseases, as mania, suicide, &c.—so perfectly allied are these apparently dissimilar morbid affections.

The effects are various, as Dr. Abercrombie has so admirably stated. I received a letter quite recently, from which the following is an extract:—

" Mr. L——, of this neighbourhood (Derby), a dissenting minister, has been subject to a peculiar loss of memory, a slight unconsciousness for a few minutes, coming on at intervals more or less frequent. These attacks were denominated *epilepsy* by Sir Arnold Knight, of Sheffield, who was consulted, some years ago, by Mr. L——. I wrote to Sir A. Knight, a year ago, and he then stated that he considered the attacks *epileptic*. But of late the attacks have put on somewhat more the appearance of *apoplexy;* and the last attack, about two months ago, was certainly more *apoplectic* than epileptic."

One patient, subject to attacks of epilepsy, was occasionally seized, whilst walking in the streets, with a transitory hemiplegia. A third patient is subject to paroxysms of mania, being sane in the intervals. Apoplectic and epileptic attacks have sometimes led to mania, as mania is frequently complicated with epilepsy or paralysis, and leads to apoplexy—another fertile field for the medical enquirer.

§ 8. *The* THEORY, *Causes, and Prevention of Paroxysmal Apoplexy.*

The slightest paroxysmal occurrence of head-affection should be as a most earnest warning voice to the physician and to the patient, being carefully traced to its cause—whether this be emotion, with its direct influence, or irritation, with its reflex action, on the muscles of the neck, and the consequences on the venous circulation of the encephalon.

This warning voice unheeded, and apoplexy, hemiplegia, or more partial paralysis, and the loss of the mental faculties, are the consequence: the young become old and decrepid, the aged become infirm and crippled, in a moment of time.

All emotion should be mitigated or removed by absence and recreation—affairs should be relinquished, and diversion and change, and active occupation, should be sought carefully. *The* remedy of remedies is—*travelling.*

The source and nature of the irritation should be discovered; the stomach and intestines should be kept absolutely free from all indigestible ingesta, and from excretions too long retained; uterine irritation should be as carefully allayed.

On the occurrence of the *slightest* admonitory symptom, the patient should be enjoined to take some fluid, and promptly and effectually to irritate the fauces and induce vomiting; and then to use an ample enema. He should then, if necessary, take an efficient emetic and purgative.

These remedies should be kept in readiness at all times and places.

They are equally important, whether the apoplectic, the epileptic, or the maniacal seizure be portended.

The most rigid system of diet, the strictest attention to the state of the bowels, the utmost care at catamenial periods, should become the patient's duty, and be most conscientiously performed.

In the actual attack, an effectual emetic, enema, and purgative, should still be speedily administered, together with instant venesection. Afterwards, in the case of uterine irritation, fomentations, enemata of warm water, perhaps slightly opiate, should be administered.

As preventives, early hours, a raised position in bed, the head being kept cool, and the stomach being empty; freedom

from emotion, ample walking exercises in the course of the day, with a very light digestible diet, and an unloaded condition of the bowels; great attention at the catamenial periods, &c. and all these well-sustained, are the most important.

The objects throughout are,—to avoid all exciting causes, to remove these if they have been allowed to exist, and to exchange the morbid actions for others. In this last point of view, the excitement of vomiting is most important. Cold water may also be dashed on the face and neck, to excite other actions—the act of inspiration, by which the veins are emptied, especially. With the same views, the nostrils may be irritated. In a slighter attack, the patient should be instructed to make frequent, energetic, and deep inspirations voluntarily.

It is scarcely necessary to add, that the most *direct* remedy, in the case of actual seizure, is to relieve the sphagiasmus by opening the external jugular at once, or by emptying the intermediate cutaneous vessels by cupping.

The reader is, doubtless, now convinced of the importance of a full development of the *theory* of apoplectic, of convulsive, and of maniacal affections; for *all* these are closely allied. The *first* step towards the comprehension of this subject was the separation of *The Spinal System*, with its excito-motor, reflex, actions and functions, from the cerebral and the ganglionic; the *second* is the due appreciation of the direct and reflex muscular actions, and their varied influences, taking place in the important region of *the Neck*.

It must be remembered that the preceding observations relate entirely to what I beg to designate *paroxysmal* apoplexy —that form of apoplexy in which our attempts at PREVENTION are most available. Of the other forms of apoplexy and hemiplegia I have treated, however inadequately, in the volume recently published by the London Medical Society. My next communication will relate to paroxysmal *Mania*.

# ESSAY II.

## THEORY OF PAROXYSMAL INSANITY, AND ITS TREATMENT.

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THERE is nothing more important in investigation than the just definition and use of terms. In medicine, of all the arts and sciences, we have most erred in this matter. The term epilepsy, and the term insanity, means *every* thing; the former of the convulsive character; the latter, of loss or aberration of reason.

Now, as epilepsy may be of organic origin, or arise from a multitude of other less permanent causes, and be curable or incurable; so may insanity. And indeed all that I have said on *this* topic, in these Essays, in regard to epilepsy, may be said of insanity; the difference being, that the former affects the spinal system primarily, the latter the cerebral; except, indeed, in those cases in which these affections pass variously into each other; for I have already noticed the connection between epilepsy and insanity.

I would institute this great distinction in both diseases, viz. between the organic and the inorganic, the structural and the functional and the paroxysmal, the cases in which the *scalpel* would, and the cases in which it would not, detect a change.

It would be of great value to pursue this parallel; but I leave the important task to my reader, merely adding, that, as any organic disease may, if duly situated, be the cause of aberration of motion, even to epilepsy, so any organic disease may prove the source of aberration of intellect, even to insanity.

The study of *this* form of insanity is, therefore, the study of all intra-cranial diseases.

But there is, as I have suggested, a *Class* of cases of insanity, as of epilepsy, in which *no* disease, no organic change, is discoverable.   In what do these consist?

Many years ago, I traced the case of puerperal mania to intestinal irritation and loss of blood, to mental emotion and physical shock, and its peculiar form perhaps, to the condition of the sexual system.

This is the very *type* of inorganic insanity.

A deranged state of the system generally; a state of exhaustion especially; mental emotion or excitement; physical excitement, shock or fatigue; irritation, mental or physical, or sexual; such are the causes of inorganic or paroxysmal insanity.   It is in the condition of the nervous system, of the vascular system, of the general system, and especially, in an exhausted excited and irritated condition of these, that we find the principal causes of *this* form of insanity.

As the exciting causes, so the condition of the system, and so the hope of cure, vary, and especially, differ from those of organic insanity.

I need scarcely observe how important is their distinction. On the diagnosis depends the prognosis.   Once more, the question is precisely similar to that in regard to organic or inorganic epilepsy.

Whether the condition of the muscular and venous structures of *the Neck* has an influence in insanity similar to that which is observed in epilepsy, or whether there be sphagiasmus, and in what degree, I leave as a question well worthy of the most attentive and continued observation and inquiry.   One patient has paroxysms of insanity, without a trace of epilepsy; another has an epileptic seizure, which, as its resultant coma passes off, leaves a state of insanity! There is at present no paralytic affection in either.   But how soon may there not be, especially in the latter, that form of paralysis which, from its origin or connection with spasmodic or convulsive affection, I have designated *spasmo-paralysis*. How different is this from organic insanity, which so frequently issues in a slow and general paralytic condition!

