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Frederick Barlow, Esq.
On the Relation of the Spinal Marrow to Parturition; by W. Tyler Smith, M.B.—On the Use of the Ergot in Uterine Leucorrhœa.

PRACTICAL

OBSERVATIONS AND SUGGESTIONS

IN

MEDICINE.

PRINTED BY JOSEPH MALLETT,
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PRACTICAL

OBSERVATIONS AND SUGGESTIONS

IN

MEDICINE

Second Series

BY

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

L. AND E.

FOREIGN ASSOCIATE OF THE ROYAL ACADEMY OF MEDICINE OF PARIS;

ETC. ETC. ETC.

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MDCCCXLVI.

PREFACE.

In the preface to my former little volume, I observed—'the following pages contain a part only of a series of papers which I have either printed formerly, or prepared for the press. If they meet with a favorable reception from the profession and the public, I shall proceed forthwith to the publication of a second volume.' I have again to say the same thing. I find I have similar sketchy papers for a third volume of the same unpretending character.

The papers in this volume are of a more scientific nature than those of the former one. I am persuaded that physiology, or a knowledge of the healthy actions, is the only foundation for practical medicine,—and the only remedy against the hydra, quackery, now so prevalent, both in and out of the profession. This physiology should be at once experimental and clinical. The biblio-physiology of the day can issue in no good whatever. The medical mind wants discipline; we should study the works of Harvey and of M. Louis; experiment, and observation, and philoso-

phy, should go hand in hand. A just knowledge of the nervous system is at once a guide to the diagnosis, the pathology, and the treatment of its diseases. A knowledge of the modes, forms, and principles of action in the true spinal system especially, has become, in reference to diseases of the nervous system, in some degree what the stethoscope is in diseases of the thorax.

When every member of our profession has a sound knowledge of physiology, derived from his own cautious observation, and not, at second and third hand, from books, medicine will take its just position, and quackery its departure. But whilst a medical person can be found to boast that he, forsooth, is a "mere practical man," quackery will continue. One kind of mere empiricism is as good as another.

A physiologist could not, if he would, either be a quack or disposed to quackery. There is nothing in Mesmerism, hydropathy, homœopathy, that could lay hold of his tutored, chastened, philosophic mind. To the hideous folly of Mesmerism, and the disguised nothingness of homœopathy, he would feel an ineffable disgust; of hydropathy he would think as of any other system of gambling—with the addition that, in this case, safety, health, and life are the stakes.

The principal subject of *practice* in this volume is that of sporadic puerperal diseases; and I am persuaded that the views given on that subject, pp. 103—

213, 350, are calculated to lead to a decisive and safe treatment in cases of great difficulty. Before my publications on this subject, many of the fatal cases, arising from the want of just rules for the administration of blood-letting, purgative medicines, opiates, stimulants, and nutriment, occurred in this important class of diseases.

As these volumes are intended to be *suggestive* of new investigations, as well as the record of some observations of my own, I will here add a list of subjects of inquiry, for the benefit of those who might wish to employ their time usefully, but to whose minds no such subject has yet presented itself: such are—*the true spirit of physiology in the clinical ward; the physiology of life, disease, death; the true spinal system traced throughout the whole animal series; the inverse ratio between the dynamics and the stimuli traced throughout the scale of animated being; the reciprocity between the ingesta and egesta in the animal and vegetable kingdoms; the sympathetic* actions, *as between the mammæ and uterus, the sympathetic* pains,—*all which take place through the medium of the ganglionic system and its spinal connections; the influence and agency of mind, nerve, blood, and muscle, respectively, in the animal œconomy; the influence of emotion especially, through the medium of the true spinal and ganglionic systems.* Such are some of the subjects requiring fresh investigation which have occurred to me;

but chiefly I would see *physiology applied to clinical medicine;* for this, as I have said, is the only true source of the just elevation of our profession in itself and in public estimation, and the only hope of the extinction of quackery. We are indebted to Hunter not less for having laid the foundation of surgery in physiology, than for his effectual rescue of that branch of the healing art from degradation by the ignorant pretender.

Quackery will cease, when the public are satisfied that the first steps towards the reparation of the deranged machine is a knowledge—a real, sound, practical knowledge—of its springs of action, and of its functions, and that the educated members of our profession, and no others, possess that knowledge.

I had once the idea of making a special study of the physiology of death, &c. so as to give evidence in trials involving the questions of suicide, homicide, &c. my object being to succour the innocent, and not to spare the guilty. I would *suggest* and recommend this project to some young and generous-hearted physician, as not unworthy of a life of special devotion and research. But I fear there is little *poetry* in our profession, and that "the age of chivalry is gone."

P.S. The correction of this volume was necessarily left with my printer.

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PRACTICAL

OBSERVATIONS AND SUGGESTIONS.

CHAPTER I.

INTRODUCTORY OBSERVATIONS.

TIME was when astronomy and chemistry, as well as medicine, had their quackeries, under the respective designations of astrology and alchemy. But the light of science has dispelled these ignes fatui by its brightness, and they are no more seen.

When will medicine effect what astronomy and chemistry have accomplished? When will its *science* shine so resplendent that its mockeries will, in their turn, disappear?

Alas! the public mind is still in a deplorable state of misconception—I had almost said delusion—in regard to medicine, even to this day.

We cannot wonder that, when our profession was viewed and designated as the "*art and mystery*" of physic, the public was always looking for the unin-

telligible, the inexplicable, and the wonderful. But that, in the present era of science, and of the 'march of intellect,' it should still be that

"the less they understand,
The more they 'dmire the sleight of hand,"

is indeed incomprehensible.

Yet thus it is. The public mind is not prepared to be satisfied with the logical and faithful deductions from careful observation, but still looks for some mystery, some marvel, some unintelligible remedy, or system of remedies: hence homœopathy, from its very infinitesimism, and hydropathy, from its herculean agents, equally please persons of dissimilar mental character. In thinking of these forms of quackery, I am often induced to exclaim, mentally, as poor Malesherbes did, as they were dragging him to the guillotine—'au moins, s'il y avoit du bon sens!' and I grieve to think how precious are the hours and days lost in the nothingness of the one, and how hazardous is the gambling for health amidst the extravagancies of the other. And then comes the crowning folly of Mesmerism! Yet *all* these delusions have their advocates, as their victims—even amongst the patricians and the literati of our country. There is, in fact, no folly too foolish for some of those who are the *judges* of our qualifications for the practice of our profession.

One would think that if a physician displayed great talent and great devotion to his profession, he would

certainly be rewarded. It is not so; but a certain 'savoir faire,' or 'tact,' which would be more truly designated *trick*, is but too frequently the cause and secret of success; of which I could point out some examples.

Nevertheless, an accurate knowledge of anatomy, physiology, pathology, and therapeutics,—great skill in diagnosis, and in the selection and appropriation of remedies, about all which the public do not give themselves the time and trouble to think,—are the only real foundation for the honorable, safe, and beneficial practice of medicine.

If the public mind could be well and deeply imbued with this fact, so true and so noble, the systems of quackery would fade away, and we should as much expect to meet with a quack maker and mender of the most delicate instruments of astronomy, as of the human frame.

But there is a principle in the animal œconomy, by the influence of which diseases sometimes subside without the aid of medicine, and even in spite of many and powerful baneful agencies; and so homœopathy and hydropathy *appear* to make their conquests over disease. Homœopathy may, also, quite unknown to the patient, cure, not by its homœopathy, but by its time and its dietetics; hydropathy, not by its hydropathy, but by its early hours, its air, its exercise, and its dietetics too; and so may Mesmerism, by its influence through the medium of *emotion*, that still untraced

power to induce and to remove disorder if not disease.

The advocates of these various quackeries are little aware how very silly their remarks appear to any one whose mind is imbued with physiology, and the Baconian philosophy!—with the difficulty of the subject, and — for the saying of Hippocrates, ἡ κρισις χαλεπη, is still as true as ever—with the difficulty of forming a correct judgment. There never was a royal road to geometry; nor will there ever be a royal road to medicine. The temple of Apollo is only to be entered through the portal of science.

What then is to be done? The public mind should be cured of its ignorance, and of that which always accompanies ignorance, its superstition. It should be reminded that all the quackeries hitherto have proved cheats, or fallacies, and have fallen successively into oblivion—from the royal touch, the amulets, &c. down to Perkinism. It should be taught to see that, of the three quackeries of the present day, homœopathy, hydropathy, Mesmerism, *one* only *can* be right,—that all cannot be so; and that the *chances* are every way greatly against each individual devotee. But especially it should be taught that the animal frame is a delicate and complicated machine, not to be trifled with either in its health or its derangements, and that much labour is required in the engineer who would understand its structure and the nature of its springs; and that if either of these be

put out of order, great wisdom and care, as well as knowledge, are required to restore them to their natural condition *safely*. It should be taught that all that is mysterious and marvellous is dishonest and untrue; and that truth is at once intelligible and honorable. Oh! little do the devotees and victims of quackery know to what danger they expose themselves, and to what temptations they expose the humbler members of our profession!

A physician without physiology is an empiric—certainly in its good sense, and I think also in its ignominious one. What then is the real remedy against quackery? KNOWLEDGE! Knowledge amongst ourselves; knowledge of the actions and functions of the animal machine. *Its* influence will soon be felt by the public.

Let no one henceforth imagine that he can be a physician, or maintain the dignity of our profession, without a sound knowledge of physiology: and let us remember that there is much impertinence, indolence, and ignorance, in the phrase, 'I am a mere practical man.' Such empty boasts have had their day. A profound physiology will henceforth be deemed the true light in medicine. This knowledge will distinguish the able physician, and will in due time be discerned by the public, and quackery will be no more seen.

Why have we no quack engineers? Because the public know, as I have said on another occasion,

that to remedy a defect in a steam-engine, we must begin by understanding its motor power, its structure, and its functions.

HUNTER—whose name is its own enduring monument — introduced physiology into Surgery, and wrested that part of medicine from the encroachment of the quacks. He would deserve a civic crown, who should accomplish the same great good for the Physician's department of our profession.

Unfortunately, although we have nearly completed the first half of the nineteenth century, these labours still meet with no sympathy from either the profession or the public.

CHAPTER II.

INSTANCES OF THE RELATION OF PHYSIOLOGY TO PRACTICE.

A SHORT time ago I carefully examined a case of hemiplegia. I stated it as my opinion that the patient would die. Not many days afterwards, I visited another case: the hemiplegia was as decided; yet I prognosticated that the patient would survive.

In both these cases, the face, the tongue, the arm, and the leg, were completely hemiplegic. This paralysis is an affection of the *cerebral* system. But, in the first case, the *spinal* system was involved in the attack, and, in spite of every proper remedy, the symptoms of spinal affection continued unremoved: there were dysphagia, dyspnœa, — some defective action about the larynx and pharynx. In the second, the spinal system was spared.

Is it not interesting, at least, and something of a rather higher order than mere empiricism, to observe and trace these *physiological* phenomena?

If the case be limited to the *cerebral* system, the patient survives. If, with the cerebral, the *spinal* system be involved, and if this spinal affection does not speedily subside under the influence of the proper re-

medies, the prognosis is unfavorable, if not fatal. In the former case, the disease is limited to the cerebrum; in the latter, it extends, either in itself or in its influence, to the *spinal marrow*. I have traced some of these cases with the deepest interest, imparted by their physiological relations, and by the feeling that I was enabled to accomplish what a mere empiric could never pretend to do—that is, to *understand* my patient's case.

I was taken recently, by my friend, Dr. Webster, of Dulwich, to see a patient who, shortly before, had suffered from an attack of an epileptic character. He had recovered in every respect but one. On carefully listening to the posterior part of the thorax, I discovered a diffused but distinct mucous rattle. It was *bronchial*, without being *bronchitic;* for the patient had had no bronchitis. It was the *death-rattle*, not in the trachea, but in the bronchial tubes. It most probably arose from compressed pneumogastric nerves.

A patient was sent to me, a few days ago, attacked by what was designated and considered as severe bronchitis. And sure enough there was a mucous rattle diffused over the bronchial tubes. But, on a careful examination, I discovered that the heart was greatly dilated; and it became obvious that the bronchial affection was again *not bronchitis*. It was that affection of the bronchial membrane which, as I have described elsewhere, arises from impeded *arrière* circulation of the blood.

There is no more interesting *physiological* fact than that which we observe in every case of peritonitis, enteritis, &c. in the influence of affections of this class on the action of the heart, and on the circulation in the minute arteries and veins, and capillary vessels. The pulse is small. The surface, and especially the hands, become livid, cold, and clammy. Even in the tuberculous affection of the abdomen in adult persons, a great characteristic is a cold and livid state of the extreme parts of the frame—the hands, the nose, the ears, &c.

Is this influence of abdominal affection on the power of the heart of no practical interest? And is it not a physiological fact?

These affections, which implicate the *heart,* spare the *brain;* and the patient, when in articulo mortis, is perfectly conscious, and free from delirium, coma, or other affection of the intellect.

Another point of physiological interest is the effect of peritonitis, for example, on the function of the subjacent muscular tissue: *this is paralysed.* Purgative medicines and enemata are given in vain,—but not, I believe, with safety and impunity. The physiological fact suggests a most important therapeutical principle. Ought we to give purgative medicines, when the tissue which they excite into contraction is incapable of its function?

Very different is the effect of inflammation of the mucous membrane on the contiguous muscular tis-

sue, from that of inflammation of the peritoneum, just described. In dysentery there is frightful tenesmus; there is also strangury. In inflammation of the neck of the bladder, there are the same symptoms. These are reflex actions. A ligature on a hæmorrhoid produces the same effects. In all this there is a physiological interest and a practical value not to be mistaken, except by those ignorant of physiology.

It has often struck me as a fact full of physiological interest, that whilst in pneumonia, the lungs being supplied by the pneumogastric, there is *no pain*, —in inflammation of the pleura, supplied by the spinal intercostals, the pain is most acute.

The symptoms attendant on biliary and urinary calculi; the occasional but well-known consequences of passing a bougie along the urethra; and of irritating the meatus auditorius; are all facts which speak to the physiologist a language not to be misunderstood, but which a mere empiric will look upon with empty wonder.

These facts are sufficient. We cannot now walk through the clinical ward without having our attention continually drawn to the physiological relations of the nervous system especially, since the important division of that system connected with the spinal marrow has been distinguished. In many cases, we have to observe the cerebral, the spinal, the ganglionic symptoms, as we could not do before.

The condition of the circulating system, its central organ, its minute arteries, its capillary tubes, and its minute veins; the condition of the coronary circulation; the condition of the arrière circulation:—all this is physiology, physiology of the most interesting and *suggestive* kind—*physiology in the clinical ward!*

The physiology of the nervous system is the very *key* to the act of parturition, in its normal and abnormal forms, and the very foundation of the obstetric art.

In medical jurisprudence, physiology is every thing.

CHAPTER III.

EXTRACT FROM A LECTURE ON THE NERVOUS SYSTEM, DELIVERED AT ST. THOMAS'S HOSPITAL*.

'GENTLEMEN;—It is my duty once more—and most probably for the last time—to introduce to you the important subject of the nervous system.

Before I enter upon this precise subject, I must beg your attention to the two-fold aspect in which science in general, and physiological science in particular, may be viewed.

All and each of the sciences may be divided into two parts—*the Material* and *the Dynamic*—the facts—the laws—the results of observation, and the deductions of theory.

The observers in astronomy prepared the way for Kepler and Newton; the former of whom raised his science by discovering the three great *Laws* of the planetary motions; whilst the latter exalted it to its greatest height by establishing the THEORY of its dynamics.

In our own day and country, we are called upon to admire the genius of Faraday, the more than worthy successor of Davy, in the Royal Institution of

* In December, 1845.

Great Britain; and in another country, the labours of Liebig, in the now far-famed laboratory of Giesen.

It is invidious, perhaps, to contrast the labours of these philosophers, when all is so splendid and beautiful. Yet I think I may assert that the feeling of admiration induced by the contemplation of the dynamic, exceeds that of the material science.

What shall we say of *physiology?* *It* also has its dynamical and its material departments; the former embracing the motor and active powers in the animal œconomy; the latter, the forms and the material, the fluids and the solids, of which the animal frame is composed.

Hitherto the material has chiefly occupied the attention of the physiologist; and analysis and the microscope have been the chief means of investigation. Yet there *are* powers—there *are* dynamical principles in the animal œconomy, of the phenomena of which our senses are cognizant, as of those of electricity in its manifold and newly discovered relations to magnetism, heat, and light. It remains to deduce from these phenomena the *Laws* and THEORY of the powers on which they depend.

You are well aware that if, in a newly amputated limb, we irritate a nerve, or a muscle, by the probe or the forceps, a contraction of the muscular fibre ensues. There are, in the animal œconomy, a *vis nervosa*, and a *vis muscularis*—a power of exciting contraction, and a power of manifesting contraction.

These are *facts*. What place do the motor principles, evinced by these facts, hold in our works on physiology? Have the *Laws* of action and *physiological* application of the *vis nervosa* been investigated? I am compelled to answer—No! Hitherto it has been asserted that the *vis nervosa* acts only in the one direction, from nerve to muscle, or from the spinal chord to the muscles. As long as this idea prevailed, it had, and could have, no application to physiology.

And yet it is impossible that a power should exist in the animal œconomy, without having its appropriate use and function in physiology. Led by a train of experiments, the details and results of which I shall lay before you shortly, I resolved, if possible, to raise the veil which hung over this mystery. I discovered new facts, at variance with the received opinion; and I deduced from them *the physiological Law of action of the vis nervosa.*

There are again other facts scarcely less known to physiologists, although no such observations may have fallen under your own eye, as in the case of the *vis nervosa*, to fix them in your memory. In the decapitated animal,—the frog, the salamander, the tortoise, &c. &c.—when all sensibility, and all power of volition, when, in a word, all mental power is removed, there are movements of the extremities on irritating the cutaneous surface.

These facts were well known to Redi and Whytt,

to Legallois, to Blane, &c. and a vague relation had been noticed between them and certain very obvious symptomatic actions — as sneezing, coughing, — by Prochaska, &c. They were not only never claimed by me, but were expressly disclaimed in no less than *three* paragraphs (viz. § 7, 107, 129) in my very *first* Memoir on the Nervous System. One of these paragraphs (§ 7) also contains a remark on the subject of "*sympathetic*" actions; the whole constituting a remarkable reply, by anticipation, to numerous ill-natured and disreputable inuendoes about Whytt, Prochaska, &c. &c.

Neither the facts themselves, to which I have just adverted, nor the *motor principle* involved in them, had any application to *physiology*. Any such application was as hidden and unknown as that of the *vis nervosa*. It is this application, in both instances, and *not* the facts themselves, which I profess to have first discovered.

Before I quit this subject, I think it just to say, that it is not to Whytt, after all, that we are indebted for our knowledge of the facts in question. The reflex actions were amply detailed by Redi, as observed in the decapitated tortoise; and for our knowledge of the effect produced by removing the spinal marrow, we are indebted to Hales, who writes to Whytt in the following terms:

"Dr. Hales informed me, that having many years since tied a ligature about the neck of a frog, to pre-

vent any effusion of blood, he cut off its head, and, thirty hours after, observed the blood circulating freely in the web of the foot: the frog also at this time moved its body when stimulated: but that, on thrusting a needle down the spinal marrow, the animal was thoroughly convulsed, and immediately after became motionless*."

It would be easy to select passages from Whytt and Prochaska, to whom so much reference has been made of late, to shew their profound ignorance of the nervous system, as it is now understood.

It is not necessary for me to add any commentary. Both these authors have, doubtless, great merit; but they were both entirely and absolutely unacquainted with the distinct and exclusive *physiology* of the true spinal marrow, in the acts of ingestion and of egestion, in their relation to the preservation of the individual, and the propagation of the species.

It is to this large view of the subject that I shall beg to call your special attention. Do not be satisfied with any limitation of it to mere experimental facts, or to a few very obvious sympathetic actions; but inquire whether the subject has any dynamic, anatomical, physiological, pathological, and therapeutical relations. Inquire whether it can aid you in the clinical ward or the sick-room; whether it can assist you in the diagnosis of diseases, and in the choice of

* Whytt's Works, ed. 1768, 4to. p. 290.

their remedies. I am of opinion that a knowledge of the true spinal system is to diseases of the nervous system, what the stethoscope is to diseases of the thorax; not in the same degree indeed, but in a very useful degree, and in circumstances of still greater obscurity.'

CHAPTER IV.

A SUCCINCT VIEW OF THE NERVOUS SYSTEM.

THE cerebrum is the centre, to which all the nerves of *special sense* proceed, and from which all nerves of *volition* emanate.

The principal part of the nerves of touch and of volition take their course within the spinal canal, and may be designated—(and it is most essential that our terms be accurately defined)—the *spinal* CHORD *of intra-vertebral cerebral nerves.*

The ganglionic system is connected with the intra-vertebral nervous structure at each spinal space between the several pairs of vertebræ. This may be designated the *spinal* CONNECTION *of the ganglionic system.*

And this, I think I may assert, is all that was known of the intra-spinal nervous structure.

But we continually hear of the *spinal* MARROW. What is the meaning of this term, and what are its appropriate functions? The reply to these questions has, I believe, been afforded by my own labours; the result of which, notwithstanding all my opponents have been pleased to say, is the discovery of the true *spinal* MARROW, with its principle and modes of

action, its own special nerves, and its own special functions.

By means of the cerebral system, we are connected mentally with the external world; by means of the spinal system, every act of ingestion and of egestion is performed, the individual preserved, the species continued; by means of the ganglionic system, the ingesta are assimilated to the tissues, nutrition and growth are effected, the egesta are prepared.

These distinctions of functions are readily seized.

If the cerebrum, including the cerebellum, be denuded and irritated, no muscular contractions are induced. The cerebrum and cerebellum are *in*-excitor.

If the spinal marrow be treated in the same manner, violent muscular contractions are induced. The spinal marrow is *excitor*.

These facts are *constant*. They have been noticed by many excellent observers, in many careful experiments.

To the cerebrum, as *in-excitor*, must be added the incident cerebral nerves—the olfactory, the optic, the acoustic, &c. These are in-excitor.

To the spinal marrow, as excitor, must be added that system of *incident spinal* nerves recently discovered *as such*. These are excitor.

Through the medium of the cerebral nerves, *sensations* are induced in the mind, and, as consequences, perception, judgment and *volition*, and *voluntary motion*, on the one hand, and *emotion* with *emo-*

tional movements on the other, may occur. But the connection between these sensations and these muscular actions is neither immediate nor necessary. There is no such thing as 'sensational movements,' or 'reflex actions of the brain.'

Through the medium of the incident spinal nerves, a series of physiological muscular acts are excited, of a peculiar, special, and definite character, the acts following immediately and necessarily upon the appropriate excitant.

Such is the broad distinction between the cerebral substance and the spinal marrow, and their respective incident nerves.

The property which, absent from the cerebrum, is thus the exciting agent in the spinal marrow, has been designated by the term excitability by M. Flourens, by whom its existence or absence in the different parts of the nervous masses have been admirably traced. It ought to be called the excito-motor power. It was known as a mere *experimental fact;* its laws of action and its physiological relations being entirely unknown, until they were discovered in the course of my investigations. I have obtained the following important results:

1. *The true Spinal Marrow;*
2. *Its Reflex mode of Action; viz. of its Excito-motor Power;*
3. *Its Incident and Reflex Nerves, channels along which this Power acts;*

4. *Its Reflex Function*—
    1. *All the Acts*
        1. *Of Ingestion, and*
        2. *Of Egestion; in*
    2. *The Preservation of the Individual, and*
    3. *The Continuation of the Species;*
5. *Its Pathology;*
6. *Its Therapeutics.*

This is sufficient to give my reader an *idea* of the spinal system. It must be studied in my more elaborate works, if the reader wishes to become acquainted with it more particularly. I will conclude by the detail of an easy experiment, which any one may perform on the common frog:

1. Remove the brain;
2. Remove all the viscera.

The first operation removes the centre of the cerebral system; the second, almost every branch of the ganglionic.

3. What then *remains?* *The spinal* MARROW; the true spinal *marrow*, hitherto undistinguished from the spinal *chord* of cerebral nerves, and the spinal *connections* of the ganglionic system.

CHAPTER V.

ON THE INFLUENCE OF EMOTION.

THE influence of *Emotion* on the health, and in inducing and modifying diseases, is far greater than has been supposed.

There is good reason, I believe, for concluding that emotion, the passions, and the sense of pain, have their seat in the medulla oblongata, and their action, not along the *cerebral*, but the true spinal and the ganglionic nerves. The emotions remain when the cerebrum is reduced to its minimum; the arm, when perfectly paralysed to volition, in hemiplegia, is agitated by emotion; and, lastly, emotion exerts its influence on the heart, the intestinal tube, the secretions, &c.

Hope and tranquil joy, and the sense of duty, as in attendance on a sick child or parent, sustains the powers, which, in the last case, frequently decline fearfully when the object of care is removed.

The influence of expectation, hope, confidence, in sustaining the health of an army, is well known.

As a cause of disease, the influence of the more violent and painful emotions is most extraordinary.

But no cause of disease is more dire in its effects than *fright*.

Two cases of hemiplegia, under my care at this moment, were both induced by parental anxiety.

By far the most common cause of the accession and of the aggravation of the *paralysis agitans*, is emotion.

During the reign of terror in France, the Abbé ——— was seized by the mob, with cries of "à la lanterne!" By some good fortune he escaped; but he was ever afterwards subject to violent tremor of the limbs.

In one case, this disease was induced by the anxieties attendant on a ruinously expensive election for Parliament. This patient could not walk alone; but if his wife gave him her hand in the gentlest manner, he walked well enough. Any source of agitation or emotion paralysed him completely. He was always much worse after sexual intercourse.

In another case, also induced by anxiety about money, the patient was much better, when his son, having been entrusted with a large sum of money to take to the bank, delayed his return home by going to Sadler's Wells. The patient became infinitely worse, and almost hemiplegic.

I could adduce many examples of this kind. The paralysis agitans may, indeed, be viewed as a disease of emotion. It subsides at first during tranquil sleep. It is augmented by agitation, and in proportion to

that agitation, both in its tremor and its palsy. It is augmented by turbulent dreams.

Whatever the *cause* of *chorea* may be, this disease is greatly exaggerated by every exposure to agitation and emotion. Indeed, the muscular movements subside, at first, as in paralysis agitans, during tranquil sleep, and during perfect tranquillity of mind even when the patient is awake.

Another disease which is induced and renewed by emotion is epilepsy. Epilepsy of the most intractable kind has arisen from fright. Hope and expectation cure epilepsy for a time. Esquirol observes that a new remedy, given with expressions of confidence in its beneficial effects, always did good for a time. Despondency is as injurious.

There is a fact of a singular kind: I know a person who cannot attempt to untie a small knot without a sense of nausea. The case is not a solitary one. And Dr. W. Tyler Smith has related to me an instance of an epileptic girl who experienced an attack whenever she tried to undo a difficult knot in her work, which was tapestry.

Stammering would scarcely exist without emotion.

The same observation applies to that sort of nervous tremor which, for example, renders it almost impossible for certain persons to sign their name even, in public.

I need scarcely mention hysteria, which is emphatically the disease of emotion. Nor need I do

more than to advert to the phenomena of Mesmerism, Perkinism, &c.

The effects of the Royal touch, or that of a hanged man's hand—for the human mind is prone to extremes,—can only act by inducing emotion.

To retard the clock has postponed the expected paroxysm of ague.

Hope or despondency promotes or delays the act of parturition.

CHAPTER VI.

ON THE INFLUENCE OF SLEEP.

An interesting essay might be written on this subject. But my present object is only to make a few observations generally, in reference to what I have said in the last chapter.

I have there observed that emotion is sometimes the exciting cause of epilepsy. But so also is sleep. I will state what appears to me to be probable, on this subject.

Little or nothing is yet known of the immediate cause of sleep. I am of opinion, and I shall have to repeat the observation, that a state of contraction of certain muscles of the neck takes place, analogous to that of the orbicularis palpebræ, as sleeps comes on; that certain veins are compressed; that congestion of the brain takes place; and, lastly, as a consequence of this last, *sleep*. A similar event takes place, for a moment or two, in some cases, inducing that short oblivion, or epilepsy, of which Heberden gives so just a picture.

No wonder, then, that other and worse forms of epilepsy take place during sleep.

In sleep, the entire encephalon is in a state of congestion, the medulla oblongata included. The respiration is impaired.

There is but a step from this state of things to that in which the larynx is entirely closed, and in which complete epilepsy occurs.

Sleep, then, is allied to epilepsy.

The same remark applies to the crowing and other convulsive diseases—the epilepsy, in a word, of infants and children.

Emotion seems to induce epilepsy directly, by acting through the spinal system immediately.

Sleep induces epilepsy by allowing the excito-motor power to act uncontrolled by volition. (It allays the movements in the paralysis agitans and chorea, by allaying emotion.)

It is in the *first* or *deepest* sleep that the epileptic attack most frequently occurs; that is, generally about midnight. Two modes of prevention should be adopted: the first is an early hour in going to bed; the second, some slight movements and noises in the room, which, without startling the patient, should prevent the sleep from being profound.

The sleep should in no case be suddenly broken; nor should it be curtailed. In either case, epilepsy may be induced. A young lady, subject to epilepsy, rose early to go a journey. She had an attack, after a lengthened interval, in the coach.

The due treatment of epilepsy is not a very easy

thing. Our efforts may be frustrated in a thousand ways. It is especially in epilepsy that the words of Hippocrates, in the latter half of his first aphorism, are true. But this subject will be again noticed in the following chapter.

Sleep and emotion induce similar *results*, acting on different principles: in the former, the excito-motor power is permitted to act freely; in the latter, the muscular system is excited psychically. Certain muscles become contracted, and as the exterior vessels in blushing, so the internal vessels in sleep, become congested.

CHAPTER VII.

ON THE INFLUENCE OF THE MIND ON THE BODY*.

'NOT a thought—not a feeling—and especially, not an emotion—can occur, without its being impressed on the various parts of the animal frame. Hence arises the science of the Anatomy of Expression, in which every feature of the countenance, every limb of the body, is involved. Hence arises a peculiar department of the science of medicine, involving a thousand changes and affections—of the heart, the stomach, the secretions, &c. &c. with which the practical physician must be intimately acquainted.

But, in order that I may dismiss these general views, and arrive at once at views of a more individual character, I must beg to lay before the Society a brief—and very incomplete—arrangement of the mental conditions themselves. I may thus be enabled to trace their effect upon the animal frame and functions more distinctly.

* Being an extract from the Annual Oration delivered at the London Medical Society, in March 1845.

The faculties of the mind may be divided into—

1. The Intellect;
2. The Emotions;
3. The Desires or Passions;
4. The Instincts.

In connection with these, I must enumerate—

1. Attention;
2. Impression;
3. Temper;
4. Pain;
5. Sleep.

The first of these, or the Intellect, is displayed principally in the faculties of—

1. Sensation;
2. Perception;
3. Judgment;
4. Volition.

These are much modified by the exertion of *Attention*, and by the influence of *Impressions;* and they are nearly, but not entirely, suspended during *Sleep*.

The second, or the Emotions, consist principally of—

1. Hope;
2. Fear;
3. Love;
4. Hatred; &c.

The third, or the Desires or Passions, consist of—

1. The Appetite for Food;
2. The Sexual Appetite.

Lastly — the Instincts, seen principally in the lower tribes of animals, are certain phenomena which, if not entirely, are chiefly seen in connection with the Desires or Passions. They are principally observed, therefore, in certain acts which have an immediate connection with—

1. The Search after Food, and
2. The Production and Care of Offspring.

Before I proceed, I beg to be permitted to state, in what part of the animal frame, or system, each of these mental faculties may be supposed to have its seat.

The Intellect, then, seems to be seated in the upper part of the cerebrum. In proportion as the development of this is defective, the being is unintellectual; he is an *idiot.*

Its more manifest phenomena are connected with a certain set of nerves which may be termed Cerebral, and which are employed in conveying Sensations towards the central intellectual organ, and Volition from that organ.

The Emotions are, I believe, seated lower down. The idiot, though deficient in intellect, is frequently swayed by the most violent emotions, and especially by the most extreme Fear, and the most violent Anger.

The emotions display themselves principally, I believe, along that part of the nervous system which I have denominated the *true spinal*, or excito-motor.

The Desires and the Passions are seated lower

still. The idiot, who is so deprived of intellect as not to approach articles of food set before him even, swallows portions of that food placed within the mouth, with the most extreme avidity and voracity.

The Instincts appear to me to be complicated in a high degree; and to combine—1, an act of volition; 2, the display of desire and passion; and 3, an act, probably unintellectual, and of an excito-motor character.

The lark ascends the atmosphere by an act of volition, with the lively expression of a sexual passion, and probably keeps on the wing by an excito-motor act.

What the lark does for its mate, the swallow does in search of food. It undertakes a long flight or aërial journey, urged by desire, guided by its intellect, sustained by the excito-motor principle—which is not subject to fatigue,—with the express object of the search of food.

In the same manner, the bee provides its honey, and forms its honey-comb: this act combining mysteriously the influence of volition and of passion, whilst the actual deposit of its wax, and of its honey, may be effected, like those of deglutition and of inspiration—certainly not less wonderful or inscrutable, —by an excito-motor power impressed by the Creator for this purpose, as in other acts apparently of design.

Thus also the beaver builds its hut, and the bird its nest,—impelled by passion, guided by volition, and aided, probably, by the excito-motor power.

However the truth in all these points may be, I have ventured to throw out these hints for the consideration of those members of this Society who are interested in what I may justly term—the Philosophy of Medicine.

I now retrace my steps a little. And, in the first place, I wish to call the attention of my fellow members to the influence of an intense attention, a vivid impression, and of sleep.

I may first observe, that too intense attention, too long sustained, has produced its own baneful influence: the student for honours at Cambridge has too frequently induced fatal actions or disease in the brain or general system: such, for example, was the fate of Henry Kirke White.

Intense attention renders us almost insensible to pain, and singularly interferes with volition, and especially that kind of volition which is in constant operation in respiration and other functions of the œconomy, sometimes designated the 'mixed.'

There is no fact of which I feel more satisfied, than that there is a continual action of *volition* on many parts of the animal frame in which it is not always suspected. In intense attention, this influence is more or less withdrawn. Watch the person deeply engaged by an intellectual pursuit, as that of a deep mathematical problem: his breathing becomes impaired; it is audible, oppressed, suspended, sighing; &c. But look also at his countenance, his

limbs, &c. and observe the play of the 'anatomy of expression.' The same sort of phenomenon is observed in the engraver, the watch-maker, &c. Attention, then, diminishes or suspends the influence of volition, whilst it is itself impressed, in its own manner, on the muscular system. Intense thought and intense feeling produce the same effect, or rather a similar effect in a much higher degree.

The influence of volition is still further withdrawn in sleep, and the respiration becomes still more audible, and even stertorous, and the acts of deglutition, to remove the accumulating saliva, are sometimes suspended, leading to fits of choaking.

In these and other phenomena, the influence of volition is ascertained by the effects of its temporary removal. But there is no doubt that, in many other acts of the animal frame, in which it is supposed to have less to do, it performs a no insignificant part. Even the sphincters, acting as they do on the excito-motor principle, are guarded, on occasions of effort especially, by an energetic act of volition.

Certainly one of the most inscrutable phenomena, in connection with our present subject, is that of SLEEP. What is its immediate *cause* or *causes?* what its *nature?* If I offer a conjecture on this subject, it must be regarded as a mere conjecture.

Sleep, then, seems to be induced by any event which first gently excites and then gently lulls the attention. The influence of volition is removed. The

levator palpebræ, a purely voluntary muscle (?), is consequently paralyzed; and the orbicularis—a muscle purely of excito-motor action (?)—is allowed its uncontrolled play; and the eye-lids close.

Does any thing of this kind take place elsewhere? I have sometimes imagined that it does, and that it is *the* event which induces sleep. Certain muscles may be muscles principally of excito-motor action; and when volition is withdrawn from the other muscles of the neck, *they* may contract like the orbicularis, and gently compress the jugular veins, and so induce congestion of the brain, and sleep,—and, as we so often observe, attacks of apoplexy and of epilepsy. But I repeat that this is a mere conjecture—to be accepted for what it is worth, and a mere foil, if unfounded, to excite others to efforts more fortunate.

This subtraction of the influence of volition is seen in its effect on the countenance, and on the respiration, on the *approach* of sleep, as well as in actual sleep itself.

But the most extraordinary influence, and that to which our attention is continually drawn in practice, is that of a deep impression made on the mind under certain circumstances. There is no phenomenon of intellect, of emotion, of passion, on which this power is not to be traced.

Let a patient be impressed with the idea that he will do well, and he recovers; let him be impressed with the idea that he will die, and his disease terminates fatally.

No remedy ever performs the same wonderful cures in the hands of his successors, as in those of its original enthusiastic propounder. The sanguine physician, I am persuaded, cures more patients than the cold and phlegmatic, always auguring evil, and killing by his gravity of demeanour.

It was acutely observed by Esquirol, that a new remedy always made even the epileptic patient better. In the same manner, probably, is this malady sometimes cured by *musk*, on account of its remarkable odour; by *indigo*, on account of its deep blue colour; by the Hague medicine, because it comes from a foreign land; &c.

We all remember the cure of Dr. Clarke's ague by the fact of his acute friend's having put back the clock. We all have heard of the cure of the same extraordinary disease by the impression made on the patient's mind by being ordered to swallow a living spider enveloped in its own web.

I must here beg leave to adduce an interesting anecdote of the late Sir Humphry Davy.

"As soon as the powers of the nitrous oxide were discovered, Dr. Beddoes at once concluded that it must be a specific for paralysis. A patient was selected for the trial, and the management of it was entrusted to Davy. Previous to the administration of the gas, he inserted a small thermometer under the tongue of the patient, to ascertain the temperature. The paralytic man, wholly ignorant of the process to

which he was to submit, but deeply impressed, from the representations of Dr. Beddoes, with the certainty of its success, no sooner felt the thermometer between his teeth, than he concluded that the *talisman* was in full operation, and declared that he already experienced the effects of its benign influence. Davy desired his patient to renew his visit on the following day, when the same ceremony was again performed, and it was repeated every succeeding day for a fortnight, the patient gradually improving during that period, when he was dismissed as cured, no other application having been used than that of the thermometer."

The influence of the metallic tractors of Perkins, so admirably exposed by the late Dr. Haygarth, of Bath, was precisely of the same nature. And at this moment we hear of marvellous cures by merely wearing what is ridiculously designated the galvanic ring!

In this manner we explain the wonders of Homœopathy, of Mesmerism, &c. The principle of the influence of a deep impression has been the good fortune of quacks and quackery in every age.

What shall I say of amulets? What of the removal of warts by the touch of a piece of cloth, subsequently buried in the earth, to undergo decay, with which the subsidence of the disease keeps pace? what of the Royal touch? and what of the touch of a hanged man's hand? for here again extremes meet each other.

The truth is, that certain deep impressions, certain emotions, as hope and confidence, cure the patient; whilst other and contrary influences sink him into a state of dissolution. This is so true, that I always experience a painful effect from the expressions of despondency in acute, and especially in puerperal, diseases; and so, I believe, do surgeons, in cases of proposed severe operations: and I doubt not that the same feeling has been realized by every member of this Society, of some experience.

We all remember the fatal effect of a mock execution, so admirably pourtrayed in one of Miss Joanna Baillie's Plays on the Passions.

Another influence, not less marked, is that of monotony. To excite this influence is the secret of those who pretend to possess the power of inducing sleep. The *attention* is first gently excited. It is then gently lulled—by reading, or some continuous slight action of the attendant, by music, by rhythm, &c. Such is the influence—too often felt—of a dull book. Such is the only real influence of that delusion, Mesmerism.

The influence of music, and of rhythm in general, is extraordinary, and still almost untraced and unknown. The dancer, the dancer on the tight rope, the circus rider, would be incapable of performing their almost wonderful feats, without the constant aid of music. The influence of combined music and of rhythm, in mental diseases and extreme cases of emo-

tion, still remains open to full investigation. We all remember, I trust, the account of the balmy influence of the harp, in the hands of the Psalmist of Israel, on the mind of the wretched Saul*.

But nothing in medicine is more extraordinary than the influence of emotion.

Stammering, and chorea, and similar diseases, would scarcely be manifested at all without emotion. They are, on the other hand, observed to be greatly increased by every kind of mental agitation. Chorea and the paralysis agitans subside, at first, during sleep.

Hysteria is greatly a disease of emotion and passion itself.

Of all the diseases we are called upon to treat, I know of none more deplorable than those which arise from fright. The form of epilepsy arising from this cause is of the most intractable character. The tocsin, in the terrible days of the French Revolution, induced many a dreadful and incurable malady.

Fright frequently acts on the other systems. The tongue and the mouth become instantly dry; and cessation of the flow of the catamenia is frequently instantaneously induced by this emotion. Dr. Bateman briefly details the case of a poor woman, who, fearing that her little property was lost, became affected with dropsy and icterus.

* I Samuel, xvi, 23.

The action of emotion on the skin, on the kidneys, and on the intestines, is well known. The hair is said to have grown white during a night of fearful agitation—its colour having, I suppose, been destroyed by some morbid secretion from the skin. I have recently known the teeth to decay in an extraordinary manner in a few weeks, as the effect of painful emotion, more allied to fear than any other.

It is obvious, from these observations, that emotions act principally through the spinal marrow and the ganglionic system.

Grief produces a feeling of oppression in the breathing which is almost insupportable; and it induces actual and intolerable pain in the region of the heart, doubtless affording the origin of that too true designation—the heart-ache.

I say nothing of the more common phenomena of emotion in quickening and augmenting or diminishing the action of the heart, suffusing or blanching the cheek, &c.

What is the conclusion from all that has been said? Certainly that, as Sir Gilbert Blane formerly expressed it—"Those who conceive the whole art of medicine to consist in wielding the powers of the Materia Medica, entertain a narrow and unworthy conception of their own duty, and of the value and dignity of their profession.*"

* Elements of Medical Logic, 1821, p. 13.

The physician should inspire *hope*. There is no more real cordial. He is not to state a falsehood—he is not to do evil that good may come; but also he is not to be the continual augurer of misfortune. He may cheer, as Celsus beautifully and classically expresses it, 'probabili sermone.' He should be of a cheerful, not of a rueful, countenance. He should know that looks and words cure and kill, and act accordingly. One of the most successful practitioners of the present day is possessed of the most perfect gaiety of mind; and I think I know another, in the same department of practice, whose too serious and lugubrious gravity mars what would otherwise be his just degree of success.

But to return to my subject. The influence of emotion on the appetites is not less marvellous than those to which I have adverted. I need scarcely recall to your mind the well-known words addressed by Henry the Eighth to Cardinal Wolsey:

> Read o'er this,
> And, after, this; and then to breakfast, with
> What appetite you may.
>
> ACT III, Sc. 2.

I have recently known a painful emotion to change a moderate appetite into the most painful and absolute disgust for food, in a moment of time.

Nor need I recall to your mind the advice given by that original man, John Hunter, to the young and newly married husband, who was in absolute despair

on account of an imagined, and, as he supposed, an incurable impotence.

I have hitherto chiefly noticed the baneful influence of the emotions or passions too justly denominated the depressing passions. But who has not seen the sunken and pallid countenance rounded and coloured, by the improved circulation of its blood, under the influence of hope, joy, and happy love?

Before I conclude, I would briefly advert to that form of paraplegia which is, I believe, the effect of sexual excesses. The limbs, the sexual organs, are paralyzed; there is no morbid appearance on dissection. It is the exhaustion induced by repeated shock. It may well be classed amongst the most deplorable of diseases, whether we contemplate it in reference to its causes or its effects. It is like the dementia arising from an over-wrought brain.

There are still two other topics to which I must advert briefly: 1, that of *temper;* and 2, that of *pain*.

It is astonishing how frequently temper mingles itself with the worst forms of hypochondriasis, and even with actual insanity. The physician would be totally incompetent to understand these diseases, without a full and previous knowledge of this strange mental condition. I now speak of the adult male subject. In females, and in boys, I have repeatedly known temper to constitute the sum and substance of the whole malady, disguising itself in every extraordinary form.

There is an interesting fact which I cannot pass over: a disgusting object frequently acts on the spinal and ganglionic systems so as to induce sickness and faintness. This has been called a reflex cerebral action. It is mere emotion.

Another fact, of no less interesting kind, is that of the absolute, though temporary, paralysis induced by a smart blow on the tibia. Is this the result of pain, or of shock? I imagine the latter. The fact may be associated with that form of paralysis observed in teething.

Of pain, I have only space to observe, that its central seat seems, from an experiment, to which I was witness, by M. Longet, of Paris, to exist when *every* part of the encephalon, with the sole exception of the medulla oblongata, is removed. It is also certain, I think, that it has its further seat, in many of the cases which come before the physician, in the *ganglionic* system.

If this view of the subject be just, it follows that the trifacial nerve, so subject to be the seat of pain, contains ganglionic filaments, of which, indeed, from other considerations, there is little doubt.'

CHAPTER VIII.

GALVANISM AS A TEST OF THE IRRITABILITY OF THE MUSCULAR FIBRE.

In the nineteenth chapter of my former volume of Observations and Suggestions, I treated of the question of the irritability of the muscular fibre in paralytic limbs, and pointed out the erroneous mode of applying the galvanic influence, as a test of this property, employed by Dr. Pereira and Dr. Todd. I now proceed to lay before my readers some further observations on this subject.

I have already stated, that, in using the magneto-electric machine, and solutions of salt, those gentlemen had deviated from the original experiment, which they controverted. I am now enabled to say, from fresh investigation, that the results which they obtained were the results of their mode of proceeding, and not in the least contradictory of my own.

Suppose two sets of muscles,—one less nourished, perhaps, but of higher irritability,—the other well nourished, but of comparatively low irritability; and suppose a very mild galvanic shock to be passed through both; what will happen? The more irritable muscle will manifest its irritability, whilst the other

may be motionless. Now suppose the same muscles exposed to violent magneto-electric influence; the *effect* being compounded of the strength and size of the muscle, its irritability, and the stimulus, the larger and stronger muscle may contract the more forcibly of the two, though its irritability be less. And thus it was in Dr. Pereira's and Dr. Todd's experiments.

To determine the question of irritability, the galvanic influence must be used in the *mildest* form which will induce a *perceptible* effect.

It should be *influence* too, and not *shock*. Now the magneto-electric machine shocks; the addition of salt to the water in which the hands are placed, also adds to the shock, the *quantity* of galvanic influence remaining the same.

The shocks of the magneto-electric machine are too rapid too, to admit of the effect being accurately observed. From all these circumstances, the shock of galvanism is too much *felt* by the patient; there is alarm, and there is wincing, and the result is obscured. In a word, this mode of applying galvanism is no accurate *test* of *irritability*.

