

A N
E S S A Y
ON THE
R E C O V E R Y
OF THE
APPARENTLY DEAD.

BY CHARLES KITE,

Member of the Corporation of Surgeons in London,
and Surgeon at Gravesend in Kent.

Being the Effay to which the Humane Society's Medal was adjudged.

To which is prefixed,

D R. L E T T S O M ' s A D D R E S S
ON THE DELIVERY OF THE MEDAL.

hac animas ille evocat Orco
Pallentes. VIRG.

L O N D O N :
PRINTED FOR C. DILLY IN THE POULTRY.
M.DCC.LXXXVIII.

326

DR. LETTSOM having been appointed by the members of the Medical Society of London, to deliver before them, and the President, Vice Presidents, Clergy, and Governors of the Humane Society, the honorary medals of this institution for the year 1788, the following extracts from his address on the occasion are prefixed, in order to explain the proceedings of these Societies.

“ I CANNOT, Gentlemen, better
“ explain the occasion of the present
“ meeting, than by introducing the
“ proceedings of the Humane and
“ Medical Societies; which I shall
“ request to do by their respective
“ minutes.”

‘ MEDICAL SOCIETY of LONDON,
‘ July 30th 1787.

‘ The following resolution of the
‘ Humane Society was laid before the
‘ Medical Society, by the President, and
‘ read,

“ H U M A N E S O C I E T Y,
“ July 19th 1787.

“ JOHN DAVENPORT, Esq; in the chair.

“ *Resolved unanimously,*

“ That the Medical Society of
“ London be respectfully requested to
“ be the adjudicators of the first prize
“ medals for the best original Essays on
“ SUSPENDED ANIMATION, which are
“ to be adjudged the second week in
“ March 1788; and that the Register
“ transmit this unanimous resolution to
“ the Medical Society, and report their
“ answer

“ answer to the next meeting of the
“ Humane Society.

“ Signed, by order,

“ W^m HAWES, Register.”

‘ The Society having taken this
‘ proposal of the Humane Society into
‘ consideration, the same was agreed to
‘ unanimously; and the Secretary was
‘ ordered to notify to the Register of the
‘ Humane Society, that the request of the
‘ latter was complied with : The Secretary
‘ therefore drew up an answer, in the
‘ form of a resolution, as follows.

‘ Monday, July 30th 1787.

‘ At a meeting of the *Medical Society*
‘ of London, held this evening,

‘ DOCTOR JAMES SIMS, President, in
‘ the chair ;

‘ THIS SOCIETY having taken into
‘ consideration the resolution of the

‘ Humane Society, of the 19th of July,
‘ relative to the adjudication of the first
‘ prize medals for the best original Essays
‘ on Suspended Animation, it was
‘ unanimously resolved, that thanks be
‘ returned to the Humane Society for
‘ the honour proposed, and that the polite
‘ offer of that Society be cheerfully
‘ accepted.

‘ Signed, by order,

‘ W^m CHAMBERLAINE,
‘ Secretary.’

‘ AT A MEETING of the
‘ MEDICAL SOCIETY of LONDON, held
‘ at their house in Bolt Court, Fleet Street,
‘ on the 26th day of March 1788 ;

‘ Mr. SOLOMON WADD, Chairman of
‘ the Council, in the chair ;

‘ THE SOCIETY having read, and
‘ deliberately considered, *Eight Dissertations*
‘ on the Prize Question proposed by
‘ the Humane Society, and submitted to
‘ their determination, do adjudge the
‘ GOLD

‘ GOLD MEDAL to the Author of the
‘ Dissertation, whose motto is,

‘ *Arteria animam accipit è pulmonibus.*

‘ And the SILVER MEDAL to the Author
‘ of the Dissertation, distinguished by the
‘ motto,

‘ ——— *hac animas ille evocat Orco*
‘ *Pallentes.*’

‘ THE SOCIETY express, at the same
‘ time, their cordial approbation of the
‘ liberal conduct of the Humane Society,
‘ for this signal instance of their zeal for
‘ promoting the interests of humanity,
‘ and of science in general.

‘ Signed, by order,

‘ W^m CHAMBERLAINE, } Secretaries.
‘ JAMES HILL HOOPER, }



“ THE respectful sense I entertain
 “ of this Dissertation *; and of its
 “ immense importance in the pathology
 “ of diseases, were the experiments it
 “ contains uniformly confirmed, induces
 “ me to hope, that other ingenious men
 “ may explore the same track, and with
 “ equal candour, enlighten science. Some
 “ celebrated anatomists, we know, have
 “ drawn different conclusions from similar
 “ phænomena. The modern HUNTER,
 “ from some experiments, resembling
 “ those of our Author, deduces likewise
 “ different conclusions ; particularly
 “ respecting *the colour of the blood*, and the
 “ *irritability of the heart*. From collision,
 “ light is produced, and truth becomes

* This refers to the Dissertation with the motto,

“ *Arteria animam accipit à pulmonibus ;*”

an epitome of which Dr. Lettsom introduced into
 the Address: but it is here omitted, as well as the
 Observations on the Circulation of the Blood, the
 Properties of different Kinds of Air, and the Physiology
 of the Lungs.

“ clearer

“ clearer by investigation. May the
 “ learned Author, who has given such
 “ an originality and brilliancy to the
 “ subject wisely proposed by the
 “ HUMANE SOCIETY, persevere, with
 “ an ardour equal to the importance of
 “ the prize, under a sentiment delivered
 “ by Seneca—*Rerum natura, sacra sua*
 “ *non simul tradit.*

“ I cannot, Gentlemen, forget to
 “ mention the methodical and ingenious
 “ Essay, to which the SILVER MEDAL has
 “ been adjudged*; which contains not
 “ only many experiments illustrative of
 “ the cause of death, but also a minute
 “ and useful detail of the means of
 “ resuscitation; to which are added,
 “ tables, constructed in a manner equally
 “ ingenious and useful, which shew, in
 “ a glance of the eye, the proportions
 “ of premature deaths, and of successful
 “ recoveries, with the particular states of
 “ the body, the symptoms of life and death,

* Mr. KITE, the Author of the present Dissertation.

“ and

“ and the means employed, whether
 “ successful or the contrary. These
 “ tables must be highly important in
 “ future disquisitions of this kind, with
 “ which, I trust, the public will often
 “ be favoured, as long as science is founded
 “ upon, and illustrated by, experiment ;
 “ which, in the medical art, is the
 “ fountain of truth.

“ The Author has paid singular
 “ attention to the powers of the
 “ ELECTRICAL FIRE ; this active fluid,
 “ which pervades earth and air, is in the
 “ former, the tremendous agent of
 “ earthquakes ; and in the latter, of
 “ thunder and lightning ; equally terrible
 “ to man ; till FRANKLIN, from the
 “ new hemisphere, boldly scaled the
 “ heavens, and taught us to wield the
 “ artillery of the skies, and direct its fire
 “ to aid and restore debilitated man, by
 “ its penetrating and nervous energy.

“ There is a pleasure, Gentlemen, I am
 “ persuaded, you all experience, the pleasure
 “ of

“ of seeing the HUMANE SOCIETY
 “ established upon the basis of public
 “ utility and approbation; which the
 “ NUMEROUS Essays offered for the
 “ HONORARY PRIZES, and the appearance
 “ at this time of persons whose minds
 “ have been enlarged by true science,
 “ unequivocally testifies. It is by the
 “ combined and persevering efforts of
 “ such enlightened characters, that
 “ prejudices unworthy of the capacious
 “ attainments of human intellect, are
 “ ultimately eradicated. The Society,
 “ once oppressed by every obstacle of
 “ unbelief, now affords a proof of what
 “ may be effected by laudable perseverance,
 “ and amply encourages the pursuit of
 “ great and useful objects.

“ Many of you know, that the
 “ HUMANE SOCIETY was instituted in
 “ the year 1774, to protect the industrious
 “ from the fatal consequences of
 “ unavoidable accidents; the young and
 “ inexperienced from being sacrificed to
 I “ their

“ their recreations ; and the unhappy
“ victims of desponding melancholy and
“ deliberate suicide, from the miserable
“ consequences of self-destruction. I had
“ the honour, at that early period, of
“ associating myself with its founders ;
“ and I well remember an expression I
“ made use of at that period of its
“ embryo—*If one life be saved within the*
“ *year, the Society will be established*
“ *for ever.*—Little did I then think, that
“ in the space of a few years, it would be
“ my proud lot, to have paid the rewards
“ for the redemption of hundreds of our
“ fellow-creatures from that bourne,
“ whence no traveller ever returned, and
“ my happiness to have enjoyed the
“ genuine *auto de fe* of humanity.

“ Among the number of great and
“ good characters, who have extended
“ *their patronage to the Humane Society,*
“ suffer me to mention, with due respect,
“ our illustrious SOVEREIGN, the patron
“ of science, and the friend of humanity ;
“ who

“ who condescended, in the year 1778,
 “ to accept the gold medal of this
 “ Society, and graciously became its
 “ immediate patron in 1784.

“ THAT INDIVIDUAL *, whose
 “ perseverance in the cause of resuscitation,
 “ is almost proverbial; and *whose labours*
 “ *in establishing the Humane Society*, have
 “ been sufficient to wear down the
 “ constitution of man; hath not relaxed
 “ in energy, by the acquisition of almost
 “ incredible success: but, like a skilful
 “ General, who redoubles his efforts by
 “ the proximity of victory, he has excited
 “ to action, in concert with the Directors
 “ of that Society, by the distribution of
 “ elegant rewards, the faculties and powers
 “ of others.

“ The esteem I feel for such a conduct,
 “ independent of personal friendship,
 “ presses me to encourage this spirit

* Dr. Hawes.

“ of

“ of inquiry, that investigation may
 “ demonstrate, that the *arcana in exteriori*
 “ *sacrario NON clausa sunt*, to the
 “ penetrating eye of science.

“ Let us recall to mind, upon the
 “ subject of apparent death, the state
 “ of ignorance from which we are
 “ emancipated. Had not the spring and
 “ energy of the mind broken the fetters
 “ of darkness, by the application of
 “ the principles upon which the
 “ HUMANE SOCIETY was founded, how
 “ many of our fellow-creatures, whom
 “ we can now felicitate, would have been
 “ sunk in endless night! How many
 “ useful subjects would have been lost to
 “ the community! How many tender
 “ affections of parent and child, would
 “ have been denied, and pangs endured!
 “ How many godlike sentiments must
 “ you have been deprived of, in witnessing,
 “ that the apparently dead have been raised
 “ into existence, and the inanimate mass
 “ hath breathed the breath of life!

“ Recollect,

“ Recollect, Gentlemen, those ecstatic
“ periods, when you have accidentally
“ met a friend, whom, from long
“ absence, a dubious journey, or a perilous
“ voyage, you had deemed lost for ever !
“ With what ardour you embrace him !
“ recognize some feature or circumstance
“ that once endeared him to your heart’s
“ affections ! Recollect these ecstasies of
“ friendship, and how must your bosoms
“ rise with transport, in reflecting upon
“ hundreds, feeling, like yourselves, the
“ tenderest emotions of sympathy and
“ comfort ; who, by the exertions of the
“ HUMANE SOCIETY, joyfully exult,
“ *Is not this our brother who was dead, but*
“ *now liveth ?*

“ Impressed, as we are, with instances
“ of the uncertainty of life, from
“ casualties of every kind, to which
“ we are liable, the importance of
“ extending and elucidating the principles
“ of the HUMANE SOCIETY, must
“ appear

“ appear conspicuous; and he that effects
“ this, gloriously contributes to the
“ preservation of his fellow-creatures. It
“ is therefore, with singular pleasure, that
“ I discharge the task assigned me by the
“ HUMANE SOCIETY, and approved by
“ the MEDICAL SOCIETY, to present the
“ gold medal, bearing this inscription,

“ *Propter optimam Dissertationem de*
“ *Resuscitatione,*

“ to Dr. EDMUND GOODWYN: And to
“ Mr. CHARLES KITE, the silver medal,
“ inscribed,

“ *Propter eruditam Dissertationem de*
“ *Resuscitatione,*

“ as tributes justly due to their industry,
“ abilities, and philanthropy. And I beg
“ farther to add, that a decision in your
“ favour *, by an institution so truly

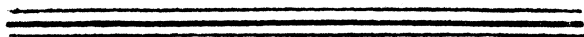
* Addressing the successful Candidates.

“ respectable,

“ respectable, as the MEDICAL SOCIETY
 “ OF LONDON, when so many well-written
 “ Essays were offered for the judgment of
 “ its members, will, I doubt not, stamp
 “ your merit with the world, and the
 “ profession in particular.

“ And I trust, that the honour now
 “ conferred, will lead to more important
 “ exertions, to fame and fortune; and
 “ that you will feel, in its fullest extent,
 “ the first of all rewards, the internal
 “ satisfaction of having contributed to the
 “ happiness of mankind.”





T H E

P R E F A C E.

THE most sincere wishes for the advancement of views so highly commendable as those of the Humane Society, started the idea of attempting to communicate some observations and expedients on the subject proposed for their honorary prizes, that might perhaps not otherwise be so generally known or adverted to. In doing this, however, it is hoped, that the consideration of more than half the time publicly assign-

ed to the performance having elapsed before any resolution had been formed of engaging in the business ; and the many interruptions inseparable from extensive country practice ; as well as a great variety of more than commonly incidental avocations of a more private nature, having on many occasions checked the progress of the undertaking—will be suffered to plead some sort of apology for the numerous inaccuracies and defects, in matter, form, and execution, that the following tract will, no doubt, too justly be found censurable for. But the delay of, or letting slip a promising opportunity of contributing to the public good, through the conceited self-importance

importance of fearing to appear divested of that form and dignity medical men in general are so very much averse to appear without, would surely be more reprehensible than the most awkward manner in the well-intended performance of a beneficial design.

Had not the weight of these considerations preponderated against all other apprehensions, the risk and inconveniences of the undertaking, so much at least as respects the present instance, had not been hazarded. When the chief purposes, however, of the scheme seemed to have been answered, by this paper being put into the hands of the Society, and of

a 3

judges

judges so capable and well disposed to embrace every opportunity of consulting most effectually for the general benefit of mankind, and even after this attempt had the good fortune to obtain approbation, so far as to be honoured with the silver medal of the Society—it had most certainly been withdrawn from publication, could my option in the matter have prevailed, or would the Society have permitted such retreat. Repeated applications were made with this view ; but my solicitations were in vain.

Out of my power of retention, the performance is now under the disposal of the Society, and is
humbly

humbly addressed to the lenity and indulgence of the public, in precisely the same state in which it was delivered for inspection.

If, however, I may have the good fortune to forward or excite others, possessed of more abilities and opportunities, to prosecute the improvement of a subject so beneficial and affecting to society, my wishes will have attained their chief expectation. Compleat satisfaction cannot, from the very limited extent of human powers, in a subject of this kind, ever be expected, as it depends on knowledge, the most important, intricate, profound, and difficult, of any in sublunary concerns ;

xxiv P R E F A C E.

cerns ; and comprehends, either in some instances remotely, or for the most part more intimately and indispensably, a reference to, and acquaintance with, almost every part, if not the whole scope, of human intelligence; exclusive of many things, wholly beyond the reach of our capacities. However discouraging the consideration of such difficulties may appear to be, we have the same consolation here, as in most other things in this imperfect state of being — that there remains within our reach a still practicable and indefinitely progressive line of truly beneficial improvement ; which it is the duty and interest of all, who have convenience

P R E F A C E. xxv

venience and opportunity, to encourage and promote; and was the motive, as we have already intimated, which prompted the production of what it was fancied might be my mite towards that purpose.



C O N T E N T S.

C O N T E N T S.

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E R R A T A.

Page 25, line 4, *for* 591 *read* 300.

29, — 3, — 591 — 300.

60, note, line 14, *for* Tilarius *read* Tilafius.

148, line 4, *for* Dethardengius, *read* Dethar-
dingius.

III, — 12, *add the following note at* Vital heat.

• This seems an improper expression. I do not at present, however, recollect a better: it is evident all I intend it to signify is, that heat which remains in the body after the pulse and respiration have ceased.

A N
E S S A Y
O N T H E
R E C O V E R Y O F T H E A P P A R E N T L Y
D E A D.

A P P A R E N T death, or suspended animation, being the subject proposed for our discussion, it will be necessary to furnish, between this term and positive death, a clear and distinct discrimination; which I conceive to rest entirely on the one circumstance, of the presence or absence of the principle of irritability: when it is present, however strong may be the appearances of death, and notwithstanding the vital, natural,
B and

and animal functions, may seem abolished, animation can only be said to be suspended; but when it is absent, the body is then to be considered as absolutely and irrecoverably dead.

The powers of life may be suspended by various causes: it is most probable, each of these causes may operate in such a manner as to produce a different effect; and consequently require some variation in the method of recovery. The nature of my engagements will not at present permit me to examine all of them so particularly as I could wish: on this account, I propose to consider principally Drowning, as the cause of suspended animation which most frequently occurs, and which is therefore the most important. The others, as more rarely presenting themselves, and particularly as they have a greater or less connection with the former, will not require to be so fully investigated.

ON THE SUSPENSION OF THE VITAL
POWERS FROM DROWNING.

*On the internal immediate cause of death;
and the manner in which this is effected,
in those who die by drowning.*

VARIOUS opinions have been entertained respecting this interesting subject; and, notwithstanding the many experiments and dissections, which have at different times been performed, with the view of determining the question, it remains nearly as unfettled as it was at first. As the most eminent of the profession have so essentially differed, and as their experiments have terminated so variously, it is evidently involved in much obscurity. On this account, it will not be improper to recite the principal opinions which have been

entertained by different authors ; and by attending particularly to each, we shall, in all probability, be enabled to form a more satisfactory and decisive opinion on this important and intricate point.

The principal causes to which the death of drowned people have been attributed, may be comprehended in the four following.

1st, That species of apoplexy which arises from an over distension of the stomach.

2dly, The blood being rendered unfit for performing its offices, by want of the action of the air, in respiration.

3dly, Water in the lungs : And,

4thly, A contraction of the parts about the larynx, preventing the air from passing into or out of the lungs, and producing death by

a. The

- a.* The inclosed air being rendered highly phlogisticated.
- b.* Suffocation, or a congestion of blood about the heart and lungs ; or,
- c.* Apoplexy.

1st. Those who have attributed the death of drowned persons to the first of these causes, have, on dissection, found the stomach much distended, from a large quantity of water in it. This over distension of the stomach, they think, would, by pressing on the aorta, stop the passage of the blood to the inferior extremities, the vessels of the brain will then become overloaded, whence apoplexy and death ensue.

That water has sometimes, and in great abundance, been found in the stomach of drowned men, and other animals, will admit of no doubt ; but that it is constantly, or even generally the case, is denied by the concurrent testimony of many re-

respectable authors; from whose experiments it appears, that frequently no water is taken into the stomach, at least by no means sufficient to produce the effect which is attributed to it. Dr. De Haen, in thirteen dogs which he dissected, found no fulness in their stomachs; and the experiments which I have made on kittens, in that respect, coincide entirely with the Doctor's, for not one drop of water was found in the stomach of any of them. As death then is often produced where this cause does not exist, the arguments which have been built upon it, must of course fall to the ground.

2dly. It is well known that the blood, in its passage through the lungs, undergoes some very particular and important change: in what this consists, we are probably not quite certain; the general opinion however, among the most celebrated physiologists of the present day, is, that a portion of pure, dephlogisticated,

or

or vital air, is imbibed from the atmosphere; and that noxious or phlogisticated air is discharged. If by any means this process is stopped, or even impeded, for a very short time, it is said by the supporters of this doctrine, that the blood will be immediately overcharged with phlogiston, or some noxious principle; and hence, when it circulates through the brain, and other vital parts, the nerves will cease to perform their office, and the action of the heart and lungs must necessarily be interrupted.

This idea, however, is opposed, and with great success, by observing, that it would be impracticable ever to recover either drowned persons or still-born children, on account of the impossibility of altering the state of the blood previous to the restoration of the circulation. Now the contrary of this, we know, every day happens; for it is no uncommon thing that life is renewed, without any attempt to correct the foul properties of the blood,

by imitating natural respiration ; and the experiments which I have made on animals, shew that they frequently recover spontaneously, some time after the vital and voluntary motions have ceased.

3dly. In answer to those who maintain the third opinion, it will be proper to observe, that although water has, beyond doubt, often been found in the lungs of drowned animals ; yet that it is frequently absent, is evident from the experiments of men of undoubted authority. Frothy mucus, now and then mixed with blood, is very generally to be met with in the lungs, and sometimes in considerable quantity, owing to the blood and mucus being forced through the vessels by the great distension of the pulmonary artery ; and this, I have no doubt, has frequently been taken for water : but if the animals are drowned in water tinged with a colouring substance, the fact will then be readily ascertained. Of ten kittens drown-
ed

ed in this manner, not one drop of the liquor was found in, or to be pressed out of the lungs.

But although it is on all hands allowed, that water is sometimes in the lungs; yet that it never gets there while life remains, is rendered extremely probable, by recollecting the exquisite sensibility with which the windpipe is endued, and which prevents the smallest quantity, either of solid or fluid, air excepted, from passing into it. In the action of deglutition, the opening into the larynx is completely shut by the epiglottis; so that whatever we swallow passes over without producing the least inconvenience. This always takes place spontaneously, and is not in the least dependant on our will. It is therefore natural to conceive, that any quantity of water may, at the time of drowning, be taken into the stomach, and yet not one drop get into the lungs.

It is certainly very remarkable, however, that water should at one time be
found

found in the lungs, and at another time not, especially as the epiglottis is always found open, and the passage into the lungs consequently free. Not one drop of water was to be found in the kittens, I have just mentioned, although they seemed to gasp under the water, and thrust out their tongues. Now it is difficult to conceive, how the tongue can be thrust out, without the epiglottis being at the same time raised, by the ligament which connects them together : if this elevation does take place, the passage must, for that time at least, be closed by the contraction of the fauces ; but this contraction does not probably at all times exist, for it often happens that water is found in the stomach when there is none in the lungs ; and in the action of deglutition, the fauces must necessarily be relaxed.

The generality of writers seem to think, that water is much more frequently found in young than in adult animals : this I cannot allow, as it is in a great measure contradicted by my experiments.

Some

Some authors have imputed it to the different conceptions of different people, while in the water ; of whom, those who apprehend ill consequences from taking water into the lungs, by closing the glottis, prevent any passing into them ; and those who have thought that death was occasioned by want of air, have contrived to open it. Of the great number of persons that have been recovered, since the establishment of the Humane Society, we do not find one who seemed to be impressed with any such design ; and if they had, I do not see how they could put it in execution, as, at the time of drowning, the whole muscular system is thrown into violent agitations, and the mind seems, in a great measure, incapable of properly regulating and directing our motions. The supposition is rendered still more improbable, by recollecting that these differences have chiefly been observed in various animals, to whom it is impossible this argument can in any measure be applied.

There are others who have endeavoured to explain it, by the difference in the temperature of the water in which the animals are drowned; the cold water inducing such a spasm about the fauces, as to prevent any being either swallowed or inspired into the lungs: and warm water, producing no such consequences, finds an easy entrance. If this be true, it follows, that all drowned in summer should have water in their lungs; but that this is not the case, we are certainly allowed to conclude, from the readiness with which many are in that season recovered, from whose lungs no water has been ejected; nor has any injury in that organ been discovered from the consequences of that accident. With the view of rendering this affair still more evident, one kitten was drowned in water of nearly its own heat; but its lungs, on inspection, were the same as in the others.

It does not appear then, that, at present, any probable cause has been assigned for
the

the uncertain occurrence of water in the lungs ; nor, indeed, does it seem to have been thought that it would be productive of any material advantage, if it were exactly ascertained. As we shall take an opportunity of discussing this point more fully in another place, it will be unnecessary to say any thing further upon it at present.

4thly. We now come to examine the opinion of those who maintain, that “ death is caused by the contraction of the parts about the larynx stopping respiration.”

Nature, from the earliest period of our existence, implanted in the *aspera arteria* the most exquisite sensibility, by which the admission of every thing, except air, into the lungs is interrupted. That this influence prevails in health and disease, in the first moments of life, and in the agonies of death, is known to every one ; and that it did exist while in utero, and
that

that it continues to be exerted during the article of submerſion, is evident, for theſe reaſons—That an inſtance has never been known where the liquor *amni*i had penetrated into the lungs of the fœtus; and water has not always, or even generally been found in the lungs of animals lately drowned: which circumſtances muſt inevitably happen, if a ſtricture of the glottis did not in every inſtance invariably take place.

However plauſible this reaſoning may appear, there are two objections to it, which preſent themſelves; and which, it may poſſibly be ſuppoſed, ought to be answered.

The firſt is, that when water is found in the lungs, which it is allowed frequently to be, no contraction could then exiſt: and the ſecond, that in thoſe diſſections made on animals, the epiglottis has always been elevated, and the paſſage into the lungs been found free.