Then we must never forget, that as the epileptic seizure may, if repeated, *lead* to organic affection, especially effusion, so the continued or repeated excitement of insanity may in-

duce the change of the inorganic into the organic form,—of the *intra*-vascular into the *extra*-vascular condition. Hence the value of *early* treatment. As in epilepsy, so in insanity, the degree of hope fades, with the duration of the affection, or with the number and repetition of the seizures.

From these remarks it will be obvious that the question, long agitated, whether insanity be accompanied with organic change or not, is founded on the want of a just view of the subject. The answer is, that it is either, or both in succession, in the various cases which occur. It is a just and careful *diagnosis* which is required.

### § 1. *Parallel between Insanity and Epilepsy.*

Such is the parallelism between insanity and epilepsy, the difference being the difference of central organ chiefly affected, that the *causes* and the *treatment* may be viewed as almost identical in both diseases. The two orders of patients might be classed together. More attention should be paid to the question of its organic or inorganic origin, than to the mere *form* assumed by the malady, whether delirium or convulsion, with their varied susceptibilities.

For the most obvious reasons, convulsive affections prevail at earlier periods of life than the maniacal. The spinal system is more excitable than the cerebral in younger, the profounder emotions act in their more violent modes in the later, periods of life. Hence the classic Heberden observes:—" Insania in illis morbis numeratur, qui vix unquam se produnt ante pubertatem."

In the female sex, it is at the moment when disappointments in love are most apt to take place ; and in the male, when disappointments in projects of ambition are most apt to occur, that we most frequently observe insanity. Such are also amongst the causes of epilepsy.

### § 2. *Organic and Inorganic Insanity.*

Almost any disease or injury of the encephalon may, under peculiar circumstances of locality, &c. be attended by protracted delirium or erroneous ideas. The causes to which I have already adverted may produce a similar effect. Surely some appropriate designation should be devised to express

their difference, and especially that between either of these and that form of insanity which is *hereditary*, and which supervenes frequently without any obvious exciting cause.

The distinction is one which leads to the prognosis, and to the solution of the important questions,—*what* the treatment should be, and whether there should be *any ;* in a word, whether the object should be *cure*, or merely *care*.

Diseases of the brain, attended by delirium, not insanity, insanity of inorganic origin, and perhaps of paroxysmal character, insanity of hereditary origin, are surely totally different diseases, and require to be viewed and treated as differently. I have already said nearly the same things of epilepsy.

### § 3.   *Proposed Rejection of the term Insanity.*

During and after parturition, there may be an attack of puerperal convulsions (or epilepsy) ; but the patient is not, therefore, branded as an epileptic. I do not know that, even in the dark ancient times, any one bethought himself— εἰς κόλπον πτυσαι.

But we may, instead of epilepsy, have an attack of puerperal mania, and then the patient is not so fortunate as to escape the stigma usually and ignorantly attached to this malady ; she is tardily consigned to an *asylum*, and there, perhaps, is *as* tardily restored to health. For, as Dr. Baillie used to remark, " the question is not *whether*, but *when* the patient is to recover."

The term insanity should be rejected, in such cases at least ; and as the term convulsions supplies the place of epilepsy in the former case, so the term delirium should be substituted for that of insanity or mania in the latter.

Thus no precious time would be lost. There would be no prejudice to overcome, and there would be no more difficulty about change of abode (to an asylum), than there is at present about " change of air to the sea-coast ;" only let that asylum be instituted for the *cure*, not for the *mere care*, of the afflicted patient. Of such an asylum I proceed to give a sketch in the following section, premising that I suppose the acute febrile stage to be over.

§ 4. *Idea of an Asylum for the* CURE *of Insanity.*

It must never be forgotten that, however our object in the establishment of a lunatic asylum be care, comfort, and safety, our chief and permanent idea should be *cure*. Even in the worst cases, this idea should be steadily kept in view; for cases of recovery have occurred, after all hope had long been lost.

As emotion is a principal cause of insanity, and of its returns, and as man, the being especially afflicted with it, lives, as it were, a life of emotion, the one first great object in the treatment of insanity is the removal of all causes and occasions of emotion. The patient should be instantly removed from his own friends and servants, with whom altercations will ever constantly occur, in conversation or otherwise. No recurrence to his delusion should be permitted.

Emotion does not exist in the excited lunatic only, but in the moody and the apparently quiet. Our object should be to displace it absolutely, and replace it by incessant grateful occupation.

The *whole* day should be actively employed in exercises, games, &c. with intervals only of just and necessary repose.

I would propose to erect a proper tent, screened on the windward side, in dark, stormy, or doubtful weather. Under this tent, or in the open air, the patients' time should be engrossed with billiards, tennis, bowls, quoits, &c. or with " les graces," and other appropriate games for female patients.

Emotion and moody melancholy should be alike excluded; for neither should *time* be given.

The intervals between these games should be engrossed by repose and meals.

Every hour in the day should have its appointed occupation. The system should be one of training.

Early hours should be observed for going to bed and for rising. The last thing at night, and the first thing in the morning, every patient should be made to use a coarse towel well, to sponge with a little cold water, and again to rub.

On first rising, each patient should take three or four ounces of hot milk; then, after sponging, he should take a short walk; then breakfast.

After breakfast, the time should be occupied, as I have said, with games.

The next meal should be a second lighter breakfast or luncheon, and again the time should be filled up with games.

At a certain hour the dinner-bell should be rung, and this meal should consist of such fish, meat, and puddings, as shall be considered the lightest, the most digestible, the most nutritive, appropriately varied, with delicious beverages, absolutely devoid of all stimulus; instead of wine, coffee and tea should be served half an hour after dinner.

Lastly, tea only, without any solid, should be allowed in the evening.

The object should be to supply every dainty, but to avoid physical as we would mental stimulus or excitement.

The hours for these meals should be eight, twelve, and four o'clock generally ; the hour for repose half-after eight, or nine, and for rising, six o'clock.

The patients should sleep with the head and shoulders raised, except in cases of exhaustion, and without a cap, the hair being wetted during the process of sponging ; and they should wear a slight loose cravat, a light hat of black straw, with wide brims generally, during the day.

The feet should be as carefully guarded against damp and cold, by the frequent systematic change of shoes and stockings, at all seasons.

Towards the close of dinner, a stomachic aperient should be taken in such proportion and dose as may be proper for each patient, whilst the utmost attention should be devoted to insure a correct state of the excretions.

I have also observed the most marked benefit from a mild mercurial course.

## ESSAY III.

ON

## THE TYPES OF DISEASES PRESENTED BY EXPERIMENTS.

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ONE of the great advantages of experimental researches in *The Spinal System* is, that they frequently present TYPES of its diseases ; and the great advantage of these is, that they present the opportunity for the investigation of the nature of those diseases, and the deduction of their remedies.

The diseases of the spinal system exist under several forms, which admit generally of being reproduced in experiments for the purpose, with the objects to which I have just adverted.

In general, the diseases of the spinal system occur under the form of *spasm*, of *paralysis*, or of the two combined—viz. *spasmo-paralysis*. They are all primarily affections of the excito-motor *muscular* system, to the exclusion of the *sentient* or cerebral system—a singular confirmation of a physiological doctrine, that these two systems are totally distinct from each other.

Generally, spasm consists in *irritation* of nervous tissue, still retaining its normal structure, whilst paralysis implies a *lesion* of that structure. But the structure of the nervous tissue must be viewed under several aspects : thus this tissue may be injured by being lacerated or bruised at any given point; it may also be strangely injured in a given point by injury inflicted at a distance, through the means of *shock*. In this manner spasm is apt to lead to paralysis, and for the obvious reason, that this peculiar lesion is of the most intimate or atomic character, unlike the division or separation of its

atoms by laceration, &c. the paralysis, or spasmo-paralysis, so induced, is less persistent than in the latter case.