In order to employ galvanism as a test of the susceptibility of the muscular fibre, its force and tension must be less, its course rendered less rapid and sudden. The common galvanic trough should be used; the water should contain no salt; sometimes a less perfect conductor than a metallic wire should be used,

as a wet string or thread. There should be no violence.

There is another point of great consequence. The *copper* end of the trough affects the muscles more than the *zinc* end. The trough should be reversed again and again, in order to determine the question of the comparative irritability of the healthy and the affected limb accurately. Or, what is better, one and the same shock should be passed along both limbs. To accomplish this, both hands should be put into the same basin of water, and a piece of copper plate placed over eight or ten folds of wet linen, on the sternum, for instance, and the galvanic influence is made to pass from the water to this copper plate ; it passes, of course, in an *equal measure* through both arms, and, these being exposed, the comparative contraction of their muscles is readily and accurately observed.

These and all other precautions being observed, I am enabled to repeat my first observations, and to declare that those of Drs. Pereira, Todd, and Copland, are erroneous. Within the last fortnight, Dr. W. Tyler Smith and I have galvanized three patients together, with every precaution to obtain accurate results : one of them was a case of spinal paralysis in the face, from affection of the facial nerve ; the two others were cases of hemiplegia. The results were those formerly obtained. The paralytic side of the face was less agitated by the galvanism than the un-

affected side; the hemiplegic hands were moved by a less degree of galvanic influence, and more by a moderate degree of this influence, than those unaffected by loss of voluntary power.

Still I propose to examine this subject anew. We *must* be accurate. And if the fact prove to be as I have stated it, it affords us a most important diagnostic in some very obscure cases of paralysis, and explains some interesting physiological and therapeutical phenomena.

CHAPTER IX.

ON A CERTAIN FORM OF PARALYSIS IN CHILDREN.

THERE is a peculiar and most interesting form of paralysis in children, on which I propose, in this chapter, to make a few observations.

The child is probably teething. I mean that teething is probably the *cause* of the affection which I am about to notice. There are frequently some spasmodic action and some paralytic condition combined.

In one case, the fingers and thumb of the left hand were slightly contracted and distorted, whilst the right foot was spasmodically drawn inwards, and the left leg was completely paralytic, without spasmodic affection. The paralytic limb was cold and livid, and its muscles less developed than those of the other leg.

In this case, the little patient was brought to me when it had laboured under this sad affection for a considerable time. A similar case, happily of short duration, is described in my volume on the Diseases and Derangements of the Nervous System, p. 198, and another of rather different character, p. 197. The former was paralytic principally; the latter, spas-

modic principally. In the one which I have just briefly sketched, the spasmodic and paralytic characters were combined.

What is the cause—what the nature—of the affection? Can teething, besides producing a severe but transitory effect, exert this chronic influence?

In order to understand the possibility of this conjecture, we must not look upon teething as a mere process of cutting through the *gums*. We must direct our attention to the condition of the bony *sockets* of the teeth during the continued process of teething. We must consider the condition of the nervous and of the sanguineous systems *within* those sockets:—the augmented nervous and vascular functions: the pain, the irritation, the augmented action and congestion of the vessels, the unyielding nature of the case of bony structure in which these take place. There is spasm; and if paralysis may be induced by this cause at all, we may readily conceive how it is so induced permanently.

And then the questions arise—are these effects the immediate effects of teething on the dental nerves? or are they induced through the medium of some morbid condition of the spinal marrow?

This is a question which, I think, has never been investigated in the only way in which an accurate result can be obtained—by careful post-mortem examination. It is therefore all conjecture.

I may here remark, that many diseases, besides

the one to which I have alluded, have a tendency to combine spasmodic and paralytic affections: such are the paralysis agitans and chorea; such are some cases of hemiplegia, not yet fully investigated. For instance, I have a patient, affected by hemiplegia, with slight clonic spasm of the affected side of the face, and a degree of contraction of the hand beyond what, I imagine, would arise from mere augmented muscular irritability.

Altogether the subject of paralysis is not likely to be treated with all the accuracy required for its investigation in mere dictionaries, or other works of compilation.

To return to the subject of teething, and of dental irritation and paralysis. If the case be as I have stated, how futile must the ordinary mode of lancing the mere apices of the gums be! To relieve the state of the alveolæ to which I have adverted, we must scarify the gums immediately contiguous to them; we must divide the very blood-vessels which feed them!—frequently—daily, or two or three times a day. But to this simple proposition objections still are made. Alas for our profession!

A series of well-conducted thermometric observations on the mouth during teething would be highly interesting, and, I think, not without its beneficial influence on our practice. Is the temperature augmented by the dental process? Is it diminished after free scarification of the adjacent gums?

It is an interesting question, why the first dentition should be so much more injurious in its influence than the second. I would observe, that, in the first place, the first dentition is more general over the whole jaw; and in the second, it occurs in a more susceptible condition of the nervous system, than the second.

CHAPTER X.

IDEA OF PHYSIOLOGY; MIND, NERVE, BLOOD, MUSCLE*.

THE highest order of faculties in man and animals are those of the mind; and the object of all the rest of the animal œconomy appears to be to prepare and maintain a structure, the cerebral system, as a seat for these faculties. They are *psychical.*

The principal of these faculties have been enumerated, p. 30.

The rest of the animated being—the general fabric of the animal frame and œconomy, is divisible into THREE parts or systems:

I. The Sanguineous,
II. The Nervous, and
III. The Muscular.

The first of these relates to the *material,* the second to the *excitor,* the *third* to the *motor,* portions of that being. They are *physical.*

The bones, the ligaments, the cartilages,—the cellular and other membranes,—merely afford *support* to the three systems to which I have adverted, being

* Being an extract from a Lecture delivered at St Thomas's Hospital, on the 1st of October, 1844.

themselves supported and nourished by them. They are mere scaffolding.

The constituent parts of the three-fold system to which I have last adverted, are mutually and essentially dependent on each other. They are like the reciprocal supports of a tripod,of which if one were to fail, the whole would fall. There are not cause and effect; but all and each are equally cause and effect, equally supporting and being supported. All this conveys to my mind the idea of Creation!

1. *Of the Sanguineous System.*

In the designation, Sanguineous System, I include all that is *material* in animated being. Cuvier beautifully described that being as a TOURBILLON, into which parts of the external material world were continually being drawn, and from which, after the strict approximation and assimilation of a portion, the rest were expelled.

"La vie est donc un tourbillon plus ou moins rapide, plus ou moins compliqué, dont la direction est constante, et qui entraîne toujours des molécules de mêmes sortes, mais où les molécules individuelles entrent, et d'où elles sortent continuellement, de manière que la *forme* du corps vivant lui est plus essentielle que sa *matière*.

"Tant que ce mouvement subsiste, le corps où il s'exerce est *vivant; il vit.* Lorsque le mouvement s'arrête sans retour, le corps *meurt.* Après la mort,

les élémens qui le composent, livrés aux affinités chimiques ordinaires, ne tardent point à se séparer, d'où résulte plus ou moins promptement la dissolution du corps qui a été vivant. C'était donc par le mouvement vital que la dissolution était arrêtée, et que les élémens du corps étaient momentanément réunis*."

In man and the higher orders of animals, the acts of ingestion are principally exerted on *masses* of the external world; those acts are performed by appropriate nerves in connection with the spinal marrow, and appropriate muscles.

It is within the cavities of the stomach and lungs that the materials so ingested in the mass are brought into contact with the nervous and muscular systems, to be acted upon particle by particle.

In the various orders of animals, and in the various conditions of the same animal, various quantities of food and of atmospheric air are ingested. These are proportionate to each other. And, as I shall have to observe shortly, they are inversely proportionate to a singular property observed in the muscular fibre; viz. its irritability, or faculty of contraction on the application of a stimulus.

This remarkable relation of the quantity of food, of respiration, and of the irritability of the muscular fibre, I observed on in a paper read before the Royal Society, and published in the Philosophical Transactions.

* Règne Animal; Paris, 1829; tome i, pp. 11—12.

It has since been amply confirmed, in reference to food and air, by the celebrated Prof. Liebig, to whom now belongs, almost exclusively, the physiology of the *material* of animated beings, and to whose work I beg to refer you, whilst I proceed to point out to you the course—the channels and organs—along which the blood flows.

The blood may be said to circulate between—

I. *The Organs of Ingestion.*	II. *The Organs of Egestion.*
i. e. chiefly	*i. e. chiefly*
1. *The Stomach;*	1. *The Kidneys;*
2. *The Ileum;*	2. *The Colon;*
3. *The Lungs;*	
4. *The Liver;*	
5. *The Lacteals;*	5. *The Secernent,*
6. *The Absorbents.*	6. *The Nutrient Vessels.*

By means of

1. *The Veins;*
2. *The Heart;*
3. *The Arteries;*

which are mere machinery to effect, in

4. *The Capillaries,*

the irrigation of the tissues.

In all this course, the blood is propelled by the action of the heart alone; at least, after much atten-

tion, and repeated examination of the subject, I can detect no other motive power.

Doubtless there are powers, however, which *modify* the circulation of the blood. The phenomena of secretion; of blushing; of the erectile tissues; of inflammation, and other morbid processes; sufficiently demonstrate this fact. The venous circulation is greatly accelerated by muscular contraction.

It must be observed, in the first place, that the phenomena of secretion are not phenomena of the *circulation*, properly so called; they do not take place in any part of the vessels of the circulation,—veins, arteries, or capillaries; *but in a system of vessels apart;* viz. the secretory, nutrient, or excernent vessels; and of the distinct nervous and muscular action of these vessels there can be no doubt. It is probable that each of these vessels is supplied by a sphincter, with all the properties of that singular structure.

The phenomena of the erectile tissues are probably phenomena of *obstruction*, rather than of action; and those of inflammation are connected with *physical* changes, and not merely by modifications of action.

2. *Of the Nervous System.*

So much has been said recently on the subject of the nervous system, that it is quite unnecessary for me to expatiate upon it at any length at the present moment.

I will, however, take this opportunity of stating, that what the heart is to the circulation of the blood, the spinal marrow is to the functions of the nervous system—the very source and centre of its operations.

This it is exclusively of the brain or cerebrum, an organ as different in its qualities and functions from the spinal marrow, as this latter is from the heart itself.

The special functions of the spinal marrow are two:

It is the central organ of *all* the acts of ingestion and of egestion in the animal œconomy, as much as the heart is the central organ of the circulation of the blood. In these acts, the *mode* and *form* of its operation are equally peculiar: the former is *excitor*, the latter is *reflex*.

The intra-spinal structure is also the central organ of the ganglionic system. I formerly supposed that the ganglia were themselves the centre of this system—an opinion founded on an experiment, the accuracy of which I am now led to doubt. It is possible, by a peculiar mode of proceeding, to destroy or remove the spinal marrow, leaving the circulation of the blood subsistent. In this case, if the stomach, or intestine, or one of the limbs, be crushed, it seems to arrest the circulation entirely and at once; the injury acting, of course, through the medium of the ganglionic system only. Dr. Stilling has recently stated that when the spinal marrow is entirely absent, no such effect is produced. He has not, I be-

lieve, deduced any inference from this experiment. The obvious inference would be, that the intra-spinal structure, and not the ganglia, is the centre also of reflected influence on the heart, and probably on all the internal organs. But the experiments require careful repetition.

If, then, the spinal marrow be, as I have stated, to the nervous system, what the heart is to the sanguineous, the reflex function, in its fullest extent, may well be compared to the circulation.

The organs of secretion afford points in which the two systems mysteriously meet and combine their functions.

3. *Of the Muscular System.*

As the characteristic property of the spinal marrow and its dependencies is the *vis nervosa*, the peculiar property of the muscular system is a *vis musculosa*, or irritability, or contractility, as it has been variously designated. By Haller, its chief discoverer, or propounder, it was designated irritability; which term I shall, in respect for that distinguished name, continue to employ.

The most distinct *test* of the irritability of the muscular fibre, is galvanism; see Chapter VIII; and, so tested, it is found that, in the different tribes of animals, irritability is inversely proportionate to the quantity of respiration.

The muscles of the frog are made to contract ener-

getically by a degree of galvanic influence which would not produce any obvious effect on the muscles of a bird, or of one of the mammalia. Now the frog is an animal of low respiration, whilst the bird-tribe and the mammalia are animals of high respiration.

Life is, indeed, *a forced state.* It consists of the action of stimuli on organs of susceptibility to those stimuli. It is chiefly through the lung, but also through the stomach, that those stimuli are conveyed to the interior of the animal frame; and, accordingly, as air and food are equally stimuli, the high breather is found to be a high feeder also.

The different *modes of life* depend upon the different degrees of stimulus and of susceptibility respectively: animals high in the scale, are animals of high stimulus, and low susceptibility; animals low in the scale, on the contrary, are animals of low stimulus, and high susceptibility. Of susceptibility, the irritability of the muscular fibre, and the excito-motor property in the nervous fibre, may be taken as the most prominent instances.

In a hot climate, or heated atmosphere, the respiration is less, the life more *reptile;* in a cold season, we breathe more, and with less irritability of the muscular fibre, there is more activity from augmented stimulus.

Muscular irritability obeys its own laws: it is augmented by repose, as in hemiplegia; it is diminished by exertion; it is augmented, even in the

same animal, by diminution of breathing, and diminished by the augmentation of the respiratory process.

The irritability of the muscular fibre is therefore augmented by *sleep;* for then there are both repose and diminished respiration: it is diminished by activity; for then muscular effort conspires with augmented respiration. It is, probably, in some degree, in this augmented irritability of the muscular fibre that the recovery from fatigue during sleep consists.

This effect of sleep is seen in its highest degree in the cases of those animals which pass into a state of hibernation, or diurnation, or of quiescence, during the winter season, as the hedgehog, or in the daytime, as the bat. In this condition, the respiration is reduced to the lowest degree, and the irritability augmented to the highest of which the animal is susceptible.

But the due condition of the irritability of the muscular fibre is linked with a due connection with the chief seat of the vis nervosa, and with a due supply of blood. If the femoral nerve in the frog be divided, the irritability of the muscles of the leg becomes diminished. I have not yet tried the effect of dividing the femoral artery, or otherwise diminishing the energy of the circulation in the limb, which I intend to do.

The muscular system may be acted upon either through the medium of the spinal marrow, or immediately: of the former mode, the action of the douche of cold water upon the uterus affected by inertia af-

fords a most interesting example; of the latter, I have this day the pleasure of bringing before you a new and most valuable illustration.

I am indebted for it to an able and experienced physician of Manchester, Dr. Radford, who does us the honour to be present on this occasion. In a case of uterine hæmorrhagy from inertia, Dr. Radford passed the galvanic current from a metallic disc introduced into the vagina, to a piece of metal fixed near the umbilicus. The effect was instantaneous; the uterus contracted—the hæmorrhage was arrested. In a case of inertia of the cervix vesicæ with enuresis, a similar beneficial result was obtained by a similar measure. The sphincter resumed its functions, and the urine was retained. This is one of the most promising applications of galvanism, and its novelty is as great as its promise.

I may now resume, and observe that—

1. The blood is essential to the action of the nerve and muscle.
2. The nerve is necessary to the action of the blood and muscle.
3. The muscle is necessary to give the due impulse *to* the *blood* and *on* the *nervous masses*: thus—

If the blood be defective, in quantity, quality, or impulse, the actions of the nervous and muscular systems cease. Withdraw blood to syncope, or sinking, and the respiration and the action of the heart fail—

either as a phenomenon of nerve or muscle, or both; the sphincters yield, the balance of absorption and secretion in the lung is broken.

If the nervous influence be defective, the phenomena of the sanguineous and muscular systems are interrupted. In the case of divided pneumogastric, the circulation and its phenomena, in the lung, are impeded; in the case of divided muscular nerve, the muscle soon loses its irritability, and its nutrition is impaired.

If the muscular influence be withdrawn, the phenomena both of the sanguineous and nervous systems cease in their turn: a due degree of *pressure* on the blood, the result of muscular action, is essential to the action of the nervous masses, and to the formation of the various secretions.

In this manner, we see how mutually and essentially dependent are the sanguineous, nervous, and muscular systems. They constitute, in their several and mutual action and reaction, the phenomena of mere *life*. They are supported by the other structures, which they mysteriously form; and they support, in their turn, the brain, on which the mind is enthroned—the highest part of animated being! To this latter end, indeed, do all things else appear to be created, whether in man, or in the animal creation.

Each of these systems, whilst it concurs in sustaining the other two, seems to have a double relation to the physical world by which we are surrounded:

one of these is that of ingestion and egestion; the other, that of assimilation.

The animal being is, in this world, continually appropriating to itself portions of the surrounding material substance: processes of ingestion are continually being carried on. Proper cavities or reservoirs exist for the reception of these matters, and the act of ingestion is performed by muscular agency, under the nervous influence—again demonstrating the mutual influence and co-operation of the three systems of blood, nerve, and muscle.

The facts of appropriate cavities and of muscular agency, in the acts of ingestion, have always formed a part of physiology; the relation of the nervous system to the acts of ingestion has been developed by my own labours.

By the acts of ingestion, deglutition, and inspiration, portions of the external world are taken into the animal, in *masses*: muscular acts, under nervous influence, bring these portions of matter into appropriate cavities, the stomach and lung, and, in them, into immediate contact with those parts of the nervous and muscular systems which act on the *particles* of matter.

In the molecular action of matter, we again see the three systems of blood, nerve, and muscle, involved: in this manner we are constrained to view every case of absorption, secretion, formation, development.

CHAPTER XI.

THE DURA MATER EXCITOR; DIAGNOSIS OF DISEASES OF THE BRAIN.

THE dura mater is supplied by the trifacial nerve. See Arnold's Icones, Tab. II. I was anxious to determine whether, being so provided with a nerve usually excitor, this membrane was, in fact, in itself excitor; and I performed the following experiment, with Mr. H. Smith. I give it in both my own words and those of Mr. Smith, on account of its importance.

The application of the results of this experiment to the diagnosis of diseases within the cranium will be obvious. But it requires to be carefully and cautiously traced.

Injuries and diseases of the dura mater, and probably of the other membranes of the nervous centres, and diseases affecting them secondarily by irritation or pressure, may be attended with spasmodic affections. This is the important fact.

June 10, 1841. We removed a portion of the cranium of a spaniel dog, just over the *left* hemisphere of the cerebrum.

We made pressure—gradually augmented: the dog became quiet, appeared to sleep; the eye-lids

closed; the breathing became audible, stertorous, slow, sighing, the pupils contracted; at length, spasmodic twitchings were observed, and, afterwards, continued spasms; the eyes rocked, the tail was drawn, and then all the limbs were agitated and became stiffened.

We removed the pressure, but the brain had been torn; the spasms ceased, the breathing became natural, the eye-lids opened, but the pupils remained contracted. The dog was *hemiplegic*, supporting his *right* side against the wall. We repeated this; the result was the same.

We irritated the *nostril* and induced *sighing*, sometimes followed by sneezing, sometimes not. We irritated the meatus auditorius externus, and the head and limbs were much agitated. Sensibility was not entirely removed.

We removed the cerebrum entirely: the pupils became permanently *dilated*. On irritating the motor oculi, the eye-lids were a little drawn by the corrugator supercilii, and closed and drawn towards the outer angle of the eye; but there was no action of the *levator*. The eyes rocked.

On irritating the *dura mater* in various parts, these and other movements were also induced.

On drawing the cerebellum forwards, convulsive movements were induced; but neither laceration of the cerebrum nor cerebellum seemed to induce muscular contraction.

When the animal appeared *blind*, approaching the candle induced closure of the eye-lids; as did always touching the eye-lashes.

The flow of saliva was constant, and in large quantity.

June 10, 1841. In a spaniel dog, a portion of the skull was removed by the trephine; but, from the thickness of the temporal muscle and the effusion of blood, it was very difficult to accomplish; the instrument therefore penetrated through the dura mater into the brain. The immediate effect was paralysis of the opposite side of the body; the animal, when placed on the ground, falling on that side, and being unable to rise. It managed, however, to struggle to the wall and corner, when, on being raised, it supported itself by leaning the paralysed side against it. The pupil of the eye was contracted on the application of light, and continued so. On introducing the finger and pressing on the brain anteriorly, the eye-lids closed, and the animal appeared as if asleep, breathing heavily. On increasing the pressure, the breathing became stertorous, with occasional, long, deep inspirations; and increasing the pressure still further, produced convulsions of both sides, the limbs of the paralysed side being stiffened; there was quivering of the eye-ball. On relaxing the pressure, the animal returned to its former state. The same effects were produced by pressing the finger to the

back part of the brain, but in a more marked degree, the convulsions being stronger, and the breathing, at last, all but suspended. This was frequently repeated, with the same results. The passing the finger backwards and forwards before the eye produced no effect; but the close approach of a lighted candle caused the eye-lid to close slightly. Touching the eye-lashes and lid produced closure. The cerebrum was next completely broken up and removed, and the top of the skull taken off. The pupil of the eye became very much dilated, and the animal lost all sensation. The cerebellum remained; the cerebrum being removed to the tentorium. The breathing continued good. The eye-lid closed on irritating the lash, and the reflex functions were entire. Pressure on the cerebellum and medulla oblongata, through the opening of the tentorium, produced convulsions and laborious breathing, which was afterwards nearly suspended. On removing the pressure, the animal recovered.

On pinching the third pair of nerves, the eye was unaffected, the lids closed, and the lower lid was drawn up by the actions of the orbicularis. Irritating the dura mater, lining the interior of the skull, produced twitchings of the muscles about the head and eye-lids. The breathing continued full an hour after the cerebrum was removed; so as to allow frequent repetitions of the above observations. The cerebellum was next partially removed, and pulling it with the forceps produced convulsive movements, by stretch-

ing the medulla oblongata. The medulla oblongata and upper part of the spinal marrow were now destroyed; this produced convulsions, and the animal ceased to breathe.

There are, doubtless, analogous facts in diseases and injuries of the head; but they are to this day undistinguished and unacknowledged in practice.

I have just carefully observed the case of a gentleman, which combined, in one attack, loss of smell, and taste, and slightly of hearing, spasmodic affection of the face, and general convulsion. Is not this an example of disease at the base of the brain, compressing the nerves and irritating the dura mater?

CHAPTER XII.

THE COMPLEX NATURE OF AN ACT OF VOLITION.

An act of volition is not so simple a matter as it is generally imagined to be. It is modified, not to say perfected, by sensation, by emotion, and by the excito-motor power.

If the sensation in the fingers be lost, a cup cannot be held by them safely without the constant aid of vision. I have a paraplegic patient, who, unable to walk or sustain himself perfectly in the light, loses even this power in the dark.

The same patient walks tolerably well when alone and feeling safe in the country, but loses that power when in the crowded streets of London. Emotion paralyses him completely.

I have detailed, in another work, the circumstances of a patient, who can use his pen for a moment or two; but, in a few moments more, the fingers become twisted, as it were, and he cannot write another word,—an action of the vis nervosa.

This is a subject worthy of the most careful and attentive investigation, both in a physiological and practical point of view.

It is interesting to observe the phenomena in limbs from which the influence of volition is withdrawn, as in hemiplegia: the fingers and wrist, for instance, are contracted. This contraction is partly owing to the influence of emotion, and ceases during quiet sleep, and partly to the action of the excito-motor power, uncontrolled by volition. These phenomena distinguish the different kinds of cerebral paralysis, and cerebral from spinal paralysis. In the last, unconnected with *irritation* of the spinal marrow or nerves, there is no spasmodic affection.

In other cases, volition exerts an unsuspected influence. See p. 33.

CHAPTER XIII.

THE CONDITION OF THE HEMIPLEGIC HAND.

I HAVE already adverted to the contracted state of the fingers, hand, and wrist, in hemiplegia, the result of the influence of emotion, and of the excito-motor, acting on muscles uncontrolled by volition.

But other changes are observed: the skin becomes remarkably smooth, the nails adunque, the colour venous, the surface cold and damp; and, in the case of a hemiplegic idiotic little girl, the fingers and hand, and the foot, of the paralysed side were affected in an extraordinary manner with chilblains.

The cause of all these phenomena seems to be the want of the propulsion given to the venous blood by frequently repeated and energetic acts of volition. These acts are, I am persuaded, a far more effective cause of the venous circulation even than has been hitherto supposed.

For want of these, the hemiplegic limb is impaired in its nutrition; and so far their place may be supplied by the persevering use of galvanism (as Mr. Barlow has proposed, in the former volume of these 'Observations and Suggestions,' p. 350), shampooing, &c. with voluntary muscular *efforts*.

This again is a subject for new investigation.

CHAPTER XIV.

ON THE NATURE OF INFLAMMATION*.

THE subject of this communication constitutes the basis of pathology, and therefore of medicine itself. It may be regarded as the first and most important to which the attention of the physician can be called. The *seat* is obviously in the *minute* vessels of the circulating system, generally speaking. It is therefore on our knowledge of these that our investigation of inflammation—of its nature and of its more precise seat—must proceed.

1. *Idea of the Circulation.*

I propose, therefore, to commence this paper by giving a brief account of the circulation.

The circulation has usually been described as carried on by means of the heart, arteries, capillaries, and veins. What the precise notion attached to the term capillaries has been, it is difficult to say; for we read of capillary arteries, and capillary veins. I conclude, therefore, that no very distinct idea, further than that of minuteness, has been in reality attached to this term.

* Being the substance of a paper read at the Medical Society of London, October 17, 1842.

I, however, am of opinion that the *true capillaries* constitute a totally distinct order of vessels, of the very utmost importance in the animal œconomy—nay, the end, *the object* of the whole circulatory apparatus. It may strike the members of this Society with surprise, if I assert that these vessels have not hitherto been described. Yet such I believe to be the fact.

The veins, the heart, and the arteries, are, in my view, but mere machinery, to conduct the blood from, and to, the true capillary vessels. In these vessels, a function is performed which I can only compare to the *flooding* or *irrigation* of a meadow, by which the soil and its roots are fertilized. The veins, heart, and arteries, are, as I have said, the *machinery;* the true capillary vessels, with the adjacent tissue, present the surface—the soil—to be irrigated.

In the irrigation of a meadow, several objects are accomplished: the atmospheric air is absorbed, and, with the various contents of the water, are brought into contact with the soil and the various *roots* of the vegetable world disseminated through it.

In the irrigation of the animal tissues by the blood, similar events take place: the atmospheric air is absorbed, and, with the nutrient matters, is conveyed to the tissues. But, in the animals of the higher orders, these two functions are performed by a double capillary circulation—or irrigation; one in the pulmonic, the other in the systemic system. In the

former, oxygen is absorbed from the atmosphere; in the latter, it is conveyed, with the other principles of the blood, to every tissue in the animal œconomy.

2. *The true Capillary Vessels, or Blood-channels.*

I proceed to describe the capillary vessels more particularly.

In the first place, I remark that the veins and arteries are *single* tubes respectively; the former formed by the combination of many roots, the latter dividing into many branches (like the roots and branches of a tree), the heart being at the point or base of junction of the two trunks. The whole presents the appearance of tubes regularly formed, and as regularly disposed; whilst the larger branches admit of being separated from the surrounding tissues, retaining the form and construction of distinct pipes or tubes.

Nothing of this kind obtains in regard to the true capillaries. These vessels have no distinct course, —no distinct successive unions, nor successive divisions,—no character of artery or vein, or of a tube of any kind. They pursue their course irregularly amongst the tissues,—sometimes uniting, sometimes separating,—uniting and dividing again,—so as to produce no appearance of a rectilinear, or indeed of a linear, tube. On the contrary, the course of these vessels is irregular, and varied in every way. It is such as one may imagine, or may have seen, to be

given to water poured in moderate quantity over an uneven surface.

Every thing, in a word, induces the belief that these capillary vessels are, in fact, not vessels, not tubes, but mere canals or channels formed amidst the tissues, like gutters in a chalky cliff. The mode of their continual junction and disjunction; the effect of certain reagents on the capillary circulation (of a solution of common salt applied to the web of a frog, for example); seem to prove this peculiar character of the capillary vessels.

Besides their rectilinear course, the veins and arteries are generally disposed *singly*, however deep the tissues. The capillary vessels, on the other hand, exist in great number, in whatever respect we consider them.

From these and other considerations, I am opinion that the term *blood-channels* would be a more just denomination for this part of the circulating system.

3. *The Pulmonic and Systemic Blood-channels.*

The characteristics of the pulmonic and systemic circulations, and of the blood-channels through which that circulation is performed, are peculiar and distinct. The object of the former being to expose the blood to the influence of the atmospheric air, the blood-channels are unistratous, and occupy as much of the exposed surface as possible. The objects of the systemic circulation being various and multiplex, the

blood-channels are multistratous, and exist in every part of the tissues.

The lung and web of the frog afford interesting examples of the peculiarities and differences between the pulmonic and systemic circulations. I have described them fully elsewhere. It is therefore only necessary for me to recall their general peculiarities on this occasion. The systemic blood-channels in the web of the frog are distributed in two distinct layers, obvious under a microscope of moderate power, and rendered still more so by arresting the flow of the blood-corpuscules in one of them, by the application of alcohol to one of the external surfaces of the web. The blood-channels in the lung are infinitely more numerous, but exist in one layer only. The circulation in the web presents an object of the utmost interest and beauty; but that in the lung is as a splendid flood of illumined gold!

The pulmonic blood-channels are as numerous as the surface over which they are exposed admits; the systemic, on the contrary, are numerous only in proportion to the offices to be performed by them. In the mesentery, they exist in extremely small numbers. Large spaces intervene. It is an interesting question —How are these spaces nourished? Do the blood-channels, as appears probable, change their position, and percolate different portions of the membrane successively; or is the nutrient process accomplished by an extensive principle of endosmosis?

4. *Function of the Blood-vessels.*

What numerous processes take place along the irrigated meadow! Not fewer, nor less important, are those which are performed at the surface of the blood-channels. At this surface, endosmosis and exosmosis occur. From this surface the nutrient and secernent vessels take their various origin. It may, in various respects, be compared to the internal surface of the intestinal canal. It is the general surface, at which pulmonic and systemic changes are induced, in and by the circulation of the blood.

It is solely by the power of the heart that the blood is propelled along the arteries, and made to permeate the blood-channels, and to flow along the veins. If the circulation be a little opposed, as by a slight ligature, the pulsatory action of the heart is obvious in the various trunks. In ordinary circumstances, the flow of the blood, otherwise pulsatory, is made equable by the elasticity of the arteries.

The true capillaries, or the blood-channels, have no vital power over the circulation of the blood within them, either to impede, promote, or modify it. It is by physical influences, or the influence of other orders of vessels, that the circulation is modified in the blood-channels.

In blushing, in which case the capillaries are distended, there is probably transient congestion, from the action of certain muscles compressing certain veins.

5. *Immediate Position of the Blood-channels.*

It may seem extraordinary that I should assert that the blood-channels had not been fairly described before the appearance of my Essay. But M. Voigt, the pupil of M. Berras of Vienna, the author of the most elaborate work on this subject, makes the same observation, in his Thesis, published in 1840, pp. 15—17, 29. M. Berras designates them the *intermediate* vessels. And they are indeed intermediate, not only between the arteries and veins, but between these and the absorbent, the nutrient, and the secernent vessels.

It is from this position that every change in the action of the heart is found impressed on the motion of the blood along the blood-channels; and that every impediment to the flow of the blood along the veins induces a corresponding effect on the course of the blood in the same channels. In the same manner it may be readily understood how arrested secretion, from cold and other causes, may induce a morbid effect, indeed inflammation itself, by arresting the flow of blood, and changing the physical condition of the blood-channels; whilst, on the other hand, congestion of the blood-channels may have its effects in changing the character of a secretion *towards* that of the blood.

The blood in these channels, being placed between the stomach and the secernent organs, may also be

viewed as intermediate between these two, and modified by each.

The blood is placed between the stomach and lungs, and the organs of secretion and excretion. Its composition must be modified by each of these.

6. *Influence of the Nervous System.*

The nervous system does not appear to have *any* immediate influence on the course of the blood along the blood-channels.

It is on the heart and on the secernent vessels that the influence of the nervous system is most obvious; and it is only in a secondary manner that this influence is felt on the intermediate order of vessels, or rather of the blood-channels.

I am aware that Dr. Philip has made statements opposite to these. But I am persuaded that that veteran physiologist was, with so many others, entirely mistaken in all his views relative to the supposed action in the (so-called, but misnamed) capillary vessels.

7. *Of Non-vascular Parts.*

Non-vascular parts, such as the cornea, the adherent nail, &c. must be nourished by endosmosis. In contiguity with the irrigated internal surface of the blood-channels, nutriment passes from the blood and becomes fixed in the non-vascular tissue.

The *force* with which the blood is circulated has

its influence on this process. In cases of exhaustion from loss of blood (as in my experiments on dogs),—of defective nutrition (as in the experiments of M. Magendie on the same animals),—and of pure debility (as I once observed in the human subject),—the cornea loses its healthy organization, becomes opaque, and perishes. In cases of protracted anæmia from loss of blood, and of chlorosis, I have observed the nail to be inadequately nourished, and to become brittle and deformed.

The nervous system has its own influence on the nutrition of the non-vascular tissues. When the trifacial nerve was divided in rabbits (in the experiments of M. Magendie), and when it has been destroyed by disease in the human subject (as in the cases of M. Serres, &c.), the cornea has equally become disorganized. In a case of divided nerve of the fore-finger, observed by myself, the nail was observed to be secreted much more slowly than in the fore-finger of the other hand, one half of its nervous influence having been cut off.

8. *Of Inflammation; the First Phenomenon of the Series—Adherence.*

In treating of inflammation, the great difficulty is to obtain the first phenomenon of the series, so that we may first observe it without complication, and then trace its effects.

If we may take, as an example of this first pheno-

menon, the effect induced on the circulation in the web of the frog by slight physical injury, as scratches by means of a needle, by the contact of a drop of hot water, by the application of alcohol, or of a solution of muriate of soda, &c. our investigation may be considered as long since begun. I am sorry to say that many observers of this first fact have been misled by preconceived hypothesis, and have not been content to detail their observations, but have added many *inferences* concerning the supposed action of the supposed capillary vessels, all of which are erroneous.

The experiment is a complicated one. We have not only minute arteries and veins, and blood-channels, but the various other tissues, cutaneous, cellular, &c. of which the web is composed. The effect of the agent applied, on each of these, must not be overlooked. It must not be forgotten that the application of any such agent *to a* capillary—as these authors express themselves—is impossible. Add to these considerations, that pain is inflicted, endosmosis and exosmosis occur, the cutaneous surface is relaxed or contracted, &c.

What conclusion then, it may be asked, *can* be drawn from an experiment so complicated?

One remark, of great practical interest, may be made, in reply to this question. Complicated as the experiment doubtless is, it is not more so than the state of inflammation itself. It therefore resembles, in this very circumstance, the subject of our investi-

gation. And if we only content ourselves with *observing;* if we refrain from incautious *inferences;* we cannot but view the appearances with great interest.

If, then, we apply pure alcohol to the upper, or under, surface of the web of the frog, carefully guarding against its spreading over the other surface, we observe, in the first place, that, in proportion to the vigour of the circulation, the effect is less and less marked, and that it requires a more and more frequent application of the liquid to produce any change. At length we observe—no contraction—no dilatation of the supposed vessels, but adherence of the blood-globules to the inner surface of the blood-channels,—in a few points at the first, afterwards more and more extensively! And now these channels become unequally dilated in parts, obviously from the crowding of the blood-globules, forced into them by the vis a tergo.

Similar effects are produced, and more speedily, by the application of a solution of muriate of soda, in the proportion of one drachm to an ounce. But, in this case, the blood-channels are still more distended, and, I may add, deformed, and the contained blood has acquired a deeper red colour (the effect of endosmosis?).

These appearances are confined to the layer to which the application has been made. In the other layer (for I think I have already stated that there are two layers of blood-channels in the web of the frog),

the blood is still flowing along the blood-channels, unaffected.

Similar phenomena are produced by scratches made by a needle, and by the application of a small drop of hot water.

May these appearances be regarded as presenting the type of the first step, or perhaps the step antecedent to the first, in inflammation? It is confessed that the animal is one of cold blood; that the subsequent steps in the inflammatory process differ widely from those observed in the human subject, and in the higher order of animals. Still it appears to me that, in these, the first effect of a cause of inflammation must be similar. I have resolved to submit the question to the test of experiment, in the mesentery of a rabbit, or other appropriate tissue.

Supposing adherence of the blood-corpuscules to the inner surface of the blood-channels to be the first effect of the application of a cause of inflammation, what other phenomena may be naturally traced from it? We have *obstructed circulation*. What are the consequences of obstructed circulation in other ascertained cases of this condition? If we tie an artery, we have a dilatation of the collateral and anastomosing branches; we have, as it were, a new series of vessels produced. If we have an obstructed vein, we have, first, congestion of the blood-channels, dilatation of the arrière roots of the vein, and effusion of serum and lymph, and even of blood. Are not these the

marked effects of inflammation? Do not the blood-vessels dilate? do not new vessels form? do not serum, and lymph, and blood, become effused? Have we not in both a sort of hypertrophy, and of hypercrisis?

What other effects of *obstructed* circulation do we observe? Do we not see gangrene from obstructed arteries, in some cases of 'ramollissement' of the brain, in the gangræna senilis, &c.? Do not we observe the same effect in inflammation,—in furuncle, carbuncle, &c. from obstructed blood-channels? But we must proceed a little more deliberately. There is one part especially to which I would draw the attention of the Society.

I had invited particular attention to the condition of the internal surface of the blood-channels, in my Essay (pp. 167, 168, &c.). Subsequently, M. Poiseuille has described a layer of immobile serum, as lining the minute blood-vessels generally. It is probably on this layer of serum that many of the causes of inflammation act, on the principle of endosmosis and exosmosis. Others doubtless act on the solid tissues of the inflamed part themselves. Others again act through the medium of the nervous system, first on the secernent vessels, and, as a consequence, on the blood-channels.

9. *Other Phenomena of Inflammation; new Vessels.*

There is a general law in the animal œconomy, according to which, whenever a vascular tube is ob-

structed, it becomes enlarged at the part anterior to the obstruction, with hypertrophy of the adjacent branches, and a disposition to the formation of new ones. The principle of this phenomenon is not a mere physical one. It is one which we must identify with the original vital energy, by which formation itself is accomplished. It is probably a function of the nervous system, which seems to impart the *form*, whilst the heart provides the *force*, and the blood the *material*, of growth and development. Thus—

If we tie a large artery, the collateral branches, both above and below the ligature, become hypertrophied, and meet and reconstruct the circulating apparatus. Now, on tying the artery, the force of the heart's action is *equally* augmented in the analogous arteries of *both* limbs,—a fact ascertained by the hæmadynamometer; but it is only in the limb of which the artery is tied, that the process of hypertrophy is set up. It is, therefore, as I have said, not a mere physical influence, but one of a mysterious vital dynamics. See vol. i, p. 234.

But it is the *fact* that this hypertrophy does take place in this case of obstructed circulation, with which we are at present interested. A similar obstruction, and a similar hypertrophy of old, or formation of new, vessels, takes place in inflammation. This is observed in non-vascular parts even, as the cornea; and in non-vascular, inorganic tissues, as new, or what have been

termed false, membranes,—in a word, in effused coagulable lymph.

These new vessels are probably, at first, mere blood-channels,—induced by the combined influence of endosmosis and the heart's impulse. Afterwards, they may become really vascular, by hypertrophy of the original vessels.

In this manner non-vascular parts acquire vascularity, and, indeed, a high degree of sensibility too, in inflammation.

10. *The Condition of the Blood itself, and of the General System.*

That morbid conditions of the blood are the frequent *causes* of inflammation, is indubitable. That the blood is, in its turn, affected by inflammation, is equally certain.

It is a well-known fact, that that form of dyspepsia which may be best termed cachectic, induces furunculi. Is this effect induced through the nervous or the sanguiferous system? through a morbid condition of the nervous influence, or of the blood? There are hitherto no *facts* to determine this question.

Gout is equally of constitutional origin. It is probably a disease of the blood. But its sudden seizure of a great toe, and its equally sudden transition from one great toe to the other, are probably the effects of nervous influence. This disease is inti-

mately connected with the secernent system,—a fact proved by the occurrence of tophaceous deposits in the joints, lithic acid deposits in the urine, &c.

In carbuncle, the urine has been observed to be diabetic.

That the blood is affected by inflammation, is proved by the fact, long observed, of the occurrence of the buffy coat, and by the fact, recently ascertained by M. Andral, of the augmented quantity of fibrine, under the influence of this morbid condition.

10. *Causes of Inflammation.*

The causes of inflammation may be external and physical, as bruises, wounds, excessive heat, excessive cold; or they may be external and act through the medium of the nervous system, and first, probably, on the secernent vessels, as cold, in the form of partial currents of air; or they may be constitutional, as in the case of furuncle, carbuncle, gout, rheumatism, &c. in which cases probably a morbid blood is circulating through the system, and becomes adherent in the blood-channels, as in asphyxia. In all these cases, then, we may readily understand how the blood-channels become affected.

In phlebitis, in encephaloid disease, there is also probably the positive application of morbid particles to the internal surface of the blood-channels.

11. *The Spread of Inflammation.*

Inflammation obviously runs along continuous tissues. This we see in phlebitis, and in inflammation of the absorbents. We observe the same fact in the serous, mucous, and cellular membranes. Hence it happens that, whilst pneumonia is usually single, bronchitis is as generally double, in its character.

12. *Treatment of Inflammation.*

We can readily understand how an undue impulse of the blood may augment the congestion of an inflamed part, and that blood-letting may be a remedy.

I have already observed that, in the case of a feeble circulation, the adhesion of the blood-globules takes place more readily. Debility may therefore dispose to inflammation, as Mr. Dalrymple has well shewn; and remedies to augment the power of the system, as quinine, may, in such a case, be useful.

Recently, *pressure*, and, in the hands of that most ingenious medical philosopher, Dr. Arnott, hydrostatic pressure, has been applied as a remedy for inflammation. We can readily understand how this agent may diminish the congestion of an inflamed part, and so conduce to its recovery. With the same object, gentle friction must be very beneficial.

13. *Tolerance of Remedies.*

It is well known that blood-letting is better borne in inflammation than in other diseases, and in inflammation of the serous membranes and the parenchymatous substance of organs, than in inflammation of the mucous membranes. This fact has become of great practical value. It is mentioned here only to complete the list of the phenomena of inflammation. The fact itself seems to *coincide* with the disposition to form the buffy coat, and with the augmented proportion of fibrine.

It is an interesting question, to be determined by experiment, whether the heart's action is augmented, so as to affect the hæmadynamometer, in inflammation.

The same fact of tolerance is observed in regard to mercury and antimony in inflammation. It is well known that the induction of ptyalism frequently coincides with the subsidence of the inflammation. And Laënnec laid it down as a rule, that the tartrate of antimony is to be continued in pneumonia as long as the crepitant rattle and the tolerance of the remedy continue.

I conclude these hints with the following resumé of the phenomena of inflammation:—

14. *Resumé.*

1. We have, first, adhesion of the blood-corpuscules in the blood-channels.

2. This leads to Obstruction, and

3. This to Congestion.

4. We have then hypercrisis, or augmented *secretion ;*

5. Hypertrophy, or augmented size of the *old,* and the formation of *new,* vessels ;

6. Hyperendosmosis ;

7. Augmented *Absorption,* or Ulceration, Phagedæna, &c.

8. Death, Sloughing, Gangrene.

CHAPTER XV.

ON THE SPRING BED.

No one can have travelled on the Continent without having experienced the luxury of sleeping, after a day of fatigue, on the spring beds so much in use there.

The hydrostatic bed proposed by Dr. Arnott is doubtless a most ingenious application of a well-known principle to the comfort and well-being of a certain class of patients. But the spring bed is not less efficacious in affording even pressure, varying only with the prominency of the form reposing upon it. In this respect, it is, in principle, identical with the hydrostatic bed. Its advantages are, that it is far less expensive, and far less liable to decay and to suffer from accident.

When in Louvain, in August last, I was informed that an ordinary spring bed, with its box complete, might be purchased for forty-two franks. I have no doubt that it might be made for one fourth of this sum, of the size too commonly used in England. Now this sum is not beyond the reach of the prudent amongst the poor of this country. I would that every labouring man in our land reposed, after the toils of

his day, on a bed of such perfect ease! I would that every inmate of our hospitals, infirmaries, and work-houses, had such a bed on which to repose his aching, perhaps sickly frame!

The perfect cleanliness of such a bed, under proper arrangements too, is a great recommendation; and I am persuaded that even the cases of incontinence of urine might be mitigated in their attendant evils by the spring bed, properly provided with a funnel to receive and remove this fluid.

In typhus fever, in some cases of fracture, &c. &c. there would be precisely the same advantages as from the hydrostatic bed, in preventing sloughing over the sacrum.

I merely throw out this 'Suggestion' as a hint to the benevolent, and to those members of our profession who may be engaged in such arrangements for the poor and sick.

CHAPTER XVI.

THE MOSQUITO-NET.

THE simplest and most efficacious defence from the night-cold of this climate, as from the mosquitoes of the warmer latitudes, is the mosquito-net. I had long been in the habit of prescribing a muslin curtain for invalids affected with bronchitis, &c. (see the former volume of 'Observations and Suggestions,' p. 202) when my attention was still more particularly drawn to this subject, when in Naples, in September last, on observing the mode of arrangement of the mosquito curtain in that city, which I have endeavoured to simplify.

There is a kind of lace or 'net,' two yards and a half wide, the price of which is one shilling per yard. From twelve to fifteen yards are sufficient for every useful purpose.

If the bed be what is termed 'a French bed,' all that is required is to pass a chord tightly from post to post, and then diagonally. On this the 'net' may be thrown simply. But as a duplicate of this net, with an intervening space of about two inches, adds extremely to its efficacy, a very large tuft of worsted should be attached *over* the former net, at the top of

each post, and over this the second fold of net is to be thrown. These tufts are to be so placed, and fixed, as to project above and laterally.

Under this double mosquito-net, the patient sleeps secure from the intense cold which prevails in this country, almost invariably, between midnight and three or four o'clock.

Under this curtain, arrangements may be made too for diffusing a gentle warmth and moisture. Thus a common tea-urn, prepared as for making tea, and well involved in flannel or a blanket, being placed at the foot of the bed, sheds a genial warmth and vapour during the entire night,—the more gently, the more it is so involved.

These things may be given or lent to the poor by the benevolent; and some equivalent may be surely provided for the inmates of our hospitals, and especially for certain classes of patients—the tetanic, the pulmonic, the dysenteric, &c.

CHAPTER XVII.

THE PHYSIOLOGY OF DISEASE, OR LIVING PATHOLOGY.

BESIDES the sketches given in Chapter II, I may here observe that it is not crude and post-mortem 'morbid anatomy,' but a knowledge of the state of the living morbid actions, which must guide us in practice.

How interesting a work might be written on the question—*How* does the physiology become pathology? *How* are the natural actions modified as they become morbid actions? and *How* are nerve, blood, and muscle, modified in disease?