In

In answer to the first, it may be observed, that the principle of irritability continues in the body a considerable time after respiration and the circulation have ceased; and so long as it remains in the muscular fibres of the epiglottis, and those which lie about the glottis, the contraction we have been speaking of will prevail; but, after an uncertain time, when this power is annihilated, a state of relaxation ensues, the elastic cartilage of the epiglottis is then spontaneously elevated, and water is allowed an opportunity of falling into the lungs.

To the second, it will be necessary to remark, that it is scarce possible to conceive, that the body of any human being was ever opened, at least with this view, till the state of relaxation we have just spoken of had taken place; and that in other animals, it is probable, the same condition may hold good likewise: but supposing some degree of irritability to exist, we are to take another circumstance
into

into consideration; which is, the difficulty of inspecting those parts; for whoever is acquainted with the slender structure of those muscles, will readily conceive, that without uncommon care and attention in the necessary dissection, much more probably than has usually been bestowed upon it, the weak and feeble power of contraction will be destroyed; for the least pressure on the tongue, or motion of the windpipe, at this time, when the irritability is so nearly exhausted, would be sufficient to elevate the epiglottis.

Allowing then, what is, I think, clearly proved, that death is caused by a contraction of the parts about the larynx stopping respiration—it still remains to enquire, concerning the manner in which this stoppage of respiration acts, so as to occasion that effect.

This part of the subject is enveloped with many difficulties and embarrassments; and notwithstanding that it has been attended to by men of the first abilities, as
yet

yet nothing satisfactory or decisive has been advanced. The appearances on dissection not being at all times so distinctly marked, as readily to determine the part principally affected, and various circumstances having sometimes conspired to occasion a real difference in the appearances, are the causes to which this uncertainty is in a great measure to be imputed. We will, however, consider each of the principal opinions, and suggest such hints as appear either to favour or oppose the principles on which they are formed.

a. The inclosed air being rendered highly phlogisticated.

This idea, which originated with the very ingenious Dr. Fothergill, is supported thus: "Air rendered impure by being often respired, acquires the same deleterious properties, and becomes equally destructive to animals, as any other noxious air. Now, if the mere shutting out of

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the former, for a few minutes, suspends the action of the lungs, the retention of the latter cannot but hasten its final extinction. From whatever cause respiration is stopped, a quantity of phlogisticated air remains stagnant in the cells of the windpipe. This, by its sedative power, specifically exerted on that organ, by degrees destroys the remnant of irritability; and thus, though hitherto unnoticed, probably gives the coup de grace, in all cases at least of the pulmonic kind. Hence, perhaps, may be explained the disagreeable sense of suffocation, which is felt on forcibly holding the breath for a few seconds; and why, if this is protracted beyond a certain time, the intolerable anxiety which it excites, becomes at length incompatible with life."

From this quotation, it appears to me, that air phlogisticated, by remaining in the cells of the windpipe, and air rendered impure by being often respired, is to be considered as precisely the same, since air being
loaded

loaded with phlogiston, and from the same source, is the case in both instances: hence, as air thus rendered impure certainly does acquire “ the same deleterious properties, proves equally as destructive to animals, and affects them in the same manner as that noxious air which arises from the grotto del cani, fumes of sulphur, charcoal, and other bodies which exhale phlogiston or mephitic air,” it follows, that death, in both instances, is effected by the same means; and consequently we must expect to find the concomitant phenomena exactly similar. Let us see whether this is the case.

Animals who perish on breathing various kinds of noxious air, do not always exhibit precisely the same appearances; but as these seem to differ more in degree than in any other respect, it will not be necessary to make any particular distinction.

It is observed, that they are generally convulsed, and that they are killed sooner
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than by strangulation, submersion, or confinement in vacuo. It is further remarked, that such bodies, instead of becoming rigid, remain generally quite flexible, and the blood continues in a fluid state, with scarce any tendency to concretion.

Now, in every one of these articles, do drowned people exhibit the opposite effects : they are not so soon killed ; their joints do become stiff ; and experience teaches us, that their blood soon begins to coagulate.

Travellers inform us, in their accounts of the pearl fisheries, in the East and West Indies, of an amazing length of time some of the divers are capable of remaining under water, without any supply of fresh air : those who are very expert are said to continue in that situation half an hour ; while those who are not so, do not much more than exceed half that time. Whether these relations are to be depended upon as strictly true, is matter of little consequence ;

consequence ; but we all know, that those people are certainly endued with the power of retaining their breath much longer than men in general ; for, by observation, it has been found, that men usually begin to drown, after being under water about half a minute. Now, soon after this period, we should expect, according to the Doctor's theory, that the air in their lungs would become highly phlogificated ; its baleful and sedative effects must therefore be exerted on the nerves of the lungs, and the intolerable anxiety which it occasions would become incompatible with life.

To this it may be objected, that those people acquire the property of remaining any considerable time under water, by imperceptible degrees, and by long and frequent habits of repetition, and therefore that their lungs are equally as likely to resist the noxious air, as to permit the continuance of the circulation through them. This I allow ; and moreover add, what Dr. Priest-

ley, and several others, have long observed ; that animals accustomed to breathe mephitic air, will live a considerable time longer in it, than those who are not ; and that those who usually respire pure air, perish sooner in noxious fluids than other animals. In answer to these, it may be said, that although some inconvenience may arise from this circumstance, yet the ill effects divers most frequently experience, while acquiring this extraordinary capacity, do not seem to arise from the action of mephitic air on the lungs, but are evidently caused by an over distension of the blood vessels of the head and thorax ; such as hemorrhages from the eyes, nose, ears, and lungs. To me it appears extremely natural to conclude, that those symptoms which are the most urgent, would, on the continuance of the same cause, be increased so as to occasion death, rather than that that effect should be produced by a fresh assemblage of circumstances, which, as yet, has caused little or no inconvenience.

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In order to determine whether there was any difference between air which had frequently been respired, and that which had long been retained in the lungs, I made several experiments:—by expelling all the air out of my chest, and keeping the vesicles of the lungs collapsed as long as I was able ; then making a full inspiration, and immediately expiring it into a bladder ;—by retaining a certain quantity in my lungs as long as I could, and then expelling it into a bladder ;—and, by breathing a specified portion into and out of a bladder for a particular time. The air to be tried was mixed for a certain space of time with an equal quantity of nitrous air; and particular attention was paid, that the nitrous air was always of the same strength, and the water in the trough of the same temperature. The event of these experiments will be found in the following table.

		Scale of Eudiometer.		Standard		Hundred parts worse than common air.
Air of the room						—
1	Four or five inspirations immediately following :—the last	—	—	—	—	2
2	Seven ditto	—	—	—	—	2
3	A full inspiration immediately expired ; the lungs having } 20 seconds previously remained empty	—	—	—	—	8
4	Ditto, the lungs remaining empty	—	—	—	—	8
5	Ditto — ditto	—	—	—	—	10
6	Ditto — ditto	—	—	—	—	15
7	Air expelled in common respiration (17 cubic inches) *	—	—	—	—	11
8	A moderate inspiration (104 cubic inches) † retained	—	—	—	—	28
9	A full inspiration (300 cubic inches) ‡ retained	—	—	—	—	31
10	Breathed 104 cubic inches as long as I could, which was	—	—	—	—	33
11	Ditto — ditto	—	—	—	—	36
12	Retained 104 cubic inches as long as I could, which was	—	—	—	—	34
13	Breathed 104 cubic inches as long as I could, which was	—	—	—	—	37
14	Ditto — ditto	—	—	—	—	39
15	Breathed 300 cubic inches as long as I could, which was	—	—	—	—	40
16	Ditto — ditto	—	—	—	—	48

* In common easy respiration, I find that I do not take in or expel more than 17 cubic inches at a time ; many times not more than 12.
 † Although I do not in common take in more than 17 cubic inches, yet I find that the whole quantity of air, at that time in my lungs, amounts to 104 cubic inches.
 ‡ My lungs, when completely distended, for instance, when gaping, contain 300 cubic inches.

I could not prevail on myself to extend these experiments any further, on account of the great inconvenience I experienced from the sixteenth, where 591 inches were breathed into and out of a bladder, for two minutes and ten seconds, which was nearly three times as long as another person could breathe the same quantity. After the first minute, I began to experience great anxiety at my breast, which in about half a minute more increased so as to become almost intolerable: my head, which at the time the oppression at the breast commenced, appeared to be distended began now to prove so distressing as to make me almost inattentive to my former sensations: my face was so much swelled, that I could scarcely shut my eyelids; it was almost black, and felt excessively hot: every object appeared red, and sparks of fire were in great abundance dancing before me. The sight began to fail; great giddiness in the head, and confusion in the senses ensued, and at last I fell into a chair.

Breathing

Breathing the fresh air gave me instant relief, but for the space of two hours I was somewhat confused and giddy. To these succeeded a violent pain in the head, which continued the remainder of the day ; but I awoke the next morning perfectly free from any complaint.

With the intention of ascertaining, as nearly as possible, the degree of phlogistication which the air receives from the lungs of animals, in the action of drowning, and afterwards when they appeared to be dead, I put a kitten under a glass receiver, exactly filled with and inverted into a tub of water : immediately a quantity of air was visible at the top of the glass ; a measure of which being mixed with an equal quantity of nitrous air, appeared very nearly of the same degree of purity as common air. Suspecting from this, that the air was not expired by the animal, but that it was separated from its ~~hair~~, or conveyed there somehow by the hand, I repeated it several times with
greater

greater care, and I took the precaution of wetting the creature's coat thoroughly, before it was put under the receiver; but the quantity of air was the same, and, as before, very little worse than the common atmosphere. When the animals were dead, I prepared to examine the state of that air, which, according to the Doctor, remains stagnant in the cells of the wind-pipe: they were therefore very gently and carefully removed from the receiver in which they were drowned, and their heads placed underneath another jar quite filled with water: in this situation, their thorax and abdomen were properly pressed; but not one particle of air escaped.

We will now finish what we have to say on this occasion, by recapitulating what has been said, and deducing a few inferences from thence.

1st. It does not appear that drowned animals are killed by mephitic air acting on their lungs, as the appearances, at the
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time death seemingly takes place, are very different from those who inspire the same kind of air.

2dly. As the inconveniences perceived by divers, after remaining a considerable time under water, do not appear to arise from the action of phlogiston on their lungs, it is highly presumable that their death, were they to remain under water long enough to occasion it, would not be produced by that cause,

3dly. The extreme anxiety which arises in consequence of forcibly retaining our breath, is not caused altogether by the action of phlogiston on the lungs, because, from a comparison of the ninth with the fifteenth experiment, it appears that the air, in this case, is nine degrees purer than that which was frequently respired, although the quantity of air, and the time it was used (300 cubic inches for 72 seconds) was the same in both instances:
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and, by comparing the ninth with the fixteenth experiment, where the same quantity was taken into the lungs, 591 inches, but in the former was retained as long as I was able, and, in the latter, was breathed into and out of a bladder as long and as often as I could—it will be found, that the air frequently respired was seventeen degrees worse than that which was retained: and at the time I was making the experiments, I found the anxiety attending N° 16 infinitely more distressing than that of N° 9: it is therefore not an improper conclusion, that the anxiety, where the breath is retained, or fully expired, arises in a great measure from an impeded circulation through the lungs, in consequence of the motion of that viscus being suspended.

4thly. That all the air is violently expelled from the lungs the instant the animal is submersed, and that none stagnates in the cells of the windpipe; consequently,
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the death of drowned animals cannot be attributed to the action of phlogiston on the nerves of the lungs.

It would be impossible, at any rate, to pass over in silence a theory so ingenious and plausible; and moreover, as it originated with an authority so learned and respectable as that of the gentleman just mentioned, we were particularly called upon to give it a serious consideration, and ample discussion. On this account, we have exceeded the bounds at first proposed, and must therefore hasten to prosecute the further consideration of our subject.

It appears to us no way unnecessary to remark, that but few dissections have been made of drowned persons, at least very few have been published; and even these have not thrown such light on the affair as might have been expected. In several instances it has appeared, that the vessels of the brain were not turgid with blood, and in some that they were rather empty: in others,

others, no notice is taken of any collection of blood in the heart or lungs ; and, in most, no particular appearance was discoverable, which could be supposed to be the cause of death. This difference in the appearances, on dissection, may be accounted for by the length of time which has frequently elapsed before the body was opened, having given an opportunity for the blood to be more generally diffused, which it certainly will be in a greater or less degree, as the humors become cold, and the fibres consequently contracted. Harvey has an observation much to the present purpose* :

* Ego aliquando, in cadavere humano noviter strangulato, intra duas horas a suspensione, aperto pectore et pericardio (antiquam faciei rubor evanuerat) auriculam dextram cordis et pulmones, plurimum distentos et infarctos sanguine, multis attestantibus ostendi ; præcipue vero auriculam, ad maximi hominis pugni magnitudinem, turgentem adeo ut disruptum iri putares. Quæ moles die sequente, refrigerato penitus corpore, et per alias vias cruore dilapso, detumescens evanuit. Exercit. alter de circul. sanguin.

“ I have,”

“ I have,” says he, “ sometimes in a human body recently strangled, that is, within two hours after hanging, when the chest and pericardium were opened (before the redness of the face was gone off) demonstrated to many witnesses, that the right auricle of the heart, and the lungs, were very much distended and stuffed up with blood; but chiefly the auricle, to the bigness of a large man’s fist, and so very turgid, that you would suppose it ready to burst. Yet all this quantity of blood, on the day following, when the body was quite cool, had entirely disappeared, having flowed down into other passages.”—This effect will be greater or less, as the internal heat may have continued a longer or shorter time; and according to the propensity which the blood has to concrete: both which circumstances, in different people, we know, vary extremely; the former remaining much longer in one in the middle of winter, than in another during the height of summer; and the blood of
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some beginning to coagulate almost the instant it is taken away, while that of others requires half an hour, nay, even upwards of an hour, to bring it to the same state. We sometimes find the coagulum of so loose a texture, that a probe passes through it almost without resistance; and, on the contrary, we do not unfrequently see it so firm and dense, as by its cohesion to sustain its own weight on the probe. What this variation is owing to, it is of no sort of consequence, on the present occasion, to enquire: the fact is extremely evident, as well from what has been said above, as from the great alteration in the external appearance of the body—that the blood continues in the vessels, where it abounded at the time of death, but a very short time. It may further be observed, that the brain, in general, is not examined till the thoracic and abdominal viscera have been dissected; in performing which, the great blood vessels are divided, and their contents are usually poured forth

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in great abundance, so that if any congelation did at that time exist in the neighbouring parts, it will probably, by these means, be lessened, if not totally overcome. These, therefore, are to be assigned as some of the principal reasons, why the appearances, on the dissection of drowned people, are so different; nay, that they sometimes may be opposite, and yet were originally nearly the same.

From what has been said, it should appear, that we are not to expect those material assistances from the dissection of drowned people, that we might otherwise have imagined; especially at the present time, when no subject can possibly be procured, that has not lain a very long time under water; or, which is less likely to answer our purpose, those on whom means have been employed for restoring life, such as heat, friction, and motion: although they may by no means be able to effect a recovery, yet there can be no doubt, but the long persistence in their application

application may answer the purpose of overcoming any congestion, and of distributing the blood more equally throughout the vascular system.

Animals have frequently been dissected, as they are more readily procured than human subjects; and it may be supposed the inconveniences I have just mentioned will by these means be overcome, as we have an opportunity of commencing our examination as soon as we wish. But, on account of the inequality of the skull, the membranes, and even the substance of the brain, have often been cut into, on sawing through the cranium; and, for want of making frequent dissections of animals who have died from different causes, we are, in a great measure, at a loss in forming an accurate opinion of the matter.

Having premised these few observations, we may, I conceive, be enabled the more readily to understand why opinions have varied concerning the manner in which death is produced, and it will likewise

assist us, in some measure, in finding out the true cause : whether it be—

b. Suffocation, or

c. Apoplexy.

Of those who are of the former opinion, Dr. De Haen stands theforemost; and, as this gentleman professes to have formed his opinion from the appearances on dissection, it will be proper to attend to what he has advanced in support of it.

On dissecting a woman who had remained several hours under water, all the parts of the lungs and breast remained entire. Upon pressing the lungs, the water which had made its way into them, evidently regurgitated by the windpipe: the lungs were entirely black; and the heart void of blood.

On opening the bodies of eleven dogs, which were drowned for the purpose, Dr. De Haen, in the second chapter of his *Ratio Medendi Contin.* informs us, that,
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in seven instances, water was inspired into the lungs; in two, the lungs were free; and in two, the membranes of the brain and lungs were inflamed and distended. In the fifth chapter of the same book, we are told, that on opening four dogs which were drowned, evident marks of congestion were found in the lungs, but no appearance of any in the brain. From his experiments and dissections, he deduces several conclusions, and among them this, “that when the brain appears affected, after hanging or drowning, it must be ascribed to an old head-ach, or some chronic disorder.”

As it is generally agreed, that the stoppage of the motion of the lungs is the first internal efficient cause of death, let us consider the effects which reason teaches us must inevitably follow the cessation of that important action.

The blood returning from all parts of the body, by the superior and inferior venæ cavæ, is collected in the right auricle

cle and ventricle of the heart; from whence, in a state of health, it is transmitted through the pulmonary artery and veins, into the left auricle and ventricle; but, in the present instance, the motion of the lungs being stopped, only a small quantity can pass through that viscus, so that the right auricle and ventricle soon become full and over distended: in consequence of this, the right sinus venosus, and the venæ cavæ will not be able to empty themselves, and the blood will be accumulated throughout the whole venal system; but as the quantity of blood sent to the brain is infinitely larger in proportion than to any other part of the body*, it necessarily follows that the ob-

* The quantity of blood sent to the brain is estimated differently by different authors. Malpighi says it is at least one-third; many estimate it at a sixth: Dr. Monro will allow that only one-tenth of the whole mass circulates within the head, which is, according to him, nearly four times more than in any other equal portion of the aortic system.

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struction of the vessels of the head, and the symptoms depending upon it, will take place sooner, as well as be more remarkable, than in any other part of the body. And if to these considerations we add the exquisitely fine texture of the vessels of the brain, which far surpasses that in any other organ, we shall consequently be led to conclude, that the effects cannot fail of being more considerable. The jugular veins therefore, and the sinuses of the dura mater, which immediately communicate with each other, cannot possibly expel their contents into the superior cava, because it is already filled; and the same cause being extended to the tender and delicate vessels of the brain, will compress its substance. Hence its faculties will immediately be affected, its functions interrupted, and, finally, its influence over the rest of the vital, as well as the natural and animal actions, must either be suspended or entirely destroyed.

We will now observe how far these circumstances are verified by actual practice; and how far the symptoms, in similar situations, and the appearances on dissection, favour or oppose the theory we have delivered.

In all those drowned people which I have had occasion to see, the face has been remarkably swelled, and of a dark red or livid colour ; the eyes violently suffused with blood, enlarged, prominent, and sometimes so protuberating, that the eyelids seemed insufficient to cover them ; the features of the countenance generally distorted ; and the tongue in part thrust out of the mouth. I appeal to those who have been in the habit of seeing drowned people, whether this is not their usual state : and I ask, if it is possible to proceed from any other cause than apoplexy, or an enormous distention of the vessels of the head ?

There are but few cases in the reports of the Humane Society, where notice is
taken

taken of the patients account of their sensations in the act of drowning, and those are but slightly mentioned. It is said, however, that on falling into the water, they immediately lost their senses, and had not the smallest recollection of what passed, till they appeared tolerably recovered. Not a word is mentioned of oppression, or even anxiety, at the breast, or any one symptom which can induce us to think that death took place from a cause residing in the chest : but the senses every one agree in allowing to be dependant on the brain; the loss of them, therefore, must be owing to its diminished energy.

Their symptoms at the time of recovery, and after life has returned, require our attention, as those parts which have suffered most from the accident, will exhibit symptoms of injury some time after recovery, and in this manner may probably indicate the part principally affected by drowning.

Before

Before I attend to those cases which are generally known, I will notice one which happened some time since under my own direction, and is quite in point. A man fell overboard, and was taken up without any symptom of life: his pulse and respiration soon returned; some glimmering of sense was likewise evident, but in a few minutes he fell into a profound apoplectic fit, from which I expected he would never recover: when, however, he did recover, there was no cough or uneasiness about the chest; but the head remained heavy and confused for some time.

One hundred and two cases are mentioned, where the symptoms, at the time of and after recovery, appeared to arise evidently in consequence of the head being affected: and thirty-nine shewed symptoms of some part within the thorax being injured; it is to be remarked, however, that in the greater number of these, symptoms of the head being affected occurred

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at the same time ; several of them therefore, with equal propriety, might be placed under the former head.

From this account it appears, that the brain is generally affected ; but that, now and then, the heart or lungs seem to sustain the principal mischief.

That oppression at the breast, with pain and difficulty of breathing, should sometimes occur, is surely as little as can be expected, from the distention which the heart and lungs suffer in the act of submersion ; and in proportion as those parts are more or less weakened or diseased, the effects will be more or less severely felt. There are few people in whom the lungs are perfectly sound : when that is fortunately the case, little inconvenience, I apprehend, would arise ; but in those whose heart or lungs have long been in a morbid state, such, for instance, as have been affected with angina pectoris, asthma, consumption, &c. death may very probably sometimes take place, by rupturing some
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of their vessels, before a sufficient quantity can be accumulated to occasion a fulness of the brain.

I never had an opportunity of dissecting any person who was drowned ; and I acknowledge I do not recollect to have read of one instance where such appearances were discovered, on dissecting the brain, as were sufficient satisfactorily to account for death. But although this be allowed to be the case, at the time of examination, it does not necessarily follow, that such a cause did not exist at the moment of death, or in the state I have just described, soon after that event has taken place. But enough has already been said on this head, to account for the different appearances which occur in different subjects, and for the absence of those appearances, the absolute existence of which has hitherto been looked upon as necessary to confirm the opinion I am endeavouring to establish.

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It will, however, be remarked, that one circumstance is as yet unaccounted for ; which is, that in dissecting those who have died of apoplexy from other causes, blood or serum has generally been found extravasated within the skull ; and from my own account, similar appearances have not been observed in examining the heads of those who have been drowned. I am well aware, this is the most important objection which will be raised against this theory. It has, indeed, hitherto been deemed a decisive and irrefragable argument against it, and, so far as I am acquainted, remains unanswered : but I am of opinion, if we attend properly to the subject, we shall find this argument will lose much of its weight, if not be entirely overbalanced.

In every apoplexy which arises from an internal cause, a predisposition has existed for a longer or shorter time : hence the vessels of the brain must necessarily become weakened and relaxed ; they are, consequently, more readily ruptured, and
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their contents effused, when the force of the circulation through them is by any means considerably encreased. For this reason, it is probable, that the same cause which produces extravasation in the brain of one previously disposed, would, in another, the vessels of whose brain are in a healthy, strong state, produce only a congestion or over distention of the vessels of that part. Indeed, I am much inclined to be of the opinion, that extravasation from an internal cause has never, in any one instance, taken place where a disease in the vessels, or some other predisponent cause, did not exist. If, therefore, such predisposition was present in a person who was drowned, effusion would, I have no doubt, just as readily happen, as when the circulation through the brain is obstructed by any other means ; but if no such cause was present, then the natural strength and elasticity of the vessels would be sufficient to prevent any such effect from taking place

Compression,

Compression, I mean from internal causes, may arise from two sources—extravasation, and fulness of the vessels: both of these, if slight, will produce nearly the same effects, only those of the former will depend in some measure on the part where the effusion happens; while the latter, acting generally, will affect the whole substance of the brain, and every part of it will suffer; but if the extravasation is considerable, then every part will likewise be affected: and [thus the two causes ultimately operate in the same manner.

That the functions of the brain are impaired or destroyed sooner by compression than any other cause, appears from a variety of causes; for why, otherwise, should the most alarming symptoms often succeed a smart blow on the head, and cease, frequently, almost instantly, on a few drops of extravasated blood being evacuated by a perforation made through the skull? and, on the other hand, in those accidents with bad and extensive fractures,

which originated from a much more violent cause, where not only the cranium has been depressed, and the membranes lacerated, but where even a considerable portion of the bone, membranes, and substance of the brain itself, has been destroyed, no alarming symptoms whatever have followed, and a cure has been effected with but few inconveniences. How can we account for the effect being so disproportioned to the cause, but by attributing it to the greater degree of pressure which the brain suffered in that case where the bone was found, than in the other where there was a large opening for the blood and serum to be discharged, and thus preventing any considerable compression?