This remark leads me to the subject of the excito-motor power itself, on which all the movements connected with the spinal system depend. This power may be diminished or even suspended in its energies; it may also be greatly augmented, in which case there is proportionate augmented *susceptibility* to impressions, and to excited actions, the results of those impressions.

The former state of things is induced by all agents of such violent character as to induce shock; the latter is induced by peculiar agents, of a chemical or physical character, which act more gently on the nervous structures. The same identical agent may produce either of these effects, indeed, according to its degree. Thus too large a dose of strychnine speedily destroys all excitability; a very minute dose, on the contrary, induces the most extraordinary phenomena of augmented excitability which we can witness. The action of the electric current is precisely similar; a very mild current produces purely physiological effects; too strong a current soon induces destruction of the excitability of this part of the nervous system. The first effect of decapitation (of shock) in a frog, is a suspension of the excito-motor power; the second and ulterior effect is, or is supposed to be, an augmented susceptibility and activity of this vital agent. Electricity, heat, and the class of agents called stimuli, generally—may be employed so as to act as augmentive or destructive of the excito-motor nervous power.

As an example of these effects, I may mention, for the benefit of those who have not performed an experiment, that immediately after decapitation of the frog, no reflex actions are produced on irritating the foot; it is diminished excitability, the effect of shock. On administering a minute dose of strychnine, on the contrary, the touch, even of a feather, induces reflex action of a tetanic force and character.

From *experiments* we learn that this augmented susceptibility or excitability may exist in *force* without existing in *action*. A frog may be under the influence of strychnine, yet, if not actually *excited*, it may remain quiescent, relaxed in posture: it is tetan*ode*, without being tetanic, affording a

*type* and idea of certain diseases of the spinal system, of the deepest interest—one on which the *rationale* of the symptoms, and the adaptation of remedies, alike and equally depend.

Now, in this point of view, the effect of strychnine on the frog presents the type of hydrophobia. In both, the *blood* is poisoned; in both, the spinal system is in a condition of extremely augmented *excitability*, without being necessarily *excited*. Avoid all excitation, and the frog recovers. Apply excitation of the mildest character continuously, and the frog speedily dies. Here an experiment accurately presents, not only the *type* of the malady, but of the treatment!

In this experiment, as in hydrophobia itself, we have two conditions—one of *excitability*, the other of *actual excitement*, according as excitation is averted or admitted.

I propose to designate the former condition by the termination *ode*, the termination ωδης denoting *fulness* (as in the term hæmatode), the latter by that of *ic*. The frog, unexcited, is still tetan*ode*; excited, it becomes tetan*ic*. The patient affected with hydrophobia is hydrophob*ode*; is he necessarily hydrophobic? The former state admits of recovery; the latter soon destroys.

In this point of view we may consider other diseases of the spinal system. The patient affected with tetanus is not necessarily tetan*ic*; he is only tetan*ode*. If excited, he dies. What if he were, or could be, preserved absolutely from all excitement! He dies of violent and exhausting spasms. These spasms are *reflex* actions; reflex actions are necessarily *excited*. Remove all excitation, and the spasms—that is, the cause of death—would be averted.

In like manner the newly decapitated snake is *full* of excitor and motor power, yet free from movement unless an excitant be applied.

So also of certain forms of convulsive disease in infants and in adults. The patients are spasmat*ode*, or spasmodic, according as they are excited or preserved from excitement.

The difference throughout is that of the *disposition* to, or actual *condition* of, spasmodic action, or that of *excitability* or of *excitement*. The former may subside; the latter destroys!

The further difference between hydrophobia and tetanus is, as my friend Mr. Simpson has so well portrayed, in the

fourth plate of my " New Memoir," that the former is induced through the medium of the blood ; the latter through that of an incident nerve.  Of the former, the frog affected with strychnine presents the exact type ; of the latter, I doubt whether we possess an exact type in any experiment.

No experiment has been devised, to my knowledge, to induce augmented excitability of the spinal system through the medium of an incident nerve or nerves, or of any part of the spinal system.  It is said that the decapitated batrachian is more excitable than the entire animal.  But I think this a mistake.  The effects of excitation are controlled by efforts of volition in the perfect animal, and uncontrolled in the decapitated animal.  The difference is rather apparent than real.

Thus, of traumatic tetanus, I believe I may affirm that we have not yet an experimental type.  This is to be regretted the more, because many questions arise which can only be speedily determined by means of experiment.  For example, do the spasms perfectly relax during the course of the disease ? The trismus seems persistent—is it so ?  Or does it cease, and return on any excitement from volition, emotion, or excitation of reflex action ? Does an act of volition, exclusive of emotion and of reflex action, pass into spasm ? As, in the stammerer, the attempt to speak passes into excited action ; so, in trismus, the attempt to open the mouth closes the jaws more firmly. Volition passes into excited action.

I fear that in extreme cases the acts of respiration and of deglutition may pass into general spasm ; so that to avoid *all* morbid action and its consequences may be impossible.  Still, the *type* of the disease in its augmented excitability, and the *principle* to guide us in the treatment—that of avoiding all excitation—are set before us in an experiment ; and though the spasm *may* never cease absolutely, it will not be the less essential to avoid all causes of its exasperation.

It is to be observed, too, that in *all* experiments on the batrachian tribes, it is only types and principles which are presented to us, and on which our office is to reason correctly, and perhaps to experiment in our turn.  It was an experiment on the *frog* which suggested to me the only *hopeful* way of treating *hydrophobia* and *tetanus !*

In dentition there is a state of augmented excitability,

arising, as in tetanus, from injury done to a nerve. I have not, as I have already said, seen augmented excitability in any experiment consisting of injury inflicted on nervous tissue.

I now come to a new series of *types* of disease of the spinal system. They consist in actual excitement of its different parts, the incident nerves, the spinal centre, and the muscular nerves, portrayed in a series of experiments on electrogenic states of these living tissues, laid before the Royal Society, but not understood by those who pretended to judge them there.

The electrogenic state is that induced in a nervous structure by the continuous passage of a current of galvanism, of a force in due physiological relation to the excitability of the animal. Its phenomena are observed on withdrawing this agency.

The effect of this electrogenic state on the incident nerves is seen in varied reflex actions. The experiment is a *type* of those convulsive maladies which consist in excited reflex actions, such as are seen in dental, gastric, intestinal, and uterine irritation.

The electrogenic condition of the spinal marrow itself is the *type* of the class of certain convulsive affections which arise from arachnitis at the base of the brain, spinal arachnitis, &c.

Lastly, the electrogenic condition of the muscular nerves is the *type* of those cases of spasmodic affection arising from neuritis, or of inflammation of the neurilemma. Such a state of things exists in the second or convalescent stage of facial paralysis. The tumefaction of the neurilemma having subsided, the neurine is irritated instead of being compressed, and spasm, instead of paralysis, is the consequence. In the experiment of the electrogenic condition of a muscular nerve, the frequent discharge of the electrogenic state produces a similar effect on the nervi-muscular fibre.

There is still another class of types of diseases of the nervous system displayed in our experiments. The cerebrum and cerebellum being removed in a dog, extraordinary reflex actions are induced by irritating the dura mater at various points.

Having removed the head and sternum in a turtle, various reflex movements are produced by tearing away the viscera.

It is obvious that irritation of the internal membranes and tissues may thus be a source of reflex convulsive maladies; that of the cerebral membranes induces various convulsive or tetanoid affections; so does irritation of the serous membranes within the thorax and abdomen,—especially that of the pericardium.