The reflex actions arising from internal diseases irritating the serous and mucous membranes, and the internal canals, require to be traced. I must refer to the experiment detailed in Chapter XI; to the effects of inflammation of the serous membranes already observed in pericarditis, by Dr. Bright and Dr. Burrows; and to other effects of this kind hitherto undetected.

Irritation of the mucous membranes seems less disposed to produce these effects; but we have noticed the tenesmus and the strangury which result from

irritation of the mucous membrane of the rectum and bladder; and we are all aware of the sickness and vomiting, and the spasmodic and even epileptic affections, induced by irritation of the mucous membrane of the stomach and bowels; one form of these being that induced by worms.

I need scarcely advert to the rigor, and sickness, and vomiting, caused by calculus in the gall-duct or ureter; the rigor induced by passing the catheter, and the singular effect of irritation of the meatus externus of the ear.

It is a fact full of physiological and practical interest, to observe that, whilst peritonitis paralyzes the intestine, inflammation of the mucous membrane of the intestine has precisely the contrary effect.

What other more hidden springs of action are there in the animal machine and œconomy?

We still want the physiological spirit of a HUNTER in our Medical Clinical Wards!

These hints and 'Suggestions'—for I repeat that they pretend to be nothing more—are thrown out for the future inquirer.

CHAPTER XVIII.

ON THE COLICA PICTONUM.

An interesting example of living pathology is afforded by the Colica Pictonum. The ingestion of lead produces three remarkable effects: 1, it is seen in a remarkable blue line at the edge of the gums—a highly important diagnostic, first pointed out by Dr. Burton; 2, its effect is traced in a defective nutrition and power of the adductor pollicis, and of the muscles which raise and sustain the wrist, so that the ball of the thumb is shrunken, and there is what is characteristically denominated the 'wrist-drop;' 3, there is probably a similar condition of the muscular tissue of the large intestines, so that retention of their contents takes place, and ultimately attacks of colic, only to be relieved by the action of such drastic purgatives as will act on the partially paralyzed intestine. In addition to these pathognomonic effects, there is, in two cases now under my observation, defective power of the sphincter vesicæ, with a disposition to stillicidium urinæ.

In one of the cases to which I have alluded, the blue circle round the gums has gradually but entirely disappeared in the space of between two or three years

of treatment, consisting of purgative medicine, a drink acidulated with the sulphuric acid, and the use of distilled water to drink only. I never could trace the source of the lead satisfactorily; the water used passed through, and might sometimes stagnate in, a leaden pipe. The blue circle was most marked, and was seen by Dr. Burton, to whom I sent the patient for inspection. The wrist-drop was complete, but, with the blue circle, has entirely disappeared, and the patient is restored to his avocation as shop-keeper to a jeweller in Chancery Lane.

The second patient has not at this time the blue circle of the gums. His case is of long duration. The ball of the thumb is shrunk in an extreme degree, and his attacks of colic are most severe.

A carefully conducted series of experiments on the influence of galvanism and of strychnine is much wanted in these cases, the object being to nourish the affected muscular fibre.

I suspect the deleterious action of the lead is first exerted on the muscular *nerves*. Heberden speaks of the 'vis plumbi venenata, nervis inimicissima:' hence the diminished irritability of this muscular fibre, as tested by galvanism, to which its defective nutrition adds its own influence.

How mysterious, that the influence of lead should be so partially exerted! This poison has sometimes induced sudden death. Has this been by its special effect on the heart itself?

CHAPTER XIX.

ON SUDDEN DEATH, AND ON DISSOLUTION IN GENERAL.

ABSOLUTELY sudden death can only occur from causes which suddenly affect the innervation, or interrupt the circulation—1, in the vessels of the medulla oblongata, or, 2, in the coronary vessels of the heart.

The first of these effects may be produced by any disease which immediately or mediately arrests the course of the blood in this all-essential part of the nervous system. Dislocation of the skull upon the atlas or second vertebræ; the sudden crush from a tumor whose situation has been suddenly changed; the rupture of one of the vessels, with the effusion of blood, in however small quantity, in the substance of the medulla, or of a larger quantity from the meninges; all may arrest the circulation in this 'nœud vital,' arrest the respiration, and, with it, life itself, immediately.

Violent but general apoplexy of the encephalon, whether of the substance or membranes of the brain, may induce similar effects by counter-pressure on the medulla oblongata. In this manner, epilepsy itself,

and some forms of convulsive diseases of infants, proved suddenly fatal.

Precisely similar conditions may obtain in regard to the heart: the circulation in its substance may be arrested from disease of its arteries, immediately, or by disease of the substance of the heart, the fatty or muscular tissue of which may be hypertrophied, interrupting the circulation in its coronary or capillary vessels.

The detraction or loss of blood, the state of anæmia, or of chlorosis (a special form of anæmia), may act on the circulation in both the medulla oblongata and the substance of the heart, and induce either the 'mors brevis,' observed in syncope, or actual death.

Shock to the nervous system also acts on both these vital organs, so as to induce fatal effects: emotion, violence, without detectible physical lesion, have proved suddenly fatal, whether acting on the heart, the medulla oblongata, or both. In those cases in which the death is not quite sudden, both the beat of the heart and the acts of the respiration are singularly affected, just as in the case of the loss of blood.

The fatal effect of hæmorrhage is marked by convulsion—a proof that the spinal marrow is specially affected.

There are other kinds of *shock*, which deserve to

be particularly noticed. Internal rupture or laceration induces an effect of this kind. In perforation of the pleura, and especially of the intestines, we find the patient suddenly in a state of collapse, the beat of the heart and pulse feeble, the respiration impaired, the capillary circulation venous, the general surface livid, cold, and clammy.

Rupture of the cerebrum is distinguished from its mere congestion by an effect of this kind.

In a word, any sudden physical lesion, even of a limb, as in comminuted fracture, or in the case of an amputation, if performed in rude health, is attended by shock, sometimes fatal in its issue.

Great disease of the cerebrum, of the lungs, and even of the heart, may exist without proving fatal. It is with justice that Bichât has designated these important organs the ‘ trépied de la vie.’ Life cannot be sustained with the loss of the function of any one of these organs. The brain, indeed, may be removed without the immediate extinction of life; and an anencephalous fœtus may live for fifty hours or so. But such a fœtus, much less an animal so treated, is not ‘ viable,’ as the French jurists express it; and the idiot seems to be short-lived in proportion to the development of its brain.

Still more remarkably, but not less necessarily connected with life, are the stomach, the colon, the kidneys. If the function of any one of these be suspended, the animal soon begins to pass through a series of processes, which eventually, and even speedily, prove fatal.

I have repeatedly described the symptoms which occur in the sinking state: see especially vol. i, p. 310. I need not, therefore, repeat them here. But it is interesting to revert to the successive affections of the ganglionic and spinal systems, of the excretions, and of the respiration, of the brain and of the heart, which occur in succession, in those fatal circumstances.

There is still ample scope for a useful treatise on the physiology of death and of dying. The great HUNTER has treated briefly of 'dissolution.' It would be interesting, and perhaps practically useful, to trace the *modes* in which each fatal disease of each organ destroys life.

CHAPTER XX.

SOME OBSERVATIONS ON PUERPERAL DISEASES.

1. *On Puerperal Diseases in general.*

In scarcely any other cases do so many and such various circumstances require to be taken into consideration at once, as in puerperal diseases.

This class of diseases may be considered as embracing all those morbid affections which arise out of the state of pregnancy, of child-bearing, or of lactation. They may be divided into those which occur in the earlier, and in the later, periods of pregnancy, —immediately before, and after, and during the act of, parturition,—during what is termed the puerperal state,—and during the period of lactation.

In the early period of pregnancy, many organs, but especially the stomach, suffer, in consequence of the source of irritation then set up in the uterine system.

In the later periods of pregnancy, several causes combine their influence, especially to endanger the state of the brain. It is upon the conjoined and separate operation of these causes that our attention should be particularly fixed, in regard to the diseases of this period; for it is frequently by their co-opera-

tion alone that their morbid influence on the brain is brought into activity, whilst it may occur, afterwards, that one or even several of these causes may be removed, and yet a remaining one may renew or continue the morbid effect upon the brain, which they had induced conjointly. The causes which co-operate, in the last period of utero-gestation, in inducing a morbid state of the brain, are chiefly uterine and intestinal irritation, concurring with the actual pressure of the gravid uterus upon the various viscera and vessels situated behind it, and the state of plethora of the vascular system especially, occasioned by this pressure.

During parturition, the contractile efforts of the uterus and of the abdominal muscles add another source of danger to those already mentioned; and it is at this period that the brain and medulla oblongata are most subjected to fulness and pressure, and that apoplexy or convulsions are apt to occur.

Several sources of danger are removed when delivery has taken place; and yet this is not always sufficient to protect the patient from an attack of convulsion; for this terrible affection has first occurred even after delivery had been effected. In this case, especially, I suspect that a state of intestinal load and irritation has been the exciting cause of the attack of convulsion. And this observation confirms the remark already made, that when several causes have co-operated to induce a state of danger, some of them

may be removed, and yet, if one remain, it may lead to the most disastrous events. This peculiarity in the study of puerperal diseases cannot be pointed out too often, or too strongly.

Convulsions occasionally occur after delivery, even although the system be in a state of exhaustion from hæmorrhagy. The state of general exhaustion is not, I believe, incompatible with a state of fulness of the vessels of the brain and medulla oblongata; but this kind of convulsions will be found, I think, frequently to involve also a state of intestinal load and irritation.

But immediately after delivery, the danger may arise more directly and simply from a state of inanition and exhaustion, the result of an emptied condition of the uterus and abdomen, of pressure abstracted from the viscera and blood-vessels along the spine, and perhaps of loss of blood.

To these sources of danger, after delivery, must also be added, the effects, perhaps, of protracted suffering, of violent pain, of mental alarm, and of what may be termed the 'shock' of parturition.

There is another series of puerperal affections, which do not occur, for the most part, until some hours at least after delivery. These affections consist principally in uterine or peritoneal inflammation, in the effects of intestinal irritation, in the effects of loss of blood, or in two or more of these combined. There are two other sources of irritation, in the condition of

the mammæ, and occasionally of the uterus; and there is that terrible disease, the epidemic puerperal fever.

Considering the important and sudden change which takes place in the condition of the uterus, in parturition, we cannot be surprised that this organ should frequently be the subject of inflammation in the puerperal state. Neither can it be matter of surprise, that its appendages, the adjacent viscera, and the peritonæum at large, should, not unfrequently, participate in this morbid condition. And when we further consider the degree of violence to which the brain has been subjected, during parturition, we must be led to expect that this important organ should be left by that process in a state of proneness to morbid affection; and this is precisely the case; for, next to the viscera of the abdominal cavity, the brain is, perhaps, the organ which is most apt to become affected by puerperal irritation or inflammation.

There is another not less fertile source of puerperal disease, in the state of the alimentary canal after delivery. This state consists, in general, in a loaded or disordered condition of the large intestines; but too frequently, also, in improper things taken into the stomach. It is most important to observe, that the effects of stomachal or intestinal irritation are very similar to those of inflammation, as it affects the head or abdomen; for on the just diagnosis of these cases depends the proper application of the remedies.

Similar observations apply to the effects of loss of blood, when these are of the remote character, and attended by the phenomena of reaction. In this case, the head is apt to be so affected as to lead to the idea of inflammation of the brain; and the heart, so as to present the symptoms of disease of this vital organ.

But it is rare that these sources of disease act thus distinctly; it is far more usual to observe them co-operating together to produce a mixed case; and it is in such complicated cases that all the attention and energies of the mind are required to appreciate the influence of each, and to adapt the remedies to this complicated form of disease.

There is, not unfrequently, also, a source of irritation in the state of the uterus itself. A certain degree of after-pain is usual in almost every case; but a state of irritation and pain are frequently kept up by the presence of clots of blood, and the efforts for their expulsion. This state of the uterus is full of danger; not in itself, but by masking and concealing the beginning of dangerous diseases. Pain of an inflammatory kind is too apt to be neglected, under the impression that it is but the usual after-pain.

A similar remark may be made in regard to the irritation excited in the establishment of the secretion of the milk. This process is apt to be attended by pain, fever, and affection of the head, which frequently mask the beginnings of puerperal disease.

Both these sources of irritation concur to add

complexity to the character and difficulty to the diagnosis of puerperal diseases, and to constitute that peculiarity of this study to which I have already alluded.

The first of these classes of disease might perhaps be denominated parturient, whilst the second might be distinguished by the epithet puerperal; the former occurring chiefly in or near the act of parturition; the latter, usually, some hours afterwards. There is a third class of morbid affections, which follow still more remotely upon child-bearing, and which consist, principally, in the more continued effects of intestinal disorder, or of loss of blood, and issue, for the most part, in an inability to support the drain occasioned by lactation.

A fourth series of puerperal maladies, using this term in its most extended sense, arises out of undue lactation itself. They consist in the various forms and effects of exhaustion, and constitute a most important and interesting subject for renewed inquiry; for I believe them not to be at present by any means fully understood.

There is still another consideration which is full of interest, in regard to puerperal diseases; namely, the state of health of the patient previously to her confinement. That which most frequently modifies the puerperal state, is disorder of the general health, of the various characters described in the first part of another work. It frequently occurs, from such a state of general disorder, that the recovery, after confinement,

is tardy, the secretion of milk scanty, or even morbid, affecting the health of the infant, and that there are many local affections, especially of the head or of the heart, which are full of pain and suffering.

I have now taken a rapid survey of the principal causes of puerperal diseases. It may be truly said that many of these causes co-operate in every case; but it is also true, that each puerperal disease is to be referred to one or two of these causes more especially. Every case of puerperal affection may, therefore, be considered as a case of modified disease, requiring that the mind of the physician be active and comprehensive, so as to embrace the numerous circumstances of the malady. This is true in a degree which scarcely obtains in any other class of diseases; and it is on this account that I have represented the study of puerperal diseases as requiring peculiar habits of inquiry and investigation.

2. *Of the Morbid Affections which occur in the Parturient State.*

I have adopted the term parturient, to express the condition of a person just before, just after, and during, the act of parturition. It is my intention, in this section, briefly to notice the morbid tendencies of this state, as a necessary introduction to the more detailed account of some of the morbid affections which occur in that which may be more properly termed puerperal. The distinction between the parturient and the puer-

peral states will be found to be at least of great practical utility.

I have cursorily alluded, in the preceding section, to the principal causes of apoplexy and convulsions, as they occur in the last stage of utero-gestation, and in the act of parturition. It is my present object to enter into this important question with somewhat more detail.

The first cause which I enumerated as conducing to these affections of the brain, was uterine irritation. That this species of irritation does indeed dispose to disease of the brain, is sufficiently obvious from the occasional occurrence of convulsions in cases even of dysmenorrhœa, or painful menstruation.

A second exciting cause of affection of the brain, probably not very different in its nature from the former, is the parturient efforts of the uterus when labour has begun. The effects of labour-pain upon the vascular system of the head is sufficiently seen in the flushed and even ecchymosed state of the countenance. And the attack, or the recurrence of convulsion, not unfrequently takes place with each uterine effort.

With the uterine efforts, however, must be conjoined those of the abdominal and other muscles, in our estimation of the influence of labour-pains upon the state of the brain.

The third cause of affection of the head in the parturient state, is stomachal or intestinal load or irritation. It appears almost unnecessary to adduce

any example of the influence of these causes upon the vascular system and nervous origins within the head*. The presence of indigestible substances in the stomach, and of indurated or otherwise morbid fæcal matters in the large intestines, are amongst the most usual causes of apoplexy and convulsions in those who are predisposed to these affections, and especially in the puerperal state. The late Dr. John Clarke published an interesting and important paper†, to which I shall have occasion to revert hereafter, upon the morbid influence of oysters, taken at this period, upon the brain; and it cannot be doubted that other indigestible substances have frequently, perhaps unsuspectedly, produced the same deleterious effects. One of these effects was convulsion. And it is to be particularly remarked, that the cases published by Dr. Clarke all occurred after delivery, and of course even after some of the predisposing causes of puerperal convulsion had ceased to operate.

But a still more frequent concurrent cause of convulsion, or of apoplexy, in the parturient state, is a loaded condition of the large intestines. The operation of this cause is frequently made obvious by the effects of purgative medicines and enemata, in these cases, both in the relief they effect in the symptoms of affection of the brain, and in the character of the alvine evacuations; the quantity of scybalous fæces

* This was written and published *before* 1832!

† Transactions of the College of Physicians, vol. v, p. 109.

which have thus been evacuated, in some instances, would appear incredible, were not the torpid and dilated condition of the intestine taken into the account.

Nor can there be any doubt that the gravid uterus itself acts, by its size and by its pressure upon the descending aorta, in inducing fulness of the vessels of the brain, in the last period of utero-gestation. It is on this principle that delivery frequently secures the patient against the recurrence of the fit of convulsion. When the pressure of the gravid uterus falls more particularly upon the vena cava, the effect of interrupted circulation is, of course, observed in the lower extremities, chiefly under the form of œdema, or anasarca.

It usually happens, as I have observed already, that apoplexy or convulsion occurs, in the parturient state, from the conjoined operation of several of these causes. And it is only by an attentive consideration of all these sources of danger, that the attack is to be prevented in the first place, and its recurrence in the second.

It is important also, with the view of prevention, to consider the probable condition of the encephalon itself immediately leading to an attack of convulsion or apoplexy. It is, doubtless, one either of irritation or of fulness. Every cause of these morbid states of the brain must therefore be carefully removed and avoided, whilst their effects are combated by the most vigorous remedial measures.

This is the more important, because each recurrence of convulsion is not only attended by immediate danger, but aggravates the morbid condition of the brain, and augments the tendency to the repetition of the paroxysms of convulsion. The same observation may be made of each contractile effort of the uterus and of the abdominal muscles during parturition, which, like the fits of hooping-cough in other circumstances, has in some instances led to convulsion.

The state of the system which obtains immediately after delivery, is, in many important circumstances, different from that which exists during pregnancy, and in the act of parturition.

The emptied state of the uterus and abdomen constitutes in itself a source of inanition; and there is usually more or less of loss of blood, and sometimes even an extreme degree of hæmorrhagy; so that the system in general must be considered to be in a state of exhaustion.

There can be no doubt that this very exhaustion alone has, in some instances, induced convulsion. But it is probable that, in many, some of the causes of this terrible affection which have been mentioned, and especially a state of uterine, stomachal, or intestinal irritation, have concurred to produce this effect.

The more usual immediate consequences of delivery, and of uterine hæmorrhagy, is a state of syncope. This is more or less severe and alarming, according to the degree of loss of blood, and of the

susceptibility to its effects, and varies from the slightest degree of faintishness to such a state of syncope as may endanger life.

Similar effects are sometimes to be attributed to the protracted sufferings of a lingering labour; in other cases, to the violence of pain; and in others, to alarm and dreary apprehensions and anticipations on the part of the patient.

These circumstances sometimes lead to sudden death—an event which may occur immediately upon delivery. In such cases, cordials given during the last stage of labour, the recumbent position guardedly preserved, and the immediate and careful application of the abdominal bandage, may save the patient.

Perhaps the condition of the system, under the influence of some of the circumstances of parturition, cannot be better expressed than by the term 'shock;' and it may be aptly compared to a similar state under very different circumstances, and especially those of a painful operation. This state of shock seems to consist in a partially suspended power and action in the system. It may be suddenly fatal; or it may yield to re-action, which may or may not pass the boundary of health; or, lastly, after some feeble efforts, it may lead to a gradual, but irretrievable, sinking of the vital powers. This subject has not been sufficiently noticed in medical writings, especially in connection with the parturient state.

One of the influences of shock still requires to be

mentioned. Many causes of disorder may long remain dormant, or may be affecting the system in the most gradual manner only, until they are called into a more active operation by some kind of shock. This is particularly true in regard to intestinal irritation. This cause of disorder may long subsist in an inactive state, until, by the occurrence of some shock to the system, it is brought into but too effective operation. It is for this reason that the effects of intestinal irritation are so frequently observed in the puerperal state, and after various accidents; without which, this cause of constitutional derangement might have long remained inoperative, or at least insufficient for the production of acute disease.

In the treatment of apoplexy or convulsions before delivery, and even after delivery, except in cases of profuse uterine hæmorrhagy, the principal remedy is blood-letting; the second object is the removal of all those exciting causes of the disease which have been mentioned; and the third is cupping of the occiput and neck.

In the case of hæmorrhagy, the remedies are still the removal of the exciting causes, and cupping.

It is not my intention, in the present Chapter, to pursue the subject of the treatment of these affections; because it is my wish rather to confine myself to the description of some other forms of puerperal disease which have, in my opinion, been greatly overlooked. But I cannot refrain, even in this place, from

pressing several points upon the attention of practitioners.

Of the absolute necessity for full blood-letting, I need not speak. But I would particularly observe, that a state of exhaustion, from loss of blood generally from the system, does not protect the brain from a state of vascular fulness. This I consider to be abundantly proved in the excellent paper of Dr. Kellie, in the Medico-Chirurgical Transactions of Edinburgh, and by the fact of the occurrence of convulsions, and even of apoplexy, in this state of exhaustion. It is in this very case that cupping of the occiput and nucha is so strongly to be recommended. The brain, in some cases of exhaustion, is relieved by the topical abstraction of a very small quantity of blood; and this relief is not only obtained by a less expenditure of blood, but is more permanent than similar relief effected by general blood-letting.

The next point upon which I would insist, is the careful removal, not of one or two, but of all sources of irritation—of all the possible exciting causes.

A point not less important than the treatment of these affections, is their prevention. I believe no means would conduce so much to this purpose as the invariable administration of copious warm water enemata at some period before or during labour. The large intestines would thus be relieved of their load, and a great and fertile source of future disease would

be removed. And this remark applies not to affections of the head only, but to many other puerperal diseases, as will be noticed in the subsequent section.

3. *Of the morbid Affections which occur in the Puerperal State.*

The morbid affections which occur in the puerperal, as distinguished from the parturient, state, usually commence at such a period after delivery, as may have given space for re-action to take place from the state of inanition and exhaustion which usually obtains immediately upon parturition.

It should be observed, however, that there is scarcely a disease of the puerperal state which does not occasionally show itself before delivery. In these cases, the disease usually remains stationary, or nearly so, until parturition has taken place, and then assumes its exasperated form.

In some instances, and those of the most serious kind, puerperal disease supervenes insidiously, and makes a slow, and probably an unheeded, and fatal progress.

Even of those puerperal diseases which commence by marked symptoms, the more serious are not always the most unequivocal in their mode of attack. Pure inflammation is, for example, less marked by rigor, heat, and other obvious symptoms, than the effects of intestinal irritation. This is a point which requires

to be enforced upon the attention of practitioners; for, in inflammation especially, it is of the utmost importance to detect the disease in its very origin.

I have already observed that it is not my intention, in this volume, to treat of the whole of those diseases which occur in the puerperal state; but to lay before my readers some observations which I have made in practice, in regard to some of them. This I shall do by first treating of abdominal inflammation and its varieties; secondly, of intestinal irritation in its various forms; thirdly, of the effects of loss of blood; and fourthly, of mixed cases which combine two or more of these morbid states. I shall then resume the diagnosis, and the comparative treatment of these diseases, in a separate chapter.

Subsequent experience has only confirmed the opinion which I expressed many years ago, that the effects of intestinal irritation, and of loss of blood, constitute a great part of puerperal diseases, and a great proportion of the fatal cases; and that, of those fatal cases, many are rendered so by a mistaken use of the lancet.

The effects of intestinal irritation, and of loss of blood, are indeed, as I shall proceed to show, apt to produce symptoms of increased action resembling those of inflammatory disease, and prompting the use of evacuant remedies. This proceeding is attended by two sources of error: in the first place, the symptoms are frequently relieved in the first instance—a

state of faintishness taking place of that of re-action, and the physician is apt to judge that the remedy had relieved, but was used in too mild a degree to subdue the disease, and is thence led to a repetition of the measure; in the second place, after the first and second moderate use of the lancet, for instance, the re-action returns in a still more violent degree than before; and it is then imagined that the disease, though relieved, was not only not subdued, but had been suffered to make fearful progress; the lancet is therefore again used, until it may be that the powers of the system yield, and sinking takes place of re-action; or, if the last blood-letting be considerable, the scene may be closed by a sudden and unexpected dissolution. I published several sad instances of this kind in a former little work upon this subject.

I have already observed that the effects of inflammatory action, of intestinal irritation, and of loss of blood, are alike apt to prevail in the puerperal state. It is only necessary to add, that they variously resemble each other, in different instances, so as to require the utmost attention for their diagnosis, and yet require totally different remedies for their safe treatment and cure, to give the subject all the interest of which it is susceptible.

CHAPTER XXI.

ON PUERPERAL PERITONITIS.

Inflammation within the abdomen, as it occurs in the puerperal state, may be divided into three kinds: that which chiefly affects the uterus and its appendages; that which appears to be general over the peritonæum; and that which is confined to a portion of this membrane.

A distinction of still greater practical importance, is that between the acute and the insidious forms of puerperal inflammation of the abdomen. Sometimes the attack is distinctly characterized from the beginning; at others, it is of the most insidious character, perhaps to be referred back to a date anterior to parturition, or even apparently issuing out of mere labour-pain. These are points which require to be deeply impressed upon the mind of the young physician, in order that they may induce in him that degree of watchfulness, in regard to these diseases, which they so imperatively demand.

Inflammation within the abdomen, of whatever kind it may be, is only to be ascertained by the presence of pain, induced or aggravated upon pressure.

This is the pathognomonic symptom of the disease. All the other symptoms are only accessory; and they are all, without exception, inconstant. In some insidious cases of abdominal inflammation, even the tenderness is only discovered by a careful examination. And there is sometimes pain under pressure when there is no inflammation. The most careful examination of the abdomen, and of the symptoms in general, should be made in every case of puerperal disease.

The acute attack of puerperal inflammation within the abdomen is frequently marked by rigor. This is frequently, in the worst cases, only slight. I cannot sufficiently enforce this fact upon the attention of my readers. Some have imagined that there could be no puerperal inflammation of the abdomen without severe rigor; and they have generally supposed that severe rigor necessarily supposes an attack of inflammation. I can most unequivocally attest, that both these opinions are erroneous, and contradicted by facts.

I would make precisely the same observations in regard to great heat of surface, or fever. I have known many instances of acute puerperal inflammation within the abdomen unattended by heat of skin, and many cases resembling inflammation, but not in reality inflammatory, in which the heat of surface was extreme.

Frequency of the pulse is not a less uncertain in-

dication of inflammation. I am enabled to say, from careful observation, that the pulse is but little accelerated in many cases of puerperal inflammation within the abdomen, whilst it is excessively and even alarmingly frequent in some cases in which inflammation does not exist.

In regard to pain and affection of the head, they are by no means essential attendants upon puerperal inflammation of the abdomen, in its first stages; but, on the contrary, appear to me to denote another and different kind of morbid affection, to be described hereafter, which may exist alone, or as a complication of inflammation.

Pure puerperal inflammation of the peritonæum is to be ascertained by an attentive examination of the abdomen. There is either pain increased upon pressure, or tenderness discovered upon pressure; and this is either general over the abdomen, or confined to the hypogastric region, or, lastly, in cases of partial peritonitis, to some other part of the abdomen. With the pain or tenderness, there is frequently either general tumidity of the abdomen, or a local hardness: in the latter case, it is frequently such as to denote an enlarged and inflamed condition of the uterus; but it occasionally arises from an affection of the ovarium, or from partial inflammation and suppuration of the peritonæum.

There are sometimes, and only sometimes, sickness and vomiting; there are also, in some instances,

a suppression of the lochial discharge, and a flaccid state of the mammæ. But I do not think the precise cases, in which these effects do or do not occur, have been distinctly ascertained by the observation of a sufficient number of facts.

In pure puerperal inflammation of the abdomen, there is not necessarily much rigor, heat of skin, load of the tongue, affection of the head, or great frequency of the pulse; there is, on the contrary, in many instances, only a slight degree, or even an entire absence of rigor, little or no heat of surface, or whiteness of the tongue, little frequency of the pulse, and no affection of the head. But the countenance, manner, and respiration, usually become highly characteristic.

I long ago* observed that inflammation within the abdomen was attended and denoted by a *peculiar* expression of the countenance; and I find the remark confirmed and stated in still more emphatic language by the celebrated and lamented M. Laënnec†. Puerperal inflammation within the abdomen is marked by an expression of extreme pain and anxiety in the countenance; the brow is contracted, and the upper lip is drawn upwards in a peculiar and characteristic manner, and bound round the teeth, or rather gums. These appearances are increased on pressing upon the abdomen, or they are observed at that moment, if

* See the Treatise on Diagnosis, passim.

† Traité de l'Auscultation Médiate (ed. 2nde), tome x, p. 615. Journal de Médecine, t. iv, p. 50.

they had not been manifest before. The countenance is generally pale, and rather sunk, but with partial heats.

The manner of the patient is much changed, and has become expressive of suffering and anxiety. The movements of the body are attended by pain, and are therefore suppressed; or, if performed at all, it is with an expression of suffering in the countenance, and of caution in the manner; and there is an appearance as if the body had become heavy and helpless.

The respiration becomes rather hurried and anxious, and it is performed principally by movements of the thorax, those of the diaphragm and abdomen being, more or less, sometimes completely, suppressed —a circumstance which gives great peculiarity to the appearance of the breathing. Sometimes there is considerable heaving of the chest, with some hurry, some noise from the ingress and egress of the air, and sometimes with a sort of blowing. This state of the respiration is attended by the utmost danger, being frequently one of the first symptoms of the sinking state, of which I shall have to speak immediately, and to which I wish earnestly to call the attention of my readers.

The general surface is usually a little increased in its temperature, and there is frequently perspiration.

The pulse is at first only moderately frequent, but gradually becomes more so, and it is often small and apparently feeble.

I have already alluded to the occasional occurrence of sickness and vomiting. The abdomen is frequently tense and tumid, as well as tender under pressure. This is an affection to be anxiously watched; it sometimes increases to a state of complete tympanites. The state of the bowels is very various; there is by no means always constipation; sometimes there is diarrhœa, with or without the discharge of mucous stools.

Instead of general tumidity of the abdomen, there is frequently a distinct tumor, with tenderness, in the region of the uterus, in the iliac region, or in some other region of the abdomen, leading to the suspicion of an especial affection of the uterus or ovarium, or of a partial inflammation and suppuration of the peritonæum.

It would be well to ascertain the state of the lochia, and of the mammæ, in cases of pure and unequivocal inflammation in the abdomen in the puerperal state. I do not think these points have been determined in an explicit manner; because I believe that several other affections, of a different nature, have been confounded with inflammation, and that the symptoms and effects of these different diseases have been blended and confounded together, both in practice and in medical writings upon this subject.

I have thus described the most usual form of puerperal inflammation of the abdomen, in its commencement. I do not think it either possible or pro-

fitable to divide the disease into distinct stages. But it is quite incumbent upon the practitioner to trace the usual changes which are observed in this disease: these are, first, a gradual amendment; secondly, a gradual exasperation of the disease; and thirdly, the supervention of the state of 'sinking.'

Little can or need be said upon the two first of these changes. Every appearance of a return to a healthy state of the functions and general appearances of the patient will raise our hopes; but there are no points of so much importance to be watched as the expression and condition of the countenance, the manner, and the state of the abdomen. No apparent amendment is at all to be depended upon, unless it has continued and been progressive for four and twenty hours. This is a caution of great importance to the young physician, in guiding him in his expressions in regard to the prognosis. And even in the most favorable cases, the further progress towards recovery is to be watched with the utmost care and precaution.

In the less favorable cases, the countenance becomes more and more altered, the pulse more and more frequent, the abdomen more tender and tumid; the manner and muscular powers of the patient appear overwhelmed; the respiration becomes more heaving, and, as I have usually termed it, 'blowing,' being somewhat audible—a condition of the breathing always attended by the utmost danger. At this period,

too, there is often some degree of delirium, alternating perhaps with slight dozing; and there are, generally, restlessness and jactitation, and the patient cannot bear the arms to be covered.

At this period, too, the tongue is frequently loaded and more foul, and sometimes dry; the bowels are variable, frequently flatulent and loose. The mammæ are flaccid, the lochia suppressed; the skin is clammy and wet, if not cold; the hands and wrists are often livid, and the feet cold.

This description of symptoms applies to the case of general inflammation of the peritonæum. The more partial cases of peritonitis continue longer, and affect the constitution less, and less rapidly. In some instances, the integuments over the seat of inflammation have become tumid and inflamed, and an issue has at length been effected for the subjacent pus; the abscess has afterwards collapsed and healed, and the patient has slowly but finally recovered. This opening frequently takes place about half way between the umbilicus and spinous process of the ilium. In other instances, the matter has been evacuated by the rectum; and, in some rare examples, by the bladder. In other cases, the abscess has not been evacuated during life; but the patient has gradually emaciated, and the health and strength have failed; there have been great frequency of the pulse, and hectic, and the disease has at length, though perhaps very slowly, proved fatal. It has, however, occasionally happened

that the effused fluid has been reabsorbed, and the fatal event averted.

But the acute form of puerperal peritonitis sometimes issues in a state of sudden sinking of the vital powers. The change and symptoms are such as have frequently led to the suspicion of gangrene having taken place. But no such appearance is observed on examination after death.

This state of sinking is usually rather abrupt in its manifestation. The patient may be left, not without hope, the preceding night, but, on being visited on the ensuing morning, is found to have passed into a state of hopeless sinking. The pain has ceased, but the tumidity of the abdomen is augmented; the brain is in a state of low stupor; the breathing is attended by heaving and blowing; the skin of the arms and hands is cold, clammy, and livid; the livid colour only partially disappearing on pressure; the pulse is thready and excessively frequent; the countenance is altered and sunk; the patient may be roused, but is then, perhaps, unconscious of pain, and expresses herself as being relieved; the hands are kept out of bed; sometimes there is cough, and the feet are livid and cold.

The morbid appearances usually induced in cases of inflammation of the uterus and of the peritonæum are well known.

In inflammation of the uterus, there are, in different instances, exudations of serum, of coagulable

lymph, and of pus, from its surface; its substance is sometimes enlarged, softened, infiltrated with pus, or the seat of distinct abscesses; and its internal surface is frequently morbidly red, and the source of various discharges. The appendages of the uterus are frequently the seat of similar morbid appearances.

The peritonæum, when inflamed, pours out serum, coagulable lymph, or pus; and its different surfaces are apt to be variously glued together. Frequently the intestinal canal is found distended to the utmost, as before death, by fœtid gases.

In some instances, pus is effused and deposited in various parts of the peritonæum, being confined by the adhesion of contiguous portions of this membrane.

There is no part of the peritonæum, and no viscus in the abdomen, which may not become the seat of puerperal inflammation, and of the consequent changes of structure. The parts most frequently affected by puerperal inflammation, however, are the organs contained within the pelvis—the uterus, its appendages, the rectum, the bladder, and the peritoneal lining of the pelvis; and then the peritonæum in general.

I now proceed to state the treatment of puerperal inflammation.

And I would observe, in the first place, that nothing can be trusted to, to save the patient, but the most ample blood-letting; and, in the second place, that nothing should preclude the use of this remedy but the actual existence of the state of sinking. In

regard to the measure and the repetition of the blood-letting, many points must be taken into consideration. The earlier and the more fully this remedy is employed, the more efficacious and the safer it is, and the safer is its full repetition.

There is one point which I would particularly impress upon my reader. It is, that the blood-letting should, in this disease, ever be performed, the patient being in the erect position; and it may then, in general, be safely carried to deliquium. I do not recommend this mode of proceeding with the view of producing deliquium merely, but also that this deliquium may serve us as a guide in judging of the extent to which we may carry the depletion. If the patient be sitting upright, and faint by the loss of blood, we have a security and remedy against any danger from this event, in laying the patient low. But if deliquium be induced by bleeding the patient in the recumbent position, I cannot say that I think it will always be without danger. I think the plan which I have proposed at once far more safe, as well as far more efficacious in subduing this disease. If it were requisite, the patient's head might be laid even lower than the rest of her body.

The same rule may apply for the repetition of the blood-letting. If the fullest effect is desired which the patient can safely bear, let her be bled to syncope in the erect posture. She will faint from losing a larger or a smaller quantity of blood, precisely in the inverse

proportion of the previous exhaustion; the state of syncope will not only warn us to desist from drawing more blood, but will arrest the flow of blood itself, just at the point when the patient can bear to lose no more.

This is a most important criterion for the employment of a most powerful remedy. I do not by any means wish it to be understood that it is always safe to bleed to deliquium in the erect posture; but that, when it is determined to bleed, it is important to have the boundary, which it would be unsafe to pass, at least clearly defined. Sometimes the patient will faint on being merely placed upright: is it then ever, and in what particular cases, safe to bleed?

The next question is in regard to topical blood-letting. And I think there is one important rule for the adoption of this remedy. It may, of course, be enjoined to be done immediately after general blood-letting. But it is particularly useful in those cases in which the system is obviously subdued by the general blood-letting, and yet the inflamed part remains tender under pressure. In such cases, leeches, or, still better, cupping, if it be properly and tenderly performed, will prove a most useful remedy.

It is quite unnecessary to state the utility, or rather the necessity, for the administration of purgative medicines in this disease. There is good reason to suppose that some cases have been subdued even by this remedy alone. And the efficacy of purging in con-

junction with blood-letting is quite undoubted. A constant catharsis should be kept up, indeed, until the disease is completely subdued.

There is, however, an exceptional case; viz. that in which these remedies are either rejected, or fail to move the bowels. In this case, they only add irritation to inflammation.

In cases in which there is great tympanitic distension of the abdomen, an injection of warm water sometimes succeeds in inducing evacuations of flatus, which greatly relieve. I have sometimes thought that still more effectual relief of the same kind might be obtained by the introduction of a flexible tube, properly pierced, high into the large intestine.

Much and important relief may also be afforded in some cases, in which suppuration has taken place, by giving exit to the pus, when it plainly fluctuates and approaches the surface.

Blisters also are of great service in those cases of this disease which are not attended by much heat or irritability. But in other cases they have appeared to me to add to the patient's sufferings, to prevent sleep, and to do harm by leading to a state of exhaustion.

There are still three other powerful remedies, of which I wish to make a cursory mention in this place.

The first is the plan of emetics, which is well known to have been so successful in the hands of M. Doulcet of Paris.

The second is the spiritus terebinthinæ, recommended by Dr. Brenan, of Dublin.

And the third is the attempt to induce a state of ptyalism, by mercurial medicines and inunctions.

Of emetics, but especially of the spiritus terebinthinæ, I would observe that, like purgative medicines, they have doubtless been used successfully in many cases; but I much suspect that many of these cases were not inflammation, but intestinal irritation.

Of ptyalism, I would merely observe, that it is one of those measures which are most powerful, and yet generally unattended with risk, and that it by no means precludes the adoption of every other more prompt and efficient mode of treatment. If adopted early, it might prevent some of those protracted states of the disease which occasionally occur and wear out the patient.

I need scarcely observe that, during the existence of inflammation, the patient should be allowed absolutely nothing but tea or gruel in the smallest quantities.

In some cases in which the pain is not severe, but the tension of the abdomen great, continued but extremely light frictions of the abdomen have done great good. They may be followed by the application of a cold lotion, and by fomentation of the feet.

In cases of pure inflammation, I do not think the use of opium desirable. The pain must be subdued by blood-letting; and every thing that, by masking

the pain, can divert our minds from the use of this remedy, involves danger to the patient. There are seldom those symptoms of constitutional irritation which require the use of opium, until the inflammation has subsided. In mixed cases, I think the use of opium, especially after blood-letting, may be both necessary to subdue constitutional irritation, and beneficial in the cure of the disease.

CHAPTER XXII.

OF PUERPERAL STOMACHAL AND INTESTINAL IRRITATION.

Some of the effects of intestinal irritation may be observed before parturition. But it is far more usual to find them developed afterwards. They generally take place rather suddenly, about forty or fifty hours after delivery; but the puerperal state appears so to dispose to this affection, that the presence of any cause of stomachal or intestinal irritation cannot always be borne with impunity for many days even, after delivery.

This affection may, for the facility of description, be divided into the acute and the insidious. Each of these forms manifests itself with general symptoms only, or with some predominant local affection.

The acute form of intestinal irritation is generally ushered in by a violent rigor. This is an important fact; for rigor has been considered as denoting puerperal inflammation, and essential to the latter disease. Neither of these suppositions is true: for puerperal fever may occur, in a severe and fatal form, without rigor; and the severest rigor may only portend an attack of the effects of intestinal irritation; and, in

general, the latter disease is attended even with a severer rigor than the former.

In the attack of intestinal irritation, there is usually, after the rigor, great heat of the surface. I have already observed that this is by no means an essential part of puerperal inflammation; indeed, I do not think that it properly belongs to the latter disease, but that, when it does occur with inflammation, it denotes a mixed case, and the co-existence of intestinal irritation.

In the attack of the effects of intestinal irritation, there is usually earlier and even greater frequency of the pulse, than in cases of puerperal inflammation: the pulse is also usually fuller than in the latter disease.

Intestinal irritation induces symptoms which are similar to those of the most acute phrenitis, or to those of the most acute peritonitis. This is a remark of the utmost practical importance; for the remedies in these different cases are totally different; and I should say that, in the former, the freest blood-letting must be aided by purgative medicines; whilst, in the latter, the freest and fullest evacuation of the intestines must be aided by blood-letting. A mistake, in either case, would, in my opinion, endanger the life of the patient; and it is a foolish and idle remark to say that it is better to mistake irritation for inflammation, than inflammation for irritation. It is of the utmost importance to attend to the distinctions which I have

made between inflammation and intestinal irritation, in regard to the treatment; for, although both blood-letting and purging are to be used in every case, yet the former is *the* remedy in inflammation, and the latter in intestinal irritation. If the cure of inflammation be trusted, even chiefly, to purgative medicines, I think it will frequently proceed to the destruction of the patient; and if blood-letting should be chiefly employed, in like manner, in intestinal irritation, I believe it would leave the disease unsubdued, and eventually plunge the patient into a state of irremediable exhaustion.

The affection of the head and of the abdomen frequently co-exist, or alternate, in the same case; but sometimes one of them exists to the exclusion of the other, or supervenes upon the cessation of the other; and, in the latter case, the affection of the head usually succeeds that of the abdomen. The diagnosis is much confirmed by this conjunction of the two affections.

In the affection of the head from intestinal irritation, there is frequently the severest pain, and the utmost intolerance of noise, light, and disturbance of every kind. It is in these cases, principally, that the pavement is covered with straw, the knocker tied, the patient's room kept dark and still; so that these very external circumstances speak a significant language to the physician*. To the symptoms which have

* The other cases in which these things are also observed, are, phrenitis, the effects of loss of blood, and disease of the heart.

been enumerated, are frequently added wakefulness, and even delirium.

When the abdomen is affected from intestinal irritation, there is general pain, tenderness upon pressure, and frequently tumidity, combined with the general symptoms which I have already enumerated.

Much is effected and learnt, in this case, by the exhibition of large injections of warm water, and of active purgative medicines, a careful examination of the evacuations, and a studious observation of the effects produced upon the disease. The fæces will be found to be scybalous, or, at least, offensive and dark-coloured, and in large quantity. And the relief obtained, or the return of pain, will be found to depend upon the evacuated, or neglected, state of the bowels.

Another point of great importance is an attentive inquiry into the diet of the patient. This inquiry frequently reveals the mystery of an attack, and, of course, immediately leads to the adoption of an important remedy.

In regard to the course of cases of intestinal irritation, I imagine that, under judicious treatment, this would always be one of progressive recovery. When a contrary event occurs, I think it is to be attributed to the misuse of remedies, and especially of blood-letting. In this manner some of the symptoms which are detailed in the succeeding chapter are superinduced; and sometimes a sudden dissolution has overwhelmed the practitioner with consternation.

I have already noticed that one of the characteristics of intestinal irritation is the susceptibility to syncope upon blood-letting. This is, of course, much more remarkable upon a second or third blood-letting, than upon a first use of the lancet. I have now to add, that no dependence can be placed upon the appearance of the blood drawn. This may be much buffed and cupped, in the puerperal state, without the existence of inflammation; and in cases of the most decided inflammation, these appearances of the blood may be but little observed.

I have scarcely had an opportunity of examining the state of the internal organs after death; for, in general, the patients affected by intestinal irritation have recovered. But I have no doubt that such an examination would illustrate the following important remark of the late Dr. Denman:—"We have been told that, in the dissection of some who are said to have died of puerperal fever, no appearances of inflammation have been discovered; but I should suspect that, in such cases, some important appearances had been overlooked, or that errors had been committed as to the nature of the disease, and probably in its treatment."

A due consideration of the effects of intestinal irritation will also serve to elucidate other cases of morbid affection, in which the appearances of inflammation were looked for on dissection, but were not found. This observation applies particularly to affections of the head, heart, and abdomen.

In several cases of this morbid affection, which I had the opportunity of examining many years ago, no morbid appearances were found on the most careful inspection.

I have already sufficiently alluded to the causes of this affection. They are, for the most part, obvious sources of gastric or of intestinal irritation: the former chiefly affecting the head; the latter, both the head and the abdomen, either together or separately. This subject, as well as the symptoms and character of this morbid affection, will be aptly exemplified by the following cases.

Mrs. ——, aged 35, continued well for several days after delivery, until she partook of some ham. She soon began to complain of pain of the head and vertigo. On going to bed, the pain and vertigo increased, and she became affected with rambling and starting, with great intolerance of light, so that she complained bitterly on a candle being brought into the room; and with equal intolerance of noise and disturbance. The pain of the head occupied the occiput principally; there was also pain in the region of the stomach, and general soreness over the abdomen.

The intelligent surgeon who attended this patient prescribed a purgative enema, followed by a pill consisting of five grains of calomel and one of opium, and an active purgative mixture, and directed the feet to be fomented. The following morning, every symptom had disappeared. The patient reported that

the action of the purgative and the fomentation had promptly relieved her. She added an expression of surprise at having obtained such immediate relief, having, on a former occasion, experienced a similar attack, and been bled to no purpose, as she had continued to suffer for many days.

The following case, which I extract from the interesting paper of Dr. John Clarke* to which I have already referred, is still more extraordinary.

" Mrs. T. came to London expressly for the purpose of lying-in. She was a healthy woman, the mother of several children, and had always passed through the period of her confinement without any unfavourable complaints.

" For the purpose of her confinement, she resided in a furnished house, where two streets crossed each other, and there was a mews at the back of the house. Here she lived for three weeks before her labour. She had a very natural delivery, and slept well afterwards. By the end of ten or twelve days, she was well, and free from any disorder.

" In the course of one night, she was seized with a severe pain in her head, attended with considerable impatience of light. These symptoms became more violent towards the morning, so as to excite great alarm in her husband, who immediately came to the writer. On learning that she had been perfectly well on the preceding day, he asked if she could attribute

* Transactions of the College of Physicians, vol. v, pp. 125, 126.

the pain to any cause. She replied that she knew of none, unless that, from the situation of the house, she heard every carriage which passed the streets, and every carriage which entered or left the mews. But as she had been in the house five weeks without having found any inconvenience from it before, this did not appear a probable way of accounting for it*.