A disproportion is, by several anatomists and physiologists, supposed sometimes to exist between the brain and the cavity of the cranium; and that it is so, in some degree, seems probable, from considering that the sutures of the skull are now and then found closed in young people before the

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the head has arrived at the full size; hence its cavity is with so much difficulty enlarged, that it is possible it may never be able to attain its natural capacity: the brain, therefore, will either be stunted in its growth, or pressed closer and firmer to the inside of the skull than it naturally ought to be. To support the propriety of this supposition, we appeal to the observation, that the inner part of the skull of some people is much more furrowed than others of the same age; and this difference may be accounted for, by allowing the brain and dura mater to be pressed much closer to the bone in the one person than in the other. These indentations, when considerable, prove, that the parts must have been in that situation a long time: but as we have reason to believe that the water which is found in the ventricles of the brain, varies in its quantity, being sometimes very little, and at others in greater abundance; we see the disproportion may be on some occa-

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fions merely temporary, or at least of no material continuance. Now, allowing these circumstances to be true, and to the best of my knowledge their reality has never been disproved, it follows, that at a time when the bulk of the brain is by any means increased, so as to be firmly compressed by the skull, a smaller degree, either of extravasation or fulness of the vessels, will produce exactly the same effects as a greater, when the brain is in a contrary state, or when it does not so completely fill the cavity of the skull, but that it might allow of being somewhat distended, without any considerable compression ensuing. This, in my opinion, proves very fully and satisfactorily, not only why the distention of the vessels of the brain may occasion the same effects as effusion, but why extravasation may produce only the lighter symptoms of apoplexy in one, while an over-fulness of the vessels shall occasion death in another.

As a corroboration of what has been said, I may observe, that several instances of
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strongly marked apoplexy have occurred from various other causes, both to myself and others, where, on the strictest scrutiny, not the least degree of extravasation could be found ; but in some, the vessels have been remarkably turgid, and in others scarce any preternatural fulness could be perceived.

The event of my experiments on kittens, have turned out differently to those of Dr. De Haen ; for the brain being examined a few minutes after death, its vessels were loaded with blood : and extravasation, both under the dura mater, and into the ventricles, appeared so evident, that for some time I entertained no doubt but it had really taken place ; and had I been more intent upon establishing a favourite doctrine, than in strictly and scrupulously investigating the truth, I should have acted imprudently in giving up such an important argument, by making it known that I was mistaken ; for if the head be examined immediately after death, the blood,

at that time being fluid, accompanies the knife, falling into every cavity and recess, before you can possibly see them in their natural state, and thus affords the strongest and most lively resemblance to extravasation, sufficient to impose on almost any one. On repeating the dissection, however, a great many times, with great care, and at different times, I at last discovered the deception; and am now convinced, that extravasation did not in any one instance exist, but that a great fulness occurred in all, except one or two; and that it was not so remarkable in them, was probably owing to the examination being deferred longer in them than in the others.

Should those who are of the same opinion with Dr. De Haen, object to these experiments, as not being sufficiently conclusive, let them recollect, his experiments are liable to precisely the same objections; for, in several of the animals I dissected, and even in those where the congestion remained in the head, the heart and lungs
were

were flaccid, and contained but little blood: and the Doctor himself, in his *Pathological Observations*, giving an account of a drowned woman, says the heart was "void" of that fluid.

It seems to me, that sufficient has already been said on this head to satisfy the greatest unbeliever, that persons who die by drowning, suffer from apoplexy: but, lest any such should still remain, and especially as this question has never been settled before, we will consider the state of the body in two or three situations which arise from similar causes, and are in their effects nearly the same as that we have been treating of; and, as I am persuaded the more this subject is investigated, the plainer and more evident will this circumstance appear, we may reasonably expect it will derive additional confirmation from that source.

The situation of the strangled appears to be very similar to that of the drowned, since the death of both is usually ascribed

ed to the same cause—the stoppage of respiration; although the manner in which it is effected remains a disputed point. As we shall have occasion to attend more particularly to this subject in another place, it will only be necessary at present to observe, that as the appearances of those strangled by the halter, immediately on being cut down, exactly resemble those of the drowned, and as their death, and the manner in which it is effected, is by De Haen, Haller, &c. allowed to be exactly the same—it follows, that the appearances which present themselves on the dissection of the one (the presence of water, of course, being out of the question) will be nearly applicable to the other.

Morgagni, in a madman who had been strangled, saw the vessels of the dura and pia mater distended with black and fluid blood, and the ventricles contained a large quantity of turbid serum. He observes, that Littre, in a woman who had been strangled by two men grasping her throat, found

found blood extravasated on the basis of the cranium, and into the ventricles. In a thief, whom Pet. Nanni dissected, and at which Morgagni was present, the longitudinal sinus of the dura mater was ruptured: and Lancisi saw, in persons who had been strangled, bloody points which appeared in great abundance, and variegated the white substance of the medullary part of the brain. To these I will add but one more, and which is from De Haen: in this he mentions, that the pia mater was very red; under the tunica arachnoidea, a quantity of whitish serum was found, and the brain appeared interspersed with many red vessels.

These instances are, I presume, very sufficient to shew, that the persons in whom these circumstances were found, died in consequence of the affection of the brain. Now, if the external appearance of drowned and strangled people so exactly resemble each other; and if their cause of death, and manner of dying, is

one and the same, it certainly affords a strong presumptive argument, that, *cæteris paribus*, the appearances on dissection might prove nearly the same in both.

In the inflammatory angina, the parts about the larynx are sometimes so much swelled, that respiration is much impeded, and the lungs in consequence cannot have their usual play. Hence the blood is collected in the right auricle and ventricle; and if the disease gains ground, the same effects follow as were related at page 37, 38, and 39, and the patient will be in the same state as the drowned, and those suffocated with the halter. That this is not ideal, but that it is founded on experience, is a fact too well known to admit a doubt. From those, therefore, who attribute the death of drowned people merely to congestion about the heart and lungs, I would beg to be informed, how it comes to pass, that patients in the inflammatory angina have their face, lips, and tongue, so much swelled; their eyes inflamed,

inflamed, and ready to start from their sockets ; and why the senses of seeing, hearing, smelling, and touching, are gradually destroyed, and at last they die perfectly apoplectic ? Was death produced in the way they conceive it to be, not one of these symptoms could happen ; for the heart and lungs being overwhelmed with blood, would occasion death, before any affection of the brain could take place.

In the action of laughing, the lungs are dilated, and remain almost in the same state till the cause ceases ; but while it continues, the blood cannot be transmitted freely through the lungs : hence we easily account for the redness and swelling of the neck, face, and head ; and if the passage through the lungs is long impeded, the brain suffers, and apoplexy ensues ; which has, on many occasions, ended fatally. Cases have often happened of violent straining, and fits of coughing, which are attended with a full and long continued inspiration, terminating in the same manner ;
and

and finging, or crying, produce fimilar effects, although it feldom happens they are carried to any dangerous excefs.

Instances, almoft out of number, might be brought forward in fupport of thefe arguments ; but enough has furely been faid to fatisfy the doubts of the moft incredulous, and fix the wavering mind of the moft incorrigible fceptic.

ON THE UNCERTAINTY OF RECOVERY,
AND ITS PROBABLE CAUSES.

WHOEVER has paid the slightest attention in the perusal of the records of the Humane Society, cannot fail of being astonished at the different events in the majority of the cases there related. Some we find have been restored, who were submersed for half, nay, three quarters of an hour * ; several revived spontaneously ;

* Cases 103, 165, 350, 420, 547 *d.* (1) (11).

In referring to cases of recovery, I propose to confine myself as closely as possible to those which are to be found in the Reports of our own Society ; the circumstances of which cases may at any time be examined into, and the truth of any remarkable or uncommon incident readily ascertained. Only three quarters of an hour are there recorded as the longest extent of time that a person was in the water, who
was

neously ; and some required uninterrupted
 perseverance, in the usual methods, three
 or

was afterwards recovered. This happened only in one out of upwards of six hundred successful cases ; and he floated on the surface of the water during the whole of the time. Rare and extraordinary as this length of time certainly is, yet it is nothing when compared with several cases which are to be met with in medical histories. Kuncknel informs us of a young man remaining perfectly alive for two hours under water. Langhanfius, of a woman who was under water half a day, and was recovered in a short time. M. D'Egely, of a Swiss diver, who remained in the same state nine hours. Pechlin, of the Tronningholm gardener, that was sixteen ; Alexander Benedictus, that was forty-eight hours. Tilarius, librarian to the King of Sweden, wrote the history of a woman who was three days under water ; and Kuncknel, of one three days under the ice, who, when found, appeared full of vigour. The same author says, I am sufficiently sensible, that in Sweden, no one doubts the possibility of retaining life under water for eight days. He then relates the case of a painter who fell into the water, where he remained eight days ; at the expiration of which, he appeared alive on the surface. Gocellinus, nephew to an archbishop of Cologne,
 fell

or even four hours*, before evident symptoms of reanimation appeared: some, with the intention of destroying themselves, have plunged into the water while, it is natural to imagine, their mind must have been extremely agitated: some have fallen in during the paroxysm of an epilepsy†: and others have lain a considerable time, from half an hour to an hour and a half, when

fell into the Rhine, and was not found for fifteen days; when, being laid in a church, in order to be interred, he soon returned to life. The last case I shall notice, is that mentioned by the celebrated Mr. Burrmann, of a man who continued under water seven weeks, notwithstanding which, he not only recovered, but enjoyed a good state of health for a great many years after. Although most of these stories are attested and vouched for by men of sense and eminence, it is perfectly unnecessary to say, they are by far too extravagant to deserve the least credit. It is highly probable, however, that there has been some foundation for them, and that several have been observed to recover, who have laid a considerable time under water, and appeared to be dead.

* Cases 410, 420, 493, p. 165.

† Cases 150, 274.

they

they were taken up without any means being used for their recovery*. Add to these, that the aged†, and many others of whom there were little hopes, have been recovered: while, on the opposite side of the question, we are informed, from indubitable authority, that one subject had been scarce a minute‡, and several not more than five minutes, in or under water, who were not recovered. Others we find, with youth, strength, and apparently a good constitu-

* Cases 21, 49, 81, 265, 409, 487, 488, 489.

† Cases 19, 276, (6).

‡ Case 264.—Dr Houlston, who saw him drowning, gave him immediate assistance, and saw the means applied above two hours, with persevering assiduity.

A captain of the navy, who was present when the accidents happened, informed me of two men belonging to the Crown storeship, who fell overboard, one a marine, whose head was not under water half a minute, the other not more than a minute, before they were taken up; and notwithstanding the surgeon immediately commenced the operations recommended by the Humane Society, and persevered in their application a considerable time, yet they neither recovered!

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tion in their favour, who have had the usual method of treatment immediately employed upon them, and have been irrecoverably lost! From whence then, it is natural to ask, does this difference proceed, and to what cause is this uncertainty to be attributed*?

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* It is evident, that in by far the greater number of cases, it was not possible to fix on the precise time the person was under water; and the accounts of the different people concerned, in general, so greatly vary, that it is no very easy matter to reconcile them: under these circumstances, I fear it is the natural bias of human nature, to incline towards the most remarkable.

Sufficient attention has not been paid to the situation of the person, whether he was under the water, or whether he only floated; although, it is plain, this may make a very material difference, as in the former case respiration is impossible, whereas in the latter it may sometimes take place. This article, which indeed is extremely evident, is placed beyond doubt by several cases communicated by Dr. Houlston of Liverpool: that gentleman mentions no less than eight instances of persons, who, after sinking several times,
have

In many instances this difference is readily accounted for. If, for example, the person, previous to the accident, had indulged in eating to an excess, a much larger proportion of blood must be sent to the head, than ought naturally to be there; if he has drunken, so as to cause intoxication, the vascular system will be more distended, the determination of blood to the brain will be proportionably encreased, and death, in consequence, be much more easily brought about. Again, if the person did, at the time of or previous to the accident, labour under any disorder, it is natural to conceive, that the powers of nature would be sooner overcome. The event in these cases, I say, is readily to be accounted for; but not so those who, at

have floated for the space of ten minutes, and been taken out with evident symptoms of life; three were in the same situation for fifteen minutes; and some who had been in the water a longer time, seemed at first only in a doubtful state. See Cases 263, 262, 264, 152, 337. Reports for 81, pages 101, 102, 103.

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the time of the accident, are in a state of apparent good health.

Having, in a preceding chapter, investigated the cause of death in drowned people, it follows, whatever that cause may be, that, according as the constitution of the person was less or more predisposed for such a state, he will bear being a longer or shorter time under water, before the real state of death takes place. What we have already advanced on this part of the subject, seems to have clearly demonstrated, That the general and most prevailing condition of the body, under these circumstances, is a compressed state of the brain, and consequent apoplexy ; therefore those who, at the time of the accident, have any cause existing in their habit, which predisposes the body towards a compressed state of the brain, or an apoplexy, will be the persons who must first lose the appearances, at least, of vitality. On this account, it will be proper to enumerate those peculiar circumstances, which have been observed to

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occasion

occasion a predisposition to that affection ; and, as the manner in which they may operate, so as to produce that effect, will, I imagine, be readily understood, I shall satisfy myself with merely mentioning them, and refer those who require any further information on this part of the subject, to the numerous writers on that disorder.

Large heads.

Short necks.

Corpulency.

Indolent life, with full diet.

Frequent intoxication.

Plethoric constitution.

Suppression of usual evacuations.

Advanced state of pregnancy.

Polypous concretions.

Tumors within the skull.

Hydropic diathesis ;

In those especially above 50 years of age.

Apoplexy

Apoplexy sometimes comes on very suddenly, and without any warning: it is, however, frequently preceded by various symptoms, which indicate the disease to be at hand. When it is known any of these have appeared, in constitutions predisposed, previous to the accident, and where any of those causes which have usually been observed to excite that disease have occurred, we have, I think, every probable reason to expect, that such person will almost immediately cease to shew any appearances of life.

The principal antecedent symptoms, which are enumerated by authors, are the following :

Frequent fits of giddiness, or swimming in the head.

Tingling, or transitory numbness in the limbs.

Singing in the ears.

Great dulness.

Frequent fits of incubus.

Frequent head-achs.
 False vision.
 Loss of memory.
 Deep sleep.
 Troubled dreams.
 Great fulness of face.
 Frequent interruptions of seeing and
 hearing.
 Faltering in speech.
 Drowsiness.

The exciting causes are :

Violent exercise and exertions.
 Passion.
 External heat.
 Intoxication.
 Long stooping with the head down, or
 any impediment to the regular and
 customary return of the blood from
 the head to the heart; whether from
 external compression, or from internal
 spasm, obstruction, debility, or other
 hindrance to the action of the ves-
 sels

sels in the vicinity of the heart and lungs.

It would be easy to point out the mode in which all and every one of these causes act, so as to induce a state of apoplexy: accounts of these are, however, so very generally to be met with in authors who have written on this affection, that it will be perfectly unnecessary for me to enlarge upon them in this place.

Some cases are related, where, on recovery, greater inconveniences were experienced from an affection of the lungs, or some part within the chest, than in the brain: this, as was said before, in all probability was occasioned by the disease in those parts; and as we have seen, that the blood is accumulated in great abundance in the right auricle and ventricle of the heart, and in the pulmonary artery, before the brain suffers, it follows, that if any disease exists in, or is intimately connected with, those vital organs, death will very soon be brought

about, either directly and immediately, from a rupture of some of the parts in the thorax, or else secondarily and consequentially, from the compression of the brain being effected sooner, and with greater difficulty removed; hence, as every disease to which those parts are subject, impedes either the circulation or respiration, their presence must, according to their violence, in a less or greater degree expedite the fatal event: either in one way or the other, therefore, or by a concurrence of both, may be explained the manner in which all the diseases affecting the heart, lungs, or great blood-vessels, conduce to affect the brain.

Various other circumstances do likewise occur, and those not unfrequently, which may either materially impede, or totally prevent the recovery. These are—
1st. Intoxication. A moderate quantity of liquor, in habits not over irritable, would probably be not only innoxious, but, by increasing the vires vitæ, might act as a preventive: but how nearly intoxication
resembles

resembles apoplexy, is well known to every one; indeed, when carried to excess, it constitutes one of the most violent species of that disorder. The brain, therefore, being already compressed, and the body debilitated, a short immersion would soon occasion the vital actions to be suspended.—2dly. Great distention of the stomach, either from a hearty meal, or from a large quantity of water being swallowed: this, by acting in a manner similar to what was mentioned at page 5, although it may not produce the effect there described, will, by interrupting the flow of blood to the inferior extremities, detain it longer in the vessels of the brain than would otherwise be the case.—3dly. When the person has sunk in very deep water, the additional pressure on the surface of the body will sooner repel the blood to the heart and lungs.—4thly. When the accident has happened in very cold water, or when the body, on being taken up, has lain for some time exposed to the cold, damp air; under

these circumstances, the vessels of the trunk and surface being suddenly braced, an over-proportion of blood will be sent into the vessels of the brain, which vessels cannot be so much affected by the cold, on account of the intervention of the cranium. Cold, beyond a certain degree, acts in every constitution as a sedative, but sooner and more powerfully when the body is by any means debilitated: thus, those who are weak from preceding disease, from fasting, fatigue, evacuations, or a debauch, appear to suffer principally from cold.—5thly. Extravasation within the cranium. Although this has not been proved by dissection, yet there can be little doubt but it does sometimes take place, especially when disease in the vessels, or several of the predisponent causes of apoplexy, have occurred: when this does happen, except it be in the most trifling quantity, I do not perceive how a recovery can with any propriety be expected, for it does not appear that there is any possibility of removing the cause;

and

and till that can be effected, must not all our endeavours to reanimate prove ineffectual? But, as there is no indubitable symptom, by which we can be certain when this circumstance does exist, we should by no means, on a presumption that it may be the case, quit our operations till the full time directed by the Society is elapsed.—6thly. Contusions on the head or stomach often happen on falling into the water: it is impossible to know what injury is occasioned by these; but, as even trivial blows on the head seldom fail of producing giddiness, or momentary confusion in the senses—and as a smart blow on the stomach has often occasioned instant death—the chance of recovery will certainly be less, especially when the contusion has been considerable.—7thly. Epilepsy, palsy, and other affections of the brain. As in the brain of epileptic patients there is often found tumors, effusions, and various preternatural appearances; and as a fit is often induced by any great emotion of the

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mind,

mind, especially terror; death may very likely be precipitated by one or both of these circumstances. Dr. Cullen is of opinion, that the apoplectic state, which in some degree accompanies, and almost always succeeds, an epileptic paroxysm, does not depend upon compression, but upon a certain state of immobility of the nervous power: his method of reasoning may therefore account why some, who were submersed for a few minutes *, during a fit, have been, contrary to what might be expected, taken out with some symptoms of life. The intimate connection between palsy and some other diseases of the brain, and apoplexy, is apparent from their running so frequently one into the other; and this is a sufficient reason for presuming, that those people who labour under these diseases will soon suffer.—8thly. Improper treatment. The practice of suspending by the feet, although recom-

* Cases 150, 274.

mended by Dr. De Haen, and very lately in the Reports of the Humane Society, is, as well as rolling in or over a cask, by no means so frequent as hitherto : still, however, they are both, in the absence of medical men, sometimes practised ; and in the hurry and confusion which generally accompanies these accidents, the drowned, while carrying on shore, and removing to a convenient spot, is but too often laid in such a position, that his head is thrown either on the breast, or almost on the back. Suspension by the feet will undoubtedly increase the pressure on the brain : rolling over a cask, and similar rough usage, will produce the same effect, and may likewise tend to destroy the organization of the brain, and other vital parts : and where the neck is either bent forwards, or extended backwards, the passage of the blood through the jugular veins will be prevented, and the vessels of the brain will remain over distended.

We have thus accounted for a great number of instances that may be expected to turn out unfavourably, in a very short time : still, however, it remains to shew, what we are to apprehend in those who neither appear to be disposed to apoplectic or thoracic complaints, nor to be in the situation of those we have just described.

It appears to me, and I have long been of the opinion, that this circumstance may be explained by the difference in the constitution of the persons affected.

Have we not every day, in the course of our practice, occasion to observe the different effects the same medicine has on different patients? Do we not know, that one person shall require ten or twenty grains of emetic tartar, to produce the same effects which a quarter of a grain will in another ; and that a dram of jalap does not purge some more than a few grains of rhubarb do others ? Do we not see that one of a phlegmatic habit will bear a severe electrical shock half an inch long, equally
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as well as another of an irritable habit will one of the tenth of an inch ? Ten drops of the thebaic tincture will procure as much sleep for one, as the same number of grains of the extract will in another : a pint of wine will intoxicate one man, while another will drink more than a couple of bottles, and feel little or no inconvenience. That bark sometimes purges, and at other times binds ; that acrid humours, or worms in the intestines, occasion violent convulsions in one person, and not in another, is known to every one. I have known two grains of calomel throw a woman into a salivation ; and I have given upwards of half an ounce of calomel, and used near two ounces of the strongest mercurial ointment, to a child eighteen months old, without producing *any* perceptible effect : and in this way might we go through the whole materia medica. What then can these uncertain effects depend upon, but the lesser or greater degree of irritability of the moving fibres ; or, in other words, on the difference

difference in the constitution? Is it not therefore in the highest degree probable—may we not go still further, and say, is it not evident—if the same medicine produces different effects in different persons, that, upon the same principle, submersion must be longer in destroying animal life in one than in another?

The doctrine of temperaments, or constitutions, has of late been much disused, owing to the ancients having distinguished them according to the nature of the humours, which they conceived to be predominant, and in which they conceived the cause of all diseases to reside: thus we have the—choleric, phlegmatic, sanguineous, and atrabilious—the hot, cold, moist, and dry temperament, according as bile, phlegm, blood, or atrabilis, was supposed to abound; or as it was believed to possess a greater or less degree of heat, or a larger or smaller proportion of watery fluid. The phenomena of the animal economy being now much better explained,

by considering the state and affections of the solids, or moving powers, that distinction, with the system on which it was built, is at this time pretty generally discarded. Some mode, however, of distinguishing the different states of the body, in different people, is, without doubt, very useful on several occasions; indeed, without having recourse to some such method in the present instance, I shall not be able to make myself properly understood:—but, as I do not recollect any one who has professedly treated on this subject, since the humoral pathology has been exploded, it appears really necessary to form some arrangement, consistent with the system of the present day, which refers every thing to the solids, and views the fluids merely in a passive light. Much as I believe this to be wanting, it is far from my present intention to enter particularly, or extensively, into the consideration of this subject; all I wish for is, to make myself perfectly intelligible, and to enable others,
who

who are inclined to pay attention to this part of their profession, to decide, with tolerable readiness, to which class those persons, who may fall under their direction, are to be referred. But to do this, I find, that however averse I may be to introduce new terms, yet, under the present circumstances, some such become indispensably requisite: without any further preface or apology, therefore, I shall take the liberty to distinguish the temperament, or constitution, into the three following classes.

- I. The *Tonic*—indicating strength, firmness, and vigour in the muscular fibres.
- II. The *Atonic*—denoting weakness, relaxation, and inactivity.
- III. The *Irritable*—exhibiting quick, lively, and impetuous motions.

I find myself unequal to the charge of conveying that perfect, clear, and distinct idea,

idea of these different constitutions, that I would wish to do : words, however well selected, or in whatever manner they may be combined, appear to me not sufficiently expressive ; although it is certain, that every one who attentively engages in the actual exercise of the medical art, forms to himself a tolerably distinct perception of them, and regulates his practice accordingly. Having therefore given the outlines, I might probably be induced to leave them to be filled up by the skill of the reader : as this, however, would be quitting the subject in too unsettled a state, I shall briefly mention the leading circumstances ; for the minutiae, after all, must be left to the discretion and taste of every individual.

In the *Tonic* constitution, the make is strong and robust ; the muscles firm, large, and distinctly marked, covered either with a small or moderate quantity of cellular membrane ; the hair dark, thick, and a-

G abundant ;

bundant; their complexion dark, and sometimes red, with a firm, or fierce, and reddish eye: the external veins are many and large; and their pulse is slow, full, and strong. They are not quickly excited, but their actions are vigorous; they are laborious, capable of great exercise, and are of vast strength. Their temper is generally very equal; hence they are either friendly and sincere, or quite the reverse; and, if offended, revengeful and inflexible: their spirits are good and regular; their sensibility not in the extreme. The diseases to which they are subject, are almost always of the inflammatory kind; and they are very violent when they do occur, as the strength of the constitution prevents their being affected by trivial causes.

The *Atonic* constitution is entirely and exactly the reverse. They are weak, often corpulent, and their muscles, although they may be large, are soft and flaccid, having a large quantity of adipose mem-

brane interspersed among their fibres. Their countenance is heavy, and void of expression, of a pale, fallow, or white hue; their hair thin and light; and their eyes dull. The external veins are few, and small; and the pulse soft and low. Their perseverance in pursuits is sometimes astonishingly great; but they are in general indolent, and of a pliant disposition. They are dull, and unthoughtful: their sensibility is but little; and such people are supposed to be peculiarly inclined to cowardice, fear, and avarice. They are subject to all the diseases which depend on relaxation, which are therefore more obstinate and tedious, than severe or violent.

The *Irritable* constitution is by far the most common. The make is usually delicate and slender; though there is sometimes a good quantity of adipose membrane. The features of the countenance are strongly marked: the skin is commonly fair, soft, and delicate; the eyes

keen, penetrating, bright, and clear, often blue, and the pupil frequently dilated. Their external veins are not remarkable either in number or size; the pulse contracted, frequent, and easily quickened. Their disposition is lively and enterprising: all their senses are extremely acute; and their passions are readily excited: they are light, inconstant, and fickle; their spirits are either very high or very low; and their propensity for pleasure is very great. Their diseases are principally of that kind which is called nervous; but they are subject to glandular complaints, scrophula, and consumption.