It is but a step from these affections to those dependent on dental, gastric, intestinal, and uterine irritation, with which we are so familiar.

It is but a step further to consider the remarkable effects occasionally attendant on passing a bougie or catheter, on irritating the meatus externus of the ear, on the passing of a biliary or renal calculus, &c. One patient experiences a sort of rigor and an irrepressible deep inspiration on voiding the bladder, when that act has been too long delayed. Experiments might imitate some of these morbid phenomena.

I will conclude these observations by adverting to a question full of the deepest interest. A certain class of intracranial diseases—seated, I believe, at the base, and adjacent to the medulla oblongata—is attended with protracted sickness and vomiting; tetanoid, or epileptoid spasm; perhaps priapism and sexual excitement. What is the *precise* part, or organ, irritated in such cases? Experiment alone can teach us. I propose to place animals—dogs, for example—under the influence of chloroform, and to perform a series of experiments, to determine these and other important questions, replete as they would be with diagnostic, and, consequently, with practical suggestions.

It is in this manner only that the specific effects of *irritation* of the cerebrum, of the cerebellum, of the medulla oblongata, of certain nerves within the cranium, as the nerves of special sense, the trifacial, the facial, &c. the several membranes and their sub-divisions, can be accurately and distinctly ascertained. When so ascertained, their application, as *types*, to the diagnosis of diseases, will be as obvious as it is important.

One such experiment I performed long ago*. My aversion to the infliction of pain prevented me from ever repeating it, valuable as its results appeared. The discovery of the anæsthetic effects of ether, or of chloroform, will shed a benefit upon experimental physiology, and through it, on pathology.

There is another experiment of great interest. In endeavouring to preserve the circulation in the web of the frog independently of the spinal marrow, I always found that the most careful destruction of the medulla oblongata was attended by its annihilation. This organ exerts, therefore, extreme influence on the action of the heart. Is it on this account that a state of pallor, so like that of syncope, occurs in many attacks of the apoplectic and epileptic character, in sea-sickness, in other forms of sickness, &c.

All this is a part of scientific medicine and surgery. I be-believe it was an early career of experiment which made our greatest surgeon what he is. He sees symptoms by the light of physiology, and understands them! How apt and how beautiful, and how peculiarly his own, were his illustrations of surgical disease, on all occasions, from the chair of the Royal Medical and Chirurgical Society!

There is still another type of disease afforded by experiment, and that of the most important and extensive kind. It is the type of venous congestion generally, and of sphagiasmus especially.

Let the web of the foot, or the lung, of the frog be displayed under the microscope; and let the return of the venous blood be impeded, by a ligature in the former case, and by gentle pressure in the latter : we have immediately all the phenomena of this form of malady—phenomena which we can mitigate or exasperate, by diminishing or augmenting the pressure on the venous trunk or trunks.

It is singular that the biblio-physiologist still speaks of that which is obvious to the very eye as " a distinct system of vessels," as differing " only in size from the vessels from which they receive their blood on the one side, and into which they pour it on the other," &c.

The facts are—that there is a distinct *scheme* of artery and

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* See my Observations and Suggestions, Series ii, p. 64.

of vein, for the systemic and pneumonic circulations, and a scheme of methæmatous blood-channels, as distinct from either, adapted to the several systemic and pneumonic purposes of the animal œconomy; objects which *only* require to be carefully *seen*. Into this question I cannot enter on the present occasion; yet is it a careful study of this subject in experiment, which can alone lead to a full comprehension of the nature of inflammation, and of what, I believe, has been erroneously designated the *tendency* or *determination* of blood to a part, and of the juster view of its *impeded return*.

I conclude this brief Essay by one or two

### *Suggestions for the Treatment of Hydrophobia.*

IF a frog be subjected to the influence of strychnine, two events may take place:

1st. If it be continually excited to spasm by the irritation of a probe, life becomes extinct in a very few minutes.

2nd. If, instead of being so irritated, it be placed in a cool place, as a cellar, all excitation being avoided, it as certainly recovers!

A third order of facts is one of extreme importance. The effect of strychnine is *not* one of a spasmodic condition, *but* of extreme *susceptibility* to spasm. This susceptibility is seated in the *centre* of the spinal system; but each and every spasm is an excited reflex action.

In this *last* respect, hydrophobia accurately resembles the effects of strychnine. May it not in the *first* and *second?*

But in hydrophobia the patient dies of *asphyxia,* arising from repeated paroxysmal closure of the larynx.

Imagine this asphyxia and all excitement of reflex action avoided. Of what, then, would the patient die? and why should he necessarily die?

I have often thought of a prompt mode of performing the operation of tracheotomy. This I will describe at the close of this Note. The operation being accomplished, whatever spasm of the larynx there might be, there could be no asphyxia.

The patient should then be carefully placed on a *spring-bed*, and surrounded by ranges of curtains of lace or *"net,"* and every *current* of air, every *shake* of the *bed*, or of the *floor ;* in a word, every excitation or cause of *reflex action* and of *emotion* (for these generally go together, the same *spinal centre and system* being the seat of both), should be absolutely avoided.

The patient could not, as I have said, die of asphyxia ; he would not die of the nervous exhaustion induced by the continual excitement of emotional and reflex actions. Why, then, should he die ? Why should he not survive until the poison be eliminated from the system ?

Tetanus differs from hydrophobia in being a disease of *reflex,* not *direct origin,* and, perhaps, in being more or less persistent ; but it is equally *paroxysmal* in its aggravations, if not in its actual existence, and requires in its treatment the same measures to avoid excitation.

Many other fatal diseases, besides hydrophobia, might be treated, with the hope of saving life, by the simple mode of performing tracheotomy which I have proposed, *if perfected.*

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The instrument, which I have *suggested,* consists, first, of a cylinder of steel, of the proper diameter, and with its lower edge extremely sharp. It may be either circular or oval, with greater or less eccentricity. Within this cylinder a piston moves, which, being drawn upwards, admits of being removed altogether*.

The instrument being placed over the trachea, at the point chosen by the surgeon, over which an incision is made through the integuments, it becomes an "emporte morceau." A portion of the trachea being detached and forced into the cylinder as the piston is drawn upwards by the atmospheric pressure from within the trachea, the operation of tracheotomy is performed, and without the loss of blood. The patient breathes through

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* See the Lancet for August 5th, p. 152.

the orifice thus made in the trachea, all integument, muscle,
&c. being carefully drawn aside and secured, by a thread pro-
perly applied and carried round the neck.

I believe a trocar has been proposed to effect the same
object; but this is a clumsy instrument, and, without great
care, must wound the posterior part of the trachea.

The ordinary mode of performing the operation is, in
general, so tedious, as to be inadmissible in hydrophobia or
tetanus; it would probably destroy the patient on the principle
of *excitation*.

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There is in laryngismus, in epilepsy, in tetanus, in hy-
drophobia, &c. augmented excitability,—hypererethismus,
—of the spinal centre; constituting the continued predis-
position to the attacks or paroxysms of these diseases. It is
this state of things which I propose to distinguish by terms
ending in *ode*, as epileptode, tetanode. But in each disease
there is something specific.

# ESSAY IV.

## ON THE EFFECTS OF STRYCHNINE, WITH DEDUCTIONS.

*Comparaison entre les effets tétanoïdes des états électrogéniques, et ceux de la strychnine, de la narcotine, etc\*.*

"Si l'on fait traverser la moelle épinière ou les nerfs lombaires de la grenouille, mis à nu et parfaitement isolés, par un courant voltaïque faible, mais continu, et qu'au bout de dix à vingt minutes on éloigne l'appareil voltaïque, on voit sur-le-champ se produire un état tétanoïde très-énergique des membres inférieurs.