"Every inquiry respecting her diet was made, and it appeared that she had eaten nothing but the most simple food. The writer, upon receiving this information, observed that he was glad that she had eaten no oysters. To this observation, she replied that she had, two days preceding the attack, eaten oyster-sauce to some boiled chicken, but that she could not comprehend how that should produce such a violent pain in the head; and she appeared anxious to know whence the satisfactory conclusion was drawn from her having before said that she had eaten nothing but simple food, having forgotten the oysters, of which she had swallowed about a dozen. An answer to her inquiry on this head was avoided."

I would earnestly recommend the whole of this essay to the reader's attentive perusal. It is quite obvious that the symptoms which are detailed in it, as resulting from partaking of oysters in the puerperal

* It is plain that this circumstance was the effect, and not a cause, of the disease, and consisted in intolerance of sound, so common in these cases.

state, may originate from any other equivalent source of irritation of the stomach.

The following cases appear to have arisen out of the state of the lower portion of the alimentary canal.

Mrs. ——, a healthy young person, was confined on January the 20th, 1820. On the preceding day, she had experienced inefficient, wearying pain. On the morning of her confinement, the pains were strong, but the os uteri was found to be rigid: she was therefore bled to eighteen ounces, and her labour was soon afterwards completed.

Mrs. —— continued well until the succeeding morning, when she was affected with severe shivering, which was repeated three times, occupying about the space of three hours. The rigors were succeeded by great heat of the skin, and by great sickness, retching, and vomiting. An enema and purgative medicine were administered. Much hardened fæces were expelled, together with a fluid having the appearance of yolk of egg; and much relief was experienced. In the evening and during the night, however, there was great heat of surface; there were much restlessness and constant changes of posture, and throwing the arms about and out of the bed; the sleep was disturbed by startings and slight delirium; there were head-ache, confused vision, and much humming noise; and there was great faintishness on any attempt to assume the erect posture. She was directed to take the effervescing mixture.

On the morning of the 22nd, the sickness returned; the purgative medicine had acted; there was considerable uterine discharge. A draught was given with thirty-five drops of the tinctura opii.

I saw the patient about one o'clock. The pulse was then 144; there were head-ache, intolerance of light, dimness and imperfection of the vision, and great humming noise in the ears; there was some beating of the carotids visible externally; there were restlessness, changes of posture, throwing of the arms out of bed, faintishness if raised to the erect position, a feeling of want of air, and relief on smelling vinegar. A draught, with thirty-five drops of the tinctura opii and a dram of the spiritus ammoniæ aromaticus, was ordered to be taken immediately, and to be repeated in three hours; a lotion, consisting of a dram of sulphas zinci and a pint of water, was directed to be applied to the pubes, and within the vagina. An aperient draught was prescribed, but not given.

In the evening, the pulse was 130; there had been comfortable, refreshing, and undisturbed sleep; all the symptoms were abated; the bowels had been purged; the uterine discharge was diminished. A draught, with ten drops of the tinctura opii and half a dram of the spiritus ammoniæ aromaticus, was prescribed to be taken every five hours; the effervescing medicine was continued; the face and hands are directed to be washed with a lotion, when hotter than natural.

Early on the morning of the 23rd, there was an

attack of troublesome coughing. At ten o'clock, the symptoms were nearly as on the preceding evening; at night they were still further mitigated, the pulse being 120, the bowels open, the uterine discharge more scanty.

On the succeeding day, Mrs. —— complained most of general stiffness and aching of the limbs, and the pulse was 125. The opening medicine was given, the opiate draughts were again prescribed, and the lotion was omitted. In the evening, Mrs. —— was relieved, and the pulse was 120.

On the next day, there was little complaint; the pulse was 108, the bowels open, and the lacteal discharge natural. All these symptoms at length subsided; but, soon after this time, the vein which had been pierced in the arm began to inflame, and this new but terrible disease proceeded in spite of every remedy, and destroyed the patient.

In Mrs. ——, aged 34, labour began on the 20th of November, but proceeded so slowly, that the os uteri was not fully dilated until the morning of the 24th; at which time it was thought proper, from the inefficiency of the pain, and the exhausted state of the patient, to deliver by means of the forceps.

There had been, from the obstinacy of the patient in regard to the treatment, no alvine evacuation during the long period of the labour: on the morning of the 25th, there was a costive motion. In the even-

ing, a dose of calomel was administered, and an aperient draught was prescribed.

On the morning of the 27th, Mrs. —— was extremely ill. The aperient draught had been neglected. The patient complained of head-ache and want of sleep; there were a vacant stare, quickness in the speech, an appearance of hurry and alarm in the countenance, and tremor of the muscles of the face; there were much heat of surface, and profuse perspiration; the pulse was 120, and tolerably strong: she begged that the windows might be opened, complaining of want of air: there was much pain in the iliac region, with some tenderness under pressure; and she complained of pain of the loins. She had taken tea principally.

Under these circumstances, thirty drops of the tinctura opii were administered, and followed by four grains of calomel and a purgative mixture.

In the evening, Mrs. —— expressed herself as feeling better; but the purgative had not operated. An enema was ordered to be administered immediately.

On the morning of the 28th, the enema was found to have induced most copious, offensive evacuations, and Mrs. —— was relieved in every respect.

On the succeeding day, Mrs. —— complained of want of sleep, and there was an appearance of restlessness. An opiate and a repetition of the purgative were ordered.

From this period the recovery was progressive and unvaried.

Some years after the occurrence of this attack, Mrs. —— was taken with somewhat similar symptoms, after a confinement; the abdomen was much tumid and swollen; and there was the utmost anxiety of the countenance and in the mind. She was bled fully; and, in the later period of the disease, the spiritus terebinthinæ was fully tried. But the patient sank, in spite of every effort to save her. The abdomen was examined; but there were none of the morbid appearances consequent upon inflammation.

In such cases, I am persuaded that blood-letting must not be lavishly repeated. But the bowels should be promptly and fully evacuated, and the patient soothed, and her strength supported by the mildest measures, not neglecting one full blood-letting, if necessary, or at the most two.

Mrs. ——, aged 36, was visited on January the 13th, two days after her delivery of her third child. On inquiry, it was found that she had suffered from severe attacks of pain, with diarrhœa, during the last five weeks of her pregnancy. Her labour had been natural, but followed by severe after-pain. She was now affected with excruciating pain, great tenderness, and general tumidity of the abdomen; the pulse was 150, and small; there were great general irritation and exhaustion. An enema was directed to be given, containing two drams of the tinctura opii,

and a liniment to be rubbed over the abdomen; and the patient was visited again in three hours. The pain was relieved, and the pulse was somewhat less frequent. Four grains of calomel and one of extractum opii, a purgative mixture, and a large domestic enema, were now directed to be administered without delay.

By these remedies, copious evacuations of hardened fæces were produced. The patient remained nearly as on the preceding day. The same remedies were directed to be repeated.

On the morning of the 15th, it was found that more scybalous fæces had been voided; there were still great pain and tenderness of the abdomen. During this day, an attack of vomiting came on, and left the patient much exhausted, the pulse becoming still more frequent. Half a grain of opium was directed to be given every five hours, and the effervescent mixture in the intervals.

These measures procured the desired relief; and Mrs. —— continued to improve during several days. But, on the morning of the 19th, she was taken much worse; and, on being visited, was found in a state of great lowness and restlessness, the pulse not admitting of being counted, the hands and feet being cold, clammy, and livid, and the countenance ghastly. Opiates, gentle stimulants, nourishment, and every means for restoring warmth, were recommended.

In the evening, Mrs. —— was somewhat revived.

An enema was prescribed. On the morning of the 20th, there was more warmth, and the pulse was more perceptible. The enema had brought away more scybalæ. During several days, the mouth and throat had become covered with aphthæ. Half a grain of opium was directed to be given occasionally.

The alvine evacuations became natural about the 24th. On this day there was attack of diarrhœa, with motions of a natural colour: it was suppressed by opium. A pain in the right iliac region still remained. It was gradually diminished by the use of a liniment, the opiate and aperient remedies being continued. From this period, Mrs. —— recovered slowly, but progressively and favourably.

I believe this patient would inevitably have sunk, had the lancet been employed. And it is quite obvious that such symptoms would not have so yielded, had they arisen from inflammation.

The last case which I shall detail in this place was fatal. The thorax and abdomen were carefully examined, but found free from the morbid appearances left by inflammation.

Mrs. ——, aged 35. For six weeks previously to delivery, she had been affected with uterine hæmorrhagy, varying much in degree. The bowels were in a constipated state. About seven o'clock in the morning of the 16th of September, 1819, she was affected with slight labour pains, and with increased flooding. At ten o'clock, an accoucheur was called to

the assistance of the midwife; the countenance was extremely pale, and the pulse frequent and feeble. Sixty drops of the tinctura opii were given in a little port wine, and repeated twice in brandy and water; but they were always rejected by vomiting: this medicine was at length retained on the stomach, on being given in water. When the patient was a little recovered, an examination was made per vaginam: the os uteri was somewhat dilated, the os externum more rigid than usual in such cases, the vagina plugged with coagulated blood—the flooding having much decreased. The hand was cautiously introduced into the uterus; the placenta was situated over the os uteri, and was separated in about one half of its area; delivery was effected with less difficulty than was anticipated; the contractions of the uterus had been and were still inconsiderable. After delivery, she expressed herself as feeling comfortable, and better than she could have expected.

The patient continued well until the evening of the succeeding day, the 17th, when she was seized with shivering, which was followed by great heat of skin, with a very frequent pulse. A purgative of calomel, followed by a draught with rhubarb and sulphate of potassa, was administered.

In the morning of the 18th, Mrs. —— was apparently much relieved. But in the evening, an urgent message and call were received. She appeared alarmingly ill; the pulse was 148; there was much violent

beating in the head, of the carotids, and of the heart; she required fresh air and the smelling bottle; and she was much relieved by bathing the temples with vinegar and water; there were general pain of the abdomen, and some tension and flatulency. Six grains of calomel were prescribed, and half an ounce of the oleum terebinthinæ was ordered to be repeated every hour and a half, until it should operate.

On the morning of the 19th, it was reported that the calomel and one dose of the oleum terebinthinæ had been taken, and had been followed by sleep; the the pain and tension of the abdomen were less; the bowels had been moved several times; the pulse was 130. Another dose of the oleum terebinthinæ was directed to be taken. A few hours afterwards, the patient complained of being much exhausted by the purgative operation of the medicine. The effervescing medicine was ordered, and appeared to give much relief.

On the 20th, the relief still continued. The pulse was about 130; the beating of the carotids less; and the abdomen was free from pain and flatulency.

On the 21st, Mrs. —— remained much the same; but the pulse was 140; she had taken light nourishment; there had been six alvine evacuations.

On the 22nd, the symptoms were aggravated, and Mrs. —— expired in the afternoon.

During the course of this case, there were repeated shiverings, generally after intervals of twelve hours.

These were followed by much heat of skin. At different times, there was slight delirium, and generally unusual quickness in the manner and in speaking. There was great wakefulness, or, if the patient did fall asleep, it was for a moment or two only, and she awoke alarmed and agitated. Besides the symptoms noticed on the evening of the 18th, there was also a degree of panting, and of deep breathing, somewhat resembling that of a person recovering himself after being out of breath.

An examination of the thorax and abdomen was permitted. All the viscera were found in the most healthy state. There was a little serous effusion into the general cavity of the abdomen.

In the treatment of the effects of intestinal irritation, I would by no means exclude the use of the lancet. Blood-letting may be useful in such a case, for the same reason that it is useful in simple fever. But I would repeat, that this remedy is only subsidiary to the full and free evacuation of the bowels, and, if necessary, of the stomach. If it were trusted to alone, or with only a moderate attention to the state of the alimentary canal, or if it were used in the manner which is required to be efficient in puerperal inflammation, I am persuaded that the patient would die of exhaustion, before the symptoms would yield.

The remedies of intestinal irritation and its effects, I would enumerate and arrange in the following order: first, the full evacuation of the intestinal canal;

secondly, blood-letting; thirdly, some kindly anodyne; fourthly, leeches, cupping, a lotion, a liniment, or a blister, according to the circumstances of the case, for the topical affection; fifthly, the mildest nutritious food; sixthly, the most absolute quiet, and the most perfect security from light, noise, disturbance, and every other source of excitation; seventhly, every soothing plan; eighthly, great coolness and free ventilation of the sick-room; and, lastly, a constant watching over the patient during sleep, to avoid the injurious effects of turbulent dreams on one hand, and of too long sleep and fasting on the other. Upon each of these points I proceed to make such observations as I have learnt, from practice, to be of importance.

In regard to the state of the alimentary canal, it is quite obvious that an emetic is the proper remedy when the symptoms can be attributed to any indigestible substance taken. And I would recommend this remedy, even although it might appear, from the lapse of time, unlikely that the injurious substance should still remain in the stomach.

When the case originates from intestinal irritation, I would earnestly recommend that the first remedy should be an enema, consisting of three or four pints of warm water, very slowly and gently forced into the bowels. This should be followed by an active purge. And this should, in due time, be followed by a repetition of the injection. I need scarcely observe, that the evacuations should be immediately carefully ex-

amined, and the effects upon the symptoms of the disease be watched.

To abate the general heat and excitement of the system, to relieve the head or the abdomen, and to ensure perfect safety, the patient should, in cases in which the strength is not particularly impaired, be raised into the erect posture, and be blooded until faintishness be induced. This effect also should be carefully watched and observed. If it occur from the loss of a small quantity of blood, it confirms the diagnosis; if it do not occur until much blood have flowed, it should suggest the suspicion of more than mere intestinal irritation, of one of those mixed cases which so frequently occur, and of which I propose to treat in a subsequent chapter.

I do not imagine that this decided use of the lancet can ever be attended with danger, if there have been no previous loss of blood, or other cause of exhaustion. But it could not be repeated with impunity. It would lead to exhaustion, with the symptoms of re-action, to the state of sinking, or even to sudden dissolution. And if the case be really one of intestinal irritation, and the other remedies have been duly applied, such repetition of blood-letting will not be required.

It is an observation of great importance, that, in inflammation, repeated blood-letting is required, and is borne with safety; in intestinal irritation, on the contrary, the repetition of blood-letting is neither necessary nor safe.

This free evacuation of the bowels, and detraction of blood, are very apt to be followed by symptoms of hurry and alarm in the system. These effects are frequently prevented by the timely administration of an efficient and kindly anodyne; and I believe no anodyne is possessed of these qualities in a higher degree than the liquor opii sedativus of Battley. Of this excellent medicine, a full dose may be given, and, if necessary, repeated in five or six hours.

If this plan do not perfectly relieve the topical affection, some local remedy must be applied. In cases of cerebral affection, leeches may be applied to the temples, or cupping, or a blister to the nape of the neck, a cold lotion over the whole head, and fomentation to the feet. Leeches, a fomentation, a liniment, or a blister, may be applied, if there be affection of the abdomen.

Before the patient falls asleep, I would recommend some mild food to be taken, as gruel, or panada. This plan prevents exhaustion, and frequently relieves the local symptoms, in securing a more refreshing kind of sleep.

For the same reason, the utmost quiet must be preserved in the patient's room. Every species of disturbance greatly agitates the patient, and prevents the good effects of the remedies which have been employed.

CHAPTER XXIII.

OF THE EFFECTS OF LOSS OF BLOOD IN THE PUERPERAL STATE.

THE effects of loss of blood, in the puerperal state, are either immediate or remote. In order to avoid repetition, I must beg to refer to an Essay upon the Loss of Blood, published in the Medico-Chirurgical Transactions*. It is my object, in this place, to confine myself to the statement of the remoter effects of loss of blood, as a puerperal disease.

These effects of loss of blood usually present themselves to our notice in rather an insidious manner; they are not generally introduced by rigor, or heat, or any other acute symptom; though I think there may be exceptions to the last part of this rule. It is an important remark, that the remoter effects of loss of blood are frequently developed in cases in which there is also intestinal irritation in a dormant form, but that they very rarely occur in conjunction with inflammation; the effects of loss of blood, when they do occur in cases of inflammation, generally denote that the inflammatory action has been subdued.

* Vol. xiii, p. 121.

I have already observed that there is rarely either rigor or heat of surface; there may be transient chills and flushes, and slightly augmented temperature; but the countenance, and especially the prolabium, is generally pallid, and the skin in a natural state.

The case is usually denoted by a throbbing fulness, with moderate frequency of the pulse, throbbing pain of the head, and palpitation of the heart, which is apt to alternate with a state of syncope on slight exertion, or on assuming the erect posture; and there is usually a degree of panting. There is a characteristic susceptibility to fainting, on taking a very small quantity of blood.

I have repeatedly known the effects of loss of blood to be mistaken for inflammation of the brain on one hand, and disease of the heart on the other. I consider this an important remark, as suggesting at once two characteristics of this affection, and the necessary caution in the diagnosis in puerperal diseases.

When the head is affected from loss of blood, there are much beating and throbbing of the temples, pain, a sense of pressure, or vertigo, with rushing or cracking noises.

When the heart is affected, there are great fluttering, beating, or palpitation, starting during sleep, hurry and alarm on awaking, sometimes with faintishness, a feeling of sinking, or of impending dissolution, &c.; and, with the palpitation, there are frequently beating and throbbing of the carotids, and

sometimes of the abdominal aorta, perceptible to the touch, or even to the eye. These affections sometimes recur in the form of attacks, which are attended by much hurry and alarm.

Besides these more marked affections of the head and heart, which render it so necessary to distinguish this affection from inflammation or disease of those organs respectively, there are many symptoms which occur in a less marked degree or form. There is frequently an inability to bear noise, or disturbance, or even the act of thinking with attention; but there is rarely intolerance of light; the last symptom usually denoting a state of intestinal irritation. There are frequently vertigo, or faintishness, on any exertion, or on assuming the erect posture; and when these two are combined, there has sometimes been a sudden and unexpected, fatal termination of the patient's sufferings. In many cases, there are great faintishness, and urgent demand for the smelling bottle, for the fan, or the fresh air, and for cold applications to the face or temples, and a sad feeling of impending dissolution. The respiration is affected, in different cases, with panting, hurry, sighing, heaving, blowing, moaning, gasping, catching, &c. There is, in some cases, an irritative cough, in violent fits, or in the form of perpetual hacking, apparently arising from an affection of the larynx or trachea. The stomach is liable to be affected with retching, vomiting, hiccough, and eructation, and the bowels, even in cases in which

they were not previously disordered, become variously deranged, with constipation, diarrhœa, and flatulency.

There are frequently, in severe cases, urgent restlessness, and jactitation.

In some cases, there are various spasmodic affections. In other instances, there are catching pains, which are apt to be mistaken for inflammation.

There are frequent changes, sudden attacks of alarming symptoms, a sense and fear of impending dissolution, urgent messages, &c. which become sad characteristics of this affection.

Another characteristic consists in the faintishness, gasping, or feeling of dissolution, which sometimes follows even a slight blood-letting: an awfully sudden death has immediately ensued, upon a full and mistaken blood-letting at this critical period.

Even the operation of purgative medicine has sometimes induced a degree of faintishness.

Every source of disturbance, of anxiety, or of alarm, and every kind of effort either of mind or body, is apt to be followed by a return or exasperation of the symptoms, and cannot be said to be free from danger.

I have already remarked, that an effort of the muscles, and assumption of the erect posture, have proved suddenly fatal. This sad event occurred to a lady who raised herself in bed, in this exhausted state, to make water; she fell down and expired.

But when the fatal event from loss of blood is not

sudden, in this manner, the state of re-action sometimes yields to one of fatal sinking. I have described this state in my ' Medical Essays,' to which I have already had occasion to refer, and from which I extract the following remarks, referring my readers to that little work for a further detail and exemplification of this condition of the system.

The symptoms of exhaustion with excessive re-action may gradually subside and leave the patient feeble, but with returning health; or they may yield to the state of sinking. This term is adopted, not to express a state of negative weakness merely, which may continue long, and issue in eventual recovery, but to denote a state of positive and progressive failure of the vital powers, attended by its peculiar effects, and by a set of phenomena very different from those of exhaustion with re-action.

If, in the latter, the energies of the system were augmented,—in the former, the functions of the brain, the lungs, and the heart, are singularly impaired. The sensibilities of the brain subside, and the patient is no longer affected by noises as before; there is, on the contrary, a tendency to dozing, and gradually some of those effects on the muscular system, which denote a diminished sensibility of the brain, supervene; as snoring, stertor, blowing up of the cheeks in breathing, &c. Instead of the hurry and alarm on awaking, as observed in the case of excessive re-action, the patient in the state of sinking requires a moment to

recollect herself and recover her consciousness, is perhaps affected with slight delirium, and is apt to forget the circumstances of her situation, and, inattentive to the objects around her, to fall again into a state of dozing.

Not less remarkable is the effect of the state of exhaustion, with sinking, on the function of the lungs. Indeed, the very first sure indication of this state is, I believe, to be found in the supervention of a crepitus in the respiration, only to be heard, at first, on the most attentive listening: this crepitus gradually becomes more audible, and passes into slight ruttling, heard in the situation of the bronchea and trachea; there is also a degree of labour or oppression, sighing, hurry, and blowing, in the breathing, inducing acuteness in the nostrils, which are dilated below and drawn in above the lobes, at each inspiration. In some cases, there is, besides, a peculiar, catching, laryngal cough, which is especially apt to come on during sleep, and awakes, or imperfectly awakes, the patient.

The heart has, at the same time, lost its violent beat and palpitation, and the pulse and arteries their bounding or throbbing.

The stomach and bowels become disordered, flatulent, and tympanitic, and the command over the sphincters is impaired.

The last stage of sinking is denoted by a pale and sunk countenance, inquietude, jactitation, delirium, and coldness of the extremities.

I now proceed to exemplify the effects of loss of blood, by several interesting cases.

Mrs. ——, aged 35, was confined on Friday, the 11th of June. For several weeks previous to delivery, she had been subject to pain of the head, and of the left side, which were relieved by an attention to the state of the bowels.

After the expulsion of the placenta, there was considerable hæmorrhagy, which induced great exhaustion. Two doses of forty drops of tinctura opii were given within two hours, with the effect of producing sleep. The flow of milk commenced on the same day, and was very copious.

About three hours after delivery, Mrs. —— was seized with a violent pain of the crown of the head, confined to a space which could be covered by the hand; the pulse was 80 only; there was much thirst; the tongue was little affected; the skin was natural. This pain was relieved by the cold lotion and opening medicines, and Mrs. —— continued better during ten days.

On the night of Monday, June the 21st, Mrs. — was taken, about twelve o'clock, with severe shivering, which was succeeded by intense heat and dryness of the skin, great pain of the head, and intolerance of light and of noise. At ten o'clock on the succeeding morning, these symptoms still continued; the pulse was from 120 to 130, and sharp; the pain of the head was throbbing, and the head felt as if bound

tight; the tongue was parched. Ten ounces of blood were taken from the arm, which produced temporary faintness, but some relief; the cold lotion was applied to the temples. At seven o'clock in the evening, the pain in the head was as severe as ever, especially if the lotion were not constantly applied; the pulse was 120; the tongue not so dry; the blood already drawn was buffy. Twelve ounces of blood were taken from the arm. This was followed by great faintness, and gasping breath—to such a degree, indeed, as to lead to the apprehension of dissolution even. On recovery, the pain and intolerance of light and sound remained as before; the pulse rose to 130. Leeches were applied to the temples, and the cold lotion over the head; two grains of calomel were ordered to be taken every two hours; and an opening mixture and an enema were prescribed.

At four o'clock of the morning of Wednesday, the 23rd, the symptoms continued with little change; the pulse was 120; there was much gaping. Six leeches were applied to the temples, a blister to the nape of the neck, and the medicines were continued.

On Thursday morning, the 24th, the pulse was 100, and she appeared better, but complained of a degree of beating of the heart. At four in the afternoon, the pulse was 120, the breathing was deep, sighing, and rare, and there was a sense of fluttering at the heart, the affection of the head still continuing.

Two grains of opium and five of calomel were ordered to be taken immediately.

At two o'clock on Friday morning, Mrs. —— was distressed with a feeling of hurry, of impending dissolution, and of being 'overcome' by sleep; the pulse was 120; and there were sighing and interrupted breathing. At eleven o'clock, she was more comfortable; the pulse was 100; there was less pain of the head, and of intolerance of light and sound, less sighing, and less faintishness; she had been able to sleep for ten or fifteen minutes without feeling overcome; there was some fluttering.

From this day the amendment was progressive, though slow, and, on the 29th, the following report was made. There have been some pain of the head, fluttering, faintishness, feeling of dissolution, sighing, breathing, restlessness, &c. at different times, but less than on the 25th; the skin has been, in general, hot, but once moist; the pulse about 100; the bowels rather disordered, and the stools dark and offensive.

A similar report was made on July the 3rd. It is also stated that the pulse was easily hurried, that there was an evident movement of the abdomen from the action of the aorta; and that there had been occasionally hurry and alarm during sleep.

On July the 7th, it is reported that Mrs. —— is greatly susceptible of the effects of corporal exertion, or mental emotion, which induce hurry, throbbing,

palpitation, &c.; and there are still some throbbing or pulsation observed in the neck and about the heart, some tendency to sighing breathing, faintishness, &c.; there is also a return of the pain of the left side experienced during the later period of pregnancy.

On July the 16th, there were still throbbing and palpitation on any exertion, and hurry on the slightest occasion; lowness and faintness; starting and hurry on falling asleep and on awaking; and a visible pulsation of the abdomen.

From this period until the 4th of August, Mrs. — continued to recover in the most favorable manner, when she again experienced a degree of shivering, heat, and pain of the head and of the side. The medical attendants were called: the pulse was 104; the skin hot; there were pain of the head; the feeling of dissolution on falling asleep; fluttering; faintishness; repugnance to food; severe but ineffectual retching; the flow of milk lessened; no vaginal discharge. She could not bear to sit up; the window was wide open, a fan and smelling bottle lay on the bed, and the candle was shaded. The bowels had been moved, and some dark and fœtid motions passed.

The anorexia had existed for some days, the bowels had been disordered, and Mrs. —— had parted with Mr. ——, who was gone a journey—circumstances which had appeared to conduce to this attack. A brisk purgative was prescribed, and a draught with tinctura opii, spiritus ammoniæ aromaticus, and

æther, was directed to be taken, if the operation of the purge should be too great. In the evening, I found the medicine had induced four or five alvine evacuations, which were free from fœtor or even odour. The feeling of faintness continued, and the pulse was extremely uncertain in frequency, varying from 84 to 100 in a minute; there were frequent, deep sighs, and almost gasping, with loathing, nausea, and occasionally severe retching. Some beating about the chest, some restlessness, and considerable tremor. She took a little dry toast, a little weak brandy and water, and a little porter, and was ordered half a grain of opium, two grains of carbonas ammoniæ, and three of extractum hyoscyami, to be taken every three hours. This induced much sleep, the first part of which was attended with the same overwhelming feeling as before, but the latter greatly refreshing; and, on the morning of August the 5th, she was better in every respect. In the evening she was still better, but complained of oppression, which was attributed to the extreme closeness of the evening. There had been one fæculent motion.

On August the 6th, Mrs. — was very much better. There had been a dark, fœtid, alvine evacuation.

From this time the recovery was progressive, rapid, and permanent; and the patient continues to enjoy a good state of health, with the exception of a disordered state of the digestive organs.

Mrs. ——, aged 44, mother of a large family, be-

came pregnant about the beginning of October, and from that period was subject to sickness, and a very irregular state of the bowels—constipation continually alternating with diarrhœa. About the ninth week after conception, there was a flow of fluid by the vagina, which did not coagulate: this flow continued a week; then ceased; but afterwards returned and continued, with the exception of two or three days, until at length the discharge formed into coagula, and abortion took place five weeks after the first flow.

Subsequently to this event, there were weekly returns of uterine hæmorrhagy, which continued for about two days, and then ceased, again to recur after an interval of about five days.

Before and after the abortion, Mrs. —— experienced much tremor, faintishness, and fluttering, and was unable to bear any noise or cause of hurry. These symptoms were aggravated more and more at each recurrence of the hæmorrhagy, which was always preceded by tumidity and a sense of fluttering about the abdomen, and by a peculiar inability to bear any noise or hurry, which always induced the feeling of approaching dissolution. After the loss of blood, there were also severe pain of the forehead, and palpitation of the heart, with tendency to syncope, chilliness, sense of want of air, &c. These symptoms became more and more distressing and serious at each return. The feeling of impending dissolution was so dreadful at length, that, as the patient expressed her-

self, not only noise and hurry, but even thinking was too much for her; and the subsequent affection of the head, &c. became very alarming.

I saw Mrs. —— on February the 22nd. She then complained of severe pain and heaviness of the head, with vertigo on raising herself from the pillow, of deafness, with a humming noise and beating in the ears, and of dimness of sight. She had been very wakeful; but, on falling asleep at any time, she awoke hurried, alarmed, and overcome, and expe-riencing a sense of dissolution; or if she continued to sleep, she was much disturbed by frightful dreams. She had much palpitation of the heart, with flutter-ing, and a very irregular and intermittent pulse; these symptoms were so much aggravated by any noise or disturbance, as to induce the feeling of impending dissolution, or, as the patient expressed it, 'of instant death.' There was also great tendency to syncope, requiring the window to be opened, the face to be washed with vinegar, and the smelling bottle to be applied to the nostrils: other odours, however, could not be borne. There was no nausea or sickness. The bowels had all along required purgative medi-cines, and the alvine evacuations were copious, dark-coloured, and fœtid. There was much loud rolling of the bowels. No pain of the side, or uterine region. There were great pallidness, and loss of flesh.

The affection of the head and other symptoms were not only aggravated, but distinctly reproduced,

by each return of flooding, and the patient was always enabled to foretell the recurrence of hæmorrhagy, by her feelings of internal abdominal fluttering and fulness, and the effect experienced from noise and disturbance.

I prescribed a lotion consisting of two drachms of the sulphas zinci dissolved in sixteen ounces of water, to be inserted, by means of a scroll of linen, into the vagina; purgative medicines, and the saline effervescing mixture. The lotion suppressed the hæmorrhagy, of which she had only one recurrence, and she recovered most speedily and favorably.

Mrs. ——, aged 24, was affected with continued and profuse uterine hæmorrhagy, after delivery, for many weeks. The countenance became, in consequence, extremely pale and exanguious, as well as the hands and general surface; the pulse became frequent and bounding; the head affected with throbbing pain, and, afterwards, the heart with beating, the action of the carotids being very evident to the eye and to the finger; the tongue was furred, and affected with large and prominent papillæ; and the alvine evacuations were very fœtid. Mrs. —— recovered much from taking opiate and aperient medicines, and on being allowed a little ale.

In this state of convalescence, Mrs. —— was extremely alarmed and agitated, by the occurrence of a storm of thunder and lightning, and became affected with excessive diarrhœa, hurry, and palpitation of

the heart, the pulse being too frequent to be counted, and threatening of dissolution. This state was relieved by opiates.

On the succeeding day, the countenance was again exanguious, the pulse extremely frequent, the carotids beat violently, and there were great hurry, faintishness, and debility; the appetite, which had previously returned, again failed; the bowels were open; there was pain from retention of urine; no uterine discharge.

From this time, Mrs. —— recovered favorably and permanently, on using the same medicines as before.

The cases which have been now detailed will sufficiently display the usual symptoms and effects of loss of blood, in the puerperal state, and demonstrate the danger, in different cases, of mistaking these effects for inflammation, or disease, of the brain or heart, according as the symptoms affecting the former or latter organ may predominate. The first will strongly illustrate the danger of drawing a wrong inference from the effects of blood-letting in such cases; for the symptoms were all relieved by this measure; but its repetition was attended by some alarm, if not hazard. This case illustrates another point, which is, that leeches applied to the temples may relieve and be admissible, when general blood-letting is inadmissible. It is further to be observed, too, that the application of leeches to the temples was not followed by the

same degree of re-action as the blood-letting; so that, in this respect also, they formed the appropriate remedy. The second, and especially the third of these cases, strongly exemplify the symptoms of affection of the heart arising from loss of blood.

I now propose to detail the principles of the treatment in cases of the effects of loss of blood in the puerperal state.

In the first place, the state of exhaustion from loss of blood, with or without re-action, by no means precludes the possibility of congestion within the head. And it is no less certain that the application of leeches to the temples, or of the cupping glass to the back of the neck, relieves the symptoms of the affection of the head, arising from loss of blood, in a remarkable manner. In a case given by Mr. Hey*, which I regard as being of this character, and to which I shall have occasion to revert hereafter, urgent symptoms of affection of the head were twice relieved by the abstraction of but three ounces of blood from the temporal artery. This mode of treatment must not therefore be neglected, except in the most extreme cases, in which the loss of even so small a quantity of blood, and that from the head even, might precipitate the remaining powers of the patient.

The next point of practice which requires to be mentioned, is the state of the stomach and bowels. If

* On the Puerperal Fever, p. 86.

these were free from all disorder before the occurrence of loss of blood, yet the state of exhaustion ever induces a deranged state of the alimentary canal. The state of the bowels must therefore claim our attentive consideration in every case of symptoms arising from loss of blood. Their functions and tone must be carefully restored by every means in our power, while we as carefully avoid any fresh source of exhaustion. The bowels must, in particular, be carefully evacuated daily. This may, perhaps, be best done by means of the warm water injection, so often recommended in this work already, with or without the aid of a draught containing an ounce of the infusion and two or three drachms of the compound tincture of rhubarb, and of manna.

By these means, the state of irritability which is so apt to affect the system, and especially the head and the heart, in cases of exhaustion from loss of blood, is greatly obviated. But, for this affection, it is frequently also necessary to give some mild but efficient anodyne. The tinctura opii, the tinctura hyoscyami, the spiritus ammoniæ aromaticus, &c. are extremely useful remedies in this affection. But, perhaps, the best are the liquor opii sedativus of Battley, or the extract of poppy, given in efficient doses.

When the head, the heart, and the alimentary canal, have been thus relieved, and even during the exhibition of the medicines which have been enumerated, it is of the first importance to attend to all the

following points: viz. nourishment, fresh air, quiet, soothing, sleep, &c.

It is difficult to give any rule for the administration of nourishment. But the first rule is to ascertain that the bowels have been properly evacuated; otherwise food will only oppress the stomach; the second, is to give the nourishment itself in such forms as will prove light and easy of digestion; the third, is that it should be taken at first very slowly and in small quantities. Arrow-root done in water, beef-tea, panada, sago, &c. may be given frequently.

The best restorative we possess, is, I believe, fresh air; but it is especially the best, in the cases under consideration. The warmth and closeness of a lying-in room must therefore be forthwith exchanged for free ventilation, only observing the due precautions against giving cold.

Nothing is more essential than quiet, both of body and mind. Bodily exertion leads to still further exhaustion, and perhaps even to unexpected dissolution. And every kind of mental effort or hurry not only exhausts the patient's strength, but is extremely apt to lead to those attacks of symptoms of irritability of which I have given so full a description.

The patient should be soothed and lulled in every possible way; and it is of the utmost importance to procure sleep. But it should be observed, in regard to sleep, that too long a sleep is apt to exhaust or overwhelm the patient. This is especially true, if it be

not preceded by nourishment. The sleep is also apt to be injurious by leading to turbulent dreams, which have the same bad effects as waking hurry of mind: the sleep should therefore be watched; and it should be interrupted, if the patient is observed to suffer from agitation. This is best done, I think, by offering nourishment; for the patient is immediately collected, on awaking, from knowing what is doing.

There is one point which I have not hitherto mentioned as it deserves. It is the efforts made by the parent to suckle her infant. Nothing is so injurious in *all* puerperal diseases. These morbid affections have often appeared to be first induced by the attempt to nurse; and they have still more freely been exasperated by it. This attempt especially involves within itself almost every thing which can be injurious in a state of exhaustion: the drain, the muscular effort, the mental excitement, implied in the act of suckling, are all of the most injurious tendency in this affection.

CHAPTER XXIV.

ON THE DIAGNOSIS OF PUERPERAL DISEASES.

Perhaps the cases which most frequently present themselves to our notice in practice, are of a character distinct from those which have been described in the three preceding chapters, differing from them principally by blending two, or all three, of those cases in an individual patient.

Our systems of nosology have, I am persuaded, greatly erred, in attempting to separate diseases from each other, and describe them as distinct, when they far more frequently occur in conjunction; so that the mind of the medical student is not at all prepared for the cases which most frequently occur to him when he first enters upon practice. A little experience teaches him the difficulty, nay, the absurdity, of attempting to give each individual case a name, or to put it down in a list of diseases. Each patient, on the contrary, presents to him a new congeries of symptoms, a new complication of diseases or disorders.

To apply these remarks to our present subject, it may be truly said that puerperal cases are more complicated than any. But I have already sufficiently insisted upon this point. I now proceed to illustrate

the various combinations of inflammation with intestinal irritation, or of either or both with the effects of loss of blood.

Some cases have conjoined the most decided symptoms of intestinal irritation with those of inflammation, and, having proved fatal, have, on examination, presented all the traces of inflammatory action. It has already been shown, that, in many cases of inflammation, there are none of the symptoms which denote intestinal irritation; there is an absence of rigor, of heat, of affection of the head, &c. But the effects of inflammation are found on dissection. On the other hand, there have been all the symptoms of intestinal irritation, as rigor, heat, head-ache, with pain, tenderness, and tension of the abdomen, without a trace of the effects of inflammatory action on examination after death. The conclusion from these separate statements is obvious: inflammation and intestinal irritation may exist separately; but they may also exist together.

The effects of loss of blood are frequently observed in cases of inflammation, when the primary disease has been perfectly subdued. But they are still more apt to concur and to assimilate themselves with those of intestinal irritation, when there has been much loss of blood by hæmorrhage or by blood-letting.

I propose to illustrate this subject immediately, as well as the interesting question of the diagnosis, by a reference to the valuable treatise of Mr. Hey, upon

puerperal fever. This author, as well indeed as almost every writer upon this subject, appears to me to have combined in one description all the three different cases of which I have treated. It is not, therefore, wonderful that their works should involve many inexplicable discrepancies in the symptoms and in the treatment. Some cases have occurred without rigor, heat, or head-ache; others have combined all three, with or without great affection of the abdomen. Some have been cured without the lancet; others have not yielded to the most judicious and most ample blood-letting. It is doubtless a most important question, how can these discrepancies be explained?

Other difficulties and other discrepancies have arisen from the addition or superinduction of the symptoms of loss of blood, in cases of inflammation, or of intestinal irritation. This is a mixed case which frequently occurs, and causes much embarrassment to the young and inexperienced physician. And it has too frequently happened that the lancet has been prescribed under a false impression of inflammation, and that great danger, and even immediate dissolution, have ensued.

There is a mixed case which shows itself under a still different form from any which have hitherto been described: it is *puerperal mania*. I believe this disease to result, in general, from all the circumstances following parturition combined; but chiefly from the united influences of intestinal irritation and

loss of blood. I purpose to pursue this subject hereafter. In the mean time, however, I would observe, that I am persuaded that real puerperal phrenitis is comparatively a rare disease; that puerperal mania is seldom of an inflammatory character, and that it is, especially, to be treated by those measures which are suited to the mixed case of intestinal irritation and exhaustion. This opinion is confirmed by the fact of mania occurring from undue lactation, as well as from the circumstances of the puerperal state. I am inclined to attribute much more to the combined influence of irritation and exhaustion, than to the mere "state of the sexual system which occurs after delivery," which has been assigned as the chief cause of this morbid affection, by Dr. Gooch, in a most interesting paper upon this subject, in the sixth volume of the Transactions of the College of Physicians, p. 280; although I would by no means exclude the influence of this principle altogether. There is ample evidence, in Dr. Gooch's cases, of the influence of intestinal disorder; and the events of labour, and the circumstances of lactation, ever add to this a state of exhaustion. This view is the more important, because it directly suggests the proper mode of treatment, which consists in restoring the system to a state of due health by every means in our power, whilst we adopt every measure which can soothe and allay the morbid irritability of the nervous system.

I am confirmed in this view of the nature of puer-

peral mania, not only by a careful investigation of its causes, and the good effects of the remedies which I have mentioned, but by having met with the symptoms of intestinal irritation described in Chapter XXII, as a prelude to those of mania. The following interesting case will illustrate this point.

Mrs. —— was well, except a little cough, during the whole course of her pregnancy. Labour-pains commenced on Saturday, at three o'clock in the afternoon, and continued trifling for twenty-four hours; they then became severer, and continued so until Tuesday afternoon: at this time the pains became severer still, and remained so until her delivery at midnight, when she was greatly exhausted. There was no serious flooding or bowel-complaint; and Mrs. —— continued to do well until Friday, about fifty hours after her delivery. At that time she became affected with severe pain of the head, with great beating and noise, and great intolerance of light and sound, and dozing, interrupted with much starting. She was better the succeeding morning, but became very much worse in the afternoon, with the same pain of the head, and other symptoms as before; the pain was extremely severe, and she passed a restless night. I saw Mrs. —— the next day, Sunday; she was then affected with great pain of the head, some delirium, and occasional attempts to get out of bed; intolerance of light, noise, and disturbance, and a very frequent pulse, from 130 to 140; there was a feeling of sink-

ing; starting, and alarms, and frightful visions on closing her eyes or falling asleep, with a mixture of delirium and consciousness of delirium.

This state continued until Wednesday and Thursday. On the former day, there were some delirium and much purging; on the latter, continued and violent delirium, with crying and tears, and a constant desire to get out of bed: an entire absence of rest and sleep had obtained for five days. Leeches and purgatives, and anodyne draughts of the usual strength, had been employed in vain, the symptoms having much increased in violence every day. On the evening of Thursday, a dram of tinctura opii and of the spiritus ammoniæ aromaticus were given, and repeated in the night, and snow was applied to the head. This induced a profound and quiet sleep, with only a little starting on awaking; she awoke, indeed, free from delirium, and much refreshed, and the pulse was less frequent. The draught was repeated on Friday, at bed-time. The pulse continued to diminish in frequency, and the symptoms to subside, from this time; the flow of the lochia and of the milk was natural. Once, in the course of this case, there were pains and some tenderness of the lower part of the abdomen, which were effectually relieved by a fomentation and an ammoniacal liniment.

I shall never forget the astonishing effect of the ammoniacal opiate draught prescribed on the Thursday, after the effectual evacuation of the bowels. I

would remark, that the awaking from sleep, in this case, was sometimes so frightful, that the patient would almost jump off the bed; and, had her sleep and awaking not been carefully watched, it seemed probable that she might even have expired.

Other cases begin in this manner, but go on to a protracted length.

There are frequently many of the appearances of disorder of the general health described in a preceding chapter; sometimes jaundice even; and the state of the complexion, and of the alvine evacuations, leaves no doubt as to the influence of the morbid condition of the intestinal canal. Blood-letting plunges the patient into a state of danger, perhaps into one of irretrievable sinking. I leave this interesting subject to be discussed upon some future opportunity, earnestly recommending to the reader, in the mean time, the study of the paper already quoted, by Dr. Gooch, and especially the following observation:—"If every patient who has fever, is furious, and shrinks from a candle, is judged to labour under phrenitis, mania will be mistaken for it, and, what is worse, mistreated*."

I now return to the consideration of some of the cases detailed in the treatise upon puerperal fever by Mr. Hey.

The first case which I shall quote is one of pure puerperal inflammation of the abdomen. It is highly important, by illustrating the facts, that this species

* Transactions of the College of Physicians, vol. vi, p. 279.

of inflammation may be set up without being attended by rigor, heat of surface, great frequency of the pulse, or affection of the head.

" Mrs. S—— was brought to bed on the 5th of July, 1810, about nine o'clock in the morning. In her former labours, she had been subject to a relaxation of the uterus after delivery, which usually occasioned a considerable flooding. Her discharge at this time was copious; but, being aware of the tendency to hæmorrhage, I was able, by suitable means, to keep it within moderate bounds.

" On the following day, at three o'clock in the afternoon, I was called to her in haste, on account of an excruciating pain which had suddenly seized the abdomen. It continued for half an hour without remission; but, before my arrival, it had ceased. As the pain was not preceded by rigor, and the pulse was not accelerated, I could not conclude the case to be one of puerperal fever; and therefore satisfied myself with prescribing an opening medicine, and requesting to be sent for immediately if the pain should return.

" Having heard no more from the patient, I visited her late in the evening; and then found that the pain had returned, but with a less degree of severity; and, having had regular remissions, it had been mistaken for the common after-pain, and had therefore created little alarm. The abdomen had become very tender, and the pulse frequent.

" No doubt now remained on my mind of the

nature of the disease; and, though the attack was less distinctly marked than in most of the cases which I had seen, my later experience warrants me in concluding that the disease would soon have proved fatal, had not vigorous means been employed to check its progress. As night was approaching, I feared to wait till the symptoms became more urgent; and therefore, notwithstanding my reluctance to copious bleeding was not quite overcome, I immediately took from the arm a large basin full (about twenty ounces) of blood, and directed a continuation of the purgative. A cathartic clyster was also injected. The pain was diminished while the blood was flowing, and on the following morning it was nearly gone; the fever had also greatly sudsided. The bowels had been freely evacuated; yet I thought it advisable to maintain the purging undiminished for another day; and then it was suffered gradually to abate. The patient recovered without further complaint.

"Thus was an immediate stop put to the disease, which, had the bleeding been omitted, or deferred until morning, would, in all probability, have been irremediable. For though the first attack was, in some respects, less alarming than in many other cases, yet its early period, the severity of the pain, the consequent soreness of the abdomen, and the rapid increase of the pulse, clearly point it out as a genuine, and not a very slight case of the prevailing epidemic.

Perhaps the previous hæmorrhage might, in some degree, have obviated its violence*."

It is a dangerous opinion, that puerperal inflammation of the abdomen must be ushered in by rigor—must be attended by great fever. This disease is often insidious; it frequently begins with slight rigor, sometimes with no rigor at all. And violent rigor, and great heat of surface, frequency of pulse, and affection of the head, denote the addition of intestinal irritation to the state of inflammation. I beg to repeat, that an accurate examination of the abdomen can alone establish a correct diagnosis of the latter disease; to which must be forthwith added an investigation of the powers of the system to bear blood-letting, of the effects of a free evacuation of the intestinal canal, and of the condition of the alvine discharge.

The next case which I shall transcribe is an example of intestinal irritation, and not, I believe, of inflammation.

"Mrs. N——, residing at a solitary house in the country, about three miles from Leeds, was brought to bed in the night of the 7th of February, 1810, after a short and easy labour. She was a middle-aged woman, and had borne many children. On the 9th, I gave her a gentle laxative, which had the desired effect. On the morning of the 10th, I found her sitting up to suckle her child; she seemed unusually well, and so she remained till the end of six days.