It is impossible to suppose, that every constitution we meet with, will fall immediately under any of the above heads; on the contrary, it is to be expected that very few will occur, so distinctly marked as to belong to one only; we shall find they are in general much blended together, yet not so much confounded, but that with attention we shall readily be able to

to determine which is the most predominant, and consequently to which class it ought to be referred.

We cannot but observe, in the tonic temperament, the general concurrence of every circumstance which can contribute to the action of the heart and arterial system. Such people are also in a state very nearly allied to a plethora; hence the blood circulates with such force, as to occasion hæmorrhages from many parts of the body; and the brain, from the superior delicacy and fineness of its vessels, being likely to have a superabundance of blood in it, will likewise be disposed for hæmorrhagy, and will easily be compressed, if not ruptured, as soon as any cause is applied which prevents or obstructs the circulation through them. As submersion, therefore, produces that effect, this is the constitution which will be most likely to suffer soonest.

We have seen the various effects the same articles have on different people;

and if we attend, shall find those who are the most easily affected, are such as have their nervous system very sensible and delicate. This state of the nerves peculiarly constitutes the *Irritable* temperament.

The mind, likewise, of people belonging to this class, are as easily irritated as their bodies ; all their senses, as was said before, are extremely acute ; their passions are readily excited, they are much agitated by them ; and they suffer the most from the violent transports of the soul. All their passions are carried to an excess, and we are frequent spectators of the alarming consequences produced by them.

Of all the violent emotions of the mind, terror seems to be productive of the most serious and fatal consequences ; violent tremors, palpitations of the heart, fainting, and convulsions, we every day meet with from that cause. Insanity, loss of speech, epilepsy, palsy, apoplexy, and sudden death, are but too often found on
record,

record, to allow the least doubt of their frequently happening. From the paleness of the face, the lividity of the lips, and the palpitation of the heart, it seems probable, that a contraction of all the small vessels instantly takes place, and that the blood is thrown upon the heart and lungs so suddenly, as to put an immediate stop to their motion. The proximate cause of death in these cases, however, has not been clearly ascertained by a sufficient number of dissections ; but the symptoms indicate the brain to be affected ; and as the jugular veins have been observed to be remarkably distended and puffed up ; as the vessels of the brain and pia mater have been found loaded with blood ; as much serum has been extravasated, both into the ventricles of the brain and between its membranes ; and, especially, as some people have been thrown into a perfect apoplexy ; it is highly presumable, when it does prove fatal, that the patients die apoplectic.

The horror and distress a man must suffer, consequent to falling into the water, where inevitable destruction is so very evident, can more readily be conceived than expressed; and it is very likely that, in every instance, it may in some measure tend to expedite the fatal event: but when the unfortunate subject is of that habit just described, which we know to be peculiarly disposed for the most violent exertions of the passions, and in which it is apt to produce the greatest effects, it is evident that their death will be very considerably accelerated by it, especially as it seems to operate in the same manner as submersion itself.

Persons of the irritable constitution, therefore, who are so readily and violently affected by causes too slight to make any considerable impression either on the body or mind of those of a different constitution, will, upon precisely the same principle, be much sooner destroyed by drowning, than those whose nerves are less delicate, and are with greater difficulty excited.

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As the atonic constitution is less connected with apoplexy than the tonic, and as the nervous system is not to be roused into such violent actions as in the irritable; it appears that this habit or temperament would allow of being under water longer than either of the former.

It has already been remarked, that the three constitutions are most generally mixed together; the event in these cases may be predicted, by considering the proportion in which they appear to be united; if, for example, an instance could occur, of a strong athletic constitution being joined to an exquisitely nervous system, we should have just cause to expect, if what has been said is true, that death would almost immediately take place; and, on the contrary, where the tonic, the atonic, and the irritable, are so equally blended and so exactly adjusted, that neither are remarkably predominant (and many such are, I think, to be met with) I should for the same reason conclude, these would resist the effects of submersion a greater length of
time

time than any other modification of the habit whatever.

The reason why some people exhibit symptoms of life almost directly, and that others do not, even for some hours after they are taken out of the water, appears to be accountable for principally by the degree of irritability in the constitution. It appears, from many experiments, that this peculiar property is capable of being excited after death with greater ease or difficulty, according as the animal was more or less irritable during life. We have already shewn, that those who are much so, are extremely liable to be speedily drowned; and, for the same reasons, they will be speedily recovered: on the contrary, those of an atonic habit, as they are longer in drowning, will be longer before they are recovered*.

* M. Bucquet found, that the most irritable are the most easily suffocated, and are most easily revived. They appeared also to suffer less afterwards from the suffocation to which they had been subjected.—Hist. de la Soc. R. de Med.

AN ATTEMPT TO ASCERTAIN WHETHER THERE BE ANY POSITIVE SIGN OF THE ABSOLUTE EXTINCTION OF LIFE,

HAVING ascertained the cause of death, and assigned sufficient reasons for the difference in the event of the generality of cases, and likewise for the uncertain time in which life reappears in different people, it may be expected we should now proceed to the method of recovery. Previous to this, however, it will not be improper to enquire, “whether there are any positive signs of the extinction of life?” On a question of such importance, volumes might be written: the nature, however, of the present undertaking, prevents my entering minutely into the subject; my observations will therefore be but few; they will be
confined

confined as closely as possible to facts, and as little connected with theory or hypothesis as the nature of the subject will permit.

Many, various, and even opposite appearances, have been supposed to indicate the total extinction of life. Formerly, a stoppage of the pulse and respiration were thought to be unequivocal signs of death : particular attention in examining the state of the heart and larger arteries ; the flame of a taper, a lock of wool, or a mirror applied to the mouth or nostrils, or a cup of water to the *scrobiculis cordis* ; were conceived sufficient to ascertain these points : and great has been the number of those who have fallen untimely victims to this erroneous opinion. Of late, some have formed their prognostic from the livid, black, and cadaverous countenance : others, from the heavy, dull, fixed, or flaccid state of the eyes ; from the dilated pupil, the foaming at the mouth and nostrils, the rigid and inflexible state of the body, jaws, or extremities ;

tremities * ; the intense and universal cold, &c. Some, conceiving any one of these symptoms as incompetent and inadequate to the purpose, have required the presence of such of them as were, in their opinion, the least liable to error : but whoever will take the trouble of reading the Reports of the Society with attention, will meet with very many instances, where all the appearances, sepa-

* It will be necessary to distinguish between the contraction arising from spasm, and that rigidity which arises from the inelasticity of the fibres in consequence of death. It is well remarked by Dr. Cogan, that “ the limbs are extremely flexible immediately after sudden death, whilst the body retains any internal heat : but in these cases the members do not become stiff, or the joints inflexible, until the humours are coagulated, and the fibres rendered rigid by the cold of death. If therefore any resistance is observable in the limbs, soon after a person has apparently been struck with death, it is to be presumed, that there are some latent remains of life, and that the members are inflexible from a spasm in their muscles.”

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rately*, and even where several associated in the same case, occurred, and yet the

* Instances of black, livid, or cadaverous countenance, may be found in the following cases: 2, 10, 11, 21, 22, 43, 51, 52, 54, 63, 67, 100, 101, 117, 130, 164, 238, 239, 240, 242, 244, 256, 265, 268, 278, 282, 312, 314, 324, 357, 358, 393, 396, 411, 415, 423, 424, 432, 435, 437, 445, 446, 496, 501, 561.

Eyes fixed or obscure, Case 1, 22, 57, 101, 111, 162, 240, 242, 268, 411, 492.

Even the eye-balls may be diminished in size, immoveable, and fixed in their sockets, and the cornea without lustre, and yet the patient recover; as is evinced by the 411th Case. Dr. Whytt remarked, in an apoplectic boy, whose breathing was very laborious, and his pulse small and quick, that his eyes were more *shrivelled* than they used to be in those who have been several hours dead.

Foaming at the mouth, Case 341, 379, 393, 424, 10, 11, 44, 69, 78.

Rigidity of the body, jaws, or extremities, Case 5, 10, 28, 46, 50, 53, 67, 100, 103, 111, 241, 260, 268, 258, 162, 314, 357, 370, 393, 410.

Partial or universal cold, Case 2, 5, 11, 14, 19, 21, 28, 44, 46, 50, 51, 52, 53, 57, 65, 67, 81, 89, 98,

the patient recovered : it is therefore evident, that these signs will not afford certain and unexceptionable criteria, by which we may distinguish between life and death.

Dr. A. Fothergill, in his very elegant and interesting letters, has the following observation : “ One mark of the extinction of life which generally presents itself, and which cannot fail to attract the notice of every accurate observer, is a peculiar *glassiness* of the eyes ; when this is accompanied with coldness and flaccidity of the skin, it will seldom deceive us. Another sign, which deserves our particular attention, is, when air blown into the mouth passes without interruption through the whole alimentary canal.”

The information we derive from the appearance of the eyes, as to the state of the body and the mind, both in health

98, 100, 110, 111, 115, 117, 118, 166, 237, 241, 257, 258, 260, 278, 303, 314, 316, 320, 349, 357, 410, 416, 501.

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and sickness, is very considerable : this naturally induces us to expect, that much benefit will be derived by observing the phænomena which they exhibit in the present case. With this persuasion, I have paid particular attention to them in every instance of this kind to which I have been called; how far I have succeeded, will presently appear. It is only requisite, in this place, for me to mention, that a bright, glistening, and transparent eye, I have generally met with in subjects who never recovered; but I have observed precisely the same appearances in those whose circulation had been stopped, but were afterwards renewed. Indeed, Mr. Church, of Islington, has observed, “in all the cases which have fallen under his inspection, that when the cornea of the eye was opaque or misty, the party was irrecoverably dead; but whenever it remained *clear* and *transparent*, they have been restored, although no other favourable symptom appeared.” Notwithstanding

ing this gentleman's observation could not stand the test of later experience, it is a proof several have recovered under his direction, where the eye was in that state which I conceive Dr. Fothergill means by the term *glassy*. There are two other cases, and I believe only two, recorded in the Reports of the Society, unfavourable to the Doctor's opinion. In case 258, it is said, "there was great stiffness in the extremities, and universal coldness; the cornea constantly remained clear and transparent." In the 96th case, Dr. Houlston says, "the heat was much less than natural; the eye *set* and *glassy*." Dr. Whytt, relating the history of a boy who was seized with the apoplexy, says, "his pulse was full and quick, and his eyes had something of a *glazed* look." Now, although I cannot produce a single instance of recovery, where the glassiness of the eyes was combined with coldness and flaccidity of the skin; yet, what has been said, in my mind, militates so powerfully

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against these appearances, that little confidence ought to be placed in their presence.

I have, in more than one case, where there was every reason to imagine life had really been extinguished some time, endeavoured to make the air thrown into the nostril pass through the whole alimentary canal. This, Dr. Cogan, with whom the idea originated, observes he has effected several times in still-born children. However, I could not succeed in the experiment; and indeed I am of opinion, if the stomach and intestines were removed from the abdomen, that effect would not, in general, be produced without considerable difficulty.

Favourable conclusions have been predicted from—the natural colour of the countenance—the fluidity of the blood—the flexibility of the joints—the contraction of the sphincter ani—and from the clear and transparent state of the cornea.

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In reply to these I answer, that, in the 264th Case of the Reports of the Society, Dr. Houlston, after mentioning that, from the length of time, there seemed no prospect of succeeding, yet the necessary steps had been pursued, observes, that no sign of life appeared, though the face had all along preserved the natural colour. Mr. Portal, in his account of two people who had been suffocated by charcoal, says, at the time he saw them, their faces were coloured, and their eyes bright. And it is no uncommon remark, that the countenances of some people look much better, and more natural, when dead than while alive.—2dly. It is well known to anatomists, that the blood, in many subjects, does not coagulate after death, but remains perfectly fluid: if a vein, therefore, is opened in any of these, the blood will be discharged as freely as if a languid circulation did exist.—3dly. The supple and flexible state of the joints cannot be esteemed a positive sign of life, because, in

animals that are killed by lightning, and mephitic vapours, their joints always remain flexible.—4thly. The state of the sphincter ani is noticed in only a few cases; but they directly destroy the validity of the remark: see the 51st and 411th Cases, and that related at page 154 of the Reports of 1785.—5thly. The clear and transparent state of the eye has already been said to afford us no certain information. In case 162 we read, that although there were some faint signs of life, yet “the eyes had lost their lustre;” and in the 62d Case, “not only the pupil was largely dilated, but the eyes had entirely lost their lustre;” yet both these cases recovered: and Mr. Church, with whom this idea first originated, has informed the Society, that in a case at which he assisted, though without success, the party being irrecoverably dead, he perceived the cornea perfectly clear and transparent.

Putrefaction has by every one, but particularly by those who have attended to
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the subject, been deemed a positive and unequivocal sign of absolute death ; and so most certainly it is, when far advanced : but in its incipient, early state, even this is to be viewed with a doubtful, scrutinizing eye, and can only be admitted in a certain degree ; for there are some diseases, to which the living body is liable, that so nearly resemble putrefaction, as I conceive may be easily confounded. I will only mention two—the confluent small-pox, and the sea scurvy. In the former, at the time when death usually takes place, the lower part of the body, and the extremities, are generally occupied with petechiæ, livid and flattened eruptions, with black and blue vibices ; and the head and superior part is covered with a black, scaly incrustation, which, while it prevents our forming an accurate opinion of the colour of the integuments, confines the juices in such a manner, as to occasion their running into the putrefactive fermentation, the effluvia of which affects the organs of

smell with precisely the same sensation as the fætor of putrid flesh.

That animal humors, secreted from the surface of the body, actually putrefy, is well known, and we have just given an instance of it; and that the rest of the secretions and excretions acquire a high degree of putridity is equally evident. Baron Van Swieten mentions an instance of a long retention of urine, which, when it was drawn off, was so extremely putrid, as to affect the surgeon with a slight peripneumony for several days. The same sometimes happens in putrid fevers, at which time also the fæces are in a highly putrid state. I remember attending a woman with a very large abscess, which was situated either between the peritonæum and abdominal muscles, or in the cavity of the abdomen, and vented itself by the navel. The discharge was so extremely putrid, that the women about her were driven out of the room; and my probe was tinged to such a degree, that it was several days before it recovered its usual

usual appearance. Many similar instances have occurred in my practice, and many more may be found in the writers of observations. Now, as these secretions were made immediately from the blood, it should seem that the blood itself must in some degree be in the same state; and that it is so, in certain cases, will admit of little doubt. Morton affirms, he was witness to the following circumstance: “the blood of a woman in a malignant fever, when it was let out, stunk to such a degree, that the surgeon who bled her, and others who stood near her, fainted away.”

By taking a view of some of the most remarkable symptoms which occur in the last stage of the sea scurvy, and by observing the appearances which present themselves on dissecting those who die of that complaint, this opinion will be confirmed. Dr. Lind, who has written the most accurately on this subject, gives us the following information—That on examining the lips, or the caruncles of the eyes, where the

blood-vessels lie most exposed, they appear of a greenish cast—That the gums are excessively fungous, with an intolerable degree of stench* and putrefaction, and that they have a gangrenous aspect—That they are subject to profuse hæmorrhages from different parts of the body—The blood is thin, and black as ink; after standing some time, it proved of a dark, muddy colour, the surface in many places of a greenish hue, without any regular separation of its parts; and when it was kept stirring, as it ran out of the vein, its fibrous part had only the appearance of wool or hair floating in a muddy substance. The skin was found covered with black and livid spots, resembling extravasation under it; and ulcers affording a foetid, sanious gore, abounding with putrid flesh,

* Dr. Huxham, relating the case of a scorbutic patient, says, “he stunk so much before he died, that the last time I visited him, I could scarce bear the stench of the chamber, though not a small one.”

It is a known fact, that lobsters, and some other shell fish, stink most horridly while they are alive.

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and furrounded with livid edges, were extremely liable to occur in various parts of the body.

In difsected bodies, the blood in the veins was so entirely broken, that by cutting any considerable branch, you might empty the part to which it belonged: the muscles were found stuffed with corrupted blood, and, upon handling, they fell to pieces; the ligaments of the joints were corroded and loose; the epiphyfes were separated from the bone; the cartilages of the sternum were detached from the ribs; and even some of the bones were found rotten. The heart and lungs were putrid; the bowels were corrupted; and the spleen fell to pieces, as if composed of coagulated blood. Do not all these circumstances make it manifest, that both the solids and fluids of our body may become putrid, and that in no inconsiderable degree, while we are actually alive?

The nature and phænomena of putrefaction have been but little examined into,
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and are consequently very little understood. Indeed, an intimate acquaintance with that subject does not, for the present purpose, seem absolutely necessary: all that is requisite for us to be acquainted with is, that the most remarkable changes induced by it are, an alteration in its colour and smell; both of which are so peculiarly and strongly marked, and so well known to (at least) every medical man, as to render a description of them unnecessary. Whoever, therefore, will take the trouble of forming a comparison between the putrefaction of dead animal substances, and some of the appearances in the diseases just mentioned, cannot hesitate in allowing them to be precisely the same: in no other manner does it appear possible to account for them; but in this way they can satisfactorily be explained. Even supposing, for one moment, that it may not be exactly the case, the appearances are, at any rate, so extremely similar, that it would be imprudence in the highest degree

degree to allow, that an incipient putrefaction is at all times, and under every circumstance, an infallible sign of death.

Upon the whole, then, from what has been advanced, it does not appear that any positive sign of the absolute extinction of life has hitherto been discovered.

That such marks, however, do really exist, I entertain not the least doubt, although I will not at this time take upon myself positively to assert it: but that we are in possession of a test by which we may at all times, and with certainty, be able to judge of its presence or absence, I am as convinced as conviction can make me; and I persuade myself, by attending to what I have to offer, the validity of my remark will be universally allowed.

Death may be distinguished into two kinds or species—apparent, and absolute. By apparent death, I mean a stoppage of the circulation, respiration, and action of the brain; the irritability, however, or that peculiar property of the muscular fibres

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which

which enables them to contract on being irritated, still remaining. By absolute death, I would be understood to signify, not only a cessation of the vital, natural, and animal functions, but where the principle of irritability is also entirely destroyed.

By this definition it appears, that the only true distinction between life and death, is the irritability, or what has been called, the vital principle. If, then, there are any signs which indicate its total absence, those may be deemed certain signs of death; and the following I conceive to be some of those marks, which will enable us to ascertain that point.

I. It has long been remarked by Mr. Winflow, M. de Haller, &c. that the pupils of the eye, which were very wide at the time of death, and continued so some hours, became narrower after a certain period. The same appearance have I observed in my attendance on drowned people;

people ; and for some time I conceived, the pupil being contracted would afford an unexceptionable indication of death. Dr. Whytt, however, relates two cases, where the pupil being remarkably wide, and destitute of all motion for some time, became narrower, even a day or two before death, in two boys, who died of a dropfy in the ventricles of the brain. In these patients, the *spt. falis ammon.* held to the nose, or a spoonful of cordial julep, made the pupil instantly as wide as it is observed in a confirmed gutta serena, but soon after it became narrower again. These facts will prevent our acknowledging this article as a positive sign in every instance : but as they are, to use the Doctor's own words, " remarkable histories ;" as I cannot find that the same circumstance is noticed by any other writer ; and as these children did not die a violent death ; I am still of opinion, that the pupil being contracted, especially if it has been observed to be much dilated,

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will, in cases of submersion, yield us pretty certain information.

II. There is another appearance of the eye, which I have not long, or often observed ; but as I met with two cases nearly at the same time, where this mark came on as soon as the symptom of life disappeared, it made a particular impression upon me, and I very much regret that I did not earlier attend to the subject, and thence might at this time have been enabled to speak more decisively upon it. What I allude to is, one of the pupils being more contracted than the other. I will not attempt to explain this appearance ; but shall only observe, that the motion of the pupils, both in light and darkness, in health and disease *, at the time of death, and under almost

* I recollect only one disease as an exception, and that is where the edge of the iris adheres to the capsula of the chrystalline lens, consequently its diameter can
neither

almost every circumstance, is very nearly the same in both eyes. That this sympathetic action of the muscular fibres of the iris is effected by the medium of the brain, will admit of no doubt: when therefore this regularity is infringed, that is, when the two pupils are unequally contracted, it is very presumable, that the influence of the brain and nerves is entirely annihilated, and the vital or irritable principle utterly destroyed.

III. Vital heat.—Vital heat and irritability are so intimately connected, that it is highly probable, when the former is present, the latter will be so likewise: but yet there are some circumstances attending

neither be contracted or dilated. But even “in a confirmed gutta serena, if the sound eye is covered, the pupil of the diseased eye remains in every degree of light immovable, and of the same size; but if the sound eye is exposed to the sun-beams, the pupil of the other, which shewed no motion before, will be evidently observed to contract.”

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this idea, which I cannot immediately reconcile: for instance, I have more than once perceived, on dissection, a manifest degree of heat among the intestines in the pelvis, four-and-twenty hours after death, although the limbs became cold, and sometimes rigid, soon after respiration had ceased. On looking over authors of anatomical collections, I find many similar instances, some of longer continuance, notwithstanding the weather was at the time very cold: and cases have likewise not unfrequently happened, where even the external heat has continued near twenty hours after the person has died of a fever. Whether the irritability in these bodies continued as long as the heat, is now impossible to determine; but it is by no means improbable, because the heat of all animal bodies just dead, would be reduced to the temperature of the surrounding medium in equal times with another animal of the same species and size, that was absolutely dead, but heated artificially to the same degree.

degree. The heat therefore of that body which continues longer than usual, must be supported by some internal animating or vital principle; and consequently we may, at least in cases of drowning, establish natural heat as a mark that irritability, or the vital principle, has not entirely quitted the corporeal frame:

Allowing animal heat and the living principle to be co-equal, it still remains to mention the manner by which we may with certainty judge of their presence or non-existence. We know that the internal heat always remains a considerable time longer than the external; and we have seen above, that it sometimes remains very many hours in the contents of the pelvis; after every evident external appearance of its existence has quitted the body: a thermometer, therefore, commodiously constructed*, being introduced three or four

* That described by Mr. Hunter, in his paper of
 "Experiments and Observations on Animals, with re-
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four inches into the rectum, will, by the quicksilver remaining stationary, or by its rising or falling, readily indicate the presence or positive extinction of life.

IV. It was observed before, that no probable or satisfactory cause had been assigned for the uncertain occurrence of water in the lungs; and that it did not seem to have been thought, that it would be productive of any material advantage, if it were exactly ascertained. To me, however, it appears very differently; as I am of opinion, if we attend properly to the subject, that we shall find it claims our particular notice, as it probably comprehends a circumstance of the very first importance in the resuscitating art.

In considering the causes of death, we have endeavoured to prove, that immedi-

spect to the power of producing heat," will, on account of its moveable scale, prove very convenient for introducing into cavities.

ately on falling into the water, a violent contraction seizes the muscles, which guard the aperture of the lungs so effectually as to prevent the entrance of water into the windpipe: in this state of contraction do these parts continue, not merely till death, considered as a general circumstance, effected by the suspension of the vital powers, has taken place, but probably till the irritability of the muscular fibres is destroyed. This principle remains a considerable time after the motion of the heart and lungs have ceased; but it does not continue so long in one person as in another; nor are all parts of the same body equally irritable.

Every one has, upon a thousand occasions, experienced the extreme irritability of the superior part of the windpipe; and that during life it continues so, as long as any part of the body whatever, we have good reason to presume, since we find that at the point of death, when the pulse at

the wrist has ceased; respiration become interrupted; and even when the patient is insensible to almost every other stimulus; the smallest drop of liquid getting into the lungs, immediately raises the languid and oppressed powers of nature, and the thoracic and abdominal muscles are excited by violent exertions to assist in expelling the intruding drop. And that the same power remains after death, even longer than in the heart, diaphragm, or intestines, is placed out of doubt, by one of the most powerful stimulants continuing to produce very considerable contractions about the former, when it had ceased to occasion that effect in the latter.

When irritability in any part is totally destroyed, death may then, in the strict sense of the word, be said to have taken place in that part, and a state of relaxation immediately ensues. When, therefore, this principle has quitted the superior part of the larynx (and, from what has been
said

said in the last paragraph, we should not expect it would, till every other part was abandoned) its muscular fibres, in which this power resides, will cease to act; hence the epiglottidii muscles, whose office is to draw the epiglottis close over the glottis, so as to shut completely the orifice of the trachea, lose their action; the cartilage, by means of its elasticity, is elevated, the passage into the windpipe becomes open, and now not the least obstruction exists to prevent the water getting into the lungs.

From this explanation it appears, that water never enters the lungs till the animal is in that state from which a recovery cannot possibly be expected: and, if the principles on which my opinion is formed be just, this circumstance is to be considered as a true criterion by which we may distinguish between apparent and absolute death.