Si l'on place une grenouille dans une solution d'acétate de strychnine très faible, pendant le même espace de temps, il survient aussi un état tétanoïde des membres inférieurs.

Ces états tétanoïdes sont-ils identiques dans leur mode d'action, ou bien sont-ils tout à fait différents à cet égard comme ils le sont dans leur source ; et, si cette différence existe, y en a-t-il quelque application utile à en faire à la science de la médecine ? Telle est la question que je me propose de discuter dans le Mémoire que j'ai l'honneur de présenter à l'Académie.

Il n'est pas nécessaire, depuis l'ouvrage classique de M. Flourens sur le système nerveux, de rappeler les faits qui prouvent qu'une irritation quelconque de la moelle épinère ou des nerfs musculaires produit des contractions des muscles situés au-dessous. Il est plus essentiel de citer les faits qui démontrent qu'une irritation portée sur certains nerfs *incidents* provenant des tissus cutanés, muqueux et autres, agit par le centre spinal sur des nerfs spéciaux qui sont liés mystérieusement par ce centre avec les premiers, et produit ainsi des contractions dans le système musculaire. Les premiers faits

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\* From the " Comptes Rendus " for June 14, 1847, p. 1054.

sont des exemples d'actions *directes ;* les seconds, d'actions *réfléchies.*

Y a-t-il quelque ressemblance, quelque parallélisme entre les phénomènes des états tétanoïdes *électrogéniques* et ceux que produit la strychnine ? C'est encore une question qu'il semble utile d'examiner.

### I.—*De l'état* électrogénique *de la moelle épinière.*

Dans un Mémoire récemment lu à la Société royale, j'ai décrit, avec tous leurs détails, une série d'expériences concernant les états tétanoïdes produits en exposant la moelle épinière, les nerfs musculaires, et, en quelque sorte, les nerfs incidents à un courant voltaïque. Cet état des nerfs est ce que j'appelle *état électrogénique.*

Je n'ai qu'à observer ici que cet état électrogénique des nerfs, et l'état tétanoïde des muscles, qui en est l'effet, persistent d'une manière continue jusqu'au moment où ils cessent entièrement. Il n'est pas besoin de renouveler les excitations ; il n'y a pas de paroxysmes.

J'ai reconnu plus récemment que ni le courant voltaïque, ni l'état électrogénique ne s'opposent aux actions réfléchies, effet des excitants extérieurs. Ces actions dépendent donc d'un principe moteur ou excitomoteur tout à fait différent de l'électricité ; on bien il en faudrait conclure que deux états provenant d'un seul et même principe peuvent traverser sans interférence les mêmes tissus. L'état électrogénique des nerfs est actif et direct, et continu dans son influence sur le système musculaire : c'est de l'*excitation.* Et ce n'est pas, je crois, comme l'imagine mon excellent ami M. Matteucci, de l'*excitabilité* augmentée*. Nous allons voir quelle différence et même quelle opposition existe entre cet état et celui provenant de la strychnine, tout tétanoïdes qu'ils soient tous deux.

### II.—*De l'état tétanoïde du système spinal, effet de la strychnine.*

L'état du système spinal sous l'influence de la strychnine suit une loi d'action totalement opposée à celle que nous venons de considérer. Ici pas d'activité, pas d'action continue.

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* Leçons sur les phénomènes physiques, etc. 1847, p. 242.

Ce n'est plus de l'excitation, c'est de l'excitabilité augmentée. Il faut des excitants ; les actions ne sont plus directes, elles sont réfléchies. C'est ce que font ressortir, ce me semble, les expériences suivantes :

*Première expérience.*—J'ai mis une grenouille (*Rana temporaria*) dans une solution très-faible d'acétate de strychnine, de manière à produire lentement l'état tétanoïde : le premier phénomène a été le passage du mouvement volontaire à un spasme tétanoïde de tous les membres, accompagné d'une expiration forte et coassante. Cet état de spasme a bientôt cessé, et lorsque toute excitation extérieure a été écartée, les yeux sont redevenus proéminents, la respiration s'est faite normalement, les membres supérieurs et inférieurs étaient parfaitement souples et constamment fléchis.

La grenouille semblait éviter à dessein tout mouvement volontaire. Les mouvements de la respiration offraient quelquefois des signes d'un état tétanoïde, état qui était sans doute excité dans ce cas, comme dans le cas de mouvement volontaire, par le frottement de la peau contre la table ou contre la plaque de verre sur laquelle l'animal était posé ; car la moindre excitation extérieure, le léger contact d'une plume, le plus léger contact du doigt, la plus légère secousse de la table ou du plancher, produisait un état de rigidité et de spasme tétanoïde, les yeux étant retirés, la respiration suspendue, les membres affectés de roideur tétanique.

*Deuxième expérience.*—J'ai placé un crapaud (*Bufo vulgaris*) dans une solution d'acétate de strychnine faible. Il a fallu plus de temps pour la production de l'état tétanoïde pour ce crapaud que pour la grenouille ; mais alors les phénomènes ont été, à quelques circonstances près, les mêmes. Le crapaud faisait des mouvements volontaires continuels, jusqu'au moment où l'état tétanoïde se manifestait ; et cet état était reproduit lorsqu'on passait quelque objet devant les yeux de l'animal, effet d'émotion que je n'ai pas observé sur la grenouille.

L'état tétanoïde produit par la strychnine paraît limité au système spinal. Le cerveau, le système ganglionnaire n'est pas impliqué. Il y a des mouvements volontaires dans le crapaud jusqu'au moment du développement du tétanos ; le cœur ne cesse pas de battre et la circulation continue dans les capillaires, comme je l'ai vu dans une expérience dans laquelle

j'ai divisé la moelle épinière près de l'occiput, étalé les membranes de la patte sous le microscope, et observé l'état de la circulation dans les vaisseaux capillaires.

*Troisième expérience.*—J'ai divisé la moelle épinière près de l'occiput, et appliqué une solution d'acétate de strychnine sur la surface cutanée. Dans cinq à dix minutes, l'état tétanoïde était établi, la respiration forte et coassante s'était fait entendre, les extrémités antérieures (c'était une grenouille mâle, dans le printemps) se courbaient fortement sur la poitrine, les extrémités postérieures s'étendaient tétaniquement. J'ai ôtè les téguments de la partie postérieure de l'animal ; les membres postérieurs sont devenus de suite tout à fait mous et fléchis. Plus de spasme, plus de tétanos, même lorsqu'on pinçait les membres dépourvus de leur peau, et en même temps des origines de leurs nerfs incidents excitomoteurs. Les extrémités antérieurs étaient dans l'état ordinaire, et lorsqu'on les irritait, il y avait tout à coup rigidité des membres postérieurs.

*Quatrième expérience.*—Dans une autre expérience, j'ai séparé les téguments de la partie antérieure d'une grenouille, les laissant sur les membres inférieurs. Plus d'état tétanoïde alors, en irritant les tissus dénudés des parties ou extrémités antérieures, tandis que la moindre irritation de la peau des extrémités antérieures produisait des spasmes énergiques.

Toutes ces expériences furent répétées avec les mêmes résultats. Dans les cas où la moelle épinère avait été divisée et la peau enlevée, il y avait tétanos à l'instant si l'on touchait la partie de la moelle où la section avait été faite, ou si l'on laissait tomber la grenouille sur la table.