* Pp. 91—94.

" 14th. I was called up at one o'clock in the morning to visit her, and was informed that, having gone to bed quite well, she was seized, at eleven P. M. with a shivering fit, which was succeeded by a great degree of heat, and pain in her body (shooting also into her hips and thighs) resembling labour-pain, but continuing without any perfect intermission. She complained also of much pain and throbbing in her head. Though the heat had begun to abate before my arrival, the skin was still hot and dry; but soon afterwards a profuse perspiration succeeded. The tongue was furred and very white; and the pulse beat at the rate of 150. The breasts were flaccid, and I desired that the child might not be allowed to suck. The abdomen did not show any tenderness upon pressure. The lochia had returned afresh on the preceding morning, and in the evening she had had a natural and easy stool.

" The want of success which had hitherto attended the treatment of the disease, induced me immediately (though it was night) to consult with my father on the management of this case. We were satisfied that no remedy had done so much good as purging; yet it had not proved sufficient for the cure of the disease. We therefore thought it proper to add such means as might tend to allay the local irritation, without much interfering with the operation of purgatives. With this intention, we ordered a draught with rhubarb and tartarized soda, of each a dram, to be taken im-

mediately; a small clyster with forty drops of tinct. opii to be injected; a large blister to be applied to the abdomen; and a saline draught to be taken every two hours.

"Half past two, P. M. The pain had somewhat abated before the medicines arrived. After the injection of the opiate, it had gone off entirely, and had not returned. A slight vomiting had come on after taking the purging draught, and probably a part of it had been rejected. A degree of chilliness, succeeded by heat, had returned about one, P. M. Pulse at 126. I prescribed the following mixture:

℞ Sod. tartariz.—mannæ, aa ℥ss.
Tinct. senn. ℥ij.—Aq. fervent. ℥ij.
Sumat tertiam partem alternis horis;

and ordered a domestic clyster to be injected. I took off the blister, which by mistake had been applied to the back.

"Nine, P. M. Two doses of the mixture had been taken, and had procured three loose feculent stools. A degree of nausea had once been felt after taking some broth. Pulse at 134.

"15th. Half past one, P. M. The patient had passed a very comfortable night, and had slept a good deal. She remained free from pain and soreness in the abdomen; and the secretion of milk seemed to be returning in the breasts. The tongue was cleaner. Pulse at 104. She had had one copious stool of solid fæces in the night, but none since that time. The

saline draughts were ordered to be taken every four hours, and the purging mixture in such doses as to keep open the bowels; also a clyster to be injected in the evening. A table spoonful of wine in gruel was allowed to be given now and then.

"16th. The injection had produced two plentiful stools, containing large lumps of solid fæces. The patient complained of more pain in her head, and her tongue was furred. Pulse at 96. The medicines were ordered to be continued; another clyster to be injected in the evening; and the feet to be immersed in warm water.

"17th. Four, P. M. Notwithstanding a pretty good night, she had not been so well this morning. The pain in her head continued; and she had several times experienced an acute shooting pain in the region of the uterus, which did not remain, but had produced some degree of soreness of the abdomen. She complained of thirst; the tongue was a good deal more furred, and the pulse at 104. Several loose evacuations had taken place in the preceding evening, but none after nine o'clock.

"Ordered the opening draught to be given immediately; and the clyster in the evening, if the draught should not operate before nine o'clock. The patient having taken a dislike to the saline draughts, the carbonate of potass with lemon-juice, to be taken in a state of effervescence, was substituted in their place.

"18th. The opening draught and injection had

failed to operate. The abdomen was distended and hard, but not painful. Some degree of nausea had come on in the night, but had not produced vomiting. The skin was cool and pallid. The tongue was covered with a brown fur, and the pulse was at 112. A repetition of the clyster and opening medicine was directed.

"Six, P. M. A copious stool had been obtained, containing a good deal of mucus; and much flatus had been expelled per anum. The abdomen was soft, easy, and considerably reduced in size. Countenance good. Pulse 114.

"19th. The patient had passed a very good night, and was in all respects better. The pain in the head and abdomen, and the enlargement of the latter, were quite gone. The fur of the tongue was coming off, and the pulse was at 98. A clyster had been injected, and had procured a proper evacuation.

"About noon, she was seized with a cold fit, scarcely proceeding to a rigor, which was succeeded by great heat, a very frequent pulse, and pain in the head. A second clyster was injected, which operated and gave sensible relief. I ordered an opening draught to be taken in the evening, and the clyster to be repeated if necessary.

"20th. The draught and injection had both been given, and an evacuation procured by each, containing lumps of hardened fæces, which had the appearance of having remained in the bowels for some time,

and had probably been the cause of the cold fit. The head was quite relieved; the fur was cast off from the tongue; and the pulse was reduced to 90. As there was some appearance of languor, a table-spoonful of wine was directed to be taken frequently in some nourishing liquid.

"21st. No complaint, except soreness of the tongue and fauces, which were affected with aphthæ.

"On the 22nd, the patient, having been rather longer than usual without a stool, was again attacked with chilliness, succeeded by heat, but in a much less degree than before. She was relieved by an injection; but this attack occasioned her a restless night.

"From this period she recovered without any relapse; but was some time in regaining her usual strength; on which account, she took various tonic medicines*."

In this case, there were, at first, rigor, a great degree of heat, a white and furred tongue, a pulse of 150, much pain and throbbing in the head, whilst the abdomen was free from tenderness on pressure. On the second day the abdomen was still free from pain. On the third, large lumps of solid fæces had been passed, and there was more pain of the head, but still none of the abdomen. On the fourth day, an acute shooting pain in the region of the uterus is first noticed; on the morning of the fifth, the abdomen was distended and hard, but not painful, and, in the even-

* Pp. 70—76.

ing, soft, easy, and considerably reduced in size. On the sixth day, the pain and enlargement of the abdomen were quite gone; in the evening, there were rigor, great heat, frequency of the pulse, and pain of the head; these were greatly relieved by a clyster, and on the succeeding day the patient passed lumps of hardened fæces, which had the appearance of having remained in her bowels some time.

In addition to these observations, it is to be particularly noticed that this patient recovered from this violent attack of puerperal disease without the use of the lancet.

I should be afraid of being charged with colouring, if I had given such an account of a case of puerperal disease. No one can fail to observe the entire difference between this and the former case, in every particular. The symptoms are totally different; those of the former illustrating admirably the case of rather insidious puerperal peritonitis; those of the latter, not less forcibly, the severer attack of intestinal irritation. The treatment demonstrates the same thing: it is all but impossible to imagine that such an attack should yield without the most active blood-letting, had it indeed been inflammatory. Many other patients had died under the neglect of this all-powerful and all-essential remedy of inflammation. Why should this patient escape?

The last case which I shall adduce is not a case of inflammation, nor purely of intestinal irritation, but

affords an example of intestinal irritation with the effects of loss of blood.

"June 18th, 1810, I was sent for to Mrs. B——, a stout, middle-aged woman, living at a little distance from the town, who had borne several children, and was then in labour. The early part of the labour proceeded quickly; but, the pains declining in strength, the latter part was slow. The placenta separated spontaneously, and was expelled by the natural efforts; but the uterus did not contract well afterwards, which occasioned too great an effusion of blood. However, by keeping up a compression with the hand on the fundus uteri for about an hour, the hæmorrhage was considerably restrained, and I left my patient apparently doing well.

"In about an hour, I received an urgent call, in consequence of a fainting; and found the uterus much distended with blood. I removed the coagula from the vagina; and, by gently stimulating the os uteri with two fingers of one hand, and compressing the fundus with the other, a good contraction was produced, and the hæmorrhage ceased. The patient remained languid, but had no more fainting. Pulse 120.

"19th. No complaint but languor arising from the loss of blood. Pulse the same.

"20th. The strength had improved; but the pulse had rather increased in frequency. Ordered a gentle laxative.

"21st. Eleven, A. M. The laxative had pro-

cured three good evacuations, two of which were loose. The pulse had come down to 96, and was full and strong. I observed the tongue to be dry in the middle.

" Three, P. M. Not long after my visit in the morning, the patient had been affected with a slight chilliness, which was succeeded by heat, vomiting, and a continued, though not violent, pain in the abdomen. She complained of soreness when the abdomen was touched; and the uterus, somewhat enlarged, was distinctly to be felt above the pubes. The skin had now become cool. I directed a purging clyster to be injected immediately, and a saline mixture to be taken every two hours in a state of effervescence.

" At this time I had not seen Dr. Gordon's Treatise on the Puerperal Fever of Aberdeen; for it was not much known in Leeds. But I had read the short account of it contained in Thomas's Modern Practice of Physic; and the last case which had occurred to me, having exhibited evident marks of acute inflammation, I was strongly inclined to make trial of bleeding. This inclination was strengthened by reflecting on the small success which had hitherto attended all other means; and still more so, by the consideration, that purging, the other principal remedy of Dr. Gordon, was the only one from which I had seen clear and decided advantage. Unfortunately the present case was not favourable to the trial, the patient's strength having been previously reduced by a profuse

hæmorrhage. No time, however, was to be lost: I determined therefore to repeat my visit soon, and to be guided by circumstances.

"Five, P. M. The clyster had been given an hour, and was still retained. The vomiting had not returned. The pulse was at 112; and, as it was by no means a weak pulse, I determined to take a small quantity of blood from the arm, and to observe its effect. I took away seven ounces, and also applied a large blister to the abdomen.

"At eight, P. M. my father visited the patient with me. She had parted with an astonishing quantity of fæces mixed with mucus. The pain came on at intervals, like after-pains; and was very moderate in the remissions, when she lay quite still on her back; but the least motion of the body occasioned great uneasiness. The blood exhibited a very thick inflammatory crust, and the crassamentum was remarkably firm. The pulse was 130, and hard. Under these circumstances, it was judged proper to repeat the bleeding to the same quantity.

"Ten, P. M. The second quantity of blood was not covered with so thick a crust; but the crassamentum was still more firm than the former. It was like a piece of liver; I could scarcely pierce it with my finger. The pulse had come down to 120, and was more full. She was lying upon her side, which she had not been able to do before, and was quite easy when at rest. She had complained all the day

of great thirst. The tongue was clean, but still dry in the middle. A saline draught was ordered to be taken every three hours, and, as she had had several more loose stools, thirty drops of tinct. opii were added to the first.

" 22nd. Throughout this day the pains were slight and distant, and their remissions almost complete, so that the patient could bear to take her nourishment sitting up in bed. The tongue was moist and clean. Some opening medicine being necessary, a dose of rhubarb and calomel was given, and the clyster repeated. By their joint operation, a surprising quantity of fæces was again discharged in the evening. The pulse was below an hundred in the morning, and in the evening at 116. As she had perspired a good deal, and appeared languid, the saline draughts were directed to be made with an ounce of decoct. cinchonæ. The anodyne was repeated.

" 23rd. She had passed the night without any pain; notwithstanding which, she had slept but little. Pulse at 110, and very strong. No more stools: clyster repeated.

" Having augured favourably of this case, from the gradual and complete cessation of pain, it was with no less surprise than regret that, in the evening, I found an entire new train of symptoms. The patient, having been affected throughout the day with an irresistible propensity to sleep, from which she got no refreshment, awoke in the evening with pain in her

head, accompanied with giddiness and ringing in the ears. Her face was flushed: her pulse at 132, and strong. She had had three loose stools, and had parted with a large quantity of urine. Some leeches were ordered to be applied to the temples; but, finding, on a second visit, that they had not been procured, I took three ounces of blood from the temporal artery. The saline draughts were directed to be made without decoct. cinchonæ, and a blister to be applied to the nape of the neck. Just before the bleeding, the pulse was at 120; after it, at 112.

"24th. I found the patient sitting up in bed to take some refreshment. She had slept several hours in the night. Her countenance was good. It was rather singular, that the left side of the head, from which the blood had been taken, was easy, but the opposite side painful. The crassamentum, as before, was extremely firm. Pulse 126. I took three ounces of blood from the temporal artery of the right side, and the evacuation greatly diminished the pain.

"In the evening she experienced a seizure somewhat similar to that of the preceding day. Having been visited by several friends, who had inconsiderately talked and read a good deal to her, she was suddenly affected with a sense of great confusion and noise in the head, accompanied with much heat and flushing of the face. Pulse 140. In consequence of the relief before experienced, she was very desirous to lose some more blood from the temples; and there-

fore, though the pulse appeared less strong, I took an ounce and a half from the temporal artery.

" The case having become more alarming by this relapse, a consultation was requested; and a physician, who had attended several of these melancholy cases with me, was called in: my father also visited the patient with us. The pulse had come down to 120, and was evidently fuller since the bleeding. The crassamentum was as firm as before. It was agreed that the saline draughts should be continued, that a blister should be applied to the head, and the temples and forehead be frequently bathed with cold vinegar and water.

" 25th. Eight, A. M. She had had no sleep in the night; but her head was rather more composed, and she was free from heat. Pulse 116. Some indications of a paralytic affection were now apparent. She faltered in her speech, and her tongue, when put out, was drawn to one side. At noon, the pulse got up to 140; she took little notice, and, though she sometimes spoke coherently, an answer to any question could scarcely be obtained from her; her mind also appeared much agitated.

" At four, P. M. the physician met us. It was agreed that a little wine whey should be given frequently; and the following medicine was prescribed:

℞ Spt. æther. comp. gutt. xxx.
Spt. ammon. comp. gutt. x.
Aq. puræ, ℥iss. M.

Fiat haustus tertiâ quâque horâ sumendus.

A draught with fifteen drops of tinct. opii was also directed to be taken at bed-time.

" 26th. The night had again been passed almost without sleep; but the head was free from pain, confusion, and the sense of ringing. Pulse 116.

" Two, P. M. After three hours' comfortable sleep, the head was not so well. The bowels were open, and the stools natural. Pulse 120.

" 27th. I was not able to see the patient myself on this day, and I neglected to minute any account of its occurrences.

" 28th. She had had no sleep in the night, and was very restless, with some degree of delirium. We found her incessantly talking, but could procure no answer from her to any question that was proposed. She refused all medicine. Pulse 120.

" In the course of the day, the abdomen became tumid from flatus confined in the bowels; the tumefaction was unattended by pain or soreness, and entirely subsided as soon as evacuations were procured by an injection.

" Ten, P. M. She was in all respects worse. Her urine came away involuntarily; she had some rattling in her breathing, and appeared to be sinking. Pulse 132. Thirty drops of spt. æther. sulph. were ordered to be given now and then as a grateful cordial.

" 29th. We were agreeably surprised to find our patient much better. During the night, she had been able to retain her urine, and had made a large

quantity, with proper intervals. She was quite sensible, and more composed; and had regained the power of putting out her tongue, which before she had lost. The pulse was at 106, and the tongue continued clean. Ordered to take, at regular intervals, a draught of infus. rosæ made with decoct. cinchonæ, and to have occasionally a little Madeira wine.

" These favorable symptoms did not long continue. In the evening, the pulse had got up to 120, and the heat had increased.

" From this time the patient became gradually weaker, her pulse was accelerated more and more, and her urine was again discharged involuntarily. She lived two days in a state of great anxiety and increasing restlessness, and died on Sunday night, the 1st of July.

" This case appears to me an instance of a remarkable metastasis of the Puerperal Fever; and had the disease been transferred to a less vital organ than the brain, a more happy crisis would probably have been the result. I have before mentioned that, at Aberdeen, the disease was not unfrequently transferred to the surface of the body, producing an erysipelas on the extremities, which proved a " certain sign of a salutary crisis." And the transition of inflammatory affections of various kinds from one part of the body to another, is a fact well known in the practice of physic. In the case just related, it is observable, that, while the inflammation of the abdomen subsisted,

the head was free from all complaint; and that, as soon as the inflammation was completely removed from the abdomen, to which it never in any degree returned, the head became affected with symptoms of inflammation, accompanied with evident marks of compression of the brain.

" Whatever other conclusions may be drawn from this case, the entire removal of the abdominal affection, and the appearance of the blood, which was of a firmer texture than any I had ever seen, both tended to confirm me in the propriety of bleeding in the disease under consideration*."

I believe there was not inflammation of the abdomen in this case, although I do not mean to express myself positively upon this point. But I am perfectly convinced that the disease consisted, chiefly, in the effects of intestinal irritation and of loss of blood. The attack was ushered in by rigor succeeded by heat; there was the evacuation, first, of 'an astonishing quantity,' and, on the succeeding day, of 'a surprising quantity,' of fæces, and a 'complete cessation' of the pain of the abdomen. On the third day, an event occurred which is exceedingly common in cases of intestinal irritation and of loss of blood; namely, an attack of affection of the head; pain, with giddiness, and ringing of the ears, the face being flushed, and the pulse frequent. A similar seizure was repeated on the succeeding day; there was 'a sense of great

* Pp. 81—91.

confusion and noise,' accompanied with much heat and flushing of the face. Afterwards, there were indications of a paralytic affection—an event which sometimes occurs in exhaustion from loss of blood*. In a day or two more, there were restlessness and incessant talking; and 'in the course of this day the abdomen became tumid from flatus confined in the bowels, the tumefaction being unattended by pain or soreness, and entirely subsiding as soon as evacuations were procured by a clyster.' This patient rallied a little on the succeeding day, and became 'quite sensible and more composed:' but few patients, under such circumstances, recover from a 'rattling in the breathing'—a symptom which had been remarked the day before, and which, if accurately observed in its very commencement, is amongst the first, if not the very first, of the fatal symptoms in sinking from loss of blood†.

I would here make one remark in regard to the metastasis which was supposed to take place. Of this I am persuaded, that, in many such instances, that which has been supposed to be metastasis of inflammation, was, in fact, but the wonted effects of intestinal irritation, and of loss of blood, upon the functions of the brain, or other organ, of which so much has already been said in this work.

This case, then, beautifully illustrates many points of high practical importance. First, although there

* See the Medical Essays, p. 68. † Ibid. p. 51, &c.

were three good evacuations on the twentieth, of which two were loose, they did not prevent the evacuation of an astonishing quantity of fæces on the twenty-first, and again on the twenty-second. In the second place, on the evening of the twenty-third, there was one of those sudden changes and reverses which I have mentioned as so apt to occur in these cases; there were pain in the head, giddiness, and ringing in the ears. In the third place, it is to be remarked how small a loss of blood, taken from the temporal artery, relieved these symptoms; and this very fact proves them not to have been inflammatory. In the fourth place, we have an illustration of the sad effects of the injudicious visits of friends. To this circumstance I should be apt to ascribe the fatal issue of this case even. In the fifth place, we have an example, first, of paralysis, and then of incessant delirium, from exhaustion, so often mentioned already: see p. 171. In the sixth place, we observe the supervention of rattling in the breathing, and of flatulent tumidity of the bowels, as symptoms of the sinking state. Lastly, we are taught not to be too much buoyed up by hope, from an apparent amendment in this state of exhaustion and sinking—a point to which I have particularly alluded elsewhere*.

It may not be amiss, in this place, cursorily to repeat the principles of the treatment in these puerperal diseases.

* Medical Essays, p. 83.

And, first, in regard both to pure inflammation and pure intestinal irritation, the first measure should be to place the patient upright and bleed her until she faint. It may be said, then, that the treatment is the same in both these diseases. This is by no means the case. And the difference is this. If the disease be inflammation, perhaps twenty-five or thirty ounces of blood may be taken before the patient turns faint; but if it be intestinal irritation, a much smaller loss of blood will lead to deliquium. And now the vast importance of taking blood in the upright posture is obvious; not for the sake of producing syncope merely, but with the object of being guided, also, as to the quantity of blood which should be drawn.

The next thing to be done, especially where comparatively little blood has been taken, is, fully and freely to evacuate the bowels, and attentively to inspect the alvine discharges. This object should be effected by first administering about three pints of warm water as an enema, and then efficient purgative medicines.

The same principles must guide us on our next visits. According to the state of the patient, more blood must be taken, or the bowels must be again purged. But here I would observe, that if the case have proved to be intestinal irritation, a repetition of the blood-letting must be instituted with great caution; for I have known such a repetition prove suddenly fatal, as I purpose to shew in the succeeding chapter.

In regard to the case of exhaustion, I believe that, whenever blood is taken, it should be locally only. The head being usually affected, cupping or leeches are generally to be applied to the temples or back of the neck. It is often astonishing how little abstraction of blood will frequently relieve.

In cases of exhaustion, the bowels are invariably disordered and flatulent, and either constipated or too relaxed. Efficient aperients must be given; but the strength must be kept up by light nutriment.

I think it needless to enter more fully upon the subject of the treatment of puerperal diseases, having already discussed it at some length in Chapters XXI, XXII, and XXIII. But I was anxious to present and contrast the different principles of the treatment of inflammation, intestinal irritation, and exhaustion, in this place, in order to prevent the possibility of misconception, and to simplify the subject as much as possible for the general practitioner.

In drawing these observations to a close, I would refer the young clinical student to an interesting case, published in the Edinburgh Medical Journal for July 1824, p. 53; and to some remarks upon it, in the London Medico-Chirurgical Review for January 1825, p. 243. Like the observations contained in the present chapter, they greatly illustrate the diagnosis of puerperal diseases.

CHAPTER XXV.

OF THE FATAL EFFECTS OF BLOOD-LETTING IN PUERPERAL AFFECTIONS.

No one, I think, can charge the plans of treatment proposed in the foregoing pages with indecision or inefficiency; and I am persuaded they are equally free from the opposite imputation of rashness and undue activity.

In order, however, that no caution may be wanting to guide the young physician in the treatment of puerperal diseases, and in order that the full value of the mode of proceeding which has been recommended, and the precautions which are necessary in carrying it into effect, may be felt, I think it right to adduce, in this place, several cases of the fatal effects of inconsiderate blood-letting in puerperal diseases.

These cases illustrate several points of great practical importance: and, first, the danger of the repetition of the blood-letting in cases which have been relieved by previous remedies, as a preventive merely; in such cases, all inflammation, if it existed, having subsided, a chief source of safety in the use of the lancet, as well as of the necessity for it, is removed, and the patient will be very apt to fall a prey to the

further loss of blood. This is exemplified in the first and second cases about to be adduced. In the second place, I consider the particular danger of an unguarded use of the lancet, in cases not inflammatory, to be exemplified in the third case, which was clearly one of intestinal irritation, and not of inflammation. The last case is a sad instance of an inconsiderate blood-letting, and it is to be hoped that few such examples have occurred, although, I confess, that in the prevailing mania for blood-letting, even such cases should not greatly surprise us.

The first of these cases presents the phenomena of a rather gradual sinking, from a fatal blood-letting.

Mrs. —— aged 30, had been affected with what appeared to be a slight attack of influenza; she was seized with rigor, and soon afterwards the pains of labour came on, and issued in delivery in about fifteen hours, at nine o'clock A. M. which was followed by much fever, the countenance being flushed, the pulse frequent, and the breathing difficult with incessant cough; these symptoms increased towards evening and in the night, and about forty ounces of blood were drawn from the arm at two blood-lettings, and the next morning twelve leeches were applied to the chest, with great relief. In the evening a blister was applied.

The night was passed more comfortably; she dozed a little and was cheerful, and continued relieved in the morning. As a preventive against a relapse,

however, three tea-cupfuls of blood were taken. The patient became faint during the flow of the blood,—sank from that time, and never again rallied; she became extremely feeble and could scarcely articulate, and, from being cheerful the day before, was now impressed with the conviction of approaching dissolution, and expressed herself as unable to recover from the last bleeding. During this day, Saturday, and during the two succeeding days, there was a state of extreme exhaustion,—and still a sense of load at the chest, and pain of the side.

On the Tuesday the countenance was observed sometimes to flush to a deep scarlet, and then to become quite pallid, and a profuse perspiration frequently ran down the face; the pulse was extremely frequent, and the pain severe on coughing; there was no delirium, though she awoke hurried from sleeps which she described as 'just like death.'

During the four following days there was little obvious change; distressing faintings usually came on about two or three o'clock, P. M. On the Sunday she became drowsy, and evidently more sinking; this state continued to increase, and she died in the evening of the succeeding day.

The following case presents an example of the fatal event supervening immediately on the use of the lancet.

Mrs. —— was of a pale and sallow complexion and weakly constitution. Six days before her con-

finement of her first child, she was awoke in the night by severe pain of the head, confined to one spot. This pain continued several hours, when Mrs. —— applied to her accoucheur; she was completely relieved by losing sixteen ounces of blood, followed by purgative medicine, and she continued well.

Mrs. ——'s labour occurred on September the 1st, 1817, and was rather tedious, but natural; and she had no complaint until the second day, when she experienced a second attack of pain in the head, but less violent than the previous one. She was seen six hours after this attack; she then complained of pain and beating of the head, about the anterior part of the right parietal bone; the skin was hot, and the pulse frequent and strong. Sixteen ounces of blood were taken from the arm, leeches ordered to be applied to the temples, and an enema and purgative medicine were prescribed.

In three hours' time, Mrs. —— was again visited, and it was deemed necessary to abstract more blood. Six or eight ounces were therefore taken; faintishness was induced, and the symptoms were little abated.

On the succeeding morning, September the 4th, the symptoms still remained the same; the surface was hot; the bowels had been purged, and the evacuations were natural. The saline mixture was ordered. At noon, the symptoms remaining as before, the purgative medicine was repeated, and a blister was

applied. In the evening, the evacuation of the bowels was satisfactory; the pain of the head was not severe, but there were much beating and a rushing noise; there was restlessness; and a teasing irritative cough. A draught with thirty drops of the tinctura opii was administered.

The next morning, September the 5th, Mrs. —— expressed herself as being much better, from having enjoyed comfortable sleep. The surface was still hot, and the head still affected as before. In the evening, there was a degree of tenderness in the region of the uterus; she dreaded the idea of being bled, from the faintishness she had before experienced from it, and said it would certainly kill her.

On the morning of the 6th, the pain in the region of the uterus was relieved, the head was affected as before, the window was kept open for want of air. In the evening, Mrs. —— complained of being faint and low. A mixture with camphor and sulphuric æther was prescribed.

On the 7th, the irritative cough again occurred; the pulse was frequent, from 120 to 130; and the other symptoms remained unabated. A physician was consulted. Sixteen ounces of blood were directed to be taken from the arm; a grain of calomel was given every three hours, and the effervescing medicine was ordered.

On the morning of the 8th, Mrs. —— appeared to be relieved in every respect; the heat of surface

and the pain of the head were diminished; the blood presented the buffy coat. It was thought proper to abstract more blood, as the last bleeding had apparently conferred benefit, and had been borne better than the preceding ones. Four tea-cupfuls of blood were taken; the most dreadful fainting followed, with gasping, open mouth, and a convulsive action of the diaphragm, and in an hour or two death closed the scene.

In the third case which I adduce here, the fatal event was equally sudden.

Mrs. —, aged 33, weakly, was confined of her sixth child, after an easy labour, without flooding, at midnight on the 20th July, 1818. During the ensuing day all was well. The lochia were natural; there was no alvine evacuation, but the bowels had been open during pregnancy, and twice evacuated during labour.

On the morning of the 22nd, Mrs. —— took half an ounce of the oleum ricini; and at four in the afternoon this medicine was repeated, the first dose having produced no effect; this, however, induced violent purging, occasioned great fatigue, and caused the patient to complain much. At ten o'clock in the evening, Mrs. —— was seized with rigor, which was violent and continued more than an hour; this was followed by great heat of skin, with wakefulness, restlessness, anxiety, sighing, and moaning.

At ten on the succeeding morning there were

great heat of skin, and pain at the bottom of the back. Four tea-cupfuls of blood were taken from the arm. The symptoms still continued, and at seven in the evening, three tea-cupfuls of blood, and at eleven three more, were taken from the arm, and twenty leeches were applied to the region of the uterus for the increased pain. The pain still continued to increase, with restlessness, sighing, faintishness, constant necessity for the smelling bottle, and apprehension of impending dissolution.

Afterwards, the symptoms being unabated, a physician was consulted. About three o'clock, three tea-cupfuls of blood were again taken from the arm, and leeches again ordered to be applied; an enema was given, which evacuated a quantity of fæces quite unexpected. In a short time, Mrs. —— became cold, and the surface clammy, with fainting, gasping breathing, &c. and all was done to restore warmth. After an interval of three hours, the pain was still great. Some opening medicine was prescribed. But the state of sinking continued; the smelling bottle, the fan, and fresh air, were urgently called for. All the symptoms, except the pain, were aggravated, there were gasping, a slight convulsive struggle, another, and the patient expired.

In this case, it will be observed, that the pain remained unabated, even after the last fatal blood-letting. I have reason to regard this as denoting not an inflammatory origin of the pain, but the presence of morbid alvine contents.

I give the last of these cases without comment. For I should be sorry to diminish the impression which it is calculated to make upon the mind, by any observations; and I am persuaded that no addition can add force to the plain and simple detail of its fatal issue.

Mrs. ——, aged 35, was confined on the 5th of December, 1818, at midnight, of her eighth child. She was delicate, but in good health, and the bowels were regular. The labour was favourable, but, during the first six and thirty hours, lingering; the after-pains and lochia were natural.

Mrs. —— appeared well on the 6th, and had had a good night; but she complained somewhat of the noise in the house, saying that it hurried and disturbed her.

On the morning of the 7th, she took an opening draught. This induced two unsatisfactory evacuations, with great and continued nausea without vomiting; for this nausea she was ordered a cordial draught. Soon after taking the draught, Mrs. —— was seized with shivering. About eight hours after this, she was found complaining of pain in the region of the uterus. Three tea-cupfuls of blood were taken about seven o'clock in the evening, and about half after nine four more; fomentations, &c. were used in the interval. During the night, Mrs. —— was extremely restless, tossing about, wakeful, or with a little dozing, some delirium, and hurry and starting on awaking; there

were dimness of sight; cold, clammy perspiration, and great coldness of her feet; sighing breathing, and moaning, fainting, and the necessity for being fanned. There were ten motions during the night.

The next morning, Mrs. —— was again, as it were by infatuation, bled to three tea-cupfuls. This measure was followed by paleness, coldness, cold clammy perspiration, gasping, sighing breathing, and restlessness. A physician was consulted. The pains and tenderness had subsided; but the patient remained in a state of great lowness. Mrs. —— was again visited in the evening, and wine whey, &c. were prescribed. In the night, Mrs. —— dozed, and awoke alarmed; all at once the eyes became fixed, with gasping and sighing, and she expired.

I would merely add, that such disastrous events could not have occurred, had the safe, and simple, and efficacious rules, which have been laid down for the use of the lancet, been implicitly adopted.

I have restricted myself to observations on the *sporadic* puerperal diseases, referring my reader, for accounts of the worse form of these diseases in *epidemics*, to other writers.

The subject of *puerperal mania* I propose to treat hereafter.

CHAPTER XXVI.

OF THE EFFECT OF PREVIOUS DISORDER UPON THE PUERPERAL STATE.

This is a most important and interesting question, and it has two bearings: the first, upon the parent herself; the second, through the medium of the milk, upon the infant. I chiefly allude, in this place, to the various forms of disorder of the general health.

Such a state of disorder, especially if long continued, and attended by much pallor or pale icterode hue, involves in itself a state approaching to that of loss of blood; and it has been sufficiently shown that this form of general disorder itself depends upon a deranged state of the functions of the intestinal canal, and of the other digestive organs; so that it is obvious that such a condition, before confinement, predisposes to the effects of intestinal irritation, and of exhaustion.

I need not remark, how important it is, in such cases, to devote an especial attention to the restoration of a healthy state of the system. The state of the bowels should be watched daily, a mild but invigorating diet should be enjoined, and the tonic effect of gentle exercise in the open air, should be secured

during the whole period of pregnancy; for conception is not generally prevented by this state of disorder of the general health.

In extreme cases, the bowels become exceedingly loaded, and there is a state of the system approaching to bloodlessness. In neglected cases of this description, death has quickly and unexpectedly ensued from a far less shock than that of parturition. In other cases, a series of painful symptoms has ensued, which have, perhaps, exhausted the patient finally, though more slowly; of this, the following is a most interesting example.

Mrs. ——, aged 28, had long had all the symptoms of disorder of the general health, with a pale icterode hue of the complexion. For some time before her confinement, she suffered from aphthæ, with irritability of the stomach and bowels, and there was some œdema of the ankles and of the face.

After delivery, there was a considerable flow of the lochia; the tendency to diarrhœa continued, with light yellow, fœtid stools; and the pulse was frequent. The countenance was extremely pale; and there were great pain of the head, fluttering, and tendency to faintishness.

Soon after delivery, the aphthæ, which had somewhat disappeared, were again observed on the inner part of the under lip, in the form of vesicles clustered together; and one or two were situated on the tongue, which was clean and pallid. The face was pale, the

prolabia exanguious; there was repeated bleeding from the nose, the blood becoming pale and aqueous; there was frequent pain of the head; the pulse was frequent, often 110; the bowels loose. She was much relieved by taking the tinctura opii, pure opium, the pilula hydrargyri, &c.

On the 24th of May, 1819, twenty days after delivery, and after a gradual amendment for a fortnight, she experienced, in the night, a fit of palpitation of the heart, which, however, soon went off.

On the 26th, Mrs. —— had taken a little mutton; and her room was particularly close. Under these circumstances, she became affected with great anxiety and agitation, an overwhelming internal feeling not to be described, and tendency to fainting; all increased on attempting to be moved: the pulse was small, and 156; the heart, carotids, and indeed the head, chest, and bed-clothes, were affected with throbbing and palpitation. Thirty drops of the tinctura opii were given, and repeated, with great relief.

The next day, the 27th, the pulse continued at 132, and the movement of the heart, carotids, head, chest, and bed-clothes, was still great; the pulse was fuller, the general expression and feelings more tranquil. There had been some sleep; but, on awaking, there was a temporary confusion of mind. The bowels had been gently moved by the Rochelle salt.

On May the 30th, the symptoms remained nearly

the same. The pulse 140; the beating of the carotids still visible; the palpitation greatly increased, and faintishness induced, on moving. The countenance was pale and rather tumid; the tongue and teeth appeared as if besmeared with syrup, and the breath had the odour of new milk; the bowels were confined; the urine plentiful. No tenderness of the abdomen, cough, or head-ache, or tendency to complain.

May the 31st. A mild purgative and an enema were administered yesterday, and evacuated large portions of hardened fæces; after which, a draught with thirty drops of tinctura opii was given. The pulse fell to 100; and all the symptoms were mitigated. In the evening, the pulse was about 104; there was still a little throbbing of the head; but the palpitation and beating of the carotids were much diminished; the bowels unmoved to-day; urine plentiful; fluunt catamenia. No pain or tenderness of the abdomen.

June the 3rd. Since the last report, there have been repeated attacks of sickness and vomiting, with more throbbing of the head, carotids, and heart; and the alvine evacuation has been occasionally costive. To-day, the countenance is pallid, and more swollen with œdema; there is throbbing at the occiput, with pain, and beating of the heart and carotids; a degree of labour in the breathing, and cough; tenderness of the epigastrium, sickness, and constipation. The

manner appears rather changed; speaking requires greater effort; there are greater hurry and exhaustion; and greater repugnance to food and medicine.

June the 7th. Since the 3rd, the principal symptoms have been sickness and vomiting—medicines having been quite rejected, and sometimes food. There have been once or twice deep breathing, and a sort of blowing, apparently implying a sense of want of air; there is an occasional hacking cough; some throbbing of the head; the pulse has been from 100 to 110. The countenance is pale, but the lips have a little more colour. There is much loss of flesh. The bowels have been kept open; the appetite is better. There has been good sleep.

June the 8th. The countenance is much as before; there is less throbbing in the head; no delirium; pulse 108, and rather irregular; some sighing and deep breathing; hacking cough; sickness and vomiting; some tenderness of the right hypochondrium, and beating of the abdominal aorta.

June the 9th. Less throbbing of the head; pulse 116; much pulsation over the aorta; the sickness has recurred several times.

June the 10th. This evening there is increased sickness, with dyspnœa, consisting of deep, sighing breathing; pulse 120; the throbbing, palpitation, and pulsation of the abdominal aorta, are less; no cough noticed; the sickness continues; the bowels open twice.

June the 11th. The deep breathing has been very urgent. The nose is cold and livid; the lips dry; the eyes deathly; the pulse 100, and feeble. Mrs. —— expired on the 12th, about two, P. M.

On examination, on the 13th, at noon, three or four ounces of water were found in each cavity of the pleura, and one ounce in the pericardium. In every other respect the thoracic and abdominal viscera were most healthy. The heart, the stomach, the bowels, and the liver, were free from the slightest appearance of disease. The uterus was collapsed to its natural size.

This case may be taken instar omnium. In many others, such an event has been prevented by a timely and appropriate attention to restore the general health.

It is of the utmost importance to conjoin aperients with a cordial and nutritious kind of diet. For I am persuaded that the strength is far more apt to fail, in these cases, than is generally imagined, and especially in that variety which is attended by extreme pallor, which, in fact, denotes a state approaching to bloodlessness and exhaustion.

The next point to be mentioned, is the influence of a morbid condition of the general health upon the secretion of the milk, and upon the health of the infant. It has frequently occurred to me to lament that patients have given up all hope of ever being allowed to nurse, from the sad consequences produced upon the infant. This circumstance generally depends

upon disorder of the general health of a protracted kind; and it is obviated by proper and persevering efforts to restore the functions to their natural state.

It may be necessary for the infant to be fed, or to have another nurse, if these precautions were not enforced before the approach of confinement; for time is required to subdue the disorder, and change the secretions. But if there be space for effecting the due changes, the plans which have been recommended for restoring the general health of the parent, will generally succeed in enabling her to nurse without disordering the infant.

CHAPTER XXVII.

ON THE RELATION BETWEEN THE DYNAMICS AND STIMULI IN THE ANIMAL ŒCONOMY.

The Dynamics in the animal œconomy are two: the excito-motor; and the motor. The former is seated in the system of true spinal nerves; it is the vis nervosa of Haller: the latter, in the muscular fibre, being what is usually designated the vis muscularis, or irritability.

The stimuli of the animal œconomy are also principally *two:* air and food. But there are others, somewhat subsidiary, as heat, electricity, and light.

Life consists in a series of actions and reactions of these several agents and reagents; and, in the animal series, whether specific or physiological, these bear an inverse ratio to each other: in the cases in which the dynamic is low, the stimulus is great; and in the cases in which there is a high degree of dynamic, the degree of stimulus is low. Out of the varied condition of these, relative and absolute, the varied forms of animated being take their form and origin.

Take an animal of high respiration—as the bird: the excito-motor power in the true spinal nerves, and

the motor power in the muscular fibre, are extremely low. Choose, on the other hand, an animal said to be of cold blood: its respiration is extremely low; its excito-motor and motor powers and phenomena, tested by an appropriate stimulus, are manifested in an extreme degree.

Of the excito-motor power, the *test* is, any physical stimulus; of the motor power, galvanism: inversely with these is the quantity of respiration, or of oxygen absorbed or converted, in a given space of time. The quantity of food is proportionate to that of the respiration.

The temperature of an animal is proportionate to its respiration and food, and inversely proportionate to its nervous and muscular dynamics.

In the year 1832, I read a paper before the Royal Society, on the inverse proportion of the respiration and of the irritability of the muscular fibre, which was published in its Transactions*.

I had not then investigated, as I have done since, the excito-motor power. The facts of my paper, however, relate equally to this and the motor-power, or irritability; and therefore I do not hesitate to reproduce it here, precisely in its original form.

The whole animal kingdom is subjected to the law unfolded in that paper: in repose, during sleep, there is less respiration than in activity, with proportionately augmented irritability of the muscular fibre: this fact

* See the *Philosophical Transactions* for 1832, p. 321.

is exemplified in its highest degree in hybernation. Extreme activity is accompanied by augmented respiration and diminished irritability. In the embryo, the same condition is observed as in the reptile—less respiration is conjoined with greater irritability than in the animal born. The insect tribes pass through various stages of the same kind. The fish, the reptile, the mammalia, the bird tribes, exemplify the same LAW, in the order in which I have enumerated them. I cannot imagine a more interesting view of animated Nature.

The application of these principles to Medicine is still to be accomplished.

This application will be chiefly found in the just administration of *rest*, and of *exercise*. By the former, the quantity of respiration is diminished, whilst the degree of irritability is augmented; whereas every step we take in walking adds to the respiration, and in a two-fold manner diminishes the irritability of the muscular fibre.

The question of food, the question of climate, and of the external temperature, arrange themselves here. With the respiration, the blood, the action of the internal muscles, as the heart, the stomach, the secretions, vary. As an effect of loss of blood, the heart beats violently: what is the rationale of this fact? With the diminished stimulus, is the irritability of this organ excessively augmented?

CHAPTER XXVIII.

THEORY OF THE INVERSE RATIO WHICH SUBSISTS BETWEEN THE RESPIRATION AND IRRITABILITY, IN THE ANIMAL KINGDOM.

THE object of the investigation, of which the present paper details the principles, is to trace a peculiar law of the animal œconomy, through the various series, forms, and conditions of animated being. This law may be announced in the following terms:

The quantity of the Respiration is inversely as the degree of the Irritability of the muscular fibre.

It will be necessary, in the first place, to define the terms which I am about to employ. The expression inverse ration is not used in its strict mathematical sense, but merely to designate the general fact, that, in cases in which the quantity of respiration is great, the degree of irritability is low; and that in cases in which the quantity of respiration is small, the degree of irritability is high. By the quantity of respiration, I mean the quantity of oxygen gas consumed, or exchanged for carbonic acid, in a given time, by the animal confined in atmospheric air. I have used the term irritability in the sense in which it is employed by Glisson and Haller—to designate that peculiar

property of the muscular fibre by which it contracts on the application of an appropriate stimulus; and I consider that muscle the most irritable which, cæteris paribus, contracts most and longest upon the application of the least degree of such stimulus. Haller's definition of the term is very similar*. It must be confessed that the word irritability only expresses one half of the property or function of the muscular fibre —its susceptibility to the influence of irritants or stimuli; the term contractility is equally defective, expressing only the other half of that function, viz. the effect of that susceptibility under the actual influence of stimuli. The designation irrito-contractility would express the whole phenomena.

Organic life appears to result from the impression of stimuli upon parts endued with irritability. The principal stimuli in nature are air, food, and heat; the principal and corresponding organs of irritability are the heart, the stomach, and the muscular system in general.

The animal series consists of beings variously modified by the varied degree of irritability, and by the varied quantity of stimulus. Throughout the whole, these observe an inverse ratio. The bird tribes and the mammalia are characterized by great respiration, whilst the irritability of the muscular fibre is low; the reptiles, the batrachia, and the fish tribes, on the

* Mémoires sur la Nature sensible et irritable des Parties du Corps animal, tome i, pp. 7—8, 75.

other hand, are endued with a high degree of irritability, and little respiration. The higher parts of the zoological series consist of animals chiefly characterized by the appropriation of a great quantity of stimulus; the lower, by the high degree of irritability of the muscular fibre. The former are animals of stimulus—of activity; the latter are animals of irritability.

The due actions of life, in any part of the zoological series, appear to depend upon the due ratio between the quantity of atmospheric change induced by the respiration, and the degree of irritability of the heart; if either be unduly augmented, a destructive state of the functions is induced; if either be unduly diminished, the vital functions languish and eventually cease. If the bird possessed the degree of irritability of the reptile tribes, or the latter the quantity of respiration of the former, the animal frame would soon wear out. If, on the contrary, the bird were reduced to the quantity of respiration appropriate to the reptile, or the latter to the degree of irritability which obtains in the former, the functions of life would speedily become extinct. Various deviations from the usual proportion between the respiration and the irritability, however, occur; but there is an immediate tendency to restore that proportion: increased stimulus exhausts or lowers the degree of irritability, whilst diminished stimulus allows of its augmentation. The alternations between activity and sleep afford illustrations of these facts.

Changes in anatomical form in the animal kingdom present other illustrations of the law of the inverse proportion of the respiration and irritability. The egg, the fœtus, the tadpole, the larva, &c. are respectively animals of lower respiration, and of higher irritability, than the same animals in their mature and perfect state. Changes in physiological condition also illustrate the same law. The conditions of lethargy, and of torpor, present examples of lower respiration, and of higher irritability, than the state of activity.

It may be remarked, that whilst changes in anatomical form are always from lower to higher conditions of existence, changes in the physiological condition are invariably from higher to lower.

These views are further illustrated by a reference to the quantity of stimulus and the degree of irritability of each of the parts and organs of the animal system. But it is to the quantity of respiration, and the degree of irritability of the heart, that our attention is to be principally directed at this time. The oxygen of the atmospheric air is the more immediate and essential stimulus of this organ. Taken up in respiration, it is brought into contact with the heart, by means of the blood, which may be considered as the carrier of this stimulus, as it is of temperature and nutriment, to the various parts of the system. As oxygen is the principal stimulus, the heart is the principal organ of irritability, in all the vertebrated ani-

mals; if the contact of oxygen be interrupted, all perish in a greater or less period of time.

The extraordinary differences which exist in animals which occupy different stations in the zoological scale, have long excited the attention of naturalists. Nor have the differences which obtain in the various ages and states of its existence, in the same animal, escaped the attention of the physiologist. A similar remark applies to that singular state of existence and of the functions of life, designated hybernation. But it appears to me that a sufficiently comprehensive view has not been taken of the subject, and that many facts, with their multitudinous relations, still require to be determined.

1. *Of the Pneumatometer.*

The principal of these facts is that of the quantity of respiration. This is greater in proportion as the animal occupies a higher station in the zoological scale, being, among the vertebrated animals, greatest of all in birds, and lowest in fishes; the mammalia, the reptiles, and the amphibia, occupy intermediate stations. The quantity of respiration is also remarkably low in the very young of certain birds which are hatched without feathers, and of certain animals which are born blind; and in hybernation it is almost extinct.

To ascertain the quantity of respiration in any given animal, with extreme minuteness, was a task of great difficulty. It was still more difficult to deter-

mine this problem, so as to represent the quantities of respiration in the different kinds, ages, and states of animals, in an accurate series of numbers. The changes induced in a given volume of air made the subject of experiment, by changes in the temperature and pressure of the atmosphere, and by variations in the height of the fluid of a pneumatic trough, which it is so difficult to appreciate minutely; the similar changes induced by the humidity of expired air, and by the heat of the animal itself, were so many and complicated, that it appeared almost impossible to arrive at a precise result. These difficulties, in fine, were such as to lead one of the first chemists of the present day to give up some similar inquiries in despair.

Fortunately I have been enabled to devise an apparatus which reduces this complex problem to the utmost degree of simplicity. I now beg the indulgence of the Society whilst I give a detailed description of its construction and mode of operation.