This idea, if not proved, is at least certainly not contradicted, by any case on record;

cord; for not one instance has ever occurred of a recovery taking place, where water was even suspected to be in the lungs: on the contrary, of the great number of successful cases with which the Reports of the Humane Society abound, where the people have been recovered after being under water from five to thirty minutes and upwards—a violent cough, the first symptom which must take place as soon as the action of the lungs is restored, if water is in the windpipe, has in no one instance been mentioned to have occurred at that time; and when it has happened, in the course of the recovery, it should seem that it was only in a slight degree. With respect to the difficulty of breathing, and pain in the chest, which have sometimes presented themselves, and are by many supposed to happen only when water gets into the lungs; they may, I presume, with at least equal propriety, be accounted for, by the great distention which the pulmonary vessels have necessarily

rily supported: from this expansion they will recover with little inconvenience, provided those parts are found and strong; but if they have previously been occupied by any disease, they must afterwards of course suffer, according to the length of time the distention existed, and the nature and violence of the disease with which they were affected. Similar symptoms have occurred in those strangled by the cord, although their greatest complaint is generally in their head: and why, therefore, when those symptoms appear from drowning, may they not be attributed to the same cause?

In the course of the experiments I instituted, with a view of elucidating this circumstance, I never once could perceive the appearance of the coloured liquor in the lungs of those animals which had been only a short time under water; but in those that had been long in that situation, their lungs were always evidently filled. When the lungs were free, the irritability always

remained; but when there was water in them, not the least contraction could be excited in any part of the body. As a further presumption, that the water does not enter the lungs till the animal is absolutely dead, a kitten was drowned under a glass receiver, in a strong decoction of logwood, and was kept there fifteen or twenty minutes after all motion had ceased; it was then removed from the coloured liquor into clear water, and remained there a considerable time: on opening it, the lungs were filled with water, but there was no appearance of the colouring matter; which is a convincing proof, that the water did not enter the windpipe for at least a quarter of an hour after apparent death had taken place.

It is no easy matter to determine when water is in the lungs; for if they are entirely filled, a considerable quantity will be expelled on the first pressure of the chest; but there is no method of discovering, whether it comes from the lungs or
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the stomach. If there is a small quantity only, it occasions, on inflating the lungs, a particular noise, similar to what, in dying people, is called the rattling in the throat: but almost the same noise constantly occurs, for if there is really no water in the lungs, there is generally mucus, which will occasion a similar sound. The only circumstance which I apprehend can guide us in our opinion, is by attending particularly to the effect of artificial respiration. We are able to distinguish two, and I believe only two impediments, to the proper and effectual inflation of the lungs; one, from the glottis closing the aperture of the wind-pipe; the other, from water in the lungs. When the first cause exists, we are not able, merely by blowing into the mouth or nostrils, to effect the least motion of the chest, or to make a particle of air pass into the lungs: and the greater force we exert, the less likely shall we be to succeed, till on raising the epiglottis we readily accomplish our intention; whereas, when water

is in the lungs, we can with great facility produce some motion in the chest, which shews the opening into the lungs is free ; but neither that, or the quantity of air thrown in, is at all considerable, or any-ways equal to what might be expected. This motion of the lungs, when it has been continued a short time, always forces away a quantity of very frothy water ; and as this is expelled, the lungs will admit a larger quantity of air, and the motion of the chest will become more perceptible. By attending properly to these appearances, we shall, I am persuaded, be enabled, with readiness and certainty, to decide whether the water has made its way into the wind-pipe.

Electricity has several times been applied in the recovery of the apparently dead ; and although it has not always effected the purpose for which it was applied, it has, in every instance that is made public, proved its importance, and afford-
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ed the most ample and decisive testimony of its wonderful and extensive influence. A case which happened under my care early in the year 1785, made a strong impression on my mind, and prejudiced me much in its favour. A young man, after being a considerable time under water, was exposed in his wet cloaths to the cold air for the space of an hour before any means could be used to restore him—artificial respiration, warmth, the tobacco glister, volatiles thrown into the stomach, frictions, and various lesser stimuli, were employed near an hour, without the least benefit or alteration: electricity was then applied, and shocks sent through in every possible direction; the muscles through which the fluid passed were thrown into strong contractions, nearly as violent as is usually observed in healthy people: this extraordinary appearance recurred as often as the electricity was applied, for the space of two hours, that is, four hours from the
time

time he fell overboard, and, I have no doubt, from the time his pulsation and breathing stopped; after which period its effect ceased, and no alteration whatever could be produced. Since this accident, I have constantly had recourse to the same agent in every similar case: in general it has been attended with the same effects; but in one person, whom there was afterwards reason to believe had been some hours in the water, in intensely cold weather, not the least motion whatever could be effected

“ The electrical shock was tried on the body of James Lawson, *four hours* after it was taken out of the water, every other method having been tried in vain. The first shock excited a pulsation in the temporal artery; the next diffused a florid colour over the face, and occasioned the blood to flow in a copious stream, and to a considerable quantity, from an orifice which had been opened in the jugular vein,

vein, in the beginning of the process, without a drop having issued from it. The subsequent shocks were attended with no manifest advantage, and every favourable symptom subsided." See Reports for 1775, p. 77.

My experiments upon animals coincide entirely with the above appearances. In no one instance did electricity fail in renewing the action of those muscles through which it was directed, for a considerable time after the vital actions had ceased: and when its effect was lost, not the most gentle or the most powerful stimuli, neither oil of vitriol or the knife, nay, not even the actual cautery itself, could effect the most trifling alteration in the muscular fibres.

From these considerations it appears to me, that the electrical shock is to be admitted as the test, or discriminating characteristic, of any remains of animal life; and so long as that produces contractions,

tions, may the person be said to be in a recoverable state ; but when that effect has ceased, there can no doubt remain of the party being absolutely and positively dead.

P R O G N O S T I C.

FROM a consideration of what has been delivered, respecting the tendency to apoplexy (from p. 65 to 69) and to diseases of the heart and lungs (69, 70) by attentively observing the accidental circumstances (70 to 75); the nature of the constitution (76 to 90) and the signs of life (110 to 126); I entertain no doubt but we shall be enabled to form our prognostic with tolerable accuracy and precision.

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THE METHOD OF RECOVERY.

IN explaining the most effectual method of conducting this process, it will be necessary to recal to our mind the state of the vital organs, when life is suspended by the stoppage of respiration, which we have shewn to be the cause of death in those who perish from submerſion.

The blood, returning from all parts of the body, is collected in the right auricle and ventricle of the heart, from whence it ought to be propelled through the lungs ; but their motion being ſtopped, only a ſmall quantity can paſs from the extremities of the pulmonary artery to the commencement of the pulmonary veins ; hence the right auricle and ventricle, with the pulmonary artery, will be ſoon filled and over diſtended ; in conſequence of this, the *venæ cavæ* will not be able to empty them-

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ſelves,

ſelves, and the blood will be accumulated throughout the whole venal ſyſtem, while the left auricle and ventricle, and the whole arterial ſyſtem, will be nearly deſtitute of blood: the jugular veins, therefore, and the ſinufes of the dura mater, which immediately communicate with each other, cannot poſſibly expel their contents; and the ſame cauſe being extended to the veins of the brain, that part will, on account of the great quantity of blood ſent to it, and the fine, delicate, and tender conſtruction of its veſſels, be ſooner compreſſed: its functions and influence will therefore be ſuſpended or deſtroyed, and the patient will die apoplectic*.

From

* I am ſenſible that, under particular circumſtances, beſides thoſe already mentioned, individuals may ſometimes ſuffer from ſuffocation or congeſtion about the heart and lungs, rather than from compreſſion, or an over-fulneſs of the veſſels of the brain: and where we are made acquainted with the previous ſtate of the conſtitution, we may, I think, be enabled, in a great

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meaſure,

From our knowledge of these circumstances, it becomes evident that two indications are particularly pointed out. The first—to remove the compression of the brain, and the congestion about the heart and lungs. The second—to excite the irritability of the muscular fibres.

measure, to form a tolerably just opinion when that does occur; yet it would seem, that this distinction could not afford us any material advantage in practice, since, from the intimate connection of both conditions, the same remedies in general must be equally useful in either.

It is probable also, that from certain peculiarities in the constitution, and likewise from the operation of several of the accidental circumstances mentioned at page 70 et seq. that a multiplicity of effects may take place in the system, sometimes singly, sometimes variously combined; yet, as it does not appear possible for us, generally speaking, to ascertain, with any tolerable accuracy, what these effects really may be, I am inclined, from the persuasion that the circumstance of the compression of the brain by far more generally prevails than any other, upon all occasions to pay most particular attention to it, especially as in so doing, from the mutual connection of the whole, the rest cannot be materially neglected.

I. The

I. The removal of the compression of the brain, and the congestion about the heart and lungs, may be effected by, blood-letting—the imitation of natural respiration—and by proper position.

The propriety of having recourse to early bleeding, is by no means universally allowed. The directions of the Society, although they do not positively forbid it, yet their strong dissuasion amounts almost to a prohibition; and it is but justice to mention, that the opinions of some of the first authorities are decisively against it. For my own part, although I do not think bleeding is always and in every case necessary, yet I conceive there are but few where it would be productive of mischief, provided it be properly timed, and performed in the most eligible part: but where the external appearances, such as the intense swelling and lividity of the face, the suffusion and distention of the eyes, indicate violent oppression of the brain, more especially if they happen in plethoric

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habits,

habits, or where there is any disease, or tendency to disease, in the vital organs—there bleeding ought, in my opinion, by no means to be omitted.

When this operation is to be performed, it should be had recourse to immediately, before any symptoms of life have made their appearance; for when they are present, it is evident the compression of the brain must be in some measure removed; and the event of the 3d, 10th, 144th, 247th, 260th, 421st, 467th, 485th, 487th, 498th, 499th, 595th Cases, and that related at the 145th page of the Reports for 1785, justify this advice.

It is at this time, the first appearance of life, that we should be particularly attentive not to interfere with nature too much in any respect, more especially not to disturb her salutary actions by any operation which may tend to sink the vires vitæ, or depress the already languid circulation. For this reason, I cannot avoid considering the employment of blood-letting,

letting, at this critical time, as of doubtful effect; yet we meet with very many cases where blood has under these circumstances been taken away, and in several instances it manifestly increased the symptoms of life. In the 6th Case, it is said, “ I discovered a spasm or two about his eyes : I then proceeded to venæsection; immediately the spasms increased, and were succeeded by distortions of the body and limbs.” In the 7th, as soon as the pulse was to be felt, I took away eight ounces of blood; soon after he was made to swallow. In the 21st, as soon as a trifling pulsation was discovered, a vein was opened; he then sighed, &c. In the 71st, the pulse being increased, I took away some blood, which seemed to have a very good effect. In the 80th, as soon as the pulse was perceived, a vein was opened, and the blood flowed very freely; just at that instant she fetched a deep sigh, and began to have some motion. In the 362d, as soon as a very

weak pulse was perceived, some blood was taken from the arm; and I could afterwards find the pulse and spasms get stronger. In the 400th, when he was able to speak, I took away five ounces of blood: the good effects of bleeding were very conspicuous. In the 421st, three ounces were taken away before any symptom of life, and six ounces on the first appearance of it. In the 96th Case, the patient was bled three times, although the pulse was weak and fluttering, the heat much less than natural, and the eyes set and glassy: on his losing blood the third time, the pulse grew full and regular, the heat increased, whilst the spasms and difficulty of breathing lessened. In the 302d, the man was much convulsed; ten ounces of blood were taken from his arm, after which he seemed to revive much. In the 236th, I took about five ounces of blood, which relieved him greatly, and seemed to contribute much to his more speedy recovery.

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The same practice was pursued in the 69th, 164th, 235th, 264th, 308th, 323d, 474th, 524th, 596th, 2d, 19th, 51st, 52d, 94th, 103d, 109th, 138th, 139th, 163d, 164th, 277th, 238th, 289th, 299th, 308th, 364th, 374th, 383d, 385th, 392d, and 398th Cases, and likewise in the 155th, 176th, and 177th pages of the Reports for 1785—all the cases wherein bleeding at this time is mentioned: they all terminated in the most favourable manner, and without the least apparent inconvenience from the loss of blood. Now, if blood may be taken away with advantage when the feeble powers of the constitution are just beginning to exert themselves, and when the compression of the brain is lessened; with how much greater probability of success may it be used, when the compression is complete, and before the vessels of that organ are at all unloaded?

Before our patient is perfectly recovered, but after the circulation is in a great

degree established, we shall frequently be called upon to relieve various symptoms which arise from congestion, either in the head or thorax ; such as, pain and heaviness in the head, stupidity, coma, delirium, difficulty in breathing, pain in the breast, &c. &c. Whatever objection may be urged against bleeding in the early stage of these accidents, no one will, I believe, oppose it in this ; for it is certain no remedy can answer so speedily and effectually ; and it may require to be frequently repeated before the effect is produced.

The part from whence the blood is to be drawn, is in these cases by no means a matter of indifference. If it is taken from the arm, the distention of the brain, for which principally this operation is performed, will scarcely be at all lessened on account of the stagnation of the blood, and the distance from the part affected ; added to which, blood can seldom be procured in sufficient quantity
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from this part. If the temporal artery is opened, no benefit will arise, because we have already shewn, that the veins only are overloaded, and that the arteries are almost destitute of blood: but the external jugular veins, although they bring the blood from the external part of the head only, yet as they immediately communicate with the superior venæ cavæ and internal jugulars, which receive the blood from the sinuses of the dura mater and veins of the brain, certainly ought to be preferred on these occasions.

The application of cupping-glasses to the head, neck, and breast, may be extremely serviceable, particularly if we cannot procure a sufficient quantity of blood from the jugular veins. This mode of operating, independant of the evacuation, will be attended with the additional advantage of proving a powerful stimulus.

It is, however, to be observed, that large and repeated bleedings do not seem so indispensably necessary in the present instance,

stance, as in apoplexies arising from some other causes, as artificial respiration will in general answer the purpose of removing the over-distention of the venal system, consequently the compression of the brain, nearly as effectually and expeditiously; and is not liable to be attended with any disadvantages. In a full inspiration, the vesicles of the lungs are expanded, and at the same time the capacity of the pulmonary blood-vessels is considerably increased, so as to receive a larger quantity of blood from the right ventricle. In expiration, the vesicles are collapsed, and the contents of the blood-vessels are, in consequence, driven into the left auricle and ventricle. This process, frequently repeated, will in a short time remove the congestion in the great vessels; and the compression of the brain, which depended upon that congestion, will, I conceive, be as readily overcome as by opening a vein.

On this account, and particularly as it is removing the cause of death, we cannot
hesitate

hesitate one moment in pronouncing, the restoring the action of the lungs to be of the very first importance in all our attempts to recover the apparently dead. Dr. Fothergill, with great propriety, compares the lungs of drowned people to a clock whose pendulum is stopped; yet, says he, renew but the action of the lungs in the one, and touch but the pendulum in the other, and all again is life and motion. The same gentleman observes, in another place, that to inflate the lungs, especially of drowned persons, completely, requires no inconsiderable share of skill and dexterity.

To effect this intention, the orders of the Society direct an assistant to blow into the mouth through a coarse cloth, or to introduce the nozzle of a pair of bellows either into the nostril or mouth. The blowing into the mouth may, upon an emergency, answer for a few times; but the difficulty of getting people to continue it will be easily conceived, on account of the operation

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ration being so extremely disagreeable and troublesome. The inflating the lungs, by introducing the nozzle of the bellows into the mouth, is very unhandy and difficult; and it will seldom prove more convenient when it is pushed into the nostril.

To remedy these inconveniences, several contrivances have been formed. “A wooden pipe, fitted at one extremity for filling the nostril, and at the other for being blown into by a person’s mouth, or for receiving the pipe of a pair of bellows,” is recommended by Drs. Monroe and Cullen. Mr. Hunter advises “a pair of bellows so contrived, with two separate cavities, that by expanding them when applied to the nostrils or mouth of a patient, one cavity may be filled with the common air, and the other with air sucked out of the lungs; and by shutting them again, the common air may be thrown into the lungs, and that which is sucked out of the lungs be discharged into

into the room. The pipe of these should be flexible, in length a foot or a foot and a half, and at least three-eighths of an inch in width : by this the artificial breathing may be continued, while the other operations, except the application of the stimuli to the stomach, are going on, which cannot conveniently be done if the muzzle of the bellows be introduced into the nose." Mr. Savigny's is, " an elastic tube, about twelve inches in length, to one end of which is fixed a piece of ivory, so constructed, that it may be blown through either by the mouth, or a pair of bellows adjusted to it ; and to the other end, an addition of ivory also, of such a form as to enter and fill up a nostril." Mr. Sherwen's is, " a curved inflater with a double nozzle, which may be adapted in two minutes to any pair of bellows, or to any pair of nostrils in the kingdom."

Each of these instruments will answer the purpose of inflating the lungs very effectually ;

fectually; but the first is inconvenient, on account of its interfering with, and in a great measure preventing, the application of the other remedies; a disadvantage which neither of the others are liable to, because the inflation is managed by a person stationed at the head of the body, and out of the way of the other assistants.

That invented by Mr. Hunter is certainly the most complete of these instruments; but it may be doubted whether it should in general be preferred to the others, which are more portable and simple, and less expensive, because a second assistant will, in both cases, be necessary to keep the pipe in the nostrils, the mouth shut, and a proper pressure on the cricoid cartilage: and the sucking the air out of the lungs does not appear any very material advantage, as the thorax will naturally contract when the mouth is opened; and if it does not sufficiently, a gentle compression will effectually answer that purpose.

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The difference between the elastic tube and the curved inflater seems immaterial : the former I have made several experiments with ; and every instance in which I tried it, answered completely : the latter will, no doubt, succeed equally well ; but the nozzles do not appear particularly calculated to suit every pair of nostrils, or the pipe adapted to fit every pair of bellows.

No particular directions are given for the use either of Dr. Cullen's or Mr. Hunter's instruments ; but as, from my own want of success, I conclude every one else, at least on their first trial, have not perfectly succeeded in imitating natural breathing, it may not be improper to mention the directions which are given with the two last. In using the elastic tube, it is advised, " that a proper person, stationed at the head of the body to be operated upon, passes the appropriated end of this tube into one of the nostrils ; and sustaining it there with the forefinger, he compresses

compresses both nostrils so firmly between the thumb and middle finger of the same hand, that no air can pass otherwise than by the tube; and the other hand applying the other end of the tube to his mouth, he blows with force through the pipe, into the nostril of the subject. The medical director standing at the right hand of his charge, must keep the mouth perfectly closed with his left hand, while with his right, making a suitable pressure on the prominent part of the windpipe, he prevents the air passing into the stomach; till, finding the lungs are properly distended, he is to press strongly on the chest, removing, at the same time, the hand from the mouth, so as to let the air pass out: when, by these means, the lungs are compressed, the same process is immediately to be repeated, that, as far as can be, the manner of natural respiration may be imitated."

Mr. Sherwen proposes, " that the patient should be laid on a bed, with his
head

head towards the foot it, and the curved inflater being applied, the medical assistant may sit at his ease, and take upon himself the whole of the business, both of inflating and compressing the lungs, without interfering with the rest of the assistants." Mr. Sherwen, however, does not seem to be aware, that it is one person's entire business to work the bellows; that another must be employed in making the occasional pressure on the breast and cricoid cartilage, and in keeping the mouth shut; and, beside these, it will be necessary for some one else to retain the pipe in the nostrils: so that, upon the whole, it does not appear, either that this instrument is peculiarly accommodated "to any pair of nostrils, or any pair of bellows," or that "the surgeon can take upon himself the whole of the business, both of inflating and compressing the lungs;" or that he must not "interfere with the other assistants."

If any difficulty should arise in distending the lungs, it must proceed either from water in the windpipe, or a contraction or adhesion of the epiglottis. We have already pointed out the method of discovering when the first circumstance occurs ; and when the latter is the case, we shall generally remedy the inconvenience by bringing the tongue forwards, which, being connected to the epiglottis by inelastic ligaments, must of course be elevated. Should any further impediment however occur, the crooked tube, bent like a male catheter, recommended by Dr. Monroe, and mentioned by Mr. Portal, Mr. le Cat, and others, should be introduced into the glottis, through the mouth or one nostril ; the end should be connected to a blow-pipe, or, what will be more convenient, the pipe for the nose belonging to the elastic tube may be removed, and this instrument screwed in its place, according to the plan mentioned in the description of a pocket case of instruments for

for the recovery of the apparently dead, by Mr. Savigny.

When every attempt to inflate the lungs has been made in vain, tracheotomy is our last expedient, and ought to be performed as soon as it becomes necessary. I acknowledge, however, I should not expect it would succeed when the other means have failed : but, as I have not had occasion to perform it more than once, I cannot speak decisively on the subject ; it must be left, therefore, to be ascertained by future experience. In the case alluded to, the lungs could not be inflated by the means recommended by the Society ; and, no tubes being at hand, I made an opening into the trachea, in which was introduced a common dissecting blow-pipe ; but, after all, I was not able to produce the least motion of the chest. This was occasioned by the want of proper instruments ; and it is probable the crooked pipe, screwed on the elastic tube, would effectually answer on similar occasions.

Even where there was no impediment to inflating the lungs, the operation of tracheotomy has by many, but particularly by Dethardengius, been recommended when other means have failed, that the warm air might be more conveniently applied, and the water in the lungs more effectually evacuated. In the first case, the warm air may be as readily and commodiously applied by the nostrils: and abundant experiments prove, that when water enters the lungs, it is not to be discharged either by that or any other means at present known.

Air loaded with the vapour of tobacco—of the volatile alkali—of the spirit of sea salt—and spirit of sulphur, have been recommended with the view of exciting the action of the lungs with greater expedition: the first, probably, from observing the violent exertions which were produced when, in smoking, a particle penetrated beyond the rimula glottidis; the second was introduced by the chymists, in cases
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of suffocation from mephitic air, under the idea that it would neutralise the noxious principle, which they conceived to be acid. In cases of drowning, however, it appears to be recommended, as well as the two last, merely as a stimulant. This practice I consider not only as of doubtful effect, but in general extremely hazardous, and replete with danger. In the beginning, and when we are called in soon after the immersion, they ought to be strictly prohibited; and if they are to be used at any time, I am of opinion with Mr. Hunter, it should be "when a considerable time, such as an hour, has been lost," before assistance is procured; and I should prefer, with him, the use of "the vapour of volatile alkali mixed with air; which may easily be done, by holding spirits of hartshorn in a cup under the receiver of the bellows."

With fairer prospect of success, is the dephlogisticated air of Dr. Priestley recommended for the same purpose. Dr.

Fothergill, in particular, has distinguished himself by his truly ingenious remarks on its application to the subject now under our consideration. It must be observed, however, that in this instance the Doctor's practice seems entirely influenced by a theory, which supposes the cause of death, in drowned people, to be noxious air stagnant in the cells of the windpipe: and as this species of air neutralises mephitic air, and renders it respirable, "it seems," says the Doctor, "to be the direct antidote supplied by nature for correcting the contaminated air stagnant in the bronchial cells, and also for inflating the lungs, in preference to common air."

When treating on the supposed causes of death, this theory received, what it in an eminent degree merits, a full and candid investigation; but the reader will remember, that the sum and conclusion of the arguments and experiments was, that "the death of animals cannot be attributed to the action of phlogiston on

the nerves of the lungs." If therefore this deduction be true, it does not immediately appear why dephlogistified air should be used for the purpose of inflating the lungs, in preference to common air.

The same practice is mentioned by Mr. Hunter, Dr. Stokes, and Mr. Achard: the latter relates his having recovered various smaller animals, by removing them into vessels of dephlogistified air, after being exposed so long to the different kinds of noxious air, as to bring on the appearance of death. In these experiments, the common air was found unequal to the recovery; but the pure air, especially when it was conveyed into the lungs, and when the animal was not continued in the foul air longer than a minute after respiration ceased, very generally answered. If animals suffocated in noxious air, actually draw it into their lungs, which we shall find in another place to be extremely probable, the application of pure air may then, agreeable to the idea

of Dr. Fothergill, saturate and correct the inclosed contaminated air, so as to render it harmless and inoffensive. But, as I cannot find any decisive experiments have been made with this fluid on drowned animals, I must acknowledge, that after all that has been so ably and judiciously urged in its support, it appears to me as of little consequence, or at least as a secondary consideration, whether the lungs are inflated with dephlogisticated or atmospheric air, or whether the air be blown from the lungs of a healthy person : it is their expansion and contraction we are to endeavour to promote, in order to force the blood from the right to the left ventricle of the heart ; and if that can be properly effected, it will, for obvious reasons, be the most probable means of reproducing the circulation.

I would not wish, however, to be understood as having any objections to the use of this air, further than the difficulty in procuring a sufficient quantity in a pure

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state—the want of an easy method of administering it—and its rendering the apparatus more complicated and inconvenient : on the contrary, if those inconveniences can be overcome, I think it well worth our trial. All I would aim at is, to obviate our placing too much confidence in it, and by that means retarding or preventing the employment of other remedies, whose application might prove of considerable importance *.