*Cinquième expérience.*—Dans une grenouille affectée de l'état tétanoïde produit par la strychnine, j'ai divisé les nerfs lombaires près de la moelle épinière. Le tétanos a cessé instantanément dans les membres inférieurs.

Cette influence de la strychnine sur le système nerveux est donc limitée à la moelle épinière comme centre spinal. Les nerfs n'en sont pas susceptibles : autre circonstance qui distingue l'état tétanoïde de la strychnine d'avec l'état électrogénique.

*Sixième expérience.*—J'ai soumis trois grenouilles à l'influence de la strychnine : dans une grenouille, le système

nerveux était entier ; dans les deux autres, la moelle était divisée près de l'occiput. Toutes étaient susceptibles des excitations extérieures.

J'ai placé la première de ces grenouilles dans une petite quantité d'eau, de manière à ce qu'elle pût respirer, et je l'ai bien préservée de toute excitation. Le lendemain elle était bien vivante et parfaitement libre de tout état tétanique.

J'ai mis une des deux autres, dont la moelle épinière était divisée, dans de l'eau fraîche, de la même manière, et je l'ai placée également à l'abri de toute excitation et dans une atmosphère pure et froide. Le lendemain, cette grenouille était aussi bien vivante, mais toujours affectée de tétanos.

La troisième grenouille, dans laquelle la moelle épinière avait aussi été divisée, près du crâne, a été excitée incessamment au moyen d'un stylet d'argent ordinaire, passé et repassé sur la surface cutanée : dans deux minutes elle est devenue très-faible, et dans cinq minutes elle était absolument morte.

*Septième expérience.*—J'ai soumis deux grenouilles à l'influence d'une solution d'acétate de strychnine faible, ayant préalablement divisée la moelle près de l'occiput. Toutes deux sont devenues tétaniques.

J'en ai excité une, que paraissait la plus énergique, d'une manière continue, de façon à produire un tétanos presque constant. Bientôt la susceptibilité sous les impressions, et les contractions des membres s'affaiblirent ; après un espace de temps assez court, cette grenouille était très-faible, pendant que l'autre était vivace comme auparavant. J'ai laissé la grenouille, ainsi affaiblie, en repos. Après un certain intervalle, elle s'était notablement rétablie.

*Ces expériences nous apprennent, ce me semble, ce qu'il faut faire, ce qu'il faut éviter, dans le traitement de certaines maladies, le tétanos traumatique, l'hydrophobie. Nos malades meurent s'ils sont excités ; pourraient-ils survivre s'ils étaient préservés absolument de toute excitation extérieure ?*

J'ai déjà dit que dans les grenouilles affectées par la strychnine, et dans lesquelles la moelle n'était pas divisée, la respiration n'est pas suspendue, excepté dans les moments du tétanos. L'expérience suivante prouve que l'état tétanoïde de la grenouille produit par la strychnine ne cause pas l'expulsion des œufs.

*Huitième expérience.*—Une grenouille femelle dont les oviductes étaient pleins d'œufs, fut soumise à l'influence de l'acétate de strychnine. Elle fut mise à l'abri des excitations, et elle s'est parfaitement rétablie. Quelques jours plus tard, j'observai qu'une quantité d'œufs avait été expulsée*.

Ainsi la respiration n'est pas nécessairement suspendue ; les œufs ne sont pas nécessairement expulsés, dans l'état d'éréthisme produit par la strychnine. Si la strychnine était administrée à plus haute dose, les phénomènes pourraient être différents. L'excitabilité étant extrême, le tétanos serait constant, la respiration serait suspendue, et de deux manières la mort serait prompte ; il est probable que les œufs seraient expulsés.

Ces expériences ont été faites sur des Batraciens. Quelles seraient les différences si elles étaient faites sur d'autres animaux ? Cette question, pleine d'intérêt, est d'une trop grande étendue pour que je la traite à cette occasion. Je me permettrai seulement de donner une seule expérience sur un animal vertébré et à sang chaud.

*Neuvième expérience.*—J'ai mis la quarantième partie d'un grain d'acétate de strychnine, en solution, dans la gueule d'un petit chat âgé d'une semaine ; dans un instant le larynx s'est resserré, et l'animal est mort d'asphyxie.

C'est à cette contraction du larynx qu'est due la mort presque subite produite par ce poison C'est à cette même contraction qu'il faut attribuer bien des événements fâcheux dont les médecins sont témoins dans leur pratique.

*Dixième expérience.*—J'ai mis une grenouille dans une solution d'acétate de morphine, elle est devenue simplement inerte et immobile. Dans quelque position gênée qu'on la posât, elle ne se remuait pas.

*Onzième expérience.*—J'ai mis quelques gouttes d'une solution d'acétate de narcotine dans la gueule d'une grenouille, et j'ai placé l'animal dans une solution semblable, mais faible. Le premier signe de l'influence de cet agent consiste dans des mouvements alternatifs d'extension et de flexion des deux membres inférieurs, mouvements rapides et énergiques ; le

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* Le célèbre Dupuytren a observé un cas de tétanos dans lequel le fœtus a été retenu dans l'utérus.

second signe est un état tétanoïde des quatre extrémités, en avant et latéralement, bien différent de la tension rigide produite par la strychnine, et non moins spéciale et remarquable ; le troisième, une rétraction des yeux ; le quatrième, la suspension de la respiration, d'où résulte le cinquième, c'est-à-dire des paroxysmes tétaniques, en apparence sans excitation extérieure. Ces derniers phénomènes sont probablement cause et effet ; la respiration étant suspendue, l'excitant intérieur du mouvement respiratoire s'accumule et devient cause efficiente d'une action excitée, réfléchie, spasmodique.

*Douzième expérience.*—J'ai enlevé le cerveau d'une grenouille et étalé la membrane des pattes sous le microscope ; j'ai introduit alors sous la peau une solution de *digitaline*. La circulation, dans les vaisseaux capillaires, a disparu graduellement, tandis que les actions excitomotrices restaient énergiques.

De ces dernières expériences nous concluons que, des principes actifs de l'opium, la morphine affecte le cerveau exclusivement, et la narcotine la moelle épinière d'une manière toute spéciale. La digitaline agit sur le système ganglionnaire."

# ESSAY V.

## ON

## THE THEORY OF DISEASES OF THE NERVES, AND ESPECIALLY OF THE FACIAL.

EVERY disease of the Nervous System appears to resolve itself into two Classes. The *first* consists in what may be designated ERETHISM, or *Irritation;* the *second*, in what may be termed CATALYSIS, or *abolition* of function.

If I puncture a nerve with the point of a needle, I erethise, or irritate, or stimulate, that nerve; if I compress the nerve by means of the same needle placed horizontally, I catalyse, or abolish, its function altogether.

If I expose a denuded and insulated nerve to the action of the atmospheric air, it gradually becomes dry: at the first, the nerve is erethised; if it be a muscular nerve, a series of muscular contractions is produced; afterwards it is catalysed, and the muscles, affected with convulsive movements in the former case, are now immobile, and, as far as the nervous influence is concerned, are affected with paralysis.

If we subject the lumbar nerves of a frog to a continuous galvanic current for a time, and then withdraw this agent, there is a state of tetanus of the lower extremities; the nerves are in a state of erethism: if we renew and continue the galvanic influence, the nerve or nervous power becomes catalysed or abolished, and the muscles are paralysed.