This apparatus, which I shall designate the *Pneumatometer*, consists of a glass jar *a b* (Plate*), inverted in a mercurial trough *c d*, so grooved and excavated as accurately to receive the lower rim of the jar and the lowest part of the tube *e f g*, and also to admit of the animal which is made the subject of experiment being withdrawn through the mercury. This jar communicates, by means of the bent tube *e f g h*, with the

* For this plate, to which the italic letters refer, I am compelled to refer to the *Philosophical Transactions*.

gauge *i j*, which is inserted into a larger tube, *k l*, containing water. A free communication between the jar and the external air is effected and cut off, at any time, by introducing and withdrawing the little bent tube *m n*, placing the finger upon the extremity *m*, whilst the extremity *n* is passed through the mercury.

If the jar be of the capacity of one hundred cubic inches, the gauge is to contain ten, and to be graduated into cubic inches and tenths of a cubic inch; so that each smallest division shall be the thousandth part of the whole contents of the jar.

Attached to the same mercurial trough is placed a little apparatus, *o p*, termed an *Aërometer*, and consisting of a glass ball *o*, of the capacity of ten cubic inches, communicating with a tube *p q*, bent at its upper part, of the capacity of one cubic inch, divided into tenths and hundredths, and inserted into a wider tube containing water, precisely in the manner of the gauge *i j*. In order to secure the exact proportion between the capacity of the pneumatometer and that of the aërometer, it is only necessary to add more or less of mercury to the trough.

The whole apparatus is enclosed in a glazed frame so as entirely to obviate the influence of partial currents of air. It is plain that changes in external temperature and pressure will affect both these parts of the apparatus equally; and that the fluids in the gauge *i j*, and in the tube *p q*, will move pari passu.

It is therefore only necessary to compare them, and to take the difference, for the real alteration in the quantity of the gas in the jar.

Previously to noticing this difference, the fluids in the outer and inner tubes are to be brought accurately to the same level, by raising or depressing the outer tube *k l*, and the inner one *p q*.

In order that the air within the jar and that in the aërometer may be in the same state of humidity, a little water is introduced into the ball *o* of the latter.

When the animal is to be removed, the fluid in the inner and outer tubes of the gauge are to be brought to a precise level; the animal is then to be withdrawn through the mercury, by a cord attached to a little net or box in which it is secured; a quantity of fluid will immediately rise in the inner tube, *i j*, equal to the bulk of the animal; the bent tube, *m n*, is now to be passed through the mercury into the jar, so as to effect a communication with the atmospheric air; a portion of air equal to the bulk of the animal rushes into the jar, whilst the fluids in the gauge regain their level.

To avoid the error which would arise from the influence of the temperature of the animal upon the air within the jar of the pneumatometer, the first observation of the degree upon the gauge must be made the instant the experiment is begun, and before the temperature of the animal can have been communicated to it; and the last, so long after the animal has

been withdrawn as to allow of its restoration to the temperature of the atmosphere.

In this way, all calculations for the varied temperature and pressure of the external air, for augmented humidity and temperature of the air of the pneumatometer, and for the changes in the height of the fluid of the trough, are at once disposed of in a manner the most accurate and simple.

It now remains to determine the quantity of change induced upon the air of the pneumatometer by the respiration of the animal. Two views may be taken of this change; that of Messrs. Allen and Pepys, that the oxygen which disappears is replaced by a precisely equal bulk of carbonic acid; or that of Mr. Edwards, that there is generally an excess of the oxygen which disappears, over that of the carbonic acid evolved. In either case, the quantity of respiration is ascertained by the gauge of the pneumatometer in the following manner. A frame, made of glass rods, *r s*, is placed within the jar *a b*, suspending portions of calico imbued with a strong solution of pure potassa, and provided with a small dish of wood, so as to prevent the caustic liquid from dropping upon the animal beneath. By this means the carbonic acid is removed as it is evolved, or after the animal is withdrawn. The rise of the fluid in the gauge of the pneumatometer gives the quantity of oxygen which disappears,—whether this be entirely exchanged for carbonic acid, or only partly exchanged for carbonic acid, and partly ab-

sorbed,—and denotes the precise quantity of the respiration.

The question itself, of the entire or partial exchange of the oxygen gas which disappears, for carbonic acid gas evolved, is at once determined by employing the same apparatus without the solution of potassa: in the entire exchange, there is no alteration in the bulk of the air of the pneumatometer; in the case of a partial exchange, the alteration in the bulk of the air gives the precise excess of oxygen gas which disappears, over the quantity of carbonic acid evolved.

But this question, and that of the absorption and evolution of nitrogen, with the influence of night and day, of season, &c. are reserved for a future stage of this inquiry.

It is important that the animal should be left for a considerable time in the very situation it which it is to remain during the experiment, before that experiment is begun, and before the jar is placed over it. In this manner the effect of timidity or restlessness is allowed to subside, and prevented from mingling with that of the natural state of the respiration. A bit of cork must also be attached to the mercurial trough, so as to float upon the mercury at *t*, and prevent the disturbing effect of the contact of this fluid with the animal.

It is also well, after having placed the jar in the groove of the mercurial trough, to pour a little water over the mercury exterior to the jar. The apparatus

is thus rendered perfectly air-tight, which is not always effected by the mercury alone.

By means of this apparatus we readily and accurately determine the quantity of the respiration of any given animal, in any given circumstances.

2. *Of the Measure of the Irritability.*

The problem to be next determined is that of the degree of irritability of the muscular fibre, and especially of the heart. This question is beset with scarcely fewer or less difficulties than that of the quantity of respiration, whilst it involves far greater errors and more discrepancy of opinion on the part of physiologists.

Even Baron Cuvier* has fallen into these errors. It will be shortly demonstrated that the degree of irritability is, in every instance, inversely as the quantity of respiration. Yet M. Cuvier, in a remarkable paragraph, states the very contrary, and even speaks of that which is the exhauster, as the repairer, of the irritability; whilst, on the other hand, he makes statements which appear to me at variance with this very opinion. In the Anatomie Comparée (tome i, p. 49), this celebrated writer observes, " Les expériences modernes ont montré qu'un des principaux

* Since this paper was read, science has experienced an irreparable loss in the death of this great man. I will not imagine that my comments upon what I conceive to be an error in his writings will be misinterpreted. No one can look upon Cuvier's labours with more sincere admiration than myself.

usages de la respiration est de ranimer la force musculaire, en rendant à la fibre son irritabilité épuisée." See also tome iv, p. 301. Similar observations are made in M. Cuvier's more recent work, the Règne Animal: " C'est de la respiration que les fibres musculaires tirent l'énergie de leur irritabilité." Tome i, p. 57, 2me edit. " C'est la respiration qui donne au sang sa chaleur, et à la fibre la susceptibilité pour l'irritation nerveuse." Tome ii, p. 1. On the other hand, speaking of the mollusca (tome iii, p. 3), M. Cuvier observes, of those animals of low respiration, " L'irritabilité est extrême dans la plupart." The same term is, in fact, used in two distinct senses, in these paragraphs.

No further proof can be necessary of the extreme vagueness and incorrectness of the prevailing notions and expressions of physiologists in regard to this subject. All this will appear still more extraordinary, when the law, that the quantity of respiration and the degree of the irritability are, in fact, inverse throughout all the series, stages, and states of animated being, is clearly established.

It is well known that the irritability of the heart, and of the muscular fibre in general, is greater in the mammalia than in birds, and in reptiles and the amphibia than in the mammalia, whether we judge of it by the force and duration of the beat of the heart, exposed to the stimulus of the atmospheric air, or by the contractions of the other parts of the muscular

system. Now this is precisely the order of the quantity of respiration in these animals, as ascertained by the pneumatometer, inverted. It is essential, in accurately determining the question of the irritability of the muscular fibre, to compare animals of the same class inter se; birds and the mammalia, reptiles and the amphibia, fishes, the mollusca, &c. must be compared with each other, both generically and specifically. It is especially necessary to compare the warm-blooded, the cold-blooded, the air-breathers, and the water-breathers, in this manner. However the different classes may differ from each other, there are differences in some of the species of the same class, and especially that of fishes, scarcely less remarkable.

Great differences in the duration of the beat of the heart are observed in the fœtal, early, and adult states of the higher animals; this duration being greatest in the first, and least in the last, of these conditions. The order of the quantity of respiration is inverse.

The law of the irritability being inversely as the respiration, obtains even in the two sides of the heart itself, in the higher classes of animals. The beat of the heart removed from the body, does not cease at the same time in the walls of all its cavities, or of its two sides: but, as Harvey observes, " primus desinit pulsare sinister ventriculus; deinde ejus auricula; demum dexter ventriculus; ultimo (quod etiam nota-

vit Galenus) reliquis omnibus cessantibus et mortuis, pulsat usque dextra auricula*."

Even in this case, the irritability is greatest in the part in which the respiration is least.

It was shown by Hook, in the early days of the Royal Society†, that if, the respiration being suspended, an animal appeared to be dying, the beat of the heart and the signs of life were speedily restored, on performing artificial respiration, or even by forcing air through the trachea, bronchia, and pulmonary air-cells, and allowing it to escape through incisions made through the pleura.

It was, in the next place, clearly shown by Goodwyn, in one of the most beautiful specimens of physiological inquiry in any language‡, that, in suspended respiration, it is the left side of the heart which first ceases to contract, the right side still continuing its function for several minutes, until the supply of blood may be supposed to fail.

The facts detailed by Harvey had shown that the left side of the heart was endued with less irritability than the right; the experiment of Hook, that respiration restored the action of the heart, if it had previously ceased; that of Goodwyn, that this cessation

* Opera Omnia, Collegio Medicorum Londinensi edita, 1766, p. 28.

† Phil. Trans. vol. ii.

‡ On the Connexion of Life with Respiration: London, 1788, pp. 72, 82 note.

and restoration of functions were observed in the left side of the heart. It was obvious, on the other hand, that the respiration belongs, as it were, to the left side of the heart.

It appears plainly deducible from these facts, that, in circumstances and structures the most similar, the respiration is accurately inversely as the irritability.

For the sake of a comparison with the hybernating animal, the object of which will be explained hereafter, I thought it right to repeat this experiment.

Before I proceed to detail the result, I may just describe an easy method of performing that part of it which consists of artificial respiration. A quill is firmly fixed in the divided trachea; a small hole is then cut into that part of the quill which is external; Read's syringe is then adapted to the other end of the quill. At each motion of the piston downwards, the lungs are distended; whilst the piston is raised, the air escapes through the opening in the quill, producing expiration. The experiment, therefore, only requires the common action of the syringe.

The experiment itself answered my expectation. During the cessation of respiration, the left ventricle ceased to beat, the right ventricle retaining its function; on renewing the respiration, the left ventricle resumed its beat. It appears, from this experiment, that from want of a degree of irritability equal to that of the right ventricle, and its own proper stimulus of arterial blood, the left ventricle ceased its contractions.

The function of the right ventricle must soon cease in consequence, from want of a supply of blood.

These facts prove that arterial blood is the necessary stimulus of the left side of the heart, its irritability being low; but that venous blood is a sufficient stimulus of the right, from its higher irritability: the phenomena plainly flow from the law, that the quantity of respiration and the degree of irritability observe an inverse ratio to each other, and from the facts on which that law is founded. In this double sense, besides that of distinct cavities, the mammalia have, therefore, two hearts; and as the highly aerated blood of the left is the peculiar property of birds and the mammalia, so the highly irritable fibre of the right may be compared to that of the heart of reptiles and the fishes.

Except for the objection to new terms, the left side of the heart might be termed arterio-contractile, and the right veno-contractile; the first being stimulated by arterial, the second by venous blood.

It is quite obvious that the heart will bear a suspended respiration better, the more nearly its irritability approaches to that which may be designated veno-contractile. *The power of bearing a suspended respiration thus becomes a measure of the irritability.* It is expressed, numerically indeed, by the length of time during which the animal can support a suspended respiration; a conclusion of the highest degree of importance in the present inquiry.

Birds die almost instantly on being submerged in water; the mammalia survive about three minutes; the reptiles and the batrachia a much greater length of time.

The unborn fœtus, the young animal born with the foramen ovale open, the reptile, the mollusca, having all a state of the heart approaching to the veno-contractile, bear a long-continued suspension of the respiration, compared with the mature animal of the higher classes.

But the most remarkable fact deducible from this reasoning is the following: if such a case existed as that of the left side of the heart being nearly or absolutely veno-contractile, such an animal would bear the indefinite suspension of respiration; such an animal would not drown, though immersed in water. Now there is precisely such a case. It is that of the hybernating animal. It will be shown, in the subsequent chapter, that in the state of perfect hybernation the respiration is nearly suspended; the blood must, therefore, be venous. Yet the heart continues to contract, although with a reptile slowness. The left ventricle is therefore veno-contractile, and in this sense, in fact, sub-reptile. The case forms a sole exception to the law pointed out by Harvey, that the left ventricle ceases to contract sooner than the right. If, in the hybernating animal, the left ventricle does cease to beat sooner than the right, it is only in so slight a degree as to be referred to the greater thick-

ness of its parietes, and the slight degree in which respiration still remains. It is obvious that the foregoing statement must be taken with its due limitations. Venous blood is unfit for the other animal purposes, even though it should stimulate the heart to contraction.

Another mode of determining the degree of irritability, is the application of stimuli, as galvanism. A muscular fibre endued with high irritability, as that of the frog, and the galvanic agency are mutually tests of each other*.

A third criterion and measure of the irritability is afforded by the influence of water at temperatures more or less elevated, in inducing permanent contraction of the muscular fibre.

There are two other properties of animals which depend upon the varied forms of the inverse ratio which exists between the respiration and the irritability. The first is *activity;* the second, *tenacity of life.*

The activity, which, I believe, M. Cuvier has confounded with the irritability, is generally directly proportionate to the respiration, and intimately depends upon the condition of the nervous system resulting from the impression of a highly arterial blood upon its masses, and not upon the degree of irrita-

* Bostock on Galvanism, pp. 4, 14.

bility of the muscular fibre. It is the pure effect of high stimulus.

To show that M. Cuvier has blended the idea of the irritability of the muscular fibre with that of the activity of the animal, it is only necessary to recur to the passages already quoted from that author, and to adduce the observations with which they are connected. "On vient devoir à quel point les animaux vertébrés se resemblent entre eux; ils offrent cependant quatre grandes sub-divisions ou classes, caractérisées par l'espèce ou la force de leurs mouvements, qui dépendent elles-mêmes de la quantité de leur respiration, attendu que c'est de la respiration que les fibres musculaires tirent l'énergie de leur irritabilité*." "Comme c'est la respiration qui donne au sang sa chaleur, et à la fibre la susceptibilité pour l'irritation nerveuse, les reptiles ont le sang froid, et les forces musculaires moindres en totalité que les quadrupèdes, et à plus forte raison que les oiseaux; aussi n'exercent-ils guère que les mouvements du ramper et du nager; et, quoique plusieurs sautent et courent fort vite en certains moments, leurs habitudes sont généralement paresseuses, leur digestion excessivement lente, leurs sensations obtuses, et dans les pays froids ou tempérés, ils passent presque tout l'hiver en l'éthargie†."

It is extraordinary that M. Cuvier should have

* Le Règne Animal, tome i, pp. 56, 57, 2me edit.

† Le Règne Animal, tome ii, pp. 1, 2, 2me edit.

associated the elevated temperature of the blood with a high irritability of the muscular fibre, when they are uniformly separated in nature, and are, indeed, absolutely incompatible in themselves. The muscular fibre of the frog is so irritable, that it would instantly pass into a state of rigid and permanent contraction, if bathed with a fluid of the temperature of the blood of birds*.

The same confusion of ideas on the subject of the activity of the animal and the irritability of the muscular fibre prevails, I believe, amongst our own physiologists; at least, in conversation with two, who may rank among the first, I found that they had uniformly considered the respiration and the irritability to be directly, instead of inversely, proportionate to each other.

That singular and interesting property of the lower orders of animals, termed tenacity of life, is, on the other hand, distinctly associated with a high degree of irritability of the muscular fibre. This property may be defined as consisting of the power of sustaining the privation of respiration, the privation of food, various mutilations, divisions, &c. It is greater as we descend in the zoological scale. As activity depends upon the presence and condition of the spino-cerebral masses acted upon by arterial blood, tenacity of life depends upon the diminution or absence of these masses and of this highly arterialized

* See An Essay on the Circulation, chap. vii, pp. 180, 181.

blood, being greatest of all in those animals which approach a mere muscular structure. Almost the sole vital property then remaining is the irritability; and this property does not immediately suffer from division.

It is possible to reduce some of the reptile tribes to a state approaching that of animals still lower in the scale, by removing, by very slow degrees, successive portions of the nervous masses. This is most readily done in animals in which the respiration is already low, and the irritability high, as in the fœtus, in the very young animal, in the reptile, &c. as in the experiments of Legallois*, M. Serres†, myself‡, &c.

There is, even in animals most tenacious of life, one kind of mutilation—one kind of injury—not well borne. As the blood is in its lowest condition of stimulus, it cannot be withdrawn with impunity; frogs even soon perish, if their blood be allowed to flow. As the irritability, on the other hand, is high, certain stimuli, as galvanism, slightly elevated temperatures, &c. are speedily fatal. The batrachia are promptly destroyed by immersion in water of a temperature of 108° of Fahr. and some fish and crustacea perish in great numbers under the influence of a thunder-storm. It is a singular fact, that the fish alone, whose food is found amongst animals of a high

* Experiences sur le Principe de la Vie.

† Anatomie Comparée du Cerveau, tome ii, p. 224.

‡ Essay on the Circulation, chap. iii, § 1.

irritability, should possess an electrical organ for the destruction of its prey.

Having stated the law of the inverse ratio of the quantity of respiration and of the degree of irritability of the muscular fibre, especially in the heart, I purpose to trace it, by a series of observations, through the zoological scale, and in the different stages and states of animal existence. This inquiry will be followed by an investigation into the quantity of respiration, in different temperatures and seasons, in animals which retain, and animals which lose, their temperature; it is obvious, à priori, that the former must have a lower respiration in the elevated temperatures of summer than in winter, whilst the irritability, and with it the power of supporting the privation of air, will observe an inverse ratio; in the latter, it is probable that other laws prevail.

A particular object which I have in view is to construct accurate Tables of the quantity of respiration and the degree of irritability, which cannot fail to have many important applications in physiology. They will especially afford many explanations of the facts detailed in the extraordinary works of Legallois and M. Edwards, as I shall have occasion to point out particularly hereafter. The facts in regard to the irritability, ascertained by Nysten* and Mangili†, in-

* Recherches de Physiologie, sect. iv.

† Annales du Museum, tome x, p. 434.

sulated and useless hitherto, will assume a new and high degree of importance. The law of the inverse ratio which subsists in the animal kingdom between the respiration and the irritability of the muscular fibre, which admits of being extended so as to include all stimuli, appears to me, indeed, to constitute a chain which links together all the phenomena of the animal œconomy. I believe it to be the most general and inclusive in physiology*.

* This paper was read before the Royal Society on Feb. 23rd, 1832.

As a LAW, I repeat, then, that that which has just been stated is the most extensive and general in the whole animal kingdom and œconomy. It is a deduction from an immense series of facts; and it is, as it were, *necessary;* for if the stimuli be augmented, the dynamics diminish; and if the stimuli be diminished, the dynamics augment. All this is, of course, restrained within *physiological* limits. If these limits be exceeded, the animal suffers, and at length dies, of excess, or of defect, of stimulus.

An animal placed in oxygen gas, or deprived of its just supply of oxygen gas, equally dies. If an animal in a state of hybernation be so disturbed as to be made to breathe unduly, it dies, after a time; if a bird and a mouse be placed in a limited quantity of atmospheric air until they manifest signs of deficiency of oxygen gas, and then be taken out, and be replaced in their cages, they too die, after a time, the bird first, the mouse somewhat later.

I have treated, in a little volume of Gulstonian Lectures, of a form of secondary asphyxia which is of the latter character.

If the blood of a warm-blooded animal were to circulate in the arteries of an animal of cold blood, for an instant, the latter would die of universal tonic spasm!

So also of food. Food introduced too liberally, after abstinence, destroys the patient; a deficiency of food is scarcely more destructive, though, alas! more frequently so.

Extremes meet: too much and too little of stimulus deranges the balance between that and the dynamics of nerve and muscle, and destroys life!

It is plain, then, that LIFE consists in the maintenance of this balance; whilst its different *forms* depend upon the variation of the ratios.

I recommend this view, for full investigation, to the future naturalist and physiologist. A further exemplification of its value will be given in the next chapter.

CHAPTER XXIX.

ON HYBERNATION.

THAT peculiar condition of certain mammalia during the winter season, which has been designated hybernation, has been aptly compared by various authors to ordinary sleep. In both, the respiration is diminished. This fact was first determined, in regard to sleep, by Messrs. Allen and Pepys*. It obtains in a much higher degree in the state of hybernation. It is highly probable that, in sleep, as in hybernation, the irritability of the muscular fibre becomes augmented. These two conditions of the animal system may therefore mutually illustrate each other.

Ordinary sleep is similar to the sleep of the hybernating animal; and the sleep of the hybernating animal is similar to that deeper sleep, or lethargy, which is designated hybernation. We are thus led to trace a connexion between the recurrent sleep of all animals, and the deep and protracted sleep of a few.

I. *Of the Sleep of hybernating Animals.*

In the sleep of the hybernating animal, the respiration is more or less impaired: if the animal be placed in circumstances which best admit of observa-

* Phil. Trans. for 1809.

tion, the acts of respiration will be found to have greatly diminished; if it be placed in the pneumatometer, little alteration is induced in the bulk of the air; if its temperature be taken by the thermometer, it will be found to be many degrees lower than that of the animal in its active state; if it be deprived of atmospheric air, it is not immediately incommoded or injured.

These facts I have observed in the hedgehog*, the dormouse†, and the bat‡. If other authors have not made the same observations, it is because they have not been aware how easily this sleep is disturbed. To walk over the floor, to touch the table, is sufficient, in many instances, to rouse the animal, to re-produce respiration, and to frustrate the experiment.

The bat, which is a crepuscular or nocturnal feeder, regularly passes from its state of activity to one which may be designated diurnation. The respiration and the temperature fail; the necessity for respiration is greatly lessened.

During the summer of 1831, I carefully observed a bat in this condition. If it were quite quiet, its respiration became very imperfect; its temperature was but a few degrees above that of the atmosphere; being placed under water, it remained during eleven minutes uninjured, and, on being removed, became lively and continued well.

* Erinaceus Europæus. † Myoxus avellanarius.

‡ Vespertilio noctula.

I have more recently watched the habits of two hedgehogs, in a temperature varying from 45° to 50°. These animals alternately awake, take food, and fall asleep. One of them is frequently awake whilst the other is dormant, and goes to sleep at a time that the other awakes, but without regularity. When awake, the temperature of each, taken by pressing the bulb of a thermometer upon the stomach, is about 95°; when dormant, it is 45°; that of the atmosphere being 42° or 43°. The duration of this sleep is from two to three days, according to the temperature of the atmosphere. On the 4th of February, 1832, the temperature of the atmosphere being 50°, both the hedgehogs were dormant: the temperature of one was 51°; and that of the other, 52°. On the succeeding day, the temperature of the atmosphere had fallen one degree; the temperature of one of the hedgehogs was 49°, whilst that of the other, which had become lively, had risen to 87°. On the succeeding day, the first had become somewhat lively, and its temperature had risen to 60°; that of the other being 85°, and that of the atmosphere 47°.

I have observed precisely the same alternations in the dormouse; except that this animal awakes daily, in moderate temperatures, takes its food, and passes into a state of sleep, in which the respiration is greatly impeded, and the temperature little higher than that of the atmosphere.

On the day on which the observations were made

on the hedgehogs, the atmosphere being 49°, that of two dormice was 52°; on the succeeding day, the external temperature being 47°, that is, lower by two degrees, the temperature of one of these dormice was 92°, and that of the other 94°; and only three hours afterwards, the temperatures were 60° and 70° respectively, with a slight appearance of lethargy.

The hedgehog and the dormouse appear, in fact, to awake from the call of hunger, then to eat, and then again to become dormant, in temperatures which may be termed moderate. The bat, which could not find food if it did awake, does not undergo these periodical changes, except in the summer season. It appears to me, from the most careful observation, that there is every degree between the ordinary sleep of these animals and the most profound hybernation.

It is quite obvious, from these observations, that the ordinary sleep of hybernating animals differs from that of others, by inducing a more impaired state of the respiration and of the evolution of heat, with an augmented power of bearing the abstraction of the atmospheric air. This sleep probably passes into true hybernation, as the blood which circulates through the brain becomes more and more venous, from the diminution of the respiration, and as the muscular fibre of the heart acquires increased irritability.

It is absolutely necessary, in comparing the powers of hybernating and other animals, of evolving heat, accurately to observe whether there be any degree of

sleep. Mr. Hunter's and M. Edwards's experiments are extremely deficient, for want of this attention. Mr. Hunter, comparing the common mouse and the dormouse exposed to a very low temperature, observes, that the heat of the former " was diminished 16° at the diaphragm, and 18° in the pelvis, while in the dormouse it gained five degrees, but lost upon a repetition." The explanation of these facts is afforded by noticing that when the dormouse increased in temperature, it was " very lively," but on the repetition it had become " less lively*." M. Edwards omits to mention whether the hybernating animals in his experiments were disposed to be lively or dormant, or whether they had recently recovered from a dormant state. Without a peculiar attention to this point, no correct result can be obtained. The hybernating animal in a state of vigour and activity, is a totally different being from the same animal disposed to become dormant.

II. *Of true Hybernation.*

I now proceed to the detail of my observations upon actual hybernation, and especially upon the state of the respiration and the irritability, of the sensibility, the circulation, and the digestion, in this singular condition of the animal œconomy.

* Animal Œconomy, p. 114.

1. *Of the Respiration.*

The respiration is very nearly suspended in hybernation. That this function almost ceases, is proved, 1st, by the absence of all detectible respiratory acts; 2ndly, by the almost entire absence of any change in the air of the pneumatometer; 3rdly, by the subsidence of the temperature to that of the atmosphere; and 4thly, by the capability of supporting, for a great length of time, the entire privation of air.

1. I have adopted various methods to ascertain the entire absence of the acts of respiration. I placed bats in small boxes, divided by a partition of silk ribbon, the cover of which consisted of glass, and in the side of which a small hole was made to admit of placing a long light rod or feather under the animal's stomach. The least respiratory movement caused the extremity of this rod to pass through a considerable space, so that it became perfectly apparent.

Over the hybernating hedgehog I placed a similar rod, fixing one extremity near the animal, and leaving the other to move freely over an index. During hybernation, not the slightest movements of these rods could be observed, although they were diligently watched. But the least touch, the slightest shake, immediately caused the bat to commence the alternate acts of respiration, whilst it invariably produced the singular effect of a deep and sonorous inspiration in the hegehog. It is only necessary to touch the latter

animal, to ascertain whether it be in a state of hybernation or not: in the former case, there is this deep sonorous inspiration; in the latter, the animal merely moves and coils itself up a little more closely than before. After the deep inspiration, there are a few feeble respirations, and then total quiescence. The bat makes similar respirations without the deep inspiration, and then relapses into suspended respiration.

2 As the acts of respiration are nearly suspended during hybernation, so are the changes induced in the atmospheric air.

On January the 28th, the temperature of the atmosphere being 42°, I placed a bat, in the most perfect state of hybernation and undisturbed quiet, in the pneumatometer, during the whole night, a space of ten hours, from 1 h. 30 m. to 11 h. 30 m. There was no perceptible absorption of gas.

Having roused the animal a little, I replaced it in the pneumatometer, and continued to disturb it from time to time, by moving the apparatus. It continued inactive, and between the hours of 1 h. 20 m. and 4 h. there was the absorption of one cubic inch only of gas.

Being much roused at four o'clock, and replaced in the pneumatometer, the bat now continued moving about incessantly; in one hour, five cubic inches of gas had disappeared. It was then removed. A further absorption took place of ·8 of a cubic inch of gas.

Thus the same little animal, which, in a state of

hybernation, passed ten hours without respiration, absorbed or converted 5·8 cubic inches of oxygen gas into carbonic acid in one hour, when in a state of activity. In an intermediate condition, it removed one cubic inch of oxygen in two hours and forty minutes.

I repeated this experiment on February the 18th. A bat, in a state of perfect hybernation, was placed in the pneumatometer, and remained in it during the space of twenty-four hours. There was now the indication of a very slight absorption of gas, not, however, amounting to a cubic inch.

On February the 22nd, I repeated this experiment once more, continuing it during the space of sixty hours; the thermometer descended gradually, but irregularly, from 41° to 38°; the result is given in the subjoined Table.

Date.		External Temperature.	Absorption.	Duration.
		o		h.
February 22	11 P.M.	41		
23	11 A.M.	38½	·8	12
	11 P.M.	39½	·75	12
24	11 A.M.	38	·5	12
	11 P.M.	39	·75	12
25	11 A.M.	38	·6	12
			—	—
			3·4	60
			—	—

From this experiment, it appears that 3·4 cubic inches of oxygen gas disappeared in sixty hours, from

the respiration of a bat in the state of lethargy. It has been seen that, in a state of activity, an equal quantity of this gas disappeared in less than half that number of minutes. The respiration of the hybernating bat descends to a sub-reptile state. It will be seen shortly that the irritability of the heart, and of the muscular fibre generally, is proportionably augmented.

In this experiment, it is probable that the lethargy of the animal was not quite complete. Should the temperature of the atmosphere fall, and continue at 32°, I shall again repeat it under these circumstances. The respiration will probably be still more nearly suspended.

It is important to remark, that the registration of the quantity of absorption in these experiments was not begun until several hours after the animal had been inclosed within the jar of the pneumatometer, so that the absorption of the carbonic acid always present in atmospheric air was excluded from the result.

It may be a question whether the slight quantity of respiration I have mentioned be cutaneous. The absence of the acts of respiration would lead us to this opinion. But it may be observed, that these acts have not been watched, and can scarcely be watched continuously enough, to determine the question of their entire absence. Some contrivance to ascertain whether the rod has moved along the index during the absence of the observer, would resolve every doubt

upon this interesting point. And I think it right to remark, that, after the apparent total cessation of respiration, as observed by the means which have just been described, there is probably still a slight diaphragmatic breathing. I am led to this conclusion by having observed a slight movement of the flank, in a favorable light, unattended by any motion of the thorax or epigastrium.

3. Much precaution is required in ascertaining the comparative temperature of the animal with that of the atmosphere. The slightest excitement induces a degree of respiration, with the consequent evolution of heat.

The plan which is best adapted to determine this question in regard to the bat, and which I have adopted, together with every attention to preserve the animal quiet and undisturbed, is the following: A box was made of mahogany, with a glass lid, divided horizontally at its middle part by a fold of strong ribbon, and of such dimensions as just to contain the animal. The bat was placed upon the ribbon, and inclosed by fixing the lid in its place. Being lethargic, it remained in undisturbed quiet. A thermometer, with a cylindrical bulb, was now passed through an orifice made in the box on a level with the ribbon, under the epigastrium of the animal, and left in this situation.

It was only now necessary to make daily observations and comparisons between this thermometer and

another placed in the adjacent atmospheric air. The layer of silk, and the portion of air underneath, protected the animal from the immediate influence of the temperature of the table on which the box was placed.

The following Table gives the result of observations made during many days, in very varying temperatures.

Date.		Temperature of the Atmosphere.	Temperature of the Animal.
		o	o
January 6	11 P.M.	40	40½
7	8 P.M.	43	43
8		41	41½
9	11 P.M.	47	46
10	10 A.M.	46	46
—	12 midnight.	47	47
11	10 P.M.	45	45
12	11 P.M.	45	45
13	11 P.M.	37	37½
14	11 A.M.	37	37
—	11 P.M.	40	40
15	2 P.M.	37	37
—	11 P.M.	35	35
16	11 P.M.	37	37
17	11 P.M.	42	42
18	11 A.M.	40	40
19	10 P.M.	36	36
20	11 P.M.	39	39
21	11 P.M.	40	40

Date.		Temperature of the Atmosphere.	Temperature of the Animal.
		o	o
January 22	11 P.M.	44	44
23	10 A.M.	42½.....	42½
—	11 P.M.	40½.....	40½
24	11 P.M.	43½.....	43½
25	10 P.M.	42	42
26	10 P.M.	41	41
27	10 P.M.	37	37
28	11 A.M.	34½.....	34½
—	11 P.M.	37	37
29	11 A.M.	42	42
—	11 P.M.	43	43
30	11 P.M.	42	42
31	11 P.M.	39½.....	39½

From this Table, it is obvious that the temperature of the hybernating animal accurately follows that of the atmosphere. When the changes of temperature in the latter are slight, the two thermometers denote the same temperature. If these changes are greater and more rapid, the temperature of the animal is a little lower or higher, according as the external temperature rises or falls; a little time being obviously required for the animal to attain that temperature.

Similar observations were made during the first three days of February. On the 4th, however, the temperature of the atmosphere rose to 50½°; that of

the animal was now 82°, and there was considerable restlessness. On the 6th, the temperature of the atmosphere had fallen to 47½°, and that of the animal to 48°, whilst there was a return of the lethargy.

After this period, there were the same equal alterations of temperature in the animal and in the atmosphere observed in the month of January.

It is only necessary to add to these observations, that the internal temperature is about three degrees higher than that of the epigastrium. In two bats, the external temperature of each of which was 36°, a fine thermometer, with an extremely minute cylindrical bulb, passed gently into the stomach, rose to 39°.

The following experiments, made by the celebrated Jenner, illustrate this point:

"In the winter, the atmosphere at 44°, the heat of a torpid hedgehog at the pelvis was 45°, and at the diaphragm 48½°.

"The atmosphere 26°, the heat of a torpid hedgehog, in the cavity of the abdomen, was reduced so low as 30°.

"The same hedgehog was exposed to the cold atmosphere of 26° for two days, and the heat of the rectum was found to be 93°; the wound in the abdomen being so small, that it would not admit the thermometer*.

"A comparative experiment was made with a

* The animal had become lively. See Hunter on the Animal Œconomy, p. 113.

puppy, the atmosphere at 50°; the heat in the pelvis, as also at the diaphragm, was 102°.

"In summer, the atmosphere at 78°, the heat of the hedgehog in an active state, in the cavity of the abdomen, towards the pelvis, was 95°; at the diaphragm, 97°*."

There is an error in the admirable work of M. Edwards, in relation to the present subject, which it is important to point out. M. Edwards first ascertained the interesting fact, that the very young of those species of animals which are born blind, lose their temperature, if removed from the contact of their parent; and justly concludes that they have not sufficient power of evolving heat, to maintain their natural temperature when so exposed. M. Edwards then subjected hybernating animals to the action of cold; and, observing that their temperature also fell, he concludes that they, like the very young animal, have not the faculty of maintaining their temperature under ordinary circumstances†.

It is remarkable that this acute physiologist did not perceive the error in this reasoning. In no instance does the young animal maintain its warmth, when exposed alone to the influence of an atmosphere of moderate temperature. Can this be said of the hybernating animal? Certainly not. In ordinary temperatures, the hybernating animal maintains its acti-

* Hunter on the Animal Œconomy, p. 112.

† Des Agens Physiques, p. 155.

vity, and, with its activity, its temperature. The loss of temperature in this kind of animal is an induced condition, occasioned by sleep. Nothing, therefore, can be more incorrect than the following conclusion: " Au mois d'Avril 1819, l'air étant à 16°, une chauve-souris adulte, de l'espèce nommée *oreillard*, avait une température de 34°. Elle était récemment prise et en bon état. Je la plaçai dans un vase de terre que je refroidis en l'entourant de glace pilée et d'un peu de sel. L'air y était à 1°. Un couvercle était placé de manière à établir une libre communication avec l'air extérieur. Après y avoir laissé la chauve-souris pendant une heure, sa température était réduit à 14°. Elle s'était donc refroidée de 20° dans un si court espace de temps, sous la seule influence d'un température qui n'était pas au-dessous de zéro. Des cochons d'Inde, des oiseaux adultes, placés dans les mêmes circonstances, ne se sont refroidis que de deux ou trois degrés au plus, quoiqu'on ait continué l'influence du froid pour compenser les différences de volume.

" Nous voyons par là que les chauves-souris produisent habituellement moins de chaleur que ces animaux à sang chaud, et que c'est principalement à cette cause qu'il faut attribuer l'abaissement de leur température pendant la saison froide. En comparant cette expérience sur la chauve-souris adulte avec celles que nous avons faites sur les jeunes animaux à sang chaud, on y aperçoit un rapport remarquable; ils ne pro-

duisent pas assez de chaleur pour soutenir une température élevée, lorsque l'air est à un degré voisin de zéro. Mais il y a cette différence, que c'est un état passager chez les jeunes animaux à sang chaud, et qu'il est permanent chez les chauves-souris.

" Il est évident que les autres mammifères hibernans doivent participer plus ou moins de cette manière d'être. Les faits que j'ai exposés suffisent pour nous faire considérer ce groupe d'animaux sous le point de vue suivant; qu'au printemps et en été, dans leur état d'activité et de veille, lorsque leur température est assez élevée pour ne pas différer essentiellement de celle qui caractérise les animaux à sang chaud, ils n'ont pas la faculté de produire autant de chaleur*."

There is a point unnoticed in M. Edwards's experiment. It is the condition of the bat in regard to activity or lethargy under the exposure to cold; and upon this the whole phenomena depend.

The differences between the young animal benumbed, and the hybernating animal lethargic, from cold, are both great and numerous. I purpose to point them out particularly on a future occasion.

4. It is in strict accordance with these facts, that the lethargic animal is enabled to bear the total abstraction of atmospheric air, or oxygen gas, for a considerable period of time.

Spallanzani placed a marmot in carbonic acid gas, and makes the following report of the experiment, in

* Des Agens Physiques, p. 154.

a letter to Senebier: "Vous vous ressouviendrez de ma marmotte qui fut si fortement léthargique dans l'hiver sévère de 1795; je la tins alors pendant quatre heures dans le gaz acide carbonique, le thermomètre marquant —12°, elle continua de vivre dans ce gaz qui est le plus mortel de tous, comme je vous le disais: au moins un rat et un oiseau que j'y plaçait avec elle y périrent à l'instant même. Il parait donc que sa respiration fut suspendue pendant tout ce tems-là. Je soumis à la même expérience des chauve-souris semblablement léthargiques, et le résultat fut le même*."

A bat, which was lethargic in an atmosphere of 36°, was immersed in water of 41°. It moved about a little, and expelled bubbles of air from its lungs. It was kept in the water during sixteen minutes, and then removed. It appeared to be uninjured by the experiment.

A hedgehog, which had been so lethargic in an atmosphere of 40° as not to awake for food during several days, was immersed in water of 42°. It moved about, and expelled air from its lungs. It was retained under the water during 22½ minutes. It was then removed. It appeared uninjured.

It seems probable that the motions observed in these animals were excited through the medium of the cutaneous nerves.

The power of supporting the abstraction of oxygen

† Mémoires sur la Respiration, par Lazare Spallanzani, traduits en Français, d'après son manuscrit inedit, par Jean Senebier, p. 75.

gas, or atmospheric air, belongs solely to the hybernating state, and is no property of the hybernating animal in its state of activity. After having found that the dormant bat, in summer, supported immersion in water, during eleven minutes, uninjured, I was anxious to know whether the active hedgehog possessed the same power. I immersed one of these animals in water. It expired in three minutes, the period in which immersion proves fatal to the other mammalia. Sir Anthony Carlisle has therefore committed an error, somewhat similar to that of M. Edwards, when he asserts that "animals of the class Mammalia, which hybernate and become torpid in winter, have at all times a power of subsisting under a confined respiration, which would destroy other animals not having this peculiar habit*." The power of bearing a suspended respiration is an induced state. It depends upon sleep or lethargy themselves, and their effect in impairing or suspending respiration; and upon the peculiar power of the left side of the heart, of becoming veno-contractile under these circumstances.

2. *Of the Irritability.*

The single fact of a power of sustaining the privation of air, without loss of life, leads alone to the inference that the irritability is greatly augmented in the state of hybernation. This inference flows from

* Phil. Trans. 1805, p. 17.

the law so fully stated in the preceding chapter, and the fact is one of its most remarkable illustrations and confirmations.

It might have been inferred, from these premises, that the beat of the heart would continue longer after decapitation in the state of hybernation, than in the state of activity in the same animal; an inference at once most singular and correct.

This view receives the fullest confirmation from the following remarkable experiment. On March the 9th, soon after midnight, I took a hedgehog which had been in a state of uninterrupted lethargy during 150 hours, and divided the spinal marrow just below the occiput; I then removed the brain and destroyed the whole spinal marrow as gently as possible. The action of the heart continued vigorous during four hours, when, seeing no prospect of a termination to the experiment, I resolved to envelope the animal in a wet cloth, and leave it until early in the morning. At seven o'clock, A.M. the beat of both sides of the heart still continued. They still continued to move at ten, A.M.—each auricle and each ventricle contracting quite distinctly. At half after eleven, A.M. all were equally motionless; yet all equally contracted, on being stimulated by the point of a penknife. At noon, the two ventricles were alike unmoved, on being irritated as before; but both auricles contracted. Both auricles and ventricles were shortly afterwards inirritable.

This experiment is the most extraordinary of those which have been performed upon the mammalia. It proves several interesting and important points: 1. That the irritability of the heart is augmented in continued lethargy in an extraordinary degree. 2. That the irritability of the left side of the heart is then little, if at all, less irritable than the right; that it is, in fact, veno-contractile. 3. That, in this condition of the animal system, the action of the heart continues for a considerable period independently of the brain and spinal marrow.

On April the 20th, at six o'clock in the evening, the temperature of the atmosphere being 53°, a comparative experiment was made upon a hedgehog in its state of activity: the spinal marrow was simply divided at the occiput; the beat of the right ventricle continued upwards of two hours; that of the left ventricle ceased almost immediately; the left auricle ceased to beat in less than a quarter of an hour; the right auricle also ceased to beat long before the right ventricle.

In further proof of the same fact, I may here adduce a remarkable paragraph from the paper of Mangili, in the Annales du Muséum*: " J'observai à peu près les mêmes choses dans une autre marmotte en léthargie, que je decapitai le 22 de Mars 1807. Mais en ouvrant celle-ci, j'avois deux objets: le premier, d'examiner l'état des viscères les plus importans,

* Tome x, pp. 453—456.

comme le cœur, les poumons et le cerveau. Le second étoit de voir comment procédent les phènomènes de l'irritabilité musculaire ; parce qu'ayant entendu dire à un célèbre naturaliste, que l'engourdissement avoit pour cause l'altération ou la suspension de cette irritabilité, il m'importoit de savoir si cette assertion étoit vraie. Dans la chambre où se trouvoit la marmotte, le thermomètre étoit à 6 degrés et demi : l'ayant introduit dans le bas ventre, il monta d'un degré, c'est-à-dire à 7 dégrés et demi."

" Je trouvai les poumons dans leur état naturel. Le cœur continua à battre pendant plus de trois heures. Les pulsations, d'abord vives et frequentes, s'affoiblirent et se ralentirent peu-à-peu. J'en avois compté de seize à dix-huit par minute au commencement de la première heure ; à la fin de la troisième je n'en comptois plus que trois dans le même temps. Les veines du cerveau me parurent gonflées de sang.

" La tête unie au cou ayant été séparée du tronc, je la mis dans un vase avec de l'esprit-de-vin, et j'y remarquai, même après une demi-heure, des mouvemens assez sensibles. Ce fait prouve, ainsi que plusieurs autres dont je parlerai bientôt, que si dans l'état de léthargie conservatrice la vie est beaucoup moins énergique, le principe vital répandu dans les diverses parties, a beaucoup plus de ténacité, et tarde bien plus à s'éteindre."

" Je séparai du corps de l'animal plusieurs morceaux des muscles qui obéissent à la volonté, et je vis

avec étonnement que, trois heures après la mort, ils se contractoient fortement chaque foi que je les soumettois à l'action galvanique. Ces mouvemens convulsifs ne se ralentirent qu'au bout de quatre heures.

" Il suit de là que les marmottes tuées pendant qu'elles sont en léthargie, présentent, relativement à l'irritabilité, à peu près les mêmes phénomènes qu'on remarque dans plusieurs animaux à sang froid.

" Pour savoir ensuite si les phénomènes d'irritabilité etoient les mêmes dans l'état de veille et dans celui de léthargie, le 25 de Juin, j'ai fait périr, précisément de la même manière, une seconde marmotte qui étoit éveillée depuis deux mois, et qui faisoit de frequentes courses dans le jardin. Mon thermomètre marquoit ce jour-là 18 degrés: l'ayant introduit dans le ventre de la marmotte au moment où je venois de la decapiter, il s'éleva à 29 degrés.

" Ayant mis le cœur à découvert, comme je l'avois fait dans mon experience du mois de Mars, je comptai d'abord vingt-sept ou vingt-huit pulsations par minute. Ce nombre n'étoit plus que de douze au bout d'un quart d'heure, et de huit, au bout de demi-heure: dans les dix minutes suivantes, il n'y eut plus que quatre pulsations très-foibles par minute, et elles cessèrent totalement dans les dix dernières minutes, c'est-à-dire cinquante minutes après la mort de l'animal; tandis que le cœur de la marmotte tuée dans l'état de léthargie, donnoit encore quatre légères pulsations par minute, trois heures après que la tête avoit

été séparée du corps. Cette grande différence prouve que le principe de l'irritabilité s'accumule pendant la léthargie conservatrice.

" Les chairs musculaires me semblirent plus pâles que celles de la marmotte en léthargie : elles étoient d'abord très sensibles à l'action galvanique ; mais ses signes d'irritabilité s'affoiblirent et disparurent bien plus rapidement. En effet, les chairs musculaires de cette marmotte étoient peu sensibles au bout de deux heures, tandis que dans la marmotte tuée en hiver elles se contractoient fortement au bout de trois heures, et que l'irritabilité ne s'affoiblit notablement que quatre heures après la mort.

" Les chairs des muscles intercostaux et abdominaux conservèrent leur sensibilité au stimulus électrique quelques minutes de plus que celles des membres ; d'où l'on peut conclure que le principe de l'irritabilité se conserve d'avantage dans certaines parties du même animal. Mais ce qui est prouvé jusqu'à l'évidence, c'est que ce principe a bien plus de ténacité dans les chairs de l'animal tué pendant l'état de léthargie, que dans celles de l'animal tuè pendant l'état de veille."

This author does not appear to have had any apprehension of the extreme importance of this extraordinary change in the irritability, but merely states it as a fact. Its due value can only be known by observing the dependence of the functions of life on that law of the inverse condition of the respiration and of

the irritability, of which so much has already been said. In the hybernating animal, the respiration is nearly suspended: had not the irritability become proportionately augmented, the actions of life must have ceased!

3. *Of the Sensibility.*

All the writers upon the subject of hybernation agree in stating that the sensibility is greatly impaired; and it is impossible to commit a greater mistake.

The slightest touch applied to one of the spines of the hedgehog immediately rouses it to draw that deep inspiration of which I have spoken. The merest shake induces a few respirations in the bat. The least disturbance, in fact, is felt, as is obvious from its effect in inducing motion in the animal.