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* The quantity of dephlogisticated air necessary for producing artificial respiration, even a short time, and the expence attending it, are much greater, probably, than may at first be apprehended. In this operation, I conceive it requisite to produce as much motion in the lungs as they will allow of; which, indeed, is imitating the manner nature compels us to act in, when, for a short time, we forcibly retain our breath, for we are then obliged to make several full inspirations, in order to propel the blood, which abounded in the right ventricle and pulmonary artery, into the pulmonary vein. From repeated experiments, I have found my lungs, when completely distended, to contain 300 cubic inches of air; and if we allow for what
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It is customary, in attempting recovery, to lay the body perfectly horizontal; but it will certainly prove much more efficacious, if the head and chest be raised so as to form an angle of about twenty degrees, which

is in the mouth, fauces, and cavity of the nose, and for a small waste, I think we cannot, with any propriety, estimate each inflation at less than 300 cubic inches: and if ten of these inflations are made in a minute, and the operation continued only ten minutes, both which are moderate calculations, 30,000 cubic inches will be expended. This would very nearly occupy the space of two hogsheds. The inconveniences and difficulties attending the collection of such a large quantity immediately, is not readily conceived, except by those who are in the habit of preparing artificial airs: and the expence attending it will be by no means inconsiderable, even if it is expelled from nitre, which is the cheapest method; but if the air is procured from red lead, and the nitrous or vitriolic acid, the quantity which can be obtained from these materials is so very small, that the charge would be enormous. The costliness of the article, however, is the most trifling objection which can be brought against it, and could not require one moment's consideration, was it found to answer, and could it be readily procured and conveniently administered.

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indeed is as high as it will allow of without slipping. This position, it is evident, will assist materially in diffusing the stagnant blood, and in relieving the congestion of the vital organs.

II. The exciting the irritability of the muscular fibres may be done, 1st, by general stimulants, or those which affect the whole system ; 2dly, by local stimulants, or those which are applied to irritable parts.

The general stimulants are—heat—electricity—and frictions. The local stimulants are—aromatic and irritating medicines injected into the stomach and bowels —and particular stimuli, adapted to the different organs of sense.

GENERAL STIMULANTS.

1st. **H**EAT.—We know, from an infinite number of circumstances, that heat is indispensably necessary for our existence ; we are taught by experience, that the difficulty of recovering drowned people is, in most instances, equal to the deficient degrees of heat ; and it is known by all, that the natural heat of bodies and vitality are so nearly connected, that it is certain they never can be separated, nor co-exist but within certain degrees of reciprocal proportion. From all these considerations it is presumable, that by prudently supporting and increasing the heat which remains in the body, we may at the same time augment the vital principle. The judicious and effectual application of artificial heat, therefore, requires our earliest attention.

Of all the different modes of applying this principle, that of covering the patient

tient with warm grains, appears to me the most powerful ; and immersing the body into warm water the next. Grains, or warm water, may very generally be procured, as the large quantities usually kept in breweries or distilleries will retain their heat many days. The use of either of these, however, will be attended with so many inconveniences, and must inevitably interfere so much with the application of other means, that I am of opinion they should be given up in favour of a mattress covered with a blanket, and placed at a proper distance before a large fire. The body, as was before mentioned, should be raised so as to form an angle of about twenty degrees ; and the situation should be varied, so that every part may receive a due proportion of heat.

The natural warmth of a healthy person, and warm substances, as bricks, bottles of water, &c. &c. have been recommended. The first is liable to the same objections as the bath and grains ; and the
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the last, by interfering with the frictions, will be found troublesome and inconvenient.

In the application of heat, I would wish particularly to impress the mind with the idea of the absolute necessity of its being at first employed in the most gentle manner, and that it should be increased very gradually ; otherwise, instead of being one of the most effectual remedies, it may certainly prove the most destructive ; as the sudden application of heat, in any higher than certain appropriated degrees, may produce such violent and disproportionate expansion, or action of the contiguous parts, or such changes in the arrangement and composition of the constituent principles of the respective humors or solids, to which that heat has access, as to separate those humors or parts from, or render them no longer fit for, the purposes of the animated system, as happens in the sudden thawing of stones, which are thereby crumbled and burst ; of flesh and vegetables, whose texture is entirely

tirely destroyed; or of liquors, which become thereby vapid and useless.

“ From observations and experiments,” says Mr. Hunter, “ it appears to be a law of nature in animal bodies, that the degree of external heat should bear a proportion to the quantity of life; as it is weakened, this proportion requires great accuracy in the adjustment, while greater powers of life allow it greater latitudes.

“ If an eel is exposed to a degree of cold sufficient to benumb it, till the remains of life are scarcely perceptible, and still retained in a cold of about 40° , this small proportion of living principle will continue for a considerable time, without diminution or increase; but if the animal is afterwards placed in a heat of about 60° , after shewing strong signs of life, it will die in a few minutes*.

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* It appears that cases not unfrequently occur, of persons who seem almost perfectly recovered, dying very suddenly: no cause has been assigned for this unexpected

“ I observed, many years ago, in some of the colder parts of this island, that when intense cold had forced blackbirds or thrushes to take shelter in outhouses, any of them that had been caught, and from an ill-judged compassion exposed to a considerable degree of warmth, died very soon. The reason of this I did not then understand ; but I am now satisfied, that it was owing, as in other instances, to the degree of heat being increased too suddenly for the proportion of life remaining in the animal. From these facts it appears, that warmth causes a greater exertion of the living powers than cold, and that an animal in a weakly state may be obliged to exert a quantity of the action of life, sufficient to destroy the powers themselves.”

expected circumstance ; but, from the effects of the precipitate application of too intense heat, here related, it should seem extremely probable, in many instances, to be owing to that cause.

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These very ingenious and judicious observations make it evident, that no standard can be fixed upon for the degree of heat, but it must be regulated entirely by the external warmth of the body. The applications ought in no instance, at the beginning, to exceed that warmth more than three or four degrees; and the same nicety is requisite in the increase of it, as in its first application: hence we shall sometimes be obliged to make use of so low a degree of heat, that it may at first sight appear not only ineffectual and useless, but even calculated to sink and depress the small remains of life; but if we recollect the numerous and unequivocal instances of the beneficial effects of frictions of snow on parts that are frozen, and the consequences that attend plunging the hand, when benumbed with cold, into cold water; if we consider the destruction of the part in the one instance, and the intense pain in the other, which immediately follows on precipitately applying them to the fire; we shall instantly

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conceive the propriety, and indeed the absolute necessity, of such caution.

Animal bodies are found to freeze at about the 25° : in those cases therefore, where the body or extremities are found to be frozen, frictions of snow, or the coldest water, which are at least 7° warmer than the part to which they are applied, should be had recourse to, and their use should be persevered in, till we presume the icy particles are dissolved or extracted, when artificial heat may, if there be occasion for it, be applied in the manner, and under the regulations above mentioned. In other respects, the process is to be the same as in cases of suspended animation, where the parts have not been in a frozen state.

It sometimes happens that the body, after it has lain in or under water from fifteen to twenty minutes or upwards, has required the same length of time to bring it on shore: during this period, the unfortunate wretch is in his wet cloaths,
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and (as these accidents are, for obvious reasons, more frequent in the winter than in any other season) he is probably exposed to a cold, bleak wind, in frosty weather, without any covering to shelter him: when removed to a proper place, and stripped, his body conveys a sensation to the touch similar to the coldest marble, though his limbs may not be rigid. Whether these bodies are always in a state of congelation, we cannot always be certain; but if the body is found to be colder than the 32° , no doubt can then remain of the propriety of using the same method as if the body was absolutely frozen.

Several histories are related of bodies frozen being recovered; but we have reason to think they were not actually in that state, since Mr. Hunter was not able to freeze either fish, dormice, snails, leeches, or earthworms, till they were deprived of life; nor could he, upon thawing them, although it was done in the most gradual manner, succeed in the recovery of one:

he was more fortunate, however, in his experiments on freezing the ears of rabbits, the combs and wattles of cocks, and the tails of tench; but on repeating the experiment on the tails of goldfish, it did not properly answer, for although they appeared for some days to be very well, yet in about a month it was evidently the cause of their death,

2dly. Electricity.—Soon after the institution of the Humane Society in this kingdom, electricity was recommended by Dr. A. Fothergill and Mr. Henly, in cases of apparent death: and it is matter of astonishment, and much to be regretted, that it has so seldom been employed in the recovery of those who have suffered from drowning and other causes, as there is certainly the fairest prospect of its being attended with the most happy and successful event. “Instead of losing time,” says Dr. Fothergill, “in the application of several slight stimuli to the skin and intestines,

testines, why not have recourse to the most potent stimulus in nature, which can instantly pervade the inmost recesses of the animal frame? why not immediately apply electrical shocks to the brain and heart, the grand sources of motion and sensation, the *primum vivens*, and *ultimum moriens*, of the animal machine?"

About the same time a child, "aged three years, fell out of a one pair of stairs window, upon the paved stones. She was taken up to all appearance dead. An apothecary being sent for, he declared that nothing could be done for the child. Mr. Squires, who lives opposite to the place where the accident happened, finding the case hopeless, with the consent of the parents, very humanely tried the effects of electricity. Twenty minutes had at least elapsed before he could apply the shock, which he gave to various parts of the body, without any apparent success; but at length, on transmitting a few shocks through the thorax, he perceived a small

M 3 pulsation:

pulsation: soon after the child began to sigh, and to breathe, though with great difficulty. In about ten minutes she vomited. A kind of stupor remained for some days; but the child was restored to perfect health and spirits in about a week."

In addition to these, let me refer the reader to what has been already said on the same subject, in the account of James Lawson, and likewise in the case attended by myself (page 123); in both which instances, strong appearances of life were excited, four hours after every other means had failed.

These accounts establish facts of a very important and interesting nature. Do not they prove, clearly and indubitably, that animation is capable of being suspended longer than we are aware of? Do they not plainly point out, that electricity is the most powerful stimulus we can apply? Is not the superior advantages of this stimulus evinced in the most incontrovertible
and

and unequivocal manner? And are we not justified in presuming, that if it is able so powerfully to excite the action of the external muscles, that it will be capable of reproducing the motion of the heart, which is infinitely more irritable, and by that means accomplish our great desideratum, the renewal of the circulation?

The part which, in my experiments on drowned animals, I found to be the most readily excited to action, was the diaphragm; and although the shocks were directed so as to pass through the auricles of the heart, consequently much above that muscle, yet it was always brought into great contractions: and the part which retained its irritability the longest, I found to be, in several instances, the muscles situated about the glottis. The peristaltic motion of the intestines seemed to be little affected by electricity, either as to increasing it, or reproducing it when it had ceased; and the only perceptible effect that attended passing shocks through the

cerebrum or cerebellum, was strong contractions of the muscles through or near which the fluid passed: though I have sometimes thought the contractions of the muscular system, in general, were more vivid and lively after the brain and spinal marrow had been electrified, than they were before.

The same attention and caution will be requisite in the administering this powerful agent, as in the application of heat; for in the same experiments I always found, that when violent shocks were had recourse to, their effects very soon ceased; and, on the contrary, when they were gentle, the actions were sufficiently great, and might be continued a considerable time.

From the known property of simple electrification, in promoting the motion of fluids in capillary tubes, increasing the circulation, and the insensible perspiration in living animals, it seems well adapted for the present purpose; but I have frequently

quently tried it on animals without the least sensible effect. Moderate sparks scarcely produced any motion; and even the most pungent were vastly inferior in their effects to the slightest shocks. Indeed, the same objections which were urged against the use either of warm grains or the warm bath, are likewise applicable to this article, only in a much greater degree; for while the body is insulated, every other operation, the application of heat only excepted, must be entirely suspended; a circumstance we should studiously avoid, as the delay of a few minutes at this time, or the employment of an ineffectual remedy, may be productive of irreparable consequences.

From these remarks we may gather, that electricity should neither be employed so gently as to produce no effect, or so violently as to cause mischief. Instead, therefore, of using simple electrification and drawing sparks, on the one hand; or employing such violent shocks as were recommended

commended by Mr. Henly, on the other; it will be more prudent, at least in the commencement of our operations, to apply shocks of not more than one third or half an inch, from a vial containing about twenty-four inches of coated surface. These should be transmitted through every part of the body, but more particularly through the diaphragm and intercostal muscles; the heart, the brain, and the spinal marrow.

3dly. Frictions.—These act as a stimulus in two ways; by producing motion of the blood in the vascular system, and by irritating the nerves of the skin.

M. de Haller observes, that the heart is much more affected, in animals dying, or newly dead, by the gentle stimulus of warm water, or air pushed into its ventricles, than by the most acrid liquors applied to its external surface, or even pricking it with the point of a knife: now the blood, being the best natural stimulus for excit-
ing

ing the motion of the heart, will of course act sooner, and more powerfully, than either air or water; if therefore we can by any means propel it into the cavity of the heart, it will prove more efficacious than the most acrid application to its external surface. That frictions will have this effect, there can be no doubt; for if the vessels are alternately compressed and relaxed, we in some measure supply the place of their natural motion, and their contents must of necessity be driven towards the heart, as the valves prevent its retrograde motion. Hence, in living subjects, by accelerating the motion of the blood, the action of the heart and arteries will be quickened; and if the frictions are violent and long continued, they will be increased so as to occasion a smart fever, even in those who are affected with dropical complaints.

Dr. Whytt, in his Enquiry into the Motion of the Fluids in the small Vessels, has shewn how inconsiderable the effects
of

of the projectile force of the heart must be in those vessels ; and he has made it appear, that their vibratory motion is the principal cause of promoting the circulation of their fluids. “ If,” says he, “ the motion of the fluids in the inferior order of vessels be not so much owing to the force of the heart and larger arteries, as to the gentle alternate contraction of these vessels themselves, we may easily see why frictions, warm, penetrating, and stimulating applications, are often more successful than internal medicines, in removing obstructions in the small vessels ; since they not only contribute to attenuate the obstructing matter, but greatly increase the oscillatory motion of those vessels.”

Simple frictions, with coarse cloths or flannels, will in general answer the purpose very well ; but they will be more effectual, if hair cloth or brushes are made use of. In order, however, to derive the greatest advantage from them, it has been common to make use of some stimulating

lating medium, as salt—spirits—or the volatile alkali. Frictions with salt (independent of the pressure on the veins) acts merely by its angles fretting the skin and producing pain : but as the faculty of sensation, or the perception of pain, is totally destroyed, it may justly be doubted, whether any good which may arise from it, will not be counterbalanced by the inconveniences attending its use ; for if the operation is long continued, it will prove fatiguing to the assistants ; and as considerable excoriations are very soon occasioned, it is probable, if the person should recover, they might be attended with unpleasant consequences. This conjecture is supported by the case of a boy, related by Dr. Houlston, who fell into a pit containing a very strong solution of rock salt, where he remained near fifteen minutes ; though soon after he was taken out, he discovered some signs of life. In about an hour, he was pretty well recovered ; yet he lived only two days : the
skin

skin inflamed, and swelled prodigiously; the mouth, throat, and probably the whole intestinal canal, were excoriated; and he died after two days in great agony, apparently from the stimulus of the salt ley. For these reasons I have seldom used salt as a medium, but have generally had recourse either to ardent spirits, or the volatile alkali, which, by penetrating into the pores of the skin, may probably cause an irritation and contraction in the coats of the capillary vessels to which they are applied.

Mr. Amonton, Mr. Richman, and Dr. Cullen, have by a variety of experiments proved, that fluids in evaporating produce some degree of cold: and the latter of these gentlemen imagines, that this power is nearly according to the degree of volatility in each. The quick lime spirit of sal ammoniac, he found to possess this property in the highest degree; and by spirit of wine, the mercury in the thermometer was made to sink from 44° to below the

the freezing point. On this account I am in doubt, whether the volatile alkali, or ardent spirits, may not in evaporating generate so much cold on the surface of the body, as may counteract our intentions, and prove prejudicial: and as the fumes of the volatile alkali very much affect the eyes of the assistants, and thereby prevent their doing their duty properly (an objection to which the patent mustard is also liable) I am of opinion they should be given up in favour of a liniment with strong spirit of vitriol and sweet-oil, which, when fresh made, has the property of generating, instead of diminishing heat; or, what I think still better, a strong camphorated oil, which, at the same time that it is exempt from the above inconveniences, is powerfully stimulating, of a pleasant flavour, and will allow of being used a long time without fatiguing the assistants; a circumstance which deserves our attention, when the operation is sometimes required to be performed

formed several hours. After these, I should prefer the concentrated vinegar, which may be procured in abundance, by repeatedly freezing and separating all its watery particles.

Frictions are almost always the first article which is flown to for assistance, and in general they are immediately set about with great violence; but we have just now seen, that their principal effect is to drive the blood, from all parts of the body, towards the heart and lungs; now, from our previous knowledge of the state of the vital organs, we are certain, that the *venæ cavæ*, the right auricle and ventricle of the heart, the pulmonary artery, and the veins of the brain, are already in a state of distention; it is evident, therefore, that this treatment is much better calculated to destroy than increase the small remains of life. I much fear, many, who might have been recovered, have fallen victims to such untimely zeal; and I cannot avoid considering this method of proceeding

ceeding, as one material obstacle to a more general recovery. Frictions, then, should not on any account be attempted, until the first indication, the removal of the pressure of the brain, and the congestion of the heart and lungs, is effected: even then they should be gentle, and should be increased by slow degrees, lest the tender vessels should be ruptured by an over hasty accumulation. Artificial respiration, as well as electricity, should frequently be interposed, in order to transmit the blood from the right to the left ventricle, and to expedite its passage through the vascular system.

Changing the position, and agitating the body, will, by gently rubbing the viscera together, produce nearly the same effect in the internal parts, as frictions on the extremities; they should therefore be frequently used: but, as it is well known that violent agitation affects those in high health with giddiness, faintness, and other

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symptoms

symptoms of debility, the absurdity of such practice is sufficiently evident.

LOCAL STIMULANTS.

1st. Aromatic and irritating medicines thrown into the stomach.

Mr. Hunter affirms, that the stomach sympathises with every part of an animal, and that every part sympathises with the stomach, but that this sympathy is strongest with the vital parts; “therefore,” says he, “whatever acts upon the stomach as a cordial, or rouses its natural or healthy actions, and whatever affects it so as to produce debility, has an immediate effect upon every part of the body.”

This fact, which is well known and established, strongly points out the propriety of conveying stimulating medicines to this centre of sympathy; such as vitriolic ether; any of the essential oils, as cinnamon, nutmeg, or peppermint; the volatile

latile alkali; or ardent spirits properly diluted: by these the nerves of the stomach will be irritated, and the same sensation will be conveyed throughout the whole system. The method of exhibiting these is by a syringe with an elastic pipe; a very useful instrument, contrived, I believe, by Mr. Hunter.

It is probable, however, that the most powerful and general stimulus we can apply in this way, is an emetic. I am well aware that it may be objected to by some, as causing fulness of the vessels of the brain; and by others, as, inducing nausea and debility, it will depress the powers of life: these inconveniences may, I conceive, be avoided, by waiting till the congestion of the head is removed, and then employing such substances as excite vomiting as soon as they are taken into the stomach, as the white or blue vitriol, both of which act without occasioning any previous nausea.

2dly. Aromatic and irritating medicines injected into the intestines.

The peristaltic motion of the bowels is known to continue some time after the action of the heart has ceased; and from this it is concluded, that the irritability of the former may remain longer than the latter. Of the first I am perfectly satisfied, having several times seen it in quadrupeds: but of the last I am by no means convinced; for I ever observed, that when once the motion had ceased, it was scarcely to be excited again, either by electricity, pricking with a knife, or blowing warm air into their cavity: hence I am led to believe, that stimulants applied to this part will in general fall short of their intended effect.

But granting for a moment, what I do not conceive can be proved, that the abdominal viscera retain that peculiar property which enables their muscular fibres

to

to contract, on being stimulated, longer than any other organ, and allowing it possible that the same sensation should be conveyed throughout the whole system; yet surely the method we are directed to take to effect this purpose, that of throwing up the fumes of tobacco, is of all others the most unlikely to answer. Let us examine the effects which this celebrated and favourite remedy produces in the animal economy; we may then perhaps judge, whether it be entitled to the popularity and preference which it now so eminently enjoys.

The common effects of tobacco, when given internally in small doses, either by the mouth or rectum, is, according to Dr. Lewis, to prove violently cathartic and emetic, occasioning extreme anxiety, vertigo, stupor, and disorders of the senses. Dr. Fowler says, glisters of the infusion (one dram of the plant to half an ounce of water) possess an anodyne, relaxant effect on the system in general, and a stimulating

effect on the rectum. Newman says, the oil, from repeated trials, has been found poisonous to sundry animals; and Dr. Dedier, that a drop or two of it presently kills a cat or a pigeon. The Abbé Fontana found vomiting to be the constant effect of the oil, when applied to a wound, and loss of motion in the part to which it was applied: but in none of his experiments did it occasion death. Without multiplying quotations, which it would be very easy to do, what has been said from the above respectable authorities is sufficient to prove, when it is used in any quantity, that it possesses a relaxing, nauseating, deleterious, and poisonous property: there can be no doubt but its effects are nearly the same, whether taken into the stomach, injected into the bowels, or applied externally; and it is of little consequence, whether the smoke, infusion, or decoction be used, provided the same quantity of the herb be employed in each, since upon its essential

tial oil do these properties appear to depend *.

Tobacco glisters, in strangulated herniæ, and violent constipations of the bowels, are in universal estimation. I have sometimes, it is true, seen them succeed when every other remedy had appeared unsuccessful; but it is no less certain, that I have in many instances seen them not only fail, but produce very alarming symptoms: and in more than one case, where they were persisted in too long, death itself, unless I am much mistaken, has been the consequence.

* Let it be remembered, however, that glisters of the infusion or decoction seldom contain more than one dram of tobacco; whereas, when the smoke is used in cases of apparent death, one or two ounces are generally consumed, and sometimes a larger quantity: now, if unpleasant consequences do happen from the small quantity of oil, and which is much diluted, how much reason have we to expect, that the large quantity of oil extricated from the latter, and deposited in a separate state, will be attended with the very worst effects?

Considering all circumstances, then, is it not a just inference, that although tobacco may at first act as a stimulus, yet it will afterwards, by its narcotic and deleterious properties, not only counteract what it has accomplished, but will abolish what before existed?

Although I am by no means satisfied, that the irritability of the intestines is either so considerable, or remains so long after death, as is generally supposed; yet, as a portion of the intestines retain their warmth, probably, longer than any other part; and as we have shewn that heat and irritability are always connected; and likewise as the peristaltic motion is sometimes spontaneously renewed after it has ceased; the application of stimulants to this part ought by all means to form an article of our process.

Mint, peppermint, camomile, or worm-wood, as containing abundance of warm, penetrating, aromatic oil; as they possess purely a stimulating, without any debilitating

debilitating property; and as being readily kindled—seem well adapted for this purpose.

It does not immediately appear, why the smoke of any substance is so much to be preferred, or, indeed, why it should be preferred at all; since, if we consider the subject fairly, we shall find, that heat—irritation—and distention—are not only the principal, but the sole effects, we have any reason to expect it to produce. Now, if no further benefit be expected, it should seem that the same effects may just as effectually be obtained, by diffusing a certain proportion of any essential oil in a large quantity of warm water; and this practice is certainly entitled to preference, because the one requires a large, cumbersome, and expensive apparatus, whereas the other may be commodiously administered in the common manner.

I object to the enema fumosum on another principle: it is the common practice to begin with it, and to continue vigorously injecting

injecting it till all the operations are concluded. By this means the bowels are constantly kept in a state of violent distention ; the aorta and inferior vena cava will therefore be compressed ; the passage of the blood through them will be materially impeded ; and the vital organs must in consequence remain overloaded.

3d. Particular stimuli adapted to the different organs of sense ; as

a. Light thrown on the eye.

The sense of pain which accompanies the sudden application of strong light to the eye, has been experienced by every one ; and the immediate connection that exists between the retina, which is supposed to be an expansion of a portion of the brain, and the sensorium commune, strongly points out the propriety of having recourse to that experiment at this time. A taper will, I should imagine, answer very well ; but when an opportunity

nity offers of throwing the rays of the sun, concentrated by a double convex lens, on the retina (agreeably to the recommendation of Dr. Fothergill) its effect will certainly be much more powerful*.

b. Great noises directed to the ear.

It has been supposed, that the sense of hearing remains longer in drowned persons than any of the other senses: whether it really does, I am not able to say; no inconvenience, however, can arise from making the trial; and, should the sensitive principle remain, it may probably prove useful.

* A drop or two of strong volatile alkali let fall into the internal canthus of the eye, occasions such intense pain, that I have seen many apoplectics, who were totally insensible to scarifications and the strongest light, exhibit evident symptoms of acute sensation, when it has been applied: on this account, I should recommend it in the present instance.

c. Acrid

c. Acrid liquors applied to the tongue and palate.

d. Sternutatories to the nostrils.