The terms Erethism and Catalysis are proposed to denote these conditions of the *nervous* function. If a sentient nerve be erethised, there is pain; if catalysed, there is numbness; if a muscular nerve be erethised, there is convulsive action of the muscles; if the nerve be catalysed, the muscle is inert, it is paralysed: if the cerebrum be erethised, there is delirium; if catalyed, there is coma or insensibility: if the spinal marrow be erethised or catalysed, there are convulsive movements, or paralysis, respectively.

If the condition of the nerve is changed, the phenomena are changed also: the effect of cold erethises or catalyses the sentient nerves of the face or hand, and induces pain or numbness; the former is, in this country, familiarly called the " hot-ache." If the impression of cold be severe and long-continued, there may be a permanent condition of erethism or of catalysis. In this case, the sentient nerves of the face are apt to become the seat of tic douloureux, or neurodynia, whilst the muscular nerves may be permanently either erethised or catalysed, and may originate facial spasm or paralysis—states which may exist distinctly, or pass into each other. Facial paralysis, especially, frequently assumes a spasmodic character during recovery.

So of the cerebrum and spinal marrow. Delirium, the effect of erethism, passes into coma; the effect of catalysis, or disease, as congestion or effusion, and consequent pressure, augment; whilst coma may either subside simply, or be replaced by delirium, as the pressure or catalysis is removed. All this is most distinctly traceable in the phenomena presented by ordinary epilepsy. This malady occasionally assumes the form of delirium; still more frequently its coma passes into delirium, the function of the cerebrum being at first catalysed, and afterwards erethised.

This is true of *all* diseases of the cerebrum: they present, in their different forms or stages, the effects of erethism, or of catalysis.

The same remark is true of the spinal marrow: a state of erethism is accompanied by pain or convulsion; a state of catalysis, by loss of these phenomena.

I have thus spoken of sentient and muscular nerves, and of the cerebral and spinal nervous centres. It remains for me to add a few words on the subject of the incident spinal nerves. These, like the parts of the nervous system already noticed, are capable of becoming the seat of erethism or of catalysis. If the trifacial be irritated by a grain of sand between the eye and eye-lid, the eye-lid is violently closed; if it be divided and catalysed, as in the interesting experiments of M. Magendie, and in certain cases of disease, it is *in*-excitable, and its power of inducing closure of the eye-lid is abolished. The acts of inspiration cease pari passu with the catalysis of the

pneumogastric nerve, and of the trifacial and spinal nerves, those secondary excitors of inspiration. There is an abnormally excitable and inexcitable condition of the pharynx and larynx, and of the isthmus faucium, dependent on the same erethised or catalysed condition of their incident nerves. Strangury and tenesmus are instances of the erethismus—incontinence of the urine and of the fæces sometimes, I think, of the catalysis—of the incident nerves.

Asthma, one form of this malady, at least, consists in erethism, or an erethised condition of the pneumogastric nerves. Does the case exist of a catalysed state of the nerves? If so, it has not yet been identified in the practice of medicine. But the theory of nervous diseases, well understood, will lead to observation—in due time. There is indeed a fact of singular interest bearing on the point: there is a bronchitic affection without bronchitis; that is, in certain cases of sinking of the vital powers, there are bronchitic râles, without the irritation which excites cough. I have observed this affection in the gradual sinking of the patient from loss of blood, and in various diseases. Are the incident roots of the pneumogastric in a state of catalysis? Does not opium produce a state of catalysis of the incident roots of the pneumogastric nerve, and so impair the respiration?

How much of pure and cautious observation is required for the determination of this and similar questions, I am perfectly aware. But I would remark, if I may use a simile taken from a higher science than our own, that the new planet, Neptune, would not have been *looked for*, but for the splendid anticipations of Le Verrier and of Adams.

There is still another form of affection of incident nerves: a blow on the tibia *paralyses* the limb; teething induces various forms of paralysis; so does an irritated condition of the stomach or colon; affections not yet *fully* investigated.

More frequently an affection of an incident nerve, as dentition, tic douloureux, irritated stomach or colon, being reflected, induces *spasmodic* affection.

That the conditions of the ganglionic system are those of erethism and of catalysis, is obvious from many facts in medicine: augmented and suppressed secretions, hypertrophy, atrophy, are the effects of these conditions.

*Of Affections of the Facial Nerve especially.*

I now proceed to treat of affections of the facial nerves.

Facial paralysis appears to me to be of three kinds :

1. The first is limited to the exterior branches of the facial nerve ;

2. The second has its origin within the cranium, and usually affects the portio mollis, as well as the portio dura, adding deafness to the facial paralysis ;

3. The third is, as yet, I believe, unrecognized, and consists in the *extension* of the disease along the facial nerve, or its neurilemma, into the cavity of the cranium, affecting the membranes, or the cerebrum itself; it is not necessarily combined with deafness.

In all these cases there may be the combination of spasm with the paralytic affection. In the last there may be even convulsive or epileptic affection.

It is obvious, from these observations, that facial paralysis is not always so free from danger as we should imagine, from the description given of it by Sir Charles Bell and other writers.

I proceed to treat of each of these forms of facial paralysis in its turn.

I. *Of Peripheral Affection of the Facial Nerve.*

The most common case of facial paralysis is that which is the effect of exposure to a current of wind,—at an open window,—or in the open air when the wind is bleak.

This exposure induces a peculiar condition of the nerve. It may, by acting on the nervous matter, induce paralysis directly; as a similar influence, applied to the trifacial, induces numbness or loss of sensibility. But it may induce inflammation of the neurilemma of the nerve ; and this, by its tumefaction, may so compress the nervous matter as to induce paralysis.

In this case, a singular effect is observed when the inflammation subsides. The tumefaction and consequent compression being less, the nervous matter is rather *irritated* than *compressed,* and the paralysis is replaced, in a greater or less degree, by spasmodic affection.

The case is similar to what is observed in experiments on the nerves of the frog. If one of these be isolated from the surrounding tissues, and be submitted to a galvanic current, tetanoid or spasmodic action is induced in the muscles when that influence is withdrawn. Or if the nerves be merely exposed to dry in the surrounding atmosphere, a similar spasmodic tetanoid effect takes place.

In subsiding inflammation of the neurilemma of the facial nerve, there is, in like manner, more or less of spasmodic action of the facial muscles.

The affection sometimes appears to have been transferred to the opposite side of the face; for whilst the case was paralysis, the face was drawn to the unaffected side; but when it becomes spasm, it is drawn to the affected side.

Considerable singularity of action is also observed: the orbicularis, which was simply paralysed at first, and incapable of closure, is now distorted in its partial action on attempting to close the eye.

With this spasmodic action there is a peculiar stiffness of the muscles of the face, which were merely flaccid before.

I need scarcely observe that, in cases of tumor or suppuration, in which the facial nerve is fairly crushed or discharged, the phenomena are those of pure and perfect catalysis.

## II.  *Of Intra-Cranial Affection of the Facial Nerve.*

Facial paralysis of intra-cranial origin usually depends on disease of the bones, or membranes, as nodes or caries, tumors, abscess, &c.

Usually, as I have said, the portio mollis and the hearing are injured, with the portio dura and the action of the muscles of the face.

There may also be other symptoms, of the cerebral or spinal systems, arising from the influence of the disease on other tissues or other nerves: such as ear-ache, noises, headache, and spasmodic and paralytic affections of the limbs.

In one case there was caries of the petrous portion of the corresponding temporal bone. In another there was circumscribed softening of the corresponding lateral lobe of the cerebellum: there were ear-ache, deafness, and paralysis of

the facial nerve; and the patient sank rather suddenly—the medulla oblongata doubtless becoming involved.