It is from the misconception on this point that the error has arisen, that the respiration is not absolutely suspended in hybernation. This function has been so readily excited, through the medium of an unimpaired sensibility, that the event has been considered as appertaining to the state of hybernation.

In fact, the sensibility is in nearly the same condition in hybernation as in ordinary sleep.

It must appear extraordinary that with an unimpaired sensibility there can co-exist a suspended respiration. Why is not this suspension of respiration painful in the hybernating, as in other animals? And why is not the animal roused, by this pain, from

its slumbers, if its sensibility be only slightly impaired?

But we should first ask, what are the precise seat and source of that pain which is felt during the suspension of respiration? These are, I think, demonstrably, the heart, and an impeded circulation through this organ. If, therefore, the circulation through the heart be not obstructed, there will be no painful sensation. Now it is precisely the peculiar property of hybernation, that the circulation through the heart is *not* interrupted, although the respiration be suspended. This topic is reserved, however, for a subsequent part of this paper. It is simply stated in this place as a fact, to show that the painful feelings supposed to arise from suspended respiration in hybernation do not exist; and that the difficulty of supposing a suspended state of the respiration with an unimpaired sensibility, is, in this manner, entirely removed.

The sensorial functions, on the other hand, are nearly suspended. This is proved by the suspension of respiration, which is immediately renewed, for a time, on exciting the animal. It is further proved by the fact, that, although the animal coils itself up when touched, it immediately relaxes into the former position; whereas, when it is awake, the impression of an external object induces a state of contraction and immobility which is continued for some time—probably as long as the sense of fear continues. When the hedgehog, coiled up in its state of activity, is thrown

into water, it immediately relaxes itself, from fear, and betakes itself to swimming; in the state of lethargy, on the other hand, no fear appears to be excited under such circumstances, and the animal would probably remain still and quiet for a very considerable period, if its sensibility were not acted upon by the contact of the water.

4. *Of the Muscular Motility.*

The motility of the muscles, in true hybernation, is, like sensibility, unimpaired. Those physiologists who have asserted the contrary, have, as will be shown shortly, mistaken the phenomena of torpor from cold, for those of true hybernation.

If the hedgehog, in a state of the most perfect lethargy, uncomplicated with torpor, be touched, its respiration is resumed, and it coils itself up more forcibly than before. The dormouse, in similar circumstances, unfolds itself; and the bat moves variously. Not the slightest stiffness is observed. The hedgehog, when roused, walks about, and does not stagger as has been asserted. The bat speedily takes to the wing, and flies about with great activity, although exhaustion and death may subsequently result from the experiment. The phenomena are similar to those of awaking from natural sleep. Insensibility, impaired motility, stiffness, lameness, &c. belong to torpor, and not to true hybernation.

5. *Of the Circulation.*

The wing of the bat affords an admirable opportunity of observing the condition of the circulation during hybernation. But it requires peculiar management. If the animal be taken from its cage, and the wing extended under the microscope, it is roused by the operation, and its respiratory and other movements are so excited, that all accurate observation of the condition of the circulation in the minute vessels is completely frustrated. Still greater caution is required in this case, than even in the observation of the respiration and temperature.

After some fruitless trials, I at length succeeded perfectly in obtaining a view of the minute circulation undisturbed. Having placed the animal, in its state of hybernation, in a little box of mahogany, I gently drew out its wing through a crevice made in the side of the box; I fixed the tip of the extended wing between portions of cork; I then attached the box and the cork to a piece of plate-glass; and, lastly, I left the animal in this situation, in a cold atmosphere, to resume its lethargy.

I could now quietly convey the animal ready prepared, and place it in the field of the microscope, without disturbing its slumbers, and observe the condition of the circulation.

In this manner I have ascertained, that, although the respiration be suspended, the circulation continues uninterruptedly. It is slow in the minute arteries

and veins; the beat of the heart is regular, and generally about twenty-eight times in the minute.

We might be disposed to view the condition of the circulation in the state of hybernation as being reptile, or analogous to that of the batrachian tribes. But when we reflect that the respiration is nearly, if not totally, suspended, and that the blood is venous*, we must view the condition of the circulation as in a lower condition still, and, as it were, sub-reptile. It may, indeed, be rather compared to that state of the circulation which is observed in the frog from which the brain and spinal marrow have been removed by minute portions at distant intervals†.

In fact, in the midst of a suspended respiration, and an impaired condition of some other functions, one vital property is augmented. This is the irritability, and especially the irritability of the left side of the heart. The left side of the heart, which is, in the hybernating animal, in its state of activity, as in all the other mammalia, only arterio-contractile, becomes veno-contractile.

This phenomenon is one of the most remarkable presented to me in the whole animal kingdom. It forms the single exception to the most general rule,

* M. Prunelle observes, "En comparant le sang de deux chauve-souris auxquelles j'avois ouvert les carotides, à l'une pendant son engourdissement et à l'autre dans l'état de veille, j'ai trouvé celui de la dernière beaucoup plus vermeil."—Annales du Museum, tome xviii, p. 28.

† Essay on the Circulation, pp. 136—141.

amongst animals which possess a double heart. It accounts for the possibility of immersion in water or a noxious gas, without drowning or asphyxia; and it accounts for the possibility of a suspended respiration, without the feeling of oppression or pain, although sensation be unimpaired. It is, in a word, this peculiar phenomenon which, conjoined with the peculiar effect of sleep in inducing diminished respiration in hybernating animals, constitutes the susceptibility and capability of taking on the hybernating state. On the other hand, as the rapid circulation of a highly arterialized blood in the brain and spinal marrow of birds probably conduces to their activity, the slow circulation of a venous blood doubtless contributes to the lethargy of the hybernating animal.

6. *Of the Digestion.*

There is much difference in the powers of digestion, and in the fact of omitting to take food, in the hybernation of different animals. The bat, being insectivorous, would awake in vain; no food could be found: the hedgehog might obtain snails or worms, if the ground were not very hard from frost: the dormouse would find less difficulty in meeting with grain and fruits. We accordingly observe a remarkable difference in the habits of awaking from their lethargy or hybernation, in these different animals.

I have observed no disposition to awake at all in the bat, except from external warmth or excitement.

If the temperature be about 40° or 45°, the hedgehog, on the other hand, awakes, after various intervals of two, three, or four days passed in lethargy, to take food; and again returns to its state of hybernation. The dormouse, under similar circumstances, awakes daily.

Proportionate to the disposition to awake and take food, is the state of the functions of the stomach, bowels, and kidneys. The dormouse and the hedgehog pass the fæces and urine in abundance during their intervals of activity. The bat is scarcely observed to have any excretions during its continued lethargy.

In the dormouse and the hedgehog, the sense of hunger appears to rouse the animal from its hybernation, whilst the food taken conduces to a return of the state of lethargy. It has already been observed, that there are alternations between activity and lethargy in this animal, with the taking of food, in temperatures about 40° or 45°. Nevertheless, abstinence doubtless conduces to hybernation, by rendering the system more susceptible of the influence of cold, in inducing sleep and the loss of temperature. The hedgehog, which awakes from its hybernation, and does not eat, returns to its lethargy sooner than the one which is allowed food.

III. *Of Torpor from Cold.*

It is highly important, and essential to the present investigation, to distinguish that kind of torpor which

may be produced by cold in any animal, from true hybernation, which is a property peculiar to a few species. The former is attended by a benumbed state of the sentient nerves, and a stiffened condition of the muscles; it is the direct and immediate effect of cold, and, even in the hybernating animal, is of an injurious and fatal tendency: in the latter, the sensibility and motility are unimpaired; the phenomena are produced through the medium of sleep; and the effect and object are the preservation of life.

Striking as these differences are, it is certain that the distinction has not always been made by former observers. In all the experiments which have been made, with artificial temperatures especially, it is obvious that this distinction has been neglected.

True hybernation is induced by temperatures only moderately low. All hybernating animals avoid exposure to extreme cold. They seek some secure retreat, make themselves nests or burrows, or congregate in clusters, and, if the season prove unusually severe, or if their retreat be not well chosen and they be exposed in consequence to excessive cold, many become benumbed, stiffen, and die.

In our experiments upon hybernation, we should imitate nature's operations. Would any one imagine that the following detail contained the account of an experiment upon this subject? "Le 31 Janvier," says M. Saissy, "à trois heures du soir, la température atmosphérique étant à 1°25 au-dessous de zéro,

celle d'un hérisson engourdi profondément à 3°50 au dessus, j'enfermai ce quadrupède dans un bocal de verre entourè de toute part d'une mixtion de glace et de muriate de soude. L'excés du froid le réveilla d'abord, mais trois heures ont suffi pour le replonger dans une profonde torpeur.

" J'avais placé l'animal de manière que je pouvais répéter, autant que je le jugeais nécessaire, les expériences thermométriques. Dès que sa température eut baissé jusqu'à zéro (ce ne fut qu'à 2 heures du matin), je le retirai du bocal et le placai dans une température de 12° et plus au dessus de la glace ; mais l'animal était mort*."

To induce true hybernation, it is quite necessary to avoid extreme cold ; otherwise we produce the benumbed and stiffened condition to which the term torpor or torpidity may be appropriated. I have even observed that methods which secure moderation in temperature, lead to hybernation : hedgehogs supplied with hay or straw, and dormice supplied with cotton wool, make themselves nests and become lethargic ; when others, to which these materials are denied, and which are consequently more exposed to the cold, remain in a state of activity. In these cases, warmth or moderated cold actually concur to produce hybernation†.

* Recherches sur les Animaux hybernans, par M. J. A. Saissy, pp. 13, 14.

† M. Cuvier observes of the Tenrec, " Ce sont des Animaux nocturnes qui passent trois mois de l'année en léthargie, quoique habitants

When we read of insensibility, of a stiffened state of the muscles, and of a cessation of the circulation, as obtaining in hybernation, we may be certain that a state of torpor has been mistaken for that condition. The actually hybernating animal, exposed to continued severe cold, is, as M. Saissy correctly observes, first roused from this state of ease and preservation, into a painful activity, and then plunged into a fatal torpor.

This subject will come to be considered in a subsequent part of this inquiry, in which I purpose to trace the effects of cold in changing the relative quantity of respiration and degree of the irritability in animals of different ages which do not hybernate; in the mean time, the accurate distinction between mere torpor, which may occur in any animal, and which is a destructive state, from true hybernation, which is preservative, and the peculiarity of certain animals, will enable us to correct many inaccuracies into which

de la zône torride. Bruguière assure même c'est pendant les plus grandes chaleurs qu'ils dorment." Règne Animal, ed. 1829, tome i, p. 125. This account, however, does not agree with that of Mr. Telfair, given in the Proceedings of the Zoological Society, No. viii, p. 89. Mr. Telfair states, "In the Mauritius they sleep through the greater part of the winter, from April to November, and are only to be found when the summer heat is felt, which being generally ushered in by an electric state of the atmosphere, the negroes (with whom they are a favorite food) say they are awakened by the peals of thunder which precede the summer storms, or 'pluies d'orages.' Even in summer, they are not often seen beyond the holes in which they burrow, except at night. Their favorite haunts are among the old roots of clumps of bamboos."

Legallois*, M. Edwards†, and other physiologists, have fallen.

IV. *Of Reviviscence.*

Not the least interesting of the phenomena connected with hybernation, are those of reviviscence. Hybernation induces a state of irritability of the left side of the heart, which, with high respiration and an arterialized blood, would be incompatible with life. Respiration suddenly restored, and permanently excited, is therefore as destructive as its privation in other circumstances.

All those bats which were sent to me from distant parts of the country died. The continued excitement from the motion of the coach, keeping them in a state of respiration, the animal perished. One bat had, on its arrival, been roused so as to fly about. Being left quiet, it relapsed into a state of hybernation. The excitement being again repeated the next day, it again flew about the room; on the succeeding day, it was found dead.

It is in accordance with this law, that we observe hybernating animals adopting various measures to secure themselves from frequent sources of disturbance and excitement. They choose sheltered situations, as caverns, burrows, &c. secure from the rapid changes and the inclemencies of the weather and season.

* Œuvres de Legallois; Paris, 1824, p. 282.

† Agens Physiques, pp. 292, 148.

Many form themselves nests; others congregate together. The hedgehog and the dormouse roll themselves up into a ball. The common bat suspends itself by the claws of its hinder feet, with its head dependent, generally in clusters; the horseshoe bat (ferrum equinum) spreads its wings so as to embrace and protect its fellows.

All these circumstances are obviously designed to prevent disturbed hybernation.

In the depth of caverns, and other situations sheltered from changes of temperature in the atmosphere, the calls of hunger are probably the principal cause of reviviscence in the spring. The other causes of reviviscence are the return of warmth and external excitements. It is interesting to observe and trace the gradual return of respiration in the former case, and of the temperature of the animal in the latter.

If the hybernating hedgehog be touched even very gently, it draws a deep breath, and then continues to breathe for a short time. If this excitement be repeated, the animal is permanently roused, and its temperature raised. If the temperature of the atmosphere be augmented, the respiration is gradually excited, and the animal is gradually restored to its state of activity.

If a hybernating animal be excited in a very cold atmosphere, its temperature rises variously, and then falls. A bat was perfectly lethargic in a temperature of 36°. A fine thermometer, with a cylindrical bulb,

was introduced into its stomach; it rose to 39°. One hour afterwards, the animal not being further disturbed, the respiration was rapid, and the temperature in the stomach 95°. Shortly afterwards, the temperature was 90°. The minute circulation was pretty good, and pulsatory in the arteries, the heart beating from twenty-eight to thirty-six times in a minute.

In another bat, in an atmosphere of the temperature of 36°, the thermometer in the stomach rose to 39°. The animal being continually excited, the temperature rose to 65°, but speedily fell to 60°.

The animal, excited and revived in this manner, is in a state of exhaustion and inanition. It is incapable of maintaining its temperature, if exposed to cold; and will die, unless it repass into the state of hybernation. It may be compared to the case of the mouse deprived of food, in the following experiment of Mr. Hunter. "A mouse was put into a cold atmosphere of 13° for an hour, and then the thermometer was introduced as before; but the animal had lost heat, for the quicksilver at the diaphragm was carried only to 83°; in the pelvis, to 78°.

"In order to determine whether an animal that is awakened has the same powers, with respect to preserving heat and cold, as one that is vigorous and strong, I weakened a mouse by fasting, and then introduced the bulb of the thermometer into its belly; the bulb being at the diaphragm, the quicksilver rose to 97°; in the pelvis to 95°, being two degrees colder

than the strong mouse: the mouse being put into an atmosphere as cold as the other, and the thermometer again introduced, the quicksilver stood at 79° at the diaphragm, and at 74° in the pelvis.

"In this experiment, the heat at the diaphragm was diminished 18°, in the pelvis 21°.

"This greater diminution of heat in the second than in the first, we may suppose proportional to the decreased power of the animal, arising from want of food*."

But extreme cold alone, by a painful effect induced on the sentient nerves, rouses the hybernating animal from its lethargy, as has been remarked already, and is illustrated by the following experiments of Hunter. "Having brought a healthy dormouse, which had been asleep from the coldness of the atmosphere, into a room in which there was a fire (the atmosphere at 64°), I introduced the thermometer into its belly, nearly at the middle, between the thorax and pubis, and the quicksilver rose to 74° or 75°; turning the bulb towards the diaphragm, it rose to 80°; and when I applied it to the liver, it rose to 81½°.

"The mouse being placed in an atmosphere of 20°, and left there half an hour, when taken out was very lively, even much more so than when put in. Introducing the thermometer into the lower part of the belly, the quicksilver rose to 91°; and upon turning it up to the liver, to 93°.

* Animal Œconomy, pp. 114, 115.

" The animal being replaced in the cold atmosphere at 30°, for an hour, the thermometer was again introduced into the belly: at the liver it rose to 93°; in the pelvis to 92°; the mouse continuing very lively.

" It was again put back into an atmosphere cooled to 19°, and left there an hour: the thermometer at the diaphragm was 87°; in the pelvis 83; but the animal was now less lively.

" Having been put into its cage, the thermometer being placed at the diaphragm, in two hours afterwards was at 93°*."

In these experiments, the animals appear to have been roused partly by the state of the wound in the abdomen, but chiefly by the extreme cold. They can scarcely, however, be considered as experiments upon hybernation, however interesting they may be in reference to reviviscence from that state.

The fact of the fatal influence of excited respiration during the augmented irritability of hybernation, contrasted with the similar fatal effect of suspended respiration, during the diminished irritability of the state of activity, will illustrate many of the causes, kinds, and phenomena of death. Do not these resolve themselves, in fact, into irritability insufficiently or excessively excited?

* Animal Œconomy, pp. 111, 112.

Recapitulation.

The object of this chapter has been to treat of the singular phenomena of hybernation, and especially to point out the remarkable application of the Law stated in the last chapter, to the active and lethargic states of the hybernating animal.

1. The natural sleep of the hybernating animal differs greatly, yet only in degree, from the sleep of any other animal.

2. This sleep passes insensibly into the state of true hybernation, which is more profound, as the blood loses its arterial character; for

3. In hybernation, the respiration and the evolution of heat are nearly suspended.

4. The irritability is, at the same time, singularly augmented; and the animal bears proportionately the privation of air.

5. The nervous sensibility and the muscular motility are unimpaired.

6. There is the singular phenomenon of this unimpaired sensibility, and the capability of bearing the privation of air without pain; a fact which receives an interesting and perfect explanation from the additional fact of the augmented irritability or veno-contractility of the left side of the heart.

7. There is an important distinction between true hybernation and torpor from cold, not attended to by physiologists.

8. Severe cold, like all other causes of pain, rouses the hybernating animal from its lethargy; and, if continued, induces the state of torpor.

In conclusion, one of the most general effects of sleep is to impair the respiration, and, with that function, the evolution of animal temperature. The impaired state of the respiration induces a less arterial condition of the blood, which then becomes unfit for stimulating the heart; accumulation of the blood takes place in the pulmonary veins and left auricle; a sense of oppression is induced, and the animal is either roused to draw a deep sigh, or awakes altogether.

Such are the phenomena in animals in which the heart has not the faculty of taking on an augmented state of irritability, with this lessened degree of stimulus. But in those animals which do possess this faculty, a property which constitutes the power of hybernation, the heart continues the circulation of the blood, more slowly indeed, but not less perfectly, although its arterial character be diminished, and its stimulant property impaired. No repletion of the pulmonary veins and of the left auricle, no sense of oppression is induced, and the animal is not roused; the respiration continues low, the temperature falls, and the animal can bear, for a short period, the abstraction of atmospheric air.

All the phenomena of hybernation originate, then, in the susceptibility of augmented irritability. The

state of sleep, which may be viewed as the first stage of hybernation, induces an impaired degree of respiration. This would soon be attended with pain, if the irritability of the heart were not at the same time augmented, so as to carry on the circulation of a less arterial blood, and the animal would draw a deep sigh —would augment its respiration, or awake. Occasional sighs are, indeed, observed in the sleep of all animals, except the hybernating. In these, the circulation goes on uninterruptedly, with a diminished respiration, by the means of an augmented irritability. There is no stagnation of the blood at the heart; consequently, no uneasiness; and the animal becomes more and more lethargic, as the circulation of a venous blood is more complete. This lethargy is eventually interrupted by circumstances which break ordinary sleep, as external stimuli, or the calls of appetite.

Moderate cold disposes to sleep—to lethargy. But severer cold induces a different condition of the system—that of torpor. Sleep is the *medium* between such moderate cold and the phenomena of hybernation; torpor is the *immediate* effect of the severer degrees of cold.

This investigation naturally leads to that of the comparative conditions of the respiration and of the irritability in the pupa and perfect states of some species of the insect tribes. There is much reason to suppose that these states are respectively similar to those of lethargy and activity in the hybernating animal.

POSTSCRIPT.

It will now be observed that the remarks on sensibility in the hybernant state (p. 271) are erroneous. The excito-motor principle was not then discovered. The phenomena which depend on this principle were ascribed to sensibility. No fact could be adduced so full of interest, and so explanatory of the value of the recent discovery of that principle in its application to physiology. The acts of inspiration, &c. were not the result of sensation. They were *excited*, through the medium of the spinal nerves distributed to the cutaneous surface.

CHAPTER XXX.

ON THE INFLUENCE OF AIR, EXERCISE, BATHING, CLOTHING.

It will readily appear, from the principles detailed in the three foregoing chapters, what and how great must be the influence, on the animal system, of exercise.

Every step we take, every muscular act, augments the venous circulation, and, with it, and as an effect, the number of respirations. The actions of the heart and the movements of respiration become more frequent, maintaining still, when the limits of physiology are not exceeded, the same *relative* number or ratio. The blood itself is more oxygenated; the muscular system is less irritable; *life is less reptile;* every function, every secretion is augmented.

It is obvious that, whilst a just degree of exercise does good, *excessive exertion and fatigue* must be as injurious, inducing, through over-stimulus, a state of *fever*.

This fact should never be forgotten. Patients are injudicious from ignorance, and frequently pass from inertness to fatigue. Both extremes are injurious; inertness is accompanied by languor; exertion and

fatigue induce *fever;* and this fever may, or may not, subside with its cause; it often runs on for days, weeks, or even months, after its cause has been removed: hence, principally, the chief forms of acute and slow fevers, which are not specific, varied as they are by age, sex, frame, and constitution.

Exercise should therefore be 'citra fatigationem.' It should lead us to 'sniff the caller air.' The influence of the refreshing breeze on the face and general surface must not be forgotten. This influence is *felt;* but this is not all. Let us observe the effect of a current of air on the face in sickness, syncope, asthma, and we must estimate that influence very highly. Acting on the system of incident spinal nerves, it gives tone and strength to the whole nervous system. This influence is similar in kind to that of cold-sponging of the surface, and of the shower-bath. My readers will doubtless remember the air-bath of Franklin, and its genial effect in procuring for him a delicious supplement to his too short sleep.

The rules for *taking* air, exercise, rest; for bathing and clothing; for food; for soil and climate; still remain to be physiologically deduced and fully unfolded.

During sleep, the circulation and the number of respirations are diminished, whilst the excito-motor power and the irritability of the muscular fibre throughout the system become augmented. We rise with greater susceptibility to impressions, and to be exposed to

greater impressions,—prepared, in a word, to live a life of activity.

All this appears beautiful to me, and I think it cannot fail to strike my readers with interest. It is an illustration of the varied ratio between the dynamics and the stimuli in animal life, in the human subject, of the deepest interest.

The treatment of the general surface of the body is one of the most important elements of hygiène. In bathing, the skin should be stimulated, and the temperature should be carefully preserved. In general, a coarse towel should be *first* well used; *then* the sponge, with cold water, or cold salt and water, should be passed rapidly and energetically over the surface; and, *lastly*, the towel again,—the feet being rubbed until both they and the patient glow with warmth.

The shower-bath and sea-bathing should be preceded and followed by the same energetic rubbing. If the patient is feeble, or the atmosphere cold, it is better to proceed to undress as in sea-bathing, exposing the general surface freely, and using the sponge, instead of going into the water. If the strength be better, and the atmosphere warmer, one plunge or one good swim should be taken,—and no more. Free exposure of the surface; much rubbing with a coarse towel; are most beneficial and important: and the latter should, as I have said, precede the bathing, as well as follow it.

The patient should by no means be permitted to

lose his temperature. If, on returning from bathing, the face be pallid, the lips livid, and the patient be chill, much harm has been done, instead of good.

A short brisk walk *to* and *from* the bath, is, in this point of view, most important.

The clothing should be such as to preserve the temperature, without oppressing the patient on one hand, or exposing him too much to changes in the atmospheric temperature on the other. In our variable climate, flannel should always be worn next the skin; the upper clothing should vary with the external temperature, the direction of the wind, the degree of damp, &c. Too much clothing in warm weather, and too little in severe, are equally injurious.

A horse, previously languid and feeble, became lively and vigorous on being clipped. The impression of the cool atmosphere on the surface, as an excitor of the spinal system, and as a general stimulus, effected this remarkable change. In the stable, after work, the cold, wet hair is replaced by a warm and dry rug, with scarcely less advantage.

It is unfortunately the fashion with many ladies of the present time, equally ignorant of physiology and confident in their prejudices, to let their children be exposed with bare neck, arms, and legs, until the skin becomes mottled by a stagnant venous circulation. In such circumstances, tubercles, the seeds of so much malady, and the source of so many heart-pangs, are, I am persuaded, frequently developed: experiments

on rabbits prove this. So that this cold surface is equally the source of present misery to the little child, and of future sorrow, and it ought to be of self-reproach, to the parent. Of this treatment, scrofula and consumption, in their various forms, are the frequent result.

In children especially, the skin should be excited by rubbing, sponging, &c. and protected by a *just* and *general* clothing, light in summer, warm in winter, with flannel next the surface at all times.

But the mothers of our day too frequently sow the seeds of disease in vanity, to reap the fruit in sorrow. There may be circumstances of health and atmosphere in which exposure may be right enough; but these rarely coincide in infancy and in our climate, or last the whole day.

CHAPTER XXXI.

CASE OF PUERPERAL CONVULSION.

On the 11th of May, 1845, I witnessed a most dreadful case of puerperal convulsion, admirably, though I fear unsuccessfully, treated by Dr. Bossi, of Hâvre.

The eye-lids were wide open, the eyes distorted, the pupil excessively dilated; the tongue protruded, swollen, and deeply livid, and only prevented from being bitten by a cork steadily kept between the teeth; the saliva flowed abundantly. There was absolute insensibility.

This state of things was fearfully aggravated from time to time by general convulsion, distorting every feature still more than before, and contorting the limbs; the face becoming livid, and the tongue still more livid and tumid than before; the larynx being closed.

As the blood flowed, the countenance gradually lost its colour, the tongue its tumidity, and the pulse its power; whilst the paroxysms of convulsion became less frequent and severe, and the *convulsive* actions gradually passed into a state of *apoplexy:* the eye-lids closed, and the patient appeared as in sleep; the tongue was pushed by the nurse into the mouth,

within the teeth; and the teeth were kept partly closed by gentle pressure on the chin, by which means the patient was enabled also to swallow the saliva, which had previously, if not allowed to flow from the mouth, obstructed the respiration at the larynx.

Let the reader compare this slight detail with that of the experiment, pp. 64—65; and he will be struck with the precise similarity in the phenomena, and he will perceive the advantage of experimental physiology in its relation to clinical medicine.

After several hours, I saw the patient again. She had continued better for a time; but she had then relapsed into convulsions. No progress had been made in the labour. The os uteri remained unchanged.

There was every fear of a fatal issue, when I left Hâvre.

From the experiment formerly detailed, and from this case, it is evident that a certain degree of pressure on the brain induces mere apoplexy, whilst a higher degree of that pressure induces convulsions and spasmodic affection. Of how great importance is this remark in the diagnosis of cerebral disease!

It is evident that, in the case described, the first convulsion, and the relapse into convulsion, were owing to uterine irritation. It was, in fact, uterine or puerperal epilepsy. The convulsions induced the convulsive form of congestion, which was reduced by the blood-letting into the lower and comatose or apo-

plectic form of that condition of the brain: in the latter case, there is pressure on the substance of the brain; in the former, this pressure exists in a higher degree, so as to induce counter-pressure on the medulla oblongata. It was interesting to observe the wide, staring eye softly close, as in sleep.

These effects of pressure and of counter-pressure are general; and the experiment and the case which have been given, present a beautiful example of the fact, that experimental physiology and clinical medicine meet, and throw a mutual and instructive light on each other.

CHAPTER XXXII.

REMARKS UPON THE EFFECT OF MERCURY ON THE TEETH.

* * * * * * * * *

Dr. Hall observed, he should not have risen to address the Society*, had he not particularly wished to draw its attention to another view of the subject, and that a medical one. It had been erroneously supposed that the gangrena oris originated from the influence of mercury; and the character of the medical practitioner had been made the subject of attack, by the ignorant and malignant, as having induced the disease by the remedies he had employed for the previous ailment. Recently a case of this kind had occurred at Brentford. The verdict was that death was produced by a natural cause; but it was accompanied by an observation of the Coroner, that it remained doubtful whether the disease was not occasioned by mercury. A similar case occurred shortly afterwards, in an alley not very remote from Dr. Hall's residence; and a similar uproar was raised, and a similar charge made against the medical practitioner; and, but for his (Dr. Hall's) evidence, a verdict of no

* Extracted from the Report of a discussion at the Royal Medical and Chirurgical Society.

pleasant kind might, and probably would, have been brought in.

It should be universally known that the gangrena oris is induced by causes similar to those which induce gangrene elsewhere; as in the pudenda of infants: that it is not the effect of mercury; that it is not *like* an effect of mercury; for whilst this is *diffused* over the mouth, the gangrena oris is in its origin *circumscribed*. The odour had been erroneously described, by the author of the first paper, as resembling the odour observed in ptyalism from mercury. This is not correct; the odour is that of gangrene, or of putrefaction, and very different from that observed in salivation.

Before he sat down, he would take the liberty of adding a remark on another occurrence, in regard to which medical character was equally liable to suffer injuriously and unjustly by the remarks of persons of a vindictive and malignant disposition.

If mercury were ever given, if ptyalism were ever induced, every decay of the teeth was referred, by these hasty and prejudiced judges, to this effect of this invaluable remedy.

Now it is well known that disorder of the general health is the frequent, the constant cause of decay of the teeth; but it is not known that mercury induces such decay. Mercury loosens the teeth; but it does not induce the circumscribed gangrene or decay of the teeth generally observed in, and induced by, disorder

of the general health in female youth. The teeth, when lost as an effect of the mercury, fall out entire. This view is important; for the prejudices of the ignorant may at once deprive us of an important remedy; or, if we have had the boldness to employ it, it may deprive us very wrongfully of character.

Dr. Johnson quite agreed with Dr. Hall in his last remark. Mercury saved more teeth than it destroyed. He himself had been salivated eight or nine times, and had still every tooth he had when twenty. He had seen mercury given extensively, both in this country and in India, and had never seen it induce decay of the teeth, so apt to be ascribed to it. Dentists were too fond of attributing decay of the teeth to mercury.

CHAPTER XXXIII.

ON THE FATAL ACCIDENT TO THE AMERICAN DIVER.

To the Editor of the Lancet.

SIR;—The circumstances which accompanied the sad fate of this unfortunate man are not without their interest.

Let me first adduce the principal evidence given on the inquest. Samuel Rutherford, police constable No. 7 F, deposed as follows:—About half past two on the afternoon of Monday, I was passing down the Strand, when I saw a large number of persons going towards Waterloo-bridge. After waiting there a few minutes, I saw the deceased Scott come on to the bridge, with the rope I now produce tied across his shoulders in the form of braces. (The rope was here produced, and appeared to be about the third of an inch thick.) He stood on the bridge for about a minute, when he ascended a scaffold erected over the second arch, consisting of five poles, two upright and three crossways. It was the second arch from the Somerset-house side.

On ascending the scaffold, he went from one side of the poles to the other, for the purpose of trying if they were safe, and shook them. He then ascended

the left-hand pole; at which time he had the handkerchief I now produce on his head. There were several thousand persons present, on and near the bridge, at the time. On ascending the left-hand pole, he tied the handkerchief round it, and formed a sort of flag; he then came down on to the cross pole, and shook his head at the ice and water below, and appeared to smile; he had no ladder, but climbed from one pole to the other. I should say the height of the top cross-poles was about twenty feet from the bridge. He then tied the rope round one of the cross-poles, and made a noose, not a slip-noose, and tied it to the upper cross-pole. The poles appeared to be placed in such a manner as to allow him to put his feet on one pole to prevent him slipping. He then took hold of the rope in his right hand, and jumped, as if he was going into the water; but, by the main strength of his arm, he threw himself back on to the middle pole again; he then opened the noose of the rope, and put his hands across the top pole, raised himself to the level of the pole, and placed his feet in the noose, and hung with his head downwards. After hanging in that way about half a minute, he pulled himself up again to the top pole, and unloosed the noose; he then again took the rope from the pole, and made a sliding noose which would slip, and placed it round his neck; he then took hold of the top of the rope with his hand, and, having released his feet from the second pole, let himself gently down to the

extremity of the rope. The knot of the rope was placed on the right-hand side of the deceased's head, and, to let himself down, he put his hands above his head, until he became suspended; he then appeared to me to be showing the public the symptoms and convulsions of a hanging man; he merely shrugged his shoulders, but did not put his hands up. After hanging between five and six minutes, some of the mob standing by said the man was dead. Several persons attempted to get up; but they were laughed at.

Inspector Musgrove, who was on the spot, insisted upon having deceased taken down; and persons said, "Oh, he has hung before longer than this." The Inspector, however, insisted; and, upon his doing so, 39 F and other persons rushed up to the scaffold. A ladder was procured from the toll-house, and, in about a minute after, he was got down. When he was got down, his tongue was just protruding through his teeth; and when I took the noose off, it went back. His eyes were nearly open, and his face was very black: the cord was quite tight round his neck, and I had great difficulty to unloose it."

No doubt the usual plan adopted by poor Scott was to suspend himself in a noose, the principal pressure of which was applied to the nape of the neck, extending to its sides without compressing the jugulars or the trachea; the circulation within the brain, and the respiration, would therefore not be arrested.

But, on the day of the fatal accident, the noose doubtless slipped, and the course of the jugulars and trachea was interrupted.

The circumstance which is interesting to the physiologist, and (may I not say?) to the philanthropist, is, that the moment the cord was tightened, the moment the jugulars (how well were these vessels named!) were compressed, apoplexy took place, with total loss of consciousness! Not the slightest attempt was made by the unfortunate man to recover his hold of the cord to save himself! Other facts have led to the same conclusions. On one occasion, a youth, aged eighteen, impressed with the idea of the sufferings to be endured on the occasion of an approaching execution, arranged a cord so that he could press the anterior part of the neck upon it with the weight of the body. His object was, no doubt, to ascertain the kind and degree of suffering so induced; but he lost all sensation at that very moment, and was found in that position—dead.

I once saw a dog strangled by means of a cord, tied with extreme tightness round the neck. I expected to witness great struggles: there were none. There was not a movement until after some seconds, when convulsive efforts took place. A snake, suspended by the neck, ceases to move that instant.

Now, if the deduction which I have drawn from these facts be just, may we not hope that the poor culprit suffers not an instant after suspension?

But might we not also avert the sufferings of that part of the brute creation which is slaughtered for our food and sustenance, and thus spare them the pang of the knife, and the pain of dying? Let sensibility be first induced, by a tightened cord, applied so as to compress the jugular and other veins of the neck, and then let the large vessels be divided as at present.

CHAPTER XXXIV.

NOTE ON THE RESPIRATION OF BIRDS.

In the new edition of M. Flourens' admirable work, an account is given of an experiment, in which, the cerebrum and cerebellum being removed, and the pneumogastrics divided, in a pigeon, the respiration still continued.

Now it is well known that the respiration in birds, as in insects, is *diffused*. It is ascertained that the different segments of the insect possesses distinct nerves and nervous centres (analogues of the medulla oblongata) for respiration. This is not the case with birds; but,

1. If the air cells throughout the body be, like those of the lungs, supplied with nerves;

2. If these nerves be derived from the spinal nerves, like other nerves of the general frame; and,

3. If these spinal nerves possess the *excitor* property of the spinal nerves in other animals;

If these things be, then the result of the experiment is precisely what the theory of the reflex nature of the respiratory acts would have led us to anticipate.

When, in the mammalia (especially the young), the cerebrum and cerebellum are removed, the respi-

ration continues as a purely reflex action, excited principally through the pneumogastric nerves; when these are divided in addition, a few and rare acts of respiration occur, from the influence of the trifacial and spinal nerves. In birds, these spinal nerves are as really excitors of respiration as the pneumogastric itself; they are excitors of the normal respiration; under their sole influence, respiration may continue for hours.

A series of experiments illustrative of the relative value of each of these parts of the nervous system, would be highly valuable. There is no reason, from any facts which we yet possess, to think that the medulla oblongata is the *primum* mobile of respiration. As the *secundum* mobile, the key-stone of the reflex arcs, its office is most clearly established.

CHAPTER XXXV.

EXTRACT FROM A NOTE TO DR. ROBERT LEE.

"In that tissue of nerves which you have unravelled, you have, as you say, the *ganglionic* system of the *impregnated* uterus, expanded for its newly imposed office of nutrition of that augmented organ and its contents. But you have something else: you have the *spinal* excito-motor system of the *parturient* uterus; you have an *analogue* of the *pneumogastric*—for what this is to the pharynx, œsophagus, cardia, stomach, gall-duct, &c. that tissue of nerves is to the uterus, the Fallopian tubes, the vagina, &c.

"I may add, that your discovery of the augmented nervous system in the uterus, in its impregnated condition, is probably only *one* fact of *many*, constituting a general Law. What is the condition of the nerves of the *mamma*, enlarging and equally taking on its new function with the uterus?

"Investigate the subject broadly and fully. You will remember my former proposition to expose this system of uterine nerves by means of the gastric juice, or other chemical reagent."

CHAPTER XXXVI.

THE PLAN OF OBSERVATION OF DISEASES OF THE NERVOUS SYSTEM*.

I HAVE been much struck by an observation of Sir J. F. Herschel, which, however different the occasion on which it was made, is not less applicable to the subject which I wish once more to bring before this Society: "The recent investigations" "will not only throw theoretical light on this very obscure subject†," "but (what is at present quite as much wanted) arouse the attention of observers, and at the same time give it a right direction, by pointing out *what ought to be observed*, without which all observation is but lost labour‡."

If we wish to pursue the subject of *Clinical* observation in general, we have fortunately a *perfect* model, and example, in the writings of M. Louis.

But the object of the present Memoir is more restricted. My design is to point out "what ought to be observed" in a particular Class of diseases, viz.

* Being a *fourth* Memoir, read before the Royal Medico-Chirurgical Society.

† Of the tides. ‡ Treatise on Astronomy; p. 338, note.

those of the Nervous System; and especially to point out some new objects of inquiry in regard to them.

In my three former Memoirs I have treated—

1. *Of the Condition of the Muscular Irritability in Paralytic Limbs;*

2. *Of the Morbid Reflex and Retrograde Actions of the Spinal Marrow; and*

3. *Of the Distinct Influence of Volition, of Emotion, and of the Vis Nervosa, in Diseases of the Nervous System.*

I now proceed to lay before the Society the *Plan of Observation* to be adopted in their *further* investigation.

Sufficient has now been done to shew that we must, in all such investigations, view the nervous system as subdivided, not into the cerebro-spinal and the ganglionic, but into the cerebral, the true-spinal, and the ganglionic; and that, in considering each disease of the nervous system, we must trace its influence distinctly in these three sub-divisions of that system; or, to state this view more emphatically, we must enquire—

1. *What are the distinct diseases of the cerebral, of the true-spinal, and of the ganglionic subdivisions of the nervous system?*

2. *What is the influence of disease of one of these systems on the other two respectively?*

3. *In what order is that influence manifested?*

Besides these important questions, there are several others not less momentous. They are these:

1. *What are the effects of Irritation and of Counter-irritation, of Pressure and of Counter-pressure, in diseases within the cranium or the spinal canal?*

2. *What is the special anatomy of the* base *of the encephalon, and its relation to cerebral diseases?*

3. *Why, with* similar *symptoms, have we* dissimilar *morbid appearances within the cranium; and vice versâ?*

4. *What are the diseases of the nervous system in which we find, generally speaking,* no *morbid appearances on a post-mortem examination?*

That these questions are of deep practical interest will soon become very apparent; and it is especially as an aid to the *Diagnosis* of the seat and progress of diseases of the nervous system that these views are most important. I shall proceed to treat of these subjects briefly, as in my former Memoirs.

I. *What are the distinct diseases of the Cerebral, the True-spinal, and the Ganglionic systems; their mutual influence, and the order in which they are manifested?*

If disease be limited to the cerebrum, its influence is limited to the cerebral functions. If from the cerebrum it extends its influence to the true spinal marrow, the functions of this latter are involved, and spinal symptoms are added to the cerebral; or with

the cerebral the spinal functions are impaired. This latter condition may frequently be detected by using the reflex function as a *test;* and in this manner the views of this function, which have recently been laid before the profession and before this Society, come to have their practical application. They afford, indeed, a new source of Diagnosis of the nature, seat, and extent of disease of the nervous system; and, consequently, of their Prognosis.

If disease be limited in its effects to the true spinal marrow, the symptoms are exclusively spinal, sometimes in excess, sometimes in a defective form. If the cerebral system become also involved, cerebral symptoms are superadded to the spinal.

Similar remarks may doubtless be made in regard to the ganglionic system, viewed in its connections and relations with the cerebral and spinal.

There are no diseases so distinctly limited to a system as hemiplegia and tetanus, in their simplest forms. Hemiplegia frequently dissects the nervous system, as it were, and severs the cerebral from all the other functions. The voluntary movements of the side may be absolutely annihilated, the true spinal and ganglionic functions being unaffected. I have examined such cases with a peculiar interest: the cerebral system has been distinctly affected, whilst the true spinal has been as distinctly spared. It is almost needless to state that the reverse of this event occurs in tetanus. In this formidable disease, the

true spinal system is affected, the cerebral being, very long at least, uninvolved.

These views I shall illustrate, as before, by briefly adducing cases in point. I may here observe, that we have only to read the admirable volumes of M. Lallemand, of M. Andral, of Dr. Abercrombie, &c. &c. to be convinced that these distinctions have *not* been hitherto made, and that a fresh series of cases, in which they should be accurately marked, is wanting to this department of medical science. Let any one now mark, first the simplicity, and then the complexity of the symptoms of a case of hydrocephalus, or of apoplexy, and he will observe how the cerebral, the true spinal, and the ganglionic systems are successively involved in the disease, and how the symptoms, carefully noted, denote the progress of these terrible affections. Let epilepsy or tetanus be subjected to our observation, and we shall remark, that from the true spinal system, the first seat of the disease, the other subdivisions of the nervous system become implicated.

I now proceed to notice some of the diseases of the nervous system individually, in this point of view; the first of these is hemiplegia.

I. *Hemiplegia.*

In cases of hemiplegia, the *danger* is precisely in proportion as spinal symptoms are superadded to those of the cerebral system. If the respiration be

stertorous, if the deglutition be difficult, if the functions of the bladder, rectum, and sphincters be impaired, there is great danger; if these events *continue* for a considerable time, the event is always fatal.

Case 1.—A short time ago, I visited a patient with Mr. Doubleday, of Blackfriars' Road: there was anasarca, and the urine was coagulable: Dr. Bright was consulted: suddenly an attack of the most complete hemiplegia supervened: the patient was conscious; the respiration and deglutition, and the power of the rectum, the bladder, and their sphincters, were unimpaired. The disease was *limited* to the cerebral function of voluntary motion in the arm and leg; but this was *entirely* destroyed. The foot was moved, however, on touching the sole of the foot! The patient survived the immediate attack, and was removed into the country.

Case 2.—I visited a patient with Mr. Beane, of Peckham. He had been attacked with hemiplegia of the right side of the face, arm, and leg; there was slight stertor, and slight dysphagia, with choking. The two spinal symptoms ceased on taking blood copiously. But the hemiplegia continued: when the upper and lower extremities were still motionless from any effort of volition, movements were induced by tickling, plucking a hair, or applying a spoon, just taken out of hot and cold water, alternately. The hemiplegia was complete, but the spinal functions were

in full force. The patient gradually but imperfectly recovered.

Case 3.—I visited another case with Mr. Beane, in which the symptoms were the same, but more violent: there was some degree of coma; the respiration was stertorous, the deglutition difficult, and the functions of the rectum and bladder impaired. These symptoms *continued*, in spite of active and appropriate treatment, and the patient died. This beautiful drawing shews the condition of the cerebrum; a large coagulum existed in the right hemisphere, not, however, extending to the ventricles.

Case 4.—I visited the late member for Carlow with Mr. Dodd, of Portman Street. The patient was perfectly hemiplegic, but perfectly conscious: the speech was inarticulate, the tongue put out towards the right (the paralytic) side, the right arm and leg were absolutely motionless; the patient expressed by signs that he was powerless on the right side of the mesial plane; the respiration was not yet stertorous, but the deglutition was imperfect and attended with choking; stupor and stertor gradually came on, the the deglutition became more and more imperfect, the bladder and rectum and the sphincters lost their powers. The respiration became attended with mucous rattle, irregular, and less frequent; and the pulse, from being slow, became accelerated: affections of the ganglionic system. The powers of life gradually sank. No post-mortem examination could be obtained.

These cases are sufficient to illustrate my proposition—that when, in hemiplegia, spinal symptoms exist, and do not very speedily yield to active remedies, the event is inevitably fatal.

The spinal symptoms which exist at first, and gradually yield, probably depend on *counter-pressure* from congestion; this counter-pressure is relieved by blood-letting, &c. and its effects cease. When, on the contrary, the spinal symptoms continue, in spite of the remedies, they probably depend on the extent of the effusion (as in *Case* 3, and probably in *Case* 4); and this cannot be remedied.

These views are confirmed by contrasting the cases of hemiplegia, almost invariably the effect of effusion of blood, with those of simple apoplexy.

II. *Of Apoplexy.*

The purest, the simplest form of congestive apoplexy is that which follows a violent fit of epilepsy. I was summoned to such a case in Pimlico, a short time ago, and will briefly detail its principal features.

Case 5.—There were perfect stupor and stertor: I passed my finger over the eye-lashes and the conjunctiva, and the eye-lids were motionless; I dashed cold water on the face, and the respiration was unaffected by it. We took a large quantity, I think thirty or forty ounces, of blood from the arm: there was no change in the stupor, in the countenance, or in the pulse; but now the eye-lids closed on touching

the eye-lashes, and the patient sobbed deeply on dashing cold water on the face; afterwards, too, he became gradually more and more conscious.

In this case, the state of congestion—and it was pure congestion—with its counter-pressure on the medulla oblongata, was relieved by the free detraction of blood, and the impressibility of the true spinal system, through the medium of its incident nerves, was restored.

I need scarcely remark, that in congestion of the cerebrum, in apoplexy, as well as in hemiplegia, if the symptoms of affection of the true spinal system *continue*, the issue is fatal. In such cases, the patient dies of asphyxia; and I cannot but think that tracheotomy might sometimes allow time for the operation of remedies or of Nature's resources, and prevent a fatal result. It is well known to the members of this Society*, that this operation, performed by Mr. Sampson, of Salisbury, saved the life of a poor patient, dying from the apoplexy of deep intoxication.