The whole cavity of the mouth and nose is naturally very sensible: the most effectual method of renewing its sensation will probably be, by throwing into it air strongly impregnated with the volatile alkaline vapour; or the juice of onions or garlic, or mustard or pepper, may be rubbed on the tongue, palate, and fauces; and snuff may be blown into the nostrils.

e. Scarifications, the actual cautery, &c. to the skin.

Medical histories furnish us with several melancholy instances of the efficacy of scarifications and incisions, in recovering those who were supposed dead. The great Vesalius, the most eminent anatomist of his age, who first ventured to detect the errors of Galen, and who was very near preventing

preventing our countryman, Harvey, from having the honour of discovering the circulation—in opening the body of a person of consequence, whom he had attended, and thought to be dead, perceived, when it was too late, his fatal error ; for, on penetrating the chest, he found the heart palpitating. He was accused and condemned as a murderer ; but by the interposition of the King of Spain, his sentence was mitigated. It is said that Cardinal Spinola, when he was about to be embalmed, thrust away the hand of the surgeon who performed the operation : and it is related by Terelli, that a Spanish lady being supposed dead, a celebrated anatomist was employed to open the body, but that on the second stroke of the instrument she discovered evident signs of life. P. Peu, the celebrated French accoucher, candidly relates, that being importuned to perform the Cæsarian operation on a woman whom he supposed positively dead, perceived, when it was too late, by the motion

motion of the body, the grinding of the teeth, &c. that he had been fatally mistaken. These cases, the truth of which are but too well confirmed, clearly point out the propriety of adopting similar, though more innocent measures. Scarifications, therefore, or vesications raised by fire on various parts of the skin, gradually plucking out hairs, and beating the palms of the hands and soles of the feet, ought with prudence to constitute a part of our process.

Let it be observed, as an invariable rule, that in all attempts to recover the drowned, our attention should be principally and primarily directed to—the administration and proper regulation of the inflation of the lungs—and the application of heat. These, with the occasional use of blood-letting, I consider as absolutely necessary to put the body in a state proper to be acted upon, either by the inherent powers of the constitution, or the stimulating remedies generally used. Without these, I
can

can never expect a recovery (unless the remains of life are very great indeed) even if the treatment be in every other respect unexceptionable : and with them, I am much disposed to believe, that the greater number of those who are recoverable, will be brought to life. The various other methods therefore, however highly extolled, are to be considered only in a secondary view, and consequently should by no means interfere with their application. It is matter of material consequence, and extremely fortunate, that the greater number of them, indeed the whole, except the injections into the stomach, are of such a nature, that they may be employed at the same time, without clashing, or opposing each other's effects *.

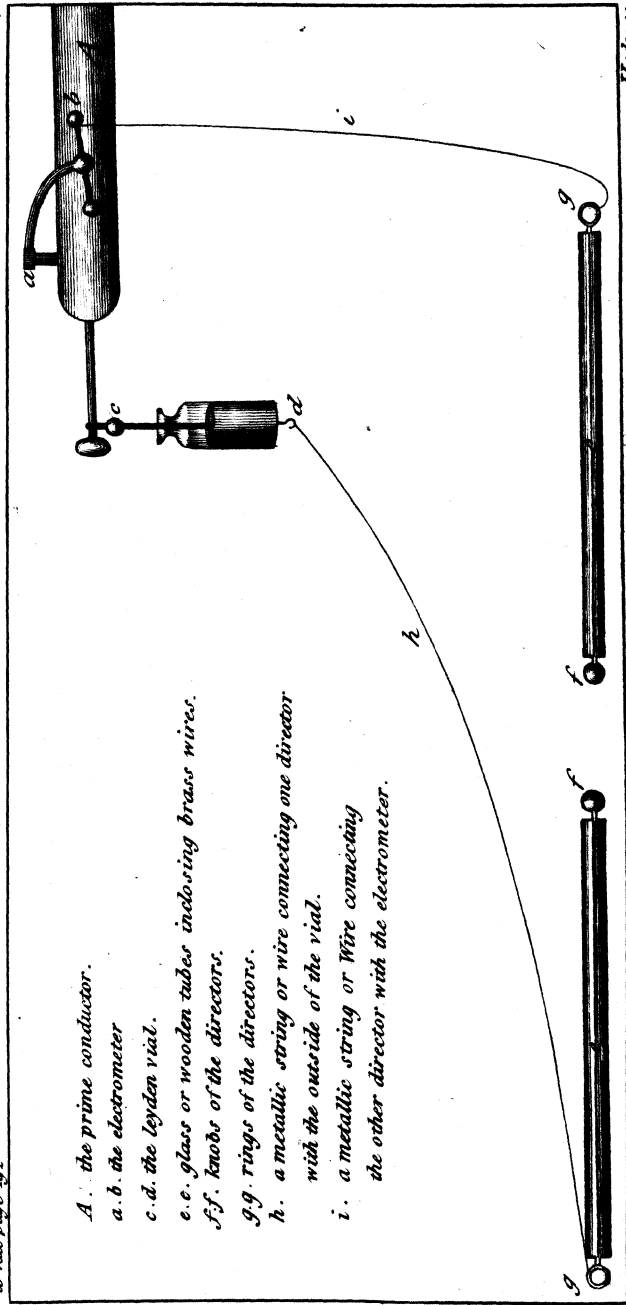
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* When I have electrified the body, all the other operations have been suspended, lest the assistants should receive the shock, instead of the patient ; which may very readily happen, as the living body is a much better conductor of the electric fluid than the dead : a very simple contrivance will prevent the occurrence of this circumstance,

It is necessary to observe, that particular attention seems requisite when the symptoms of life make their appearance: it will then be adviseable to slacken our operations, and leave as much to the exertions of the constitution as may be done consistently with prudence. At first, when the symptoms are very weak, little alteration will

stance, and will at the same time allow us to make use of the shock while the person is in the warm bath, or surrounded with hot grains; which we otherwise could not do, on account of the conducting property of the water. It is merely two pieces of brass-wire, each two feet long, inclosed in glass tubes, or wooden cases well varnished, with knobs at one end, and rings at the other: the knobs are to be applied like common directors, to those parts between which we intend the fluid to pass; and one ring connected with a chain or metallic string, coming from the electrometer, and the other with a chain joined to the outside of the vial, which will be more convenient if suspended on the prime conductor. In this manner, shocks may be sent through any part of the body; and their direction constantly varied, without a probability of the assistants receiving any inconvenience.—See Plate I.

- A.* the prime conductor.
a. b. the electrometer
c. d. the leyden vial.
e. c. glass or wooden tubes inclosing brass wires.
ff. knobs of the directors.
g. g. rings of the directors.
h. a metallic string or wire connecting one director
 with the outside of the vial.
i. a metallic string or wire connecting
 the other director with the electrometer.



IN THE RECOVERY OF PERSONS APPARENTLY DEAD FROM DROWNING, THERE ARE TWO INDICATIONS:

- I. To remove the compression of the brain, and the congestion about the heart and lungs.
- II. To excite the irritability of the muscular fibres.

I. The removing the compression of the brain, and the congestion about the heart and lungs, may be effected by,

1. Bleeding, either
 - a. From the jugular veins, or,
 - b. Cupping and scarifications.
2. Artificial respiration, with
 - a. Common air.
 - b. Warm air from the lungs.
 - c. Dephlogisticated air.
 - d. Air loaded with acrid and irritating effluvia ; as,
 1. Of tobacco,
 2. Of volatile alkali,
 3. Of spirit of salt,
 4. Of spirit of sulphur.
3. Proper position.

II. The exciting the irritability of the muscular fibres may be done by,

1. General stimulants ; as,
 - a. The proper application of heat, by
 1. Warm room,
 2. Warm bath,
 3. Warm grains,
 4. Natural warmth,
 5. Warm substances to various parts.
 - b. Electricity.
 - c. Frictions, with
 1. Coarse cloths,
 2. Flannels,
 3. Hair cloth,
 4. Brushes,
 5. Camphorated oil,
 6. Concentrated vinegar,
 7. Volatile liniment,
 8. Ardent spirits,
 9. Mustard,
 10. Common salt.
 - d. Gentle concussions.
2. Local stimulants ; as
 - a. Aromatic and irritating medicines thrown into the stomach ; as,
 1. Emetics,
 2. Etherial spirits,
 3. Essential oil,
 4. Volatile alkali,
 5. Ardent spirits.
 - b. Aromatic and irritating medicines injected into the intestines ; as,
 1. The oil, decoction, powder, or fume of aromatic substances.
 - c. Particular stimuli adapted to the different organs of sense ; as,
 1. Light thrown on the eye, either that
 - aa. Of a taper, or
 - bb. Of the concentrated rays of the sun.
 2. Great noises directed to the ears.
 3. Acrid liquors applied to the tongue and fauces ; as,
 - aa. Volatile alkaline vapour,
 - bb. Juice of onions or garlic,
 - cc. Mustard or pepper.
 4. Sternutatories applied to the nostrils ; as,
 - aa. Strong snuff,
 - bb. Volatile alkaline vapour.
 5. Scarifications, or the actual cautery to the skin.

be required ; but when they become more considerable, it is probable that our safest and most effectual practice will be, occasionally assisting, rather than importunately urging, the action of those organs which are the most defective, and which, on this account, seem more particularly to require our attention and support.

It may be of some service to have the whole of the method of recovering drowned persons collected into one view, as in the opposite table.

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Nothing

Nothing seems more essentially necessary for the improvement of the resuscitating art, than a large and diversified store of accurate histories of persons apparently dead from drowning, and other causes: indeed, till we can obtain such a properly accumulated mass of history, it is in vain to expect that our knowledge of this subject can be at all extended. There was reason to hope, from the plan and exertions of the Humane Society, that by this time we should have been in possession of ample and very sufficient information on this head; but, notwithstanding the number of cases that have with great trouble been collected together, it is too true, that but a very small proportion of them convey information even of the most common and necessary circumstances. This inconvenience might readily be overcome, would the Society agree not to bestow rewards, either in successful or unsuccessful cases, without receiving, from the person who superintended the case, a particular

particular account of every circumstance which occurred while the body was under his direction. This, it appears to me, would very soon procure us that information we so much stand in need of; and it would, moreover, be productive of another advantage, in preventing numerous applications on trivial accounts. The only ground on which this proposal may be objected to is, on account of the trouble it would occasion to the medical assistants; some of whom, rather than be at the inconvenience of stating such a particular account, would not communicate what had occurred under their direction. There are but few, I trust, to whom this argument can be applied: but if a regular plan was drawn up, containing every article necessary to be informed of, there could be no objection to it. With this view, the following sketch is laid before the Society; and it is submitted to their consideration, the propriety of sending a

copy to each medical assistant, with such resolutions annexed to it, as they may judge proper.

As an appendage to this, the plan of a general table is added, which is intended to exhibit, at one view, the whole of the history of drowned persons, with the varieties which may occur in different cases. The advantages that must arise from adopting this, or a similar plan, are sufficiently obvious.

In this table, the asterisks under the different heads point out the particular circumstances that occur, or the remedies that are used. Where any remedy or remedies appear to be remarkably serviceable in bringing about the first symptom of life, a red asterisk is to be added likewise; and where they seem evidently and materially to assist in promoting the recovery, two common asterisks are then to be made use of.

The figures under the two last divisions—the Return of Life—and the Complaints after

<i>Circumstances previous to the Accident</i>	<i>Circumstances at the time of</i>	<i>Circumstances & appearances as soon as taken up</i>
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Unsuccessful Cases

Method of Recovery

Unsuccessful Cases

S U C C E S S F U L.

III min ^s under water.		IV min ^s under water.		V min ^s under water.		V min ^s under water.		VI min ^s under water.		VII min ^s under water.		VIII min ^s under water.		IX min ^s under water.		X min ^s under water.		X min ^s under water.		X min ^s under water.		X min ^s under water.		X min ^s under water.	
Minutes before recovered.	Number of the cafe.	Minutes before recovered.	Number of the cafe.	Minutes before recovered.	Number of the cafe.	Minutes before recovered.	Number of the cafe.	Minutes before recovered.	Number of the cafe.	Minutes before recovered.	Number of the cafe.	Minutes before recovered.	Number of the cafe.	Minutes before recovered.	Number of the cafe.	Minutes before recovered.	Number of the cafe.	Minutes before recovered.	Number of the cafe.	Minutes before recovered.	Number of the cafe.	Minutes before recovered.	Number of the cafe.	Minutes before recovered.	Number of the cafe.
Soon.	465	Soon.	66	s	84	15	365	* Uncer- tain.	16	s	98	s	7	20	356	s	30	s	258	*	414	15	396	30	471
30	80	30	97	10	67			70	372	5	101	s	316			s	51	s	358	*	130	15	497	30	68
60	49			15	355							s	p. 176			s	274	s	363	3	1	20	310	30	254
				45	78							s	307			s	293	s	371	5	315	20	279	30	259
				45	422							20	535			s	311	s	501	5	22	20	484	30	415
				120	419											s	405	s	566	10	74	25	2	60	277
				120	491											s	57	* Uncer- tain.	25	10	308	30	451	60	416
X		XII		XV		XV		XV		XV		XVIII		XX		XX		XX		XXX		XL		XLV	
60	487	s	305	s	320	10	21	20	(409)	60	354	30	307	s	12	20	437	60	164	*	103	40	(1)	120	315
60	488	3	260	s	239	10	(7)	20	250	60	368			s	503	20	482	90	312	45	593				
60	498	15	161	s	351	12	252	20	546	60	494			s	6	30	407	120	392	45	(11)				
90	318	20	289	*	(408)	15	65	30	59	120	357			10	138	30	(7)	180	410	45	p. 165				
90	390	30	268	*	105	15	249	30	553	120	408			10	p. 173	45	549			45	547				
105	489	40	276	*	267	15	496	40	265					15	472	45	348			60	165				
180	493			8	398	20	14	45	561					20	11	60	13			240	420				

U N S U C C E S S F U L.

Minutes under water	Uncer- tain.	Few.	5	6	7	10	12	14	15	16	17	18	20	25	30	35	40	45	50	60	90	120	180
Number of Cafes	150	13	5	1	2	28	5	1	66	1	1	1	41	3	80	4	11	7	2	40	7	8	3

after Recovery—refer to the number of the articles in the preceding plan, where the particulars are explained more at large.

The table is divided into two parts, on account of its length.

It may not be amiss to exhibit, at one view, the length of time that was employed in each of the cases which are published in the Reports of the Humane Society (where that circumstance is specified) before the first symptom of life made its appearance: likewise the different length of time, which different cases, that were under water for the same space, required for their recovery; and also an account of the number of unsuccessful cases, with the length of time they were under water, on whom the same or similar means had been employed.

ON THE SUSPENSION OF THE VITAL
POWERS FROM HANGING.

THE proximate cause of death, in persons who perish from hanging, is a circumstance which has engaged the attention of the most eminent men, both ancient and modern; but, after all, the anatomists and physiologists of the present day seem equally in the dark, and as much unsettled in their opinion, as their predecessors. Perhaps, however, it may not be amiss to mention the different ideas that have prevailed, and still continue to prevail, concerning it.

It was one of the first opinions, that death was occasioned by the constriction of the nerves of the neck. The nerves of the neck have been tied in many and various animals: in a few it is said to have proved

proved mortal ; but in by far the generality it did not produce that effect.

Others ascribed it to a compression of the carotid arteries. The experiment has been made of tying them ; and the animal, in many instances, did not seem to labour under any very material inconvenience.

A third opinion is, that it proceeds from the compression of the jugular veins : but all the larger veins of the neck, both internal and external, have been separately tied, without apoplexy or even sleepiness having been induced. Further, it is related, that the carotid arteries and jugular veins being all tied in a dog, that he enjoyed the most perfect health and vivacity for some weeks ! The same author, Emmettus, observes, that upon repeating the operation often, although none of the dogs died, or were apoplectic, yet some of them, for the space of a few hours, seemed sleepy.

Some attribute it to a compression of the spinal marrow : but this effect cannot

often take place, without the vertebræ being either dislocated or fractured; a circumstance that is very seldom observed to occur.

With greater appearance of probability, do some impute it to the trachea being shut by the pressure of the cord, and thereby preventing respiration. As I do not recollect to have met with any experiments or observations advanced against this theory, I take it for granted, it is now the generally received opinion; more especially as Haller, De Haen, Dionis, Languthus, and several other great men, have attributed it entirely to this cause. Experiments I have none to adduce against it; but I am of opinion, if we attend to the mode in which the cord is fixed about the neck of those unhappy wretches, and the parts on which it acts, we shall not consider this affair as fixed on so firm a basis, or so entirely devoid of objection, as it may at first sight appear.

I never myself had a proper opportunity of ascertaining these circumstances; but from what my own ideas furnish me with on the subject, I should suppose the stricture generally happens either above or upon the thyroid cartilage: if above it, which I conceive happens the most frequently, notwithstanding that the soft parts give way, yet there must be some room for the air to pass into and out of the lungs; and if upon the cartilage itself, it is so firm and strong, as to be sufficiently capable of resisting the pressure which is applied to it. If this then is the case (and I have no reason to induce me to think otherwise) I do not see how respiration can be so suddenly or completely stopped as to prove the cause of death.

Although I cannot admit the stoppage of respiration to be the sole cause, yet I do not hesitate one moment in allowing it to be a principal one. Hence, if the breathing is materially impeded, the blood
will

will by degrees be accumulated in the right auricle and ventricle of the heart, and in the whole venal system : but the veins of the brain, for various reasons, as we have shewn in another place *, will be sooner distended than those of any other part ; the functions of that organ will consequently cease, and the appearance of death must then happen. If to this we join the additional resistance the blood will meet with in its passage through the veins of the neck, all of which must necessarily be compressed, while at the same time the circulation through the carotid and vertebral arteries still continues, they will both be perfectly sufficient to account for the event.

Haller, De Haen, Petit, and Lancisi, are of opinion that the cause of death resides in the chest ; while Boerhaave, Wepfer, and Littre, attribute it to apoplexy. I join the latter in opinion ; and

* Page 38, 39.

am persuaded they are right, for the following reasons.

It is true, we are circumstanced nearly the same, with regard to the dissection of those who are hanged, as of the drowned; and but little confidence is, for the same reason, to be placed in the former as well as the latter *; but cases are by no means wanting to prove, that the appearances on the body, and those which occur on dissection, as well as the sensations, and the complaints of those who have recovered, indicate that the cause resides in the head, instead of the breast. The appearances, on being cut down, very much resemble those of the drowned; that is, the face is swelled, and of a dark red or livid colour; the eyes are suffused, enlarged, and prominent; the features are distorted, and the tongue sometimes thrust out of the mouth. On dissection, the vessels of the brain have been found dis-

* See page 30, et seq.

tended,

tended, and sometimes blood has been extravasated in consequence of their being ruptured *. The sensations of those who have survived hanging, correspond entirely with what I have already mentioned. In several instances it is related, that as soon as they were suspended, sparks of fire seemed to fly before their eyes ; they were seized with stupor and loss of sense, and were not conscious of any thing that afterwards occurred, till life was perfectly restored. Some respectable authors also relate, their having seen persons apoplectic from hanging ; and a case which some time since fell under my direction, puts that matter out of doubt.

A middle-aged man hung himself : after hanging, it was supposed, from three to five minutes, he was cut down. He was senseless and speechless ; but his pulse, respiration, and power of deglutition, still remained. A surgeon was sent for, who

* See the Cases related at p. 54, et seq.

blooded him, and left him some medicine. I saw him about an hour and half after the accident, at which time he was in a deep apoplectic fit, attended with all the most violent symptoms of that strongly marked disease. As he had been drinking, several emetics were exhibited, and purgatives given, both by the mouth and rectum ; but they did not produce the least effect. The pulse being large and soft, made me dubious as to the propriety of another general bleeding ; cupping glasses, therefore, were applied to the head and breast, and three or four ounces were drawn off by their means ; frictions and stimulants were likewise had recourse to : but after lying three or four hours, nature was no longer able to maintain the unequal conflict.

The next day the body was opened. The dura mater adhered very firmly to the inside of the skull, and it required considerable force to separate them. On removing the dura mater, the vessels of
the

the pia mater did not appear more distended than usual; but I afterwards thought there was a larger proportion of blood in the vessels of the brain in general, than I had observed in others. There was no inflammation on this membrane; but at that part of it which was immediately below the junction of the coronal with the sigmoidal future, it adhered to the dura mater on each side the longitudinal sinus: these adhesions were easily separated; the intervening substance was white, and about the dimensions of a silver threepence. The same appearance was found in the middle portions of the membrane which cover the cerebellum, with this difference, that the same coagulable lymph was likewise between the cerebellum and pia mater, uniting them together. The brain in general was firmer than common. There was not more than the usual quantity of water in the lateral ventricles, and that was of a red colour. The plexus chorooides had the common vascular appearance,

ance, and there was no evident extravasation of red blood either about it, near the origin or foramina of the nerves, or upon any part of the basis of the skull. The cartilages of the trachea were all found, and they shewed no appearance of having suffered from compression. There was nothing preternatural either in the thorax or abdomen, that could account for his death: no water in the pericardium. His heart was uncommonly fat; and his lungs were, without exception, the soundest I ever beheld—not a tubercle to be perceived—nor were they, any more than the heart, in the least distended or overcharged with blood. The liver was hard, and beginning to grow schirrous. The stomach and intestines were in a very sound state: in the stomach was a small quantity of half-digested food; its internal membrane had not the least vestige of inflammation or erosion having been induced in consequence of the emetics, &c.; and there was no feces in the rectum, or urine in the bladder.

This appears to me a case quite in point. The man, on being cut down, immediately breathed, as if respiration had not been discontinued ; but he was in a state of the most profound apoplexy. On dissection, nothing preternatural was discovered, in either of the vital organs, which could be supposed capable of causing death ; and the trachea seemed in a perfectly natural state.

Be the cause of death, however, induced in whatever manner it may—whether as I have mentioned, or by the joint compression of the trachea, arteries, veins, and nerves of the neck, or in any other way—what has been said will, I conceive, be thought sufficient to prove, that those who die from hanging, suffer in consequence of pressure on the brain. Those who perish from drowning, we have found to suffer from the same cause. They ought, therefore, to be treated in precisely the same manner : the compression of the brain should be removed, and the irritability of the muscular fibres
should

should then be excited. The method of effecting these intentions, we have fully explained, when treating of the recovery of the drowned ; there can be no occasion, therefore, for repeating them in this place.

ON THE SUSPENSION OF THE VITAL
POWERS BY NOXIOUS VAPOURS.

ANIMALS who are destroyed by me-
phitic vapours, arising from ferment-
ing liquors, charcoal, the calcination of
metals, and other sources, do not appear to
suffer the same kind of death, either as the
drowned, or those who are hung; since
they are observed, in general, to be killed
in a shorter time: their limbs remain much
longer flexible after death; and their blood
is commonly fluid. It is very evident,
however, that the cause which produced
death in the former, has a very material
effect in bringing it about in the latter;
for the head, face, and neck, are violently
swelled, the eyes protrude, and the tongue
is thrust out of the mouth; the right ven-
tricle and auricle of the heart, the pulmo-
nary artery, the venæ cavæ, jugular veins,
10 and

and vessels of the brain, are all much distended with blood; and the ventricles of the brain frequently contain a quantity of bloody serum: all these circumstances seem strongly to indicate that they die apoplectic.

From a variety of circumstances, I am induced to believe, that mephitic air occasions apoplexy and death in two ways: first, by affecting the nerves of the trachea in such a manner, as to render the muscles subservient to respiration paralytic; and, secondly, by its sedative property, destroying the action of the brain and nervous system. Were the noxious vapours to act merely in the latter way, I do not conceive there would be such strong appearance of distended brain: I am, on that account, inclined to suspect, that they exert their effects principally on the organs of respiration. In opposition to this, however, I must observe, that it has been remarked by M. Bruquet, that the mephitic air does not penetrate into the lungs, because their

P 2 sensibility

ſenſibility prevents its entrance; and that animals plunged into theſe fluids make continual efforts to inſpire, though without being able to accompliſh that end. But I am perſuaded this is not always the caſe, becauſe kittens that have been confined in jars of fixed air I have heard cry, and have repeatedly ſeen their cheſt and abdomen alternately enlarged and contracted.

Many inſtances are recorded of perſons ſuffocated by noxious vapours being perfectly recovered; and, as ſeveral are known to have revived ſpontaneouſly, without any aſſiſtance from art, it is probable a much greater proportion may be preſerved, if timely aſſiſtance be given, and proper reſtoratives uſed.

We have ſeen, that the moſt common kind of noxious vapour may, in ſome degree, and for a ſhort time, be inſpired into the lungs; in which place, as I ſaid before, it ſeems principally to exert its poiſonous effects. Our attention ſhould therefore

fore be immediately directed towards correcting and expelling from that part what may remain in it. This may be done very effectually by inflating the lungs with dephlogisticated or pure air, which seems well adapted to neutralise and correct all kinds of mephitic effluvia: the difficulty, however, of procuring it at all times in sufficient quantity, and administering it conveniently, are impediments not easily overcome; till they can be surmounted, therefore, we must be satisfied by imitating natural respiration with atmospheric air: indeed, if care be taken to procure it cold, and tolerably pure (which may easily be done by Mr. Hunter's bellows, or a common pair adapted to any inflating instrument) I think it will answer this purpose very effectually; for the affinity which exists between phlogisticated and dephlogisticated air is so great, that the dephlogisticated portion of the atmospheric air will combine with the mephitic vapour; and by frequently repeating the operation, its

noxious property will soon be sufficiently altered. Should the accident happen by air extricated from fermenting substances, which yield what is commonly called fixed air, the volatile alkaline vapour diluted, will probably answer very effectually. The introduction of this fluid into the lungs of drowned people is justly esteemed a doubtful practice; but in the present case, should too high a proportion of aerial acid remain in the cells of the windpipe, the alkaline air will neutralise and correct it, equally as well, if not better, than the dephlogisticated air.

It is known by long experience, that exposing bodies suffocated by the fumes of charcoal to intense cold, and making use of frictions of snow, are as serviceable as the contrary method is pernicious. It is, however, probable, that this practice may not be equally useful when death arises from every kind of noxious vapour, since we are informed, that a moderate degree of warmth, in those suffocated by the fumes
of

of burning limestone, has been found beneficial. M. Portal has remarked, that the heat remaining in the bodies of those seemingly dead from noxious vapours, is greater than when alive, or at least than is compatible with health: it is probably on these occasions that cold may be necessary, to reduce the heat below the natural standard, so as to proportion it to the small degree of life which remains in the body, and by that means prevent the exertions which the constitution must necessarily make, in order to keep up so much heat; which effort of itself, while the powers of life are so low, would very soon be likely to prove fatal: but in those cases where the heat of the body appears nearly extinct, instead of using the cold applications, I apprehend it would be more prudent to have recourse to moderate warmth.

In every other respect, the treatment of those suffocated by mephitic vapours should be exactly conformable to the di-

rections given for the recovery of the drowned.

The salubrity of air in mines and caverns, is generally examined by means of a lighted candle; and implicit confidence is usually placed in the fidelity of this test. It is matter of some importance, however, that this article should be viewed in a proper light, or otherwise it may be productive of fatal mistakes. Dr. Priestley, several years since, discovered a method of reducing nitrous and some other kinds of air, which in their first state extinguish a candle, to a state in which a candle burns in it, *quite naturally*, or with a *greatly enlarged flame*, though they still continue as noxious as ever. The same gentleman, and others likewise, have observed, that sometimes animals will live nearly as long in air, in which candles have burned out, as in common air. Persons of delicate and irritable constitutions have been known to be attacked with dangerous symptoms from the air of coal-pits, &c. notwithstanding

standing that the candles have continued burning; and miners have been known to work many yards below where a candle would not burn.

These circumstances clearly prove, that the test of a lighted candle, if too much depended upon, may be productive of the most serious consequences: it therefore ought, by all means, if not rejected, to be applied with great circumspection and caution*.

* It is probable, that the immediate or sudden extinction of the redness of the wick, as well as the flame, would prove a more certain criterion.

ON THE SUSPENSION OF THE VITAL
POWERS FROM SYNCOPE.

THE causes of syncope are very numerous; but as I propose, at present, to confine what I have to say on this subject to the recovery of those who are in that state from loss of blood, it will not be necessary for me to enumerate all those causes here.

It is well known that this disease sometimes takes place to that degree, that neither the pulse nor respiration can be distinguished; the body becomes cold, and the countenance seems clouded by death. Under these circumstances, it is likely many may have really died, who with proper attention might have been restored; and it appears sufficiently probable, that many of the stories related of persons lying in trances, and many of the instances
of

of premature interment, which are to be met with in Bruheir, Lancisi, Kornman, Forestus, Lusitanus, &c. originated from this source*.

From

* Many of these, notwithstanding they are vouched for by men of reputed sense and eminence, are of such an extravagant nature as not to be credited: yet it is clear there must have been some foundation for such uncommon stories, and that several have recovered a considerable time after they had appeared to be dead. A few of the most remarkable I shall subjoin.

Lancisi De Morte Subitana. mentions his having seen a person of distinction recover, while the funeral service was performing over him. Three similar instances are mentioned by Pliny, in his Natural History; one by Plutarch; and two by Dr. Crafft, of Neufchatel. Plato relates the history of an Armenian, who, twelve days after he was supposed to be slain, returned to life on the funeral pile. Pliny tells us, that Acilius Aviola, who had formerly been consul, returned to life when he was upon the funeral pile, but was burnt alive. The same fate befel Lucius Lamia, who had been prætor: but Cælius Tubero was more fortunate, having discovered signs of life in time to be removed. Mons. Benard, a surgeon of Paris, saw a monk, who had been buried three or four days, taken from his
grave

From a variety of considerations it appears necessary, that the brain should always be preserved in a certain degree of tension and firmness: and it is universally allowed, that the contraction of the auricles and ventricles of the heart arises from the stimulus of the blood thrown into

grave alive, but he died immediately. A lady in Hampshire was buried three or four days after her supposed death: the next day, a noise being heard in the vault, it was opened, and she was found just expiring. Maximilian Miffon tells us of Francis de Civile, of Rouen in Normandy, who is recorded to have been three times dead, three times buried, and as many times raised from the dead. Upwards of half a dozen stories are related of persons who, being buried, were roused from their trance by the attempts which were made to rob them of valuable rings which they had on their fingers; and a greater number of instances are said to have happened, where persons being prematurely confined to their coffins, have not only devoured their shrouds, but have been reduced to the necessity of eating part of their own flesh. Many more similar cases might be given; but, in all probability, what has been said will be thought fully sufficient.

their

their cavities. A certain quantity of blood is therefore necessary to effect these purposes: if it exists in a due degree, the vital actions will proceed properly; but any material alteration in this article will be attended with a deviation from health, and will endanger the constitution: an excess of it in those parts will arise from suffocation; and a defect, from any circumstance which causes a flow of blood into a new channel, or which diminishes its quantity.

Loss of blood may, and probably does, operate in many ways with which we are unacquainted, so as to assist in producing syncope: it appears, however, to arise more particularly from the want of a sufficient quantity of that fluid in the vessels of the head, to preserve the brain in a due degree of firmness and tension; whence a diminution or deprivation of the actions of that organ, and its appendage, the nervous system. At the same time, the quantity of blood returned to the heart not being
sufficient

sufficient to distend its cavities, the action of that organ must, for want of its usual stimulus, be interrupted; and every appearance of death will consequently ensue.

The vascular system is, for the wisest purposes, endued with the property of accommodating itself to the quantity of blood circulating in it: hence, when there is a redundancy of blood, or a plethora, the capacity of the vessels is enlarged; when a deficiency of it, from hæmorrhage, or other violent discharges, happens, it will be diminished. This expansion or contraction can, however, take place but in a certain degree; for hæmorrhages are extremely liable to happen, if the plethora is increased; and faintings are very ready to occur, if the debilitating discharges are not soon checked.

From this view of the subject, we are led to a method of treatment, which seems the best calculated, that the nature of this dangerous situation will allow of, to restore life.

It

It should, of course, be our first business to prevent, as far as may be in our power, any further return of the expence of blood: with this view, supposing the accident to arise from an external injury, the great vessels, if they can readily be found, should be tied with a ligature, or otherwise effectually secured, as our subsequent mode of treatment may be very likely to renew the hæmorrhage.

We should then attempt to imitate the operations of nature, by producing a contraction of the vessels sufficient to act on their contained fluid. The contraction of the vessels may be most effectually accomplished by—the application of cold—of frictions—and tight bandages.

The power of cold, in producing contraction in the living body, is so commonly and well known, as only to require mentioning, to be immediately allowed: if the season be very cold, and other circumstances permit, exposing the body to the sharp air will probably succeed; otherwise

wife water artificially cooled, and dashed in large quantities all over the body, will be more likely to answer this purpose. Of frictions we have already spoken very sufficiently at page 170, and to which I now refer for what might here be said on their effects. Cold and frictions act powerfully during the time they are used ; but it is probable their effects are only temporary : to obviate this inconvenience, I would propose that bandages should be applied to the abdomen and extremities ; and if wetted with spirits, after they are applied, they would answer a permanently, and, I should conceive, a powerfully good effect. By these means, then, the blood from all parts of the body will be driven to the vital organs, the vessels of the brain will be distended, and the right auricle and ventricle of the heart sufficiently filled with blood.

It is presumed, that by this time the irritable principle will have so far lost its natural vigour, as not readily to be excited ;

cited : although, therefore, what we have just recommended are very powerful stimulants, as well as really necessary for putting the body in a state proper to be acted upon, yet it is probable they may not of themselves prove equal to the business : on this account, several articles of the same class should be had recourse to, such as—the inflation of the lungs—the injection of aromatic or irritating medicines into the stomach—the dilatation of the intestines by large quantities of cool liquids thrown into them—certain stimulants applied to the different organs of sense, &c. &c.—all of which were explained, both as to the manner in which they are to be applied, as well as the effects they will be likely to produce, when we were considering the recovery of the drowned ; and as what was said concerning them in that place will be equally applicable to the present purpose, there can be no occasion to repeat it.

I am much disposed to believe, that several who have no perceptible appearance of life, and who would soon be absolutely dead, may be recovered by the means above mentioned: but there is great reason to fear, that, notwithstanding the strictest attention be paid, either to this or any other plan we are in possession of at present, that it will be impossible to recover many of those whose vital powers are suspended by this cause. But as our knowledge, as yet, by no means extends so far as to enable us to determine with precision who are, and who are not, to be recovered, we ought indisputably to attempt all we can, in every case where there is the least chance of succeeding; that is, where those appearances we have before described, as the associates of absolute death, are not present; or even if they are, where, upon the application of the electrical test, the muscular fibres exhibit the least tendency to contraction.

As

As an inducement to others not to quit persons in this dangerous situation, so soon as is usually done, I will relate the particulars of a case which I attended ; and I communicate it the more readily, as it is the first case of the kind which is published, and as it is the most remarkable instance of recovery from this state, which, I believe, was ever met with.

On the second of April 1782, B—— B——, ship-steward of the Glatton East Indiaman, about thirty years old, from some domestic unhappiness, a very few days after he was married, came to the desperate resolution of putting a period to his existence. The mode in which he chose to effect the purpose was by cutting his throat ; and this he did, by several strokes, so completely, that it literally reached from ear to ear : part of each sterno mastoidæi muscle, and both the external jugular veins, were divided ; the cartilages of the trachea were separated in two places ; and a portion of the thyroid gland had been wounded.

The action was committed between the decks: immediately after it was done, he was supposed to fall down; but the blood ran out in so large a stream, and with such violence, that an officer who was walking the deck above, thought somebody had left the cock of one of the casks running; with this persuasion he went down to rectify it, and found the unfortunate subject of this case in the situation I have described. A boat was immediately dispatched for a surgeon; but the distance the ship lay from the shore prevented my being there in less than an hour.

Some time before I arrived, the poor fellow had lost the external characteristics of life; the breathing and pulsation had entirely ceased; and the senses of seeing, feeling, and hearing, were now, to all appearance, utterly destroyed. At this event I was not in the least surprised, for the quantity of blood on the floor far exceeded what I before had an idea could be expelled from the body of any human being
 whatever ;

whatever ; it was impossible to ascertain it by measure, and it is not probable that our conjectures concerning it should be at all accurate.

I at that time had heard much about the Humane Society ; and the success which attended their exertions in the recovery of the drowned, made me much wish to be called in when an instance of that kind should occur. The recovery of the present case, however, at first appeared to me entirely out of the question ; for although the Society had hinted, that the hanged, the suffocated, the apoplectic, and the frozen, might be restored, yet no notice was taken of those who are in a similar situation from immoderate loss of blood ; and the man was, to all appearance, so perfectly dead, that even a hope of reviving him scarce entered my mind. I had, however, been favoured with some *animating* letters from Dr. Hawes, whose indefatigable exertions in promoting the interests of the Society—in extending the

observations he has with so much care and assiduity collected—and in exciting and encouraging others to turn their attention to the recovery of the apparently dead—cannot be sufficiently admired : these determined me not to quit the body immediately, but to treat it as if some degree of life actually remained.

The bleeding having stopped, it did not appear necessary to pay any particular attention to the wound ; indeed, it was thought advisable to leave it open, that in case life should return, the trachea might more readily be freed from the blood with which it seemed to abound* : the cloaths were therefore immediately removed, and

* Mr. Children, an ingenious practitioner, now settled at Grays in Essex, who assisted me in the recovery of this case, mentioned an instance which he had seen some time before, where the external wound was closed before the hæmorrhage had stopped : the consequence was, that the blood fell into the windpipe, and the patient was very soon suffocated, dying in agonies scarcely to be conceived.

the

the body exposed to a current of cool air; frictions were used to the body and extremities, and plenty of cold water was dashed on the neck and face. When these means had been used for some time, we were most pleasingly surprised, by a sudden motion of the chest, attended with an inspiration! In a moment the air was violently expelled, and with it a quantity of blood, that had fallen into the trachea: this expiration was attended with the most horrid noise I ever heard; and at this instant, particularly, our patient exhibited the most shocking and dreadful appearance it is possible for human nature to form a conception of. In less than a minute, the breathing was repeated, and in a short time it became tolerably regular. The pulse at the wrist was not, on the first appearance of life, to be distinguished; it was a considerable time before it beat distinct and regularly, and then it was extremely weak.

When the trachea appeared to be tolerably freed from blood, the edges of the wound were brought together, and retained by slips of sticking plaster ; and the man now breathed freely through the mouth and nose. In about three quarters of an hour after the first appearance of life, he began to form some idea of his situation : he did not express any satisfaction at his escape, but appeared extremely distressed in his mind, and seemed to intimate, that he must continue wretched as long as he existed. Under these circumstances, I did not think it prudent to rely totally on the plaster, particularly as the constant discharge from the wound prevented its sticking properly : I therefore made several futures, applied fresh plasters, and brought the head forward on the chest, where it was retained by means of a proper bandage. He was then laid in a cool bed, an anodyne was given, and two careful men ordered to watch over him.

him. I waited till he fell into a refreshing sleep, and then resigned him to the direction of Mr. Cooper, the surgeon under whose care he properly fell, but who was absent when the action was committed. The accident happened at two o'clock in the afternoon: when I left him, about seven in the evening, he appeared to be recovered beyond expectation; the pulse and respiration were weak, but regular—the voluntary actions had returned—the external senses of seeing, hearing, and feeling, were very perfect—and the internal senses were at least not in a worse state than before the accident.

The conclusion of this case I was extremely concerned to learn the next morning, from Mr. Cooper, the medical gentleman who attended. On awaking from his sleep, he appeared cheerful, and said he was much better—expressed a concern for what had happened—but entertained hopes, that all might end well. In consequence of this favourable change, the persons

persons who watched him were not so attentive as they ought to have been: the unfortunate wretch took the advantage of their being asleep, or otherwise employed; he tore off his dressings, and opened his wound; the hæmorrhage returned, and in a few minutes he sunk into that state he so ardently wished for.

ON THE SUSPENSION OF THE VITAL
POWERS FROM LIGHTNING.

NEITHER philosophers or pathologists are at all agreed as to the manner in which those people die who are killed by lightning. Signior Beccaria supposes, that it may sometimes happen without the person being struck by the lightning, merely from the effects of the suffocating vapour, with which the flash is always accompanied. Some have attributed it to the air in the lungs rushing out with such violence, to supply the vacuum which is made near them, that they can never recover their breath: and others to the violent commotion in the atmosphere acting in some degree similar to the sudden displacement of the air by a cannon-ball, which is sometimes known to occasion death, and frequently

great inconvenience, although the cannon-ball itself had certainly not struck the person so affected.

Such explanations, however, are extremely vague; they are not supported by any experiments; and are, in my opinion, inadequate to produce the effect attributed to them.

It appears sufficiently evident, that every accident from this cause arises either—from the main stroke of a thunder cloud—from the lateral explosion—or what is called the returning stroke: but the manner in which these operate, so as to produce death, is by no means certain. Instances are related of the smaller animals being killed by electricity, when, on being opened, most of the blood vessels were ruptured, and the blood extravasated: but this is not always the case; for Dr. Priestley could not perceive any such effects, although he informs us that he made use of very strong shocks on very small animals.

That

That rupture, however, does sometimes take place, is very evident. In the case of the unfortunate professor Richman, who was destroyed by lightning, some blood ran out of his mouth;—in a duck which was killed by Mr. Henly, by a shock from a very large battery, the animal bled freely at the mouth;—and in a sheep, which was some time since killed by the same means, the part of the brain through which the charge passed was much altered in its appearance, and the duplicatures of the pia mater torn to pieces*.

Were it allowable to theorise in a matter which ought to be entirely decided by experience, I would venture to say, that in those cases where the shock is very considerable, a laceration, or at least a material

* Many instances are related of animals killed by lightning, or electricity, becoming putrid in a very short space of time: but this does not invariably take place; and it may be doubted whether it occurs more frequently on these occasions, than in other cases of violent or sudden death.

alteration in the texture, of the vessels constantly takes place; not always universally, as electricians generally teach, but only in that part of the body which forms a portion of the electrical circuit. The effects which we can produce by the most powerful electrical battery are so extremely trifling, when compared with those of lightning, that I should imagine, in its utmost accumulation, it could only produce very partial consequences: but a cloud of ten, twelve, or many more miles in length, discharging its main stroke of electricity on a person within its striking distance, must be fully sufficient to comprehend the whole of the body, and might therefore occasion a general rupture of all the vessels. This idea is corroborated by a circumstance which was communicated to me by my friend Mr. Walker, the present ingenious lecturer on Philosophy:—this gentleman, twelve hours after the accident, saw a girl that was killed by lightning; her whole body was black as ink,

ink, and the skin all over her was driven into ridges.

Upon the whole, and as far as I can judge from those circumstances which have passed under my observation, I should conceive, that although we may not be able to explain the manner in which this most powerful of all agents operates, so as to produce death, more correctly than on many other occasions; yet it should seem in every instance, whether the cloud be positively or negatively charged, that (whatever be its other modes of operation) it exerts its principal effects on the brain and nervous system, so as instantly materially to diminish, or totally overthrow, the principle of irritability: but as, according to its degree of strength, it operates differently in producing this effect, and as it likewise causes different appearances, I think it advisable to divide them into the following classes.—1st. When the shock is moderate, it merely suspends the functions of life. In this case, I should

should apprehend there would be no mark of external injury, nor that the organization of any of the vital parts would be destroyed.—2dly. When stronger, it destroys the principle of irritability. In this, some external marks may be evident; but there would probably be no perceptible mischief on dissection.—3dly. When in the most violent degree, it lacerates those parts of the body through which the fluid passes; and the mischief it occasions in these cases will be very evident in the internal parts, as well as on the integuments.

From this account it appears, that those only who come under the first class are to be considered as in a state from which a recovery can be expected; but as it may sometimes be difficult to say whether the case falls under the first or second, it will on such occasions be necessary, and on all others highly advisable, to apply the electrical test before we determine that important question.

That

That animals, to all outward appearance, totally deprived of life by artificial electricity, will often revive spontaneously, is well known to every one who has worked much at the electrical wheel; and that persons apparently dead by a stroke of lightning, may be perfectly recovered, is now placed beyond all doubt.

As we have no reason to suppose there is any fulness in the vessels of the brain, or accumulation in any part of the vascular system, the drawing off blood does not seem at all indicated; on the contrary, diminishing the quantity of blood would, by abating the pressure on the blood-vessels, be likely to lessen the small remains of life: it ought, consequently, never to be employed, at least in any considerable quantity. Our attention should therefore be chiefly directed towards exciting and restoring the principle of irritability: with this view, we should immediately commence our operations with what, at first sight, appears the most ine-

R ligible—

ligible—the application of electricity ; the very same agent which occasioned those evils we are now endeavouring to overcome. Upon further consideration, however, there seems good reason for presuming it may prove of very considerable utility in extricating our patient from his alarming situation. It is well known to be the most powerful stimulus we can apply ; that it pervades the internal as well as affects the external parts ; and that, beyond every thing, it possesses the property of exciting the irritability of the muscular fibres. It has, moreover, been ascertained by repeated experiments, that a moderate shock is peculiarly adapted to the recovery of animals whose vital functions have been suspended by very strong ones ; and in this way animation may be alternately suspended and restored, a considerable number of times, as I have often experienced. On these accounts, should any accident of this kind occur in my practice, I shall be particularly anxious to
 avail

avail myself of the advantages which I conceive will be very likely to result from the prudent exhibition of this celebrated remedy.

Although I cannot avoid considering this as an article of the first importance, yet I should be sorry to be understood as signifying, that it is the only one on which I would rely. By no means: every thing which stimulates the nervous system, and which is likely to produce contraction in the muscular fibres, I would advise to be employed. Inflation of the lungs I conceive to be most essentially requisite in every species of asphyxy; and although there may not in this case be any material congestion in the right ventricle or pulmonary artery, yet as it acts as a powerful stimulant, and as there is a very particular and strong sympathy between the heart and lungs, it should be immediately employed. Frictions—emetics—and indeed all the remedies recommended for exciting the irritable principle in the

R 2 drowned—

drowned—should, under the restrictions and regulations there proposed, be most assiduously and attentively persisted in for the full length of time directed by the Society; or, what will prove a better guide, till the irritability has entirely quitted the muscular fibres; at which time, as I before mentioned, I conceive the person to be absolutely and irrecoverably dead.

Aretæus Cappadox, who flourished before the seventh century, in cases of obstinate epilepsy, perforated the cranium with success. His example I have followed in one instance, where it answered the purpose most completely; for the person, before the operation, had thirty or forty fits in the day, and was furiously mad between each; whereas he never had one return, and immediately recovered his senses, after the operation was performed. When, from external injury, blood is in any considerable quantity extravasated immediately

diately under the skull, trepanning is the only remedy: if there is an external wound, the extravasation is in general readily found, which being evacuated, the patient not unfrequently soon recovers: but as the extravasation may be on the surface of the dura mater—between the membranes of the brain—in its ventricles—or in the substance of the brain itself; and as there is no symptom or mark by which we can possibly distinguish in which of these places the extravasation really took place, it will of course often happen, that on making the perforation no effusion whatever is met with: yet many of these patients do well. I have in two such cases operated myself with perfect success; and in a third, the symptoms were much alleviated by one small opening; but no extravasation being found, and not at that time being aware that the operation could answer in any other way than by removing an extravasated fluid, the perforation was not repeated, and the boy died. From what

has since occurred to me, however, I am much inclined to believe, that he might have been saved, had a greater portion of the cranium been removed. It is the practice of some eminent surgeons to apply the trephine, not only in those cases which are supposed to be of a mixed nature, that is, with symptoms of compression, joined to what is called concussion—but in cases of concussion only, without any external wound, where neither fissure, fracture, or extravasation is supposed to exist: and such practice, I am well informed, is attended with much better success than the usual mode of treatment. In the inflamed state of the membranes, likewise, where bleeding and the other remedies have failed in procuring a discussion, most practitioners apply the trephine without waiting till matter is formed. In these, and indeed every other instance, the removal of a portion of the skull acts merely by relieving the compressed state of the brain, and allowing it
greater

greater play: whence we can readily conceive, that although there be a general fulness of the vessels of the brain, or that extravasation may be seated in a remote part—yet that a proper opening in any part of the cranium will relieve the general over-distention; which circumstance will likewise assist materially in expediting the absorption of the extravasated fluid.

From the consideration of these circumstances, and from the similarity there appears to exist between some of the above cases, and the state of several of those people whose situation we have just described, I am induced to imagine, that the operation of the trepan may be of service in certain cases of suspended animation.

Much may unquestionably be said in favour of it; and it should seem, that but little can be urged against it; but as at present I am too much engaged to investigate its merits with that attention it appears to deserve, I must content myself

merely with naming the circumstance, and the inducements which first occasioned me to think of it. Should it, upon further investigation, appear that there are sufficient grounds for presuming it may be of service, it is hoped that its novelty will not prove any impediment to its receiving an impartial trial ; and I do not expect that the exposure of the duramater will be considered as any material objection to it, since there can be no comparison between the inconvenience which may possibly arise from it, and the destruction which most probably will ensue, should that operation be omitted.

ON THE PRESERVATION OF THOSE
UNBORN CHILDREN WHO SURVIVE
THE DEATH OF THE MOTHER.

IT is matter of very immaterial consequence, both to the party concerned, as well as to the public at large, whether a life be preserved or recovered. Hence we find that the Humane Society liberally recompence those who are instrumental in preventing accidents by drowning; and great has been the number of those who have been snatched from the most imminent danger by such timely interference. It is observable, however, that in this country one considerable source of preservation seems in a great measure, if not entirely overlooked: what I allude to is, the preservation of those unborn children who
survive

survive the death of the mother. That such cases have often happened, will admit of no doubt; and that they do occur more frequently than practitioners are in general aware of, is from a variety of considerations extremely probable. It was with this idea that, in some well-regulated states, laws were established for the performance of what is usually called the Cæsarian operation, on every woman who died far advanced in pregnancy; and those who prevented or even retarded the operation, to the loss of the fœtus