It is obvious that, in such cases, the symptoms may be at first simple enough, but may become complicated ulteriorly; and that our prognosis should be cautious.

Even when the cause is obviously an external one, as cold, its operation may be deeply seated; or it may, when this is not the case at first, pursue the course of the nerve, as I now proceed to explain, and issue in intra-cranial disease.

### III. *Of Affection of the Facial Nerve proceeding inwards.*

Miss ——, aged 38, was exposed in an open carriage to a " keen Scotch wind," eight years ago. For five years the case was one of simple facial paralysis of the right side. Afterwards other symptoms were superadded, as pain of the head, a little loss of memory, incapacity for attention.

The affection of the face became spasmodic, and was conjoined with occasional attacks of spasm of the right side of the neck; with these there was a distended state of the veins of the neck, which appeared of ' *the size of a finger.*'

The right side of the tongue became affected, with a sense of numbness of the fingers of the right hand.

It is obvious, from this recital, that an affection, at first external in the facial nerve, had become intra-cranial, with symptoms not a little threatening serious cerebral or spinal affection.

It is a question of the utmost importance, in what degree inflammation or irritation of peripheral nerves may proceed towards the centres of the nervous systems? Such a case is detailed by M. Cruveillier.

But these events are rare. Tooth-ache, tic douloureux, are scarcely known to issue in this manner; and yet we should expect, a priori, that incident nerves would be more likely to become affected with continuous inflammation or functional affection than muscular nerves.

I may state, in conclusion, that—

1. If a nerve be *irritated* only, pain or spasm is induced.

2. If a nerve be compressed, &c. catalysis is the effect, and sensibility and motion are extinct.

3. Irritation may pass into the other condition, or the latter

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into the former ; and then pain or spasm passes into paralysis, or paralysis into pain or spasm.

All these results are observed as the effects of exposure to cold on the nerves of the face.

Some cases are merely spasmodic ; others are paralytic (the severer form of the disease), and present spasmodic affections during the process of *recovery*.

Of these affections, one is a less severe or more partial injury done to the nerve than the other.

Affections of the facial nerve may be of *extra*-cranial or *intra*-cranial origin ; or, as I think, it may, in rare cases, proceed from without inwards. The case of spasm, and especially of paralysis, having their origin in incident nerves, is scarcely understood at all ; and careful observation is still required to reduce this whole subject to its just degree of certitude.

## ESSAY VI.

### ON

## THE NECESSITY FOR ALTERNATION IN THE EXCITANTS OF THE SPINAL SYSTEM.

IN every case of reflex action or function, an excitant is essential; and in the case of repetition of the action or act, the excitant must also be repeated—that is, it must be *alternant*.

The *continuation* of the stimulus is ineffective. The excitant must be repeated.

There must also be a *difference*: the sudden application of cold to the surface induces sobbing inspiration; but its continued application induces no such effect. If we descend into a hot or cold bath, inspirations are excited; but if we remain in either, no such effect is experienced. It is the sudden application of difference of temperature which is requisite.

So in regard to respiration: the *continuous* flow of blood, either arterial or venous, through the medulla oblongata, as supposed by Prof. Müller, or through the tissues of the body generally, as supposed by Prof. Volkmann, or even through the lungs, as supposed by Dr. Carpenter, can be no excitant of the repeated acts of respiration; it wants the alternation, the difference. Besides, were either of these views correct, the act of respiration would be excited in the foetus in utero. These can only be applied to the pneumogastric by the alternant presence and absence of carbonic acid in the pulmonary air-cells. The evolution of this gas in the air-cells excites inspiration; this act dilutes the acid gas, and the subsequent expiration removes it altogether; a moment of repose; renewed evolution of carbonic acid, renewed excitation of inspi-

ration, and so on.  Such is the interesting series of phenomena of alternations—cause and effect!

In asphyxia alone, in which the arterial blood in the medulla oblongata is rapidly exchanged for venous, respiratory movements of *centric* origin are observed.

In this case another excitant of inspiration is required: the dog asphyxiated in the grotto del cane is recovered by being plunged into the adjacent lago d'agnano.

This may be said to be *the Law of all the Reflex Actions and Functions.*

The acts of deglutition can only take place on the stimulus of saliva or of food; the act of emission on that of the semen.

It is plain, from these observations, that the physiological acts of respiration cannot arise from the medulla oblongata as their *primum* mobile.  There is and there can be no excitant of this central organ of the spinal system except the blood; and the impulse of this is either continuous, or synchronous with the pulsation of the heart, with which the acts of inspiration should also be synchronous, if so excited.

The same principle applies to excited movements, not reflex; as to that of the heart itself, of the alimentary canal, &c.  But this subject can only be noticed incidentally in this place.

The same principle must guide us in the use of therapeutic measures acting in and through the spinal system : in the case of *Asphyxia,* the first question is—What is the temperature of the skin?  The most efficacious mode of inducing respiration is by the sudden application of abundance of water of another temperature.  It may be *higher* or *lower*—a fact not hitherto recognized in the treatment of this accident.  Better still : it may be higher *and* lower *alternately*—another fact not hitherto ascertained.  The next question is—What should be the precise degrees of those higher and lower temperatures?

*All* these points require investigation.  The dog taken from the grotto del cane is, as I have observed, dashed into the cool water of the adjoining lake ;  but, taken in a state of asphyxia out of the water, should, if possible, be suddenly plunged to the neck in water of 104° Faht. or of some appropriate elevated temperature, ascertained by accurate experiment.

It is the principle of difference and alternation which is operative.

To dash cold water on the surface already cold, can be of no service in exciting respiration; but to dash cold and hot water on the surface, in turns, may prove most effectual.

The same principle applies to the use of the douche as a prompt remedy in uterine hæmorrhagy. It acts on the principle of difference of temperature : cold and hot water should be applied suddenly; but the just limits as to temperature and quantity, and mode of application, are still to be determined.

In the same manner, a metallic spoon just taken out of water a certain number of degrees in temperature above or below that of a paraplegic limb, and suddenly applied to that limb, equally excites a reflex action.

I suppose that if we were to divide the spinal marrow in a frog, or other batrachian, and place any appropriate object in contact with the skin, a certain number of degrees of temperature above and below that of the animal, similar reflex actions would be equally produced.

The continued application of a given temperature, like that of a given force and direction of galvanism, produces no obvious movements.

It must be remembered that I here treat of excited reflex action. The continued application of heat may prove a stimulus, and that of cold a sedative, on the other functions and on other organs.

The principle of alternation is so essential to all actions of the spinal system, that, as I have stated elsewhere, there is, even in tetanus itself, no spasm, except it be excited by the fresh application of stimulus,—and this either volition, emotion, or excitants of reflex actions.

The *forms* of diseases of the spinal system depend on the special condition of its *centre ;* the actual existence of movement or spasm depends on the application of an excitant or excitants. The spinal centre may vary in excitability in its whole extent, or in its different portions; we may witness general augmented excitability, or that limitation of it which induces laryngismus, or the affection of a hand or foot, or which assumes the hemiplegic form. It is obvious, from pathology,

that the spinal centre consists of distinct organs, whether
viewed in its length or its breadth.    One other feature cha-
racterizes its operation ; it is that described in this Essay : it
is essentially excito-motor ; its excitants must be renewed or
alternated.    It remains to determine, in any given case, whe-
ther the *centre* of the system, the incident nerves, and the
reflex nerves, with the tissues in which they are distributed,
are singly and separately affected, or together.

A new field for investigation opens upon us !

FINIS.