I may here observe, that if the stupor and if the stertor continue, the next series of phenomena are those observed to result from defect of the function of the ganglionic system. The bronchia become clogged with mucus, and the intestines distended and tympanitic from flatus. M. Andral observes—" Le stertor de la respiration est en général un signe d'un très fâcheux augure, et il est rare que les individus qui le

* See its Transactions, vol. xx, p. 45.

présentent d'une manière prononcée échappent à une mort prochaine. Pour l'expliquer, on trouve sur le cadavre un engouement considérable du poumon, et beaucoup de mucosités spumeuses dans les bronches. C'est véritablement par la gêne de la respiration que succombent les sujets frappés d'hémorrhagie cérébrale, dans le cas où l'attaque est forte, et où ils meurent promptement*." It is obvious that the stertor is not explained in this manner; but that the bronchial and tracheal rattles which occur under these circumstances are so explained. They constitute, in effect, two orders of phenomena. The stertor depends on affection of the medulla oblongata; the crepitus or rattle on that of the ganglionic system. The latter is precisely the effect observed by Sir Benjamin Brodie, Sir Astley Cooper, and other physiologists, in animals in which the pneumogastric nerves had been divided. But the stertor depends upon the affection of the true spinal system.

Not to detain the Society too long, I will here briefly advert to the interesting case of the hydrocephaloid disease of children. I need scarcely state that similar phenomena are observed in hydrocephalus, and in the case of sinking from excessive loss of blood; I have also noticed them in extreme chlorosis in adults.

* Clinique Médicale, tome v, p. 384; ed. 1833.

III. *Hydrocephaloid Disease.*

Case 6.—I attended the son of Mr. Howlett, in Thayer Street, in consultation with Mr. Grant. The little patient was four years old, and laboured under symptoms which seemed to denote the existence of hydrocephalus: there was a state of stupor; the eye-lids were only partially closed, and they were immoveable on the approach, and actual contact, of the finger; the respiration was irregular, and the pulse frequent. I observed that the phenomena presented by the eye-lids would afford a criterion, which would suggest both the diagnosis and prognosis. The history, and the cool and pale condition of the cheeks, suggested the hope that the symptoms depended more upon exhaustion than actual disease within the head. I ventured to give sal volatile, brandy, and nourishment. We had, in a short time, the pleasure of observing the eye-lids become impressible to the stimulus of the finger, the respiration to become regular, and the gradual recovery of the little patient was no longer doubtful.

IV. *Of Mania, with and without Paralysis.*

M. Leuret has specially drawn the attention of physicians to the distinction between mania with and without paralysis. The latter is, according to this estimable and intelligent writer, unattended by ap-

preciable organic lesion; the former is the effect of disorganization of the brain.

Paralysis is, indubitably, the most characteristic sign of lesion of the cerebrum; and that, generally, in the form of a solution of continuity of the hemisphere opposite to the side affected. But I cannot agree with M. Leuret, that mania, unattended with paralysis, is unattended with organic lesion altogether. Only it is attended by a lesion of a different kind. As the former is generally one of interrupted continuity, this is generally one of an *intra*-vascular kind: thus coma and delirium are alike effects of deranged conditions of the cerebral circulation; both occur from excitement, and in a state of exhaustion; and I have seen one form of mania cured in the most distinct manner by mercury, and another by steel.

This is a new and most important subject for inquiry. Puerperal mania; mania from exhaustion and anemia in general; mania from mental shock and harass; all arise from a morbid intra-vascular condition.

As disease, strictly limited to the cerebral system, is attended by cerebral symptoms only, so disease limited to the true spinal system is marked by affection of the spinal functions only. In no case is this seen so distinctly as in *tetanus*.

V. *Of Tetanus.*

This disease is, in every respect, the most unequivocal example of an affection of the true spinal marrow, through an incident and the motor nerves. All the functions of this subdivision of the nervous system are affected in the most violent form, whilst the cerebral functions are unaffected: the dyspnœa, the dysphagia, the constipation, the trismus, the emprosthotonos, the opisthotonos, the extreme susceptibility to causes of physical impression and agitation and of mental emotion, all mark an affection of the true spinal system; whilst the freedom from all affections of the senses and of the intellect, the absence at once of delirium and of coma, denote the normal condition of the serebral system.

Baron Larrey observes—" Les fonctions du cerveau restent toujours intactes jusqu'au dernier moment de la vie, en sorte que l'infortuné atteint de cette maladie se voit mourir. Je n'oserai hasarder aucune explication sur le défaut de communication au cerveau du principe morbide des nerfs affectés."

" Le malade ne peut plus avaler, ou n'avale qu'avec la plus grande peine. La poitrine est rétrécie, les contractions du diaphragme sont bornées; la respiration est courte et laborieuse. Les excrétions diminuent et se suppriment, surtout les selles."

M. Larrey adds—" Le malade tombe dans un état d'imsomnie; lorsqu'il s'assoupit, il fait des rêves sinis-

tres; il s'agite, il s'inquiète, se tourmente, et cherche à sortis de l'état de gêne où le tiennent la rigidité de ses membres et le défaut de jeu des organes*."

Dupuytren states—"A mesure que la maladie marche, on la voit s'accroître de plus en plus, et se montrer à tel point que le moindre bruit, la moindre secousse, les plus faibles émotions suffisent pour la mettre en jeu et faire entrer le système nerveux, et le système musculaire qui est sous sa dépendance dans un état de convulsion."

This is the very picture of an excited condition of the true spinal system; the cerebral system is, notwithstanding, long spaced, and it is only at a comparatively late period of the disease that delirium or stupor supervenes.

Similar remarks apply to the terrific case of hydrophobia.

VI. *Of Epilepsy.*

Epilepsy seems to occupy a place on the limits of the cerebral and true spinal systems: the first symptoms are sometimes apparently cerebral; I am of opinion, however, that this appearance is frequently deceitful, and that the very first symptom is generally, if not always, one of the true spinal kind. This first symptom is constriction about the throat, and closure of the larynx, more or less complete; then follow violent expiratory efforts and convulsive movements

* Mémoires de Chirurgie Militaire, tome i, pp. 238, 239.

of the trunk and limbs. Intermediately, and even without the convulsive movements, the cerebrum is affected with congestion, and a multitude of cerebral symptoms occur: flashes of light, tinnitus aurium, the aura epileptica; a momentary oblivion; a state of terror, of delirium, or of unconsciousness, &c.; as *parts* of the general convulsion, the tongue is protruded and bitten, the fæces, the urine, or the semen expelled; as *consequences* of that convulsion, the cerebrum is congested, and there is coma. If this state continues, another order of symptoms takes place: the respiration becomes stertorous, and, at length, affected with mucous rattle, the true spinal and ganglionic systems becoming fatally involved in the disease.

It is the constriction about the throat which assimilates epilepsy to the state of things which exists in *strangulation*, and which distinguishes it from *hysteria*. It is this circumstance which associates epilepsy with the crowing inspiration and the convulsions of children: all are *laryngismal*. In epilepsy there is sometimes a crowing inspiration; the crowing inspiration and convulsion of infants are sometimes followed by epilepsy in subsequent years.

VII. *Of Sinking.*

It is doubtful whether any set of *diseases* originates in the ganglionic system. This system, however, is frequently involved in other diseases, in a characteris-

tic manner and degree; and the balance of nutrition and of absorption, and the condition of the secretions, with the actions of the heart, stomach, and intestines, become morbidly affected.

The gradual sinking from loss of blood, especially, seems to involve every part of the nervous system. There is mild delirium or stupor from affection of the cerebral system; there is a peculiar catching motion of the larynx and other organs of respiration, from affection of the true spinal system, instead of the *equable* rhythmic movements observed in health; there is an extreme frequency of the pulse; and there is a peculiar crepitant rattle, at first in the small, and eventually in the larger, bronchia, and an equally peculiar tympanitic distension of the intestines, from affection of the ganglonic system,—*all* of fatal import; at least, I have never known any one of these symptoms to supervene (uninduced by disease of the organ) without its leading to a fatal termination. The functions of the cerebrum, of the true spinal system, and of the ganglionic system, seem to fail together.

VIII. *Of Shock.*

But if there be no *diseases* originating in the ganglionic system, there is a series of *accidents* which have their *chief* seat in this system. It is those which are caused by *shock.*

Shock may be mental or physical.

When a patient submits to an "operation de com-

plaisance," the mental effort, the anxiety, the suffering, frequently lead to a state of dangerous and even of fatal *excitement*. The crush of a limb frequently induces such *depression*, that the patient sinks without any apparent effort made to rally. In both these cases the effort produced is much displayed in the ganglionic system. The circulation, the secretions, are greatly affected.

I will merely adduce one experiment on this subject, for fear of being too prolix.

In the presence of a young Parisian student, I divided the spinal marrow in a frog. I pinched the toes, but there was no movement, no reflex action. My companion observed—"Ah, c'est fini;" I replied, "Non, ce n'est pas commencé." In a few minutes, the reflex actions became obvious, and in a few minutes more most energetic. We had examined the circulation previous to the division of the spinal marrow. It was most active. But immediately after that division, scarcely a movement was to be seen. Like the reflex actions, however, the vigour of the circulation was gradually restored.

In one frog, after the return of the circulation, I crushed the leg and thigh with a hammer. There was no sensation of course, the influence of the cerebrum having been removed. The circulation again immediately ceased. It again returned after a time.

These examples will be sufficient to illustrate the fact, that, in order to investigate the diseases of the

nervous system with advantage, we must henceforth constantly enquire whether, and in what order, each of the subdivisions of this system is affected. We must advert to the cerebral, the true spinal, and the ganglionic functions, and trace the morbid influence upon each and all of them; we must enquire into the condition of the muscular irritability, the reflex and retrograde actions of the true spinal marrow, and to the distinct actions and affections of volition, of emotion, and of the *vis nervosa*.

The cerebral, true spinal, and ganglionic subdivisions of the Nervous System, are, notwithstanding our artificial attempts to separate them, *one* in nature, and influence each other mutually. *Sensation* and *volition* combine to complicate and modify the functions of the true spinal system; *emotion* modifies the functions both of the true spinal and ganglionic systems. Respiration is made rhythmic by the influence of volition; it becomes catching and irregular when this influence is withdrawn. Certain secretions become augmented under the influence of appetite, passion, emotion; and are comparatively scanty when these are dormant and unexcited.

The purest case of successive affection of the cerebral, true spinal, and ganglionic systems, in disease, is, I think, afforded by the case of fatal sinking in exhaustion from loss of blood.

The *cerebral* system is first affected, and the previous symptoms of reaction give way to impaired

vision and hearing, dozing or slight coma, and slight delirium when roused;—then the *true spinal system* suffers, and the respiration loses its regular, even, and rhythmic character, and becomes slightly audible or stertorous, and each inspiration becomes accompanied by a sudden descent of the larynx—a symptom from which I have never known a patient recover! deglutition is slightly impaired, and the larynx is irritated to choking and violent coughing by the admission of fluids, whilst the sphincters of the bladder and rectum fail;—lastly, the power of the *ganglionic* system fails too, and the respiration becomes marked by a slight *crepitous rattle*—like the catching of the larynx, a fatal symptom—and the intestines become *tympanitic.*

I have seen precisely the same order of symptoms—the same order of affections—first of the cerebral, then of the true spinal, and lastly of the ganglionic functions, from shock to the nervous system. A sensitive person lost a favorite brother, suddenly: he fell into fever, with no definite symptoms; he at length became slightly delirious, then slightly comatose; then melæna and then tympanitis manifested themselves; then the crepitous rattle in the respiration; and then followed all the phenomena of irregular respiration and failure of the sphincters, which I have just described. A similar fatal series of symptoms was excited in a pale and chlorotic patient by a similar mental affection. This is an interesting subject,

not, I think, understood, and therefore requiring careful investigation.

The symptoms in fatal cases of coma from apoplexy or epilepsy occur in the same order: first, the respiration becomes affected; no effect is induced by dashing cold water on the face; the regular rhythmic movements of the respiration give place to audible, irregular, or catching inspirations:—then bronchial, and lastly tracheal, rattles occur, with tympanitic distension of the intestines, and a similar state of the bladder. In a word, the cerebral, the true spinal, and the ganglionic systems are affected in succession.

It would be interesting to examine the *secretions* in all these cases systematically. This, with so many others, presents promising subjects of future inquiry.

II. *The influence of Irritation, of Pressure, of Counter-irritation, of Counter-pressure, and of Irritation of the Meninges, in disease within the Cranium and Spinal Canal.*

I. *Of Irritation and of Pressure.*

Important principles in the investigation of the diseases of the nervous system are irritation and pressure. Inflammation of the arachnoid of the cerebrum and of the spinal marrow, presents us with an example of the former, and we have delirium in one case, and spasmodic action in the other; of the latter, the effusion of blood or serum affords us an example, and,

according as this takes place in the encephalon or in the theca vertebralis, we have coma or paralysis.

Not less important, and hitherto overlooked or neglected, are *counter*-irritation and *counter*-pressure, of which I shall therefore proceed to treat more particularly. The former is induced by slighter causes, as slight effusion into the ventricles; the latter, by the same causes carried to a greater degree.

II. *Counter-irritation.*

There is one idea prevailing throughout M. Andral's admirable volume: it is that the functional and organic lesions do not constantly accompany each other;—that, therefore, the diagnosis must be obscure. M. Andral observes*—"Toujours la même question réprésente: pourquoi cette diversité de symptômes avec des lésions en apparence identiques?" And, in speaking of a case of hæmorrhagy between the arachnoid and dura mater, he observes—"Ne sont-ce pas là tous les signes du ramollissement du cerveau†?" But M. Andral's sphere of investigation has been too limited: he has not borne in mind the distinction of the different subdivisions of the nervous system, with the distinct and significant symptoms attached to each of them. The subject of *counter-irritation*, and that of *counter-pressure*, in diseases of the encephalon, have been overlooked—topics to which I now beg to call

* Clinique Médicale, edit. 2, tome v, p. 58.

† Op. cit. p. 16. Compare also page 4.

the attention of this Society: we have only to revolve in our minds the complex anatomy of the *base* of the encephalon and of the cranium, to be noticed more particularly immediately, of the spinal canal and of its contents, to see the importance of these two subjects. To these must be added the topics discussed in my three former Memoirs, and it will then be confessed that a new and unexplored field of observation is opened to us, and that new and positive means of Diagnosis are in our hands.

There is another circumstance of great importance. M. Andral speaks of *irritation* of the *cerebrum* as the cause of abnormal muscular contractions. Now, in our investigations into the nature of cerebral diseases, we must remember one circumstance: it is impossible to induce muscular action by any irritation of the substance of the cerebrum itself. Whenever, therefore, there are spasmodic affections, in diseases of the nervous system, we *must* conclude that the *spinal* system is involved, either primarily or secondarily, in the disease. Irritation of the cerebrum may induce delirium and other disorders of the cerebral functions; congestion of the cerebrum may induce coma, paralysis, &c. But if these morbid conditions of the brain be attended by spasmodic or other deranged actions, it is because the true spinal system is involved in the disease, or affected by it in the way of irritation, counter-irritation, or of pressure or counter-pressure. Hence we observe the symptoms of spasm

in various diseases of the encephalon, the condition being, not the nature of the disease, but that they produce these intermediate effects.

Time, as is well known, is a very important element in this problem; and why is it so? The fact is to be explained on the same principles: the very same lesion occurring quickly will produce effects which will be totally absent if it creep on slowly. In the former case, we have the effects of irritation and pressure; or of counter-irritation and counter-pressure: in the latter, the cerebrum has so accommodated itself to the new state of things, probably by the altered condition of its vessels, as to avoid these effects, except towards the close of the disease.

We need not, therefore, now view with surprise the fact that the same lesion, as found post mortem, had been attended by a totally different series of symptoms during life, any more than the other fact, that, in the different *periods* of that lesion, the symptoms have been different.

The symptoms frequently subside too, and reappear. If the disease be not regularly progressive, the encephalon accommodates itself, as I have stated, and the symptoms disappear: if now the disease proceeds, the symptoms also return. At least, all this *may be*.

A rapid effusion of serum may resemble hæmorrhage or ramollissement in its effects; a slow effusion may merely obscure the intellectual faculties.

One of the earliest symptoms of hydrocephalus is vomiting. Is this the effect of counter-irritation? Afterwards this symptom ceases, and there is torpor of the digestive tube. Is this the effect of counter-pressure? In the absence of positive proof, I present this as a probable conjecture, and as a subject for subsequent inquiry. In a case of tubercle, seated in the median lobe of the cerebellum, observed by Dr. P. Hennis Green, the same symptom of vomiting, arising probably from irritation of the medulla oblongata, was observed. Similar remarks apply to the state of the *pupil*.

It is not, therefore, the *disease*, but its *effects* upon the brain and spinal marrow, which is the source of the symptoms. If ramollissement, effusion, a tumor, &c. produce similar effects on these textures, the same affection of the functions, the same symptoms will be observed.

III. *Of Counter-pressure.*

Having pointed out the distinct affection of a cerebral function in pure hemiplegia, and the implication of the true spinal functions when, with or without hemiplegia, there is congestion of the cerebrum, and consequent counter-pressure on the medulla oblongata, I must here briefly notice the effect, 1, of undue, and 2, of defective, counter-pressure a little more particularly. (See Chapter XI.)

It is well known, from the experiments of M. Flourens especially, that irritation of the cerebrum

has no influence in inducing spasmodic action. Whenever, therefore, spasmodic symptoms occur in diseases of the cerebrum, it must, as I have already stated, be on a principle different from that of irritation of the substance of the cerebrum itself; it must be from an impression made upon parts of the nervous system, in which the property of exciting spasmodic action on being subjected to irritation resides; these parts are the tubercula quadrigemina, the medulla oblongata, the intracranial, &c.

That *undue* counter-pressure on the medulla oblongata may and actually does excite convulsion, is proved by the following facts: In the interesting case, most anxiously watched and accurately detailed to me by my friend Mr. Toogood, of Bridgewater, of his own little girl, aged thirteen months, the croup-like convulsion occurred repeatedly, until one day, when the bones of the cranium separated, and the convulsion ceased. In a case of spina-bifida, related to me by Mr. Herbert Evans, of Hampstead, there was a croup-like convulsion, whenever the little patient turned so as to press upon the tumor. In the case of anencephalous fœtus described by Mr. Lawrence, convulsion was produced on pressing on the medulla oblongata. In a case of meningitis given by Dr. Abercrombie, the anterior fontanelle became very prominent; pressure upon it induced convulsion. Hypertrophy of the brain affords an argument of the same kind: it induces convulsion, *except* in the case

in which the cranium grows with the encephalon. These and other facts lead me to think that convulsion arising from cerebral disease is thus to be explained. I shall merely adduce the case of Dr. Abercrombie.

Case 7.—" A child, aged eight months, died on the 13th of March, 1818, of an illness which had continued more than three weeks. It began with fever, restlessness, and quick breathing; afterwards, there were frequent convulsive affections, with much oppression, and at last severe convulsions, squinting, and coma. At an early period of the complaint, there was observed a remarkable prominence of the anterior fontanelle; in the second week, this increased considerably; and in the third week, it was elevated into a distinct circumscribed tumour, which was soft and fluctuating,—and pressure upon it occasioned convulsion. It was opened by a small puncture, and discharged at first some purulent matter, afterwards bloody serum. No change took place in the symptoms, and the child died four days after*."

That *defective* pressure will produce the same effects, is proved by the following most interesting case:

Case 8.—" M. Bérard jeune a lu à l'Académie de médecine, dans sa séance du 22 Octobre, 1833, l'observation d'une tumeur fongueuse de la dure-mère. Une circonstance bien remarquable de cette observation, c'est qu'immédiatement après que le tumeur eût

* On the Brain and Spinal Cord; ed. 3, p. 57.

été enlevée par M. Bérard, avec la dure-mère avec laquelle elle adhérait, le malade fut pris de perte de connaissance et de mouvemens convulsifs du tronc et des membres. M. Bérard, pensant que la brusque sustraction d'une partie de l'enveloppe resistante du cerveau causait ces accidens, appliqua de suite sur toute la partie dénudée de l'organe un morceau d'agaric, sur lequel il pressa modérément avec la paume de la main. Sous l'influence de cette compression, les convulsions cesserent et l'intelligence se rétablit*."

The rigidity of the muscles in cases of ramollissement, and some other cerebral diseases, doubtless depends upon the same principle. Every observer will now distinguish, from this phenomenon of an acute disease, the chronic rigidity which supervenes in cases of hemiplegia†.

It may be stated, in conclusion, that the true spinal symptoms, which occur in cerebral attacks, arise from counter-pressure: when the source of this is permanent, as in hæmorrhagy, the effect is permanent too, and the case fatal; when it is remediable, by blood-letting, as in congestion, the cause and its effects are removed together.

The convulsions induced by hæmorrhage depend upon a similar subtraction of the intra-vascular pressure of the blood in the medulla oblongata. I need

* Andral, op. cit. t. v. p. 556.

† An erroneous view, I believe, is taken of this subject by M. Andral, vide op. cit. pp. 363—365.

scarcely observe, that, in order that these effects of undue or deficient pressure may be induced, it is necessary that such changes in the pressure be effected rapidly. No such effects of pressure slowly altered in chronic disease are observed.

This subject is admirably illustrated by Sir Astley Cooper's experiments on the effects of withdrawing the force of the arterial blood by applying ligatures or pressure on the vertebral arteries, which I shall notice immediately.

IV. *Of Irritation of the Membranes.*
(Added June 1846.*)*

I have detailed an *experiment* (p. 65) illustrative of the effect of *irritation* of the dura mater. That such effects present themselves to our *observation* in practice, there can be no doubt. But they are hitherto unrecognized; and, without experimental *physiology*, or a just *theory*, they would probably remain unrecognized *for ever!*—so difficult, and at the best so inadequate, is pure observation.

In a case of hemiplegia, there was much more spasmodic contraction of the muscles of the affected arm than what is commonly seen in protracted cases of this affection. There was also a slight spasmodic action of the muscles of the face about the eye, on the affected side. And, on two occasions, there were *epileptic* attacks.

Such cases should be distinguished from pure he-

miplegia. Either the membranes (see p. 64) or the spinal system is involved in the disease, primarily or secondarily. The disease may be seated in or near these tissues, or may affect them in the way of counter-pressure.

It is thus that ramollissement induces rigidity of the muscles of the limbs.

How much is required to be done, before our knowledge of this subject is at all complete!

In diseases of the spinal marrow itself, *spasm* denotes *irritation*, whilst *paralysis* results from *compression*, or absolute *destruction*.

Would that some active and able investigator would emulate M. Louis, and submit this subject to full and exclusive investigation!

I now beg very briefly to draw the attention of the Society to another interesting topic; viz.

III. *The Special Anatomy of the Base of the Encephalon in reference to Diseases of the Nervous System?*

It is unnecessary for me to do more than advert to the important anatomy at the base of the cranium, —the course of the various *Nerves*, &c. and most particularly the position of the *medulla oblongata*—parts liable to be affected by irritation and pressure, counter-irritation and counter-pressure, and the consequent source of so many symptoms, and especially of the affections of the pupil, of the respiration, of deglutition, of the sphincters, &c. Another subject of in-

terest is the peculiar position of the tentorium, leaving in its centre a sort of internal foramen magnum. By this membrane, the *direct* effects of pressure from ramollissement and other diseases of the cerebrum on the parts below are prevented, whilst an *oblique* or counter-pressure is the result, with its special effect on the symptoms. This result is modified too by the semi-solid, semi-fluid texture of the various parts of the encephalon.

It is these circumstances, combined with another element of the proposition—that of *time*—which frequently leads to an effect which I shall notice immediately; viz. the difference of symptoms with identity of lesion, and the similarity in the symptoms when the lesion is dissimilar. The same morbid change will produce very different effects, developed as an acute and as a chronic disease; and different physical lesions will produce nearly the same results if developed in nearly *equal times*. In a chronic affection, the cerebral substance yields, its vessels becoming empty, and pressure is not induced. In acute affections, on the contrary, pressure is made upon contiguous, and counter-pressure upon distant parts, with their appropriate symptoms. By degrees, even in the latter case, the cerebral substance yields; and the symptoms, in the less severe cases, subside, and even disappear.

But this last subject belongs to the next question:

IV. *Why, with similar symptoms, have we dissimilar morbid appearances; and vice versâ?* and—*What are the Diseases of the Nervous System, in which we find no morbid appearances on a post-mortem examination?*

If the source of the symptoms be not the mere lesion of a function, induced by the lesion of a special part or organ of the encephalon, but the effect of irritation and counter-irritation, of pressure and of counter-pressure, it is obvious that these primary effects, and their effects in their turn, may result from *any* disease, if the *times* be similar, whatever that may be.

It is accordingly to the *history* that we chiefly have recourse for the diagnosis of cerebral diseases, and especially to that of the seizure and first stage; at their close, almost all diseases of the encephalon are alike. Almost all terminate by coma, paralysis, convulsions, stertor, and impaired actions of ingestion and egestion, and of the orifices and sphincters, from compression of the cerebrum and medulla oblongata.

There is another view of this important subject. Morbid changes take place towards the *close* of many diseases, which do not properly or at all constitute the disease. In exhaustion, in chlorosis, in delirium tremens, effusion of serum and even of lymph occurs. In disease of the encephalon itself, such effusion also

takes place, late in its course, and *complicates* the original disease. Further—

It is plain that in the immediate effect of *shock* applied to the nervous system, whether this be mental or physical, we can expect *no* morbid physical lesion.

It is equally plain, that, in the immediate effect of *exhaustion* of the vascular system on the nervous system, we should likewise discover no organic change.

It is equally plain, that, in the immediate effects of strychnine and of the hydrocyanic acid, we should also observe the absence of all perceptible physical change.

Now these effects are the *types*, as it were, of a series of diseases in the human subject.

Shock and exhaustion induce delirium and even mania; a wounded or poisoned nerve becomes the cause of tetanus and hydrophobia; the hydrocyanic acid induces the almost sudden cessation of the functions. We could not, in any of these cases, expect organic changes.

But though there may be no such change as we have been in the habit of looking for in our post-mortem examination, it does not follow that there may be *no* physical change whatever. The effect of shock may be altogether inscrutable; but the effects of exhaustion may, even in the commencement, be perfectly real, but *intra-vascular*. This is the case in some forms of mania,—in puerperal mania, the mania from undue lactation, &c.

I must here adduce two interesting facts, one observed by myself, the other an experiment of Sir A. Cooper:

The animal which dies from loss of blood, dies convulsed. The cause of this convulsion is the anemious condition, not of the brain, but of the spinal marrow; this is ascertained in the sheep in the following manner:

Exp. The butchers usually divide the large vessels of the sheep, and the animal dies in the midst of convulsions. I begged that the spinal marrow might be first divided most completely, and then the blood be allowed to flow from the divided blood-vessels: again there were violent convulsions,—an event which could depend on the anemious state of the spinal marrow alone, the influence of the brain having been removed.

"I tied," says Sir A. Cooper, "the carotid arteries (in a rabbit). Respiration was somewhat quickened, and the heart's action increased; but no other effect was produced. In five minutes, the vertebral arteries were compressed by the thumbs, the trachea being completely excluded. Respiration almost directly stopped: convulsive struggles succeeded; the animal lost its consciousness, and appeared dead. The pressure was removed, and it recovered with a convulsive inspiration. It lay on its side, making violent convulsive efforts, breathed laboriously; and its heart beat rapidly.

"In two hours it had recovered; but its respiration was laborious*."

The compression was repeated five times with the same effects. The want of the due supply of blood to the medulla oblongata induced convulsive actions.

It is to the hidden effect of shock and the intravascular change in exhaustion, and their consequences, that I wish to direct the attention of the members of this Society. My design being merely to point out objects for observation, I do not propose to enter upon the discussion of any of them on the present occasion.

I shall conclude by observing, that besides shock and exhaustion, there are other causes of disease, or rather of derangement, of the nervous system, the effects of which require new investigation. Such are the effects of alcohol seen in delirium tremens, the effects of sexual excesses seen in some cases of paraplegic affection. The affections of the head in arthritis and in dyspepsia are of the same kind. Of the same character, and of extreme importance, are the effects of exposure of portions of the nervous system, especially of the spinal marrow and superficial nerves, to extreme *cold*. But I must conclude these remarks, and will do so by adducing interesting paragraphs from Dupuytren, M. Gendrin, and M. Andral:

"Du reste," says the former writer, "les symptômes et l'autopsie se réunissent pour démontrer que

* Guy's Hospital Reports, vol. i, p. 465.

la tétanus est une affection essentielle, nerveuse et sans lésion organique qui lui soit propre."

" J'ai observé," says M. Gendrin, " plusieurs hydrophobes, et j'ai assisté à l'ouverture des cadavres d'un plus grand nombre encore ;" " je n'ai jamais vu la moindre trace d'inflammation ou de lésion quelconque dans les organes encéphalo-rachidiens, ni dans les nerfs ganglionaires."

M. Andral observes—" Que le nombre d'altérations connues est petit à côté de celui des lésions qu'on ignore ! Les cas où, après la mort, on trouve quelque chose d'appréciable pour le scalpel sont les plus communs pour les autres organes ; pour le système nerveux, c'est tout l'opposé : les cas où on rencontre des lésions sont de beaucoup les plus rares. Cette assertion paraîtra paradoxale à ceux qui ne connaissent des lésions nerveuses que *les trois ou quatre maladies qu'on observe dans les hôpitaux ;* mais les affections nerveuses se comptent par centaines, et pour ne parler que de ces grandes perturbations qui portent sur le mouvement, sur la sensibilité, sur l'intelligence, où est la lésion dans ces cas ? La plupart du temps on n'en trouve aucune, ou celles qu'on observe n'ont aucun rapport avec les désordres fonctionels."

There is still one other topic which I must briefly notice, in connection with the present subject. It is

The Effects of Exposure to severe Cold.

I particularly noticed the effects of exposure to severe cold during my experiments on Hybernation, published in the Philosophical Transactions of 1823. Whilst exposure to a moderate degree of cold conduces to the state of hybernation, a physiological and preservative condition, exposure to intense cold induces *torpor*—a state totally different, but not sufficiently distinguished, from the former, of a pathological character, and of *fatal* tendency. In the state of hybernation, the animal is dormant and motionless, but the actions excited are perfectly regular; in the state of torpor, on the contrary, the animal moves about, but the movements are, in the highest degree, irregular and tottering. I always observed that the state of torpor issued in death.

In man, similar effects are produced: the lips cannot articulate, the fingers cannot grasp any minute object, the feet and legs cannot sustain the individual who has been thus benumbed by exposure to cold.

Exposure to extreme heat or cold equally induces spasmodic action in the muscular system. A young gentleman, having been ordered a warm bath, mistook the temperature, and exposed himself to such a degree of heat as induced general spasmodic action of the most painful kind. The effect of too intense a cold on swimmers is a fact too well known to require further notice.

When the exposure to cold is more partial, effects on both the sentient and motor portions of the nervous system are produced, which have this characteristic: there is at first paralysis, and afterwards undue action. The first effect of exposure to cold is numbness in the fingers; this usually yields to pain, vulgarly termed "hot-ache," especially if the warmth be restored too rapidly. In a relative of mine, exposure to a severe wind, with sleet, induced perfect numbness of one side of the face; this paralysis subsided, and gave way to severe tic doloureux. A lady, whose case I shall detail more at length immediately, was exposed to severe cold with wind: the next day she arose from bed with paralysis of one side of the face! this paralysis yielded by degrees to spasmodic tic.

Exposure to cold is a far more frequent cause of paralysis than is generally supposed. Such an effect on the face has been designated, in common language (which frequently involves an important truth), *a blight*. Cases of paralysis of the face from exposure to cold are detailed by Dr. Powel, in the fourth volume of the Transactions of the Royal College of Physicians. There is a poor little boy, residing near me, of six years of age, whose limbs are nearly paralytic, in consequence of a long and most criminal exposure to cold by a nurse. Some years ago, I visited a gentleman perfectly paraplegic, from long exposure to intense cold on the outside of a coach. Baron Larrey speaks of permanent paralysis left by exposure to intense

cold during the campaign in Russia. Paralysis, happily of a less permanent character, has been experienced by every one under similar circumstances.

But the point to which I must now revert, and to which I beg to call the attention of the members of this Society, is, that the first effect of a partial but severe exposure to cold is paralysis; whilst the more remote effect is undue action. This principle I proceed to illustrate by a most interesting case of *spasmodic tic*, interesting in many points of view. It is given in the form of a letter, written to an eminent authority on this subject:

Dear Sir,

I saw Lady ——, now Lady ——, before a recent visit to Switzerland, and I have this day, after my return, seen the correspondence between you and Mr. —— of —— on her ladyship's case.

There has certainly been some misapprehension in regard to it; for Mr. —— speaks of the "affection having *shifted* from one side of the face to the other;" and you say, "there is certainly a degree of *weakness* of the portio dura on the *left* side." Now I believe there has never been a change of the side affected, and that it is not the portio dura of the *left* side which is weakened, but that of the *right* which is irritated, so producing spasm. This view I will explain:

The probable cause was exposure to a severe cold wind.

When the affection *first* took place, the face was drawn towards the *left* side, but the eye-lid of the *right* was paralysed, the eye requiring the application of the finger to close it, and being *more open* than the left, *the left* being in its *natural* state. After a time, the face was drawn to the *right*, and now the *right* eye, which gaped before, became *less open* than the left; but the *left* was *still* in its *natural* state.

In a word, the change was from *paralysis to spasm*, but it was of the same side—*always* the *right;* and now, it is not *weakness* of the *left* portio dura, but *irritation* of the *right.* The *right* eye was always *morbidly* affected, first by *paralysis*, now by *spasm;* the *left* has *always* been *natural.*

The *sensibility* has always been *unaffected.*

At this time, every thing is *spasmodic*, and *that* of the right side of the face.

The right eye-lid is usually more closed than the left; and when closed by an act of volition, it is drawn a little awry (to the right); and during laughing, it is spasmodically closed without an act of volition.

The whole right side of the face is spasmodically drawn to the right on laughing, or speaking, or *eating on the right side* of the mouth, and a *new* dimple is *formed* on the right side of the chin. All is normal on the *left* side, which is only drawn a little by the spasmodic action on the *right.* The *eye-lid* is natural, and mastication is naturally performed on this side, except from the decayed state of the teeth. It is

plain that, whatever the cause might be, and I suspect it was exposure to severe cold, it first induced that change in the portio dura of the right side which produced paralysis, and which, being *diminished*, is now characterized by spasm. It is the *right* and not the *left* side, therefore, to which our remedies must be applied, if applied near the motor nerve, immediately or remotely the seat of the disease. I have seen several cases beginning with paralysis and proceeding to spasmodic affection of the portio dura of the same side. I have also seen *one* unequivocal case of paralysis affecting successively the portio dura of both sides, after an interval of several years.

I am, dear Sir, &c.

14, Manchester Square,
September 20, 1840.

From the misapprehension in regard to this affection to which I adverted in the above letter, the remedies were actually prescribed to be applied to the unaffected side of the face!

I need scarcely state that in these cases we should scarcely expect to find any post-mortem appearances.

I conclude by stating, that, in all future cases of disease of the Nervous System, we must observe the various points which have been brought before the Society, in the order given in the following

TABLE.

I. *The Cerebral Symptoms.*
   1. *Excess, or defect, in the Senses; Pain.*
   2. *Delirium; Coma.*
   3. *Paralysis.*

II. *The True Spinal Symptoms.*
   1. *Spasm, clonic or tonic,—*
   2. *Paralysis,—in regard to*
      1. *The functions of Ingestion.*
      2. *The functions of Excretion.*
      3. *The Muscular System generally.*
   3. *Reflex and Retrograde Actions.*
   4. *Irritability of the Muscular Fibre.*

III. *The Ganglionic—in regard to*
   1. *Nutrition.*
   2. *Temperature.*
   3. *The Secretions, especially those of*
      1. *The Bronchia.*
      2. *The Stomach and Intestines.*
      3. *The Kidneys and Bladder.*

IV. *The Effects of Emotion.*

V. *The Effects of Shock.*

VI. *The Effects of Counter-pressure.*

VII. *The Effects of Irritation of the Meninges.*

It was once my own intention to withdraw from practice, and proceed to Vienna, to prosecute this investigation; but that intention was thwarted.

CHAPTER XXXVII.

PLAN PROPOSED FOR THE INSTITUTION OF BLOOD-LETTING.

It is one of the most remarkable facts in physic, that if several patients of similar strength and constitution, but affected by dissimilar diseases, be respectively placed in the erect position and bled to deliquium, they will be found to have lost very various quantities of blood. I have known a patient, not apparently very feeble, faint on losing four ounces of blood; and I have known patients bear to lose fifty, sixty, and even seventy ounces of blood without syncope.

This fact, plain and simple as it is, with its rationale and practical application, has, I think, been greatly overlooked.

Its rationale is to be found, I believe, in connection with an equally interesting fact,—that different diseases induce in the constitution different powers or susceptibilities in regard to the effects of loss of blood Each disease appears, indeed, to possess its own peculiar and intrinsic virtue in this respect. This is determined by placing the patient perfectly erect, and bleeding to incipient syncope: the quantity of

blood which flows is the measure of the protective influence of the disease in one class of cases, and of its influence in superinducing a susceptibility to the effects of loss of blood in the other.

An interesting scale of diseases may be formed representing these properties. It would begin with congestion of the head, or tendency to apoplexy; inflammation of the serous membranes, and of the parenchymatous substance of various organs, would follow; then acute anasarca; and lastly, inflammation of the mucous membranes. This part of the scale would be divided from the next by the condition of the system in health. Below this would be arranged fever, the effects of intestinal irritation, some cases of delirium, reaction from loss of blood, and disorders of the same class with hysteria, dyspepsia, chlorosis, and cholera morbus.

Persons in health, and of moderate strength, will generally faint, if bled in the erect posture, on taking fifteen ounces of blood. I have known seventy ounces to be taken in the sitting posture, in the tendency to apoplexy, without syncope; but the case is an extreme one. Patients with pleuritis or pneumonia frequently lose thirty-five ounces of blood without fainting. In bronchitis, little more is borne to be lost than in health. A stout person in fever will frequently faint on losing ten, twelve, or fourteen ounces of blood. In intestinal irritation, with urgent symptoms even, the abstraction of nine or ten ounces of blood will

generally induce deliquium. In delirium tremens, or puerperal delirium, the patient soon faints from loss of blood. The same thing is still more observed in those cases of violent reaction which arise from loss of blood itself. In dyspepsia, hysteria, and chlorosis, the susceptibility to syncope from loss of blood is very great. And I have known a patient, of good strength, affected with cholera, faint on taking four ounces of blood, although she had shortly before borne to lose nearly twenty ounces without faintishness, under the influence of inflamed mamma.

I imagine that the rationale of this fact will be found in the obvious difference in the nature of these diseases. In all those cases in which the circulation of the heart and larger arteries alone is affected, and especially in such as involve irritation, or exhaustion, there is early syncope on taking blood. But in such cases as consist in an affection of the capillary circulation, and especially such of these as affect the head, it requires the abstraction of much blood to induce deliquium. Syncope is prevented by the influence exerted by this state of the capillary circulation over that of the heart and larger arteries, and over the whole system, and especially over the circulation within the brain; and it does not entirely subdue the morbid action of the capillary vessels even when induced. To induce syncope in pure fever, we have then but to subdue the state of reaction in the heart and larger arteries. In inflammation, we have not

only to do this, but to overcome the influence of a permanent morbid action of the capillaries: this is especially observed in inflammation of the serous membranes, and within the head.

The practical application of this fact consists chiefly in its affording a rule for blood-letting in all cases in which this measure is required to be fully instituted; a guard against undue blood-letting, both in this and some other cases; and a source of diagnosis.

The quantity of blood which flows, when a patient requiring full blood-letting is placed upright and bled to deliquium, seems accurately proportionate to the exigencies of the case. In inflammation, much blood should be taken; and much blood will flow before deliquium is induced: in irritation, little blood should be drawn; and there is early syncope from blood-letting. The quantities are even accurately suited, not only to the exigencies of the disease, but to the powers of the system; at least, so it appears to me, from considerable experience.

The rule is suited also to the degree and the duration of the disease; for, with each of these, its influence in inducing tolerance or intolerance of loss of blood is respectively augmented.

It is not less adapted to those most frequent of all events, mixed cases. Inflammation and irritation may be conjoined. For example, there may be mere nephralgia, or absolute nephritis, from calculus, or a mixed case involving both. There may be mingled

intestinal irritation and inflammation. In each of these circumstances, the rule for blood-letting which I have proposed adapts itself accurately to the demands of these various morbid affections, and to the actual strength and condition of the general system.

It is difficult to say whether more injury has been done by an undue or by an inefficient use of the lancet. In inflammation, we must bleed fully. In irritation, we must bleed cautiously. Inefficient blood-letting in the former disease, and undue blood-letting in the latter, are alike dangerous, or even fatal, to the patient; from both extremes we are guarded by the rule which I propose. By directing the patient to be placed in the erect position, and bled to deliquium, we often take much more blood than we should have ventured to prescribe in inflammation, and very much less than we might be disposed to direct in irritation; and in both these cases the rule conducts us to the only safe mode of treatment.

An important question relates to the due repetitions of blood-letting. This should, in general, be the more prompt, the greater the tolerance of loss of blood in the previous blood-lettings.

A further practical application of this fact, flows from the adoption of the rule. In doubtful cases, it furnishes us with a fresh means of diagnosis. If much blood has flowed before syncope occurred, we must suspect inflammation; if little, we must suspect that, however similar the symptoms, the case is in fact of a

different nature—perhaps irritation, perhaps exhaustion.

I have also found that, in every case in which early syncope occurs from blood-letting, the more remote effects of loss of blood, as reaction, or sinking, are also very liable to occur; and it is in these cases that sudden dissolution has followed the use of the lancet. There is, in every point of view, intolerance of loss of blood. The reverse of all this obtains in inflammation, which seems to be incompatible, to a certain degree, with the effects of loss of blood, which are, however, very apt to supervene, as the inflammatory action subsides.

It is by the multitude of facts alone that the propositions which have been stated can be established or corrected. With the view of obtaining these facts, I would now propose that, in every case in which full blood-letting is to be instituted, the patient should be placed perfectly erect in a chair or in bed, and bled to the very first appearance of deliquium; the quantity of blood taken is then to be noted, and accurately registered in a table. The same thing is to be observed on each repetition of the blood-letting.

And that nothing may be left unattended to which may throw additional light on the subject, to this point I would add—1, the appearances of the blood, and 2, the effects of its abstraction upon the disease.

These various facts I propose to register in the following manner:

Age and strength of the patient.	Disease, its stage and complications.	Quantity of blood taken.	Effects on the patient and disease.	Appearances of the blood.	Repetitions of the blood-letting.	Effects.

It is obvious that none but the most unequivocal cases should be thus registered. Cases, the diagnosis of which was not perfectly clear, would only add their own obscurity to the investigation.

It is equally obvious that the investigation proposed can only add useful facts, which will in their turn become useful guides to the physician. It is still true, as Celsus has observed,—"*nulla perpetua præcepta medicina recipit.*" To the young practitioner, however, I think the practice proposed will prove of great assistance; and if it preserve one from the bitter reflection, which some have experienced, of having done too much or too little, I shall not esteem that my labour has been in vain.

I would observe, in conclusion, that I do not think it safe, in any case, to bleed to deliquium in the recumbent posture. But there are few cases, if any, in which, if it be proper to bleed fully, danger can accrue from bleeding to the most incipient syncope in the perfectly upright position. Besides, the remedy is at hand. It consists simply in laying the

patient recumbent, and, if necessary, raising the feet and depressing the head.

It may become a question whether the patient may, in a little time, be again placed erect, so as to reproduce a state of slight deliquium, and thus to add to the power of the previous blood-letting in subduing the disease. But I do not think a state of continued syncope free from danger. I have known it lead to delirium.

On the other hand, the influence of an opposite position, the head being placed extremely low, and the lower part of the body being very much raised, has not been sufficiently traced in the various cases of the immediate or remoter effects of loss of blood.

Amongst the other objects of this inquiry, should be that of collecting any modifications or exceptions, in regard to the rule which I have laid down. It cannot be imagined that it should be without exceptions. It is as important that these should be pointed out, as that the rule itself should be established. There are two exceptions to the rule which I have proposed, which I would briefly mention. In some cases of fever requiring blood-letting, the patient cannot support the erect position: in such a case, the arm should be first prepared, and then the patient should be gently raised and supported in the upright position, carefully avoiding all muscular effort; the vein should then be promptly opened. On the other hand, in the case of congestion of the brain from ex-

haustion, there is not such early syncope from blood-letting as might be expected; and yet it is obvious that the system cannot bear the loss of blood. I have known this to obtain in exhaustion from undue lactation.

It will also be an interesting question, whether this rule, in its repetitions, besides excluding undue blood-letting on one hand, and inefficient blood-letting on the other, does not secure the cure of the disease with the least possible expenditure of the vital fluid.

The appearances of the blood, the effects of its abtraction upon the disease, and many other questions, will naturally come to be included in the farther prosecution of the inquiry into the effects of blood-letting.

Lastly, the effects and due application of the local abstraction of blood, by cupping or leeches, will constitute another interesting object of inquiry. This is frequently peculiarly appropriate when general depletion would be totally inadmissible.

CHAPTER XXXVIII.

ON EMETIC DOSES OF IPECACUANHA AS A RESTORATIVE; BY J. HIGGINBOTTOM, ESQ. F.R.C.S.E.

In the year 1814, I first witnessed the restorative effects of ipecacuanha as an emetic, in a female, forty years of age, who was in a sinking state, in the last stage of cholera. Her countenance was shrunk, and her extremities were cold, with cramp in the legs, and other symptoms of dissolution. I gave a scruple dose. After the lapse of two or three hours, I again visited my patient. So great a change for the better had taken place as to excite my surprise; the whole of her body had recovered its natural warmth, and all dangerous symptoms had disappeared.

My confidence in the ipecacuanha, as a remedy in such cases, has now been confirmed during the practice of thirty years.

The next case which attracted my particular observation, in regard to the utility of ipecacuanha, was one of uterine hæmorrhage. I attended the same patient three times in labour, in the years 1821, 1823, and 1826; each time most severe flooding succeeded the separation of the placenta. I employed the usual remedies; but the patient was long in great danger. In her third confinement, I feared the hæmorrhagy

would prove fatal. After having given her half a pint of brandy and a pint of port wine, unavailingly, it occurred to me that, on the former occasions on which I had attended her, there had been no amendment until she had ejected the contents of the stomach. I was therefore most anxious that vomiting should take place; for she was rapidly sinking. I gave her half a drachm of ipecacuanha: full vomiting soon succeeded. After a deep sigh, she said, "O! I am better; I'm better now." The hæmorrhage ceased; the symptoms of sinking disappeared.

I attended the same patient three times afterwards, in the years 1827, 1829, and 1831; and I then gave, in every case, half a drachm of the secale cornutum before and after the birth of the child. This remedy had the effect of preventing the hæmorrhage; so that I had no further need of the ipecacuanha; but, several years ago, I had a patient on whom the secale cornutum had no effect in preventing the hæmorrhage, and I gave the ipecacuanha with success.

I have found an emetic dose of ipecacuanha a very valuable remedy at that stage of bronchitis where a sudden, low, or sinking state has come on, with oppression at the chest, and difficult expectoration, endangering suffocation. I have also found this remedy of great efficacy in sudden cases of exhaustion, sinking, and asphyxia generally.

FINIS.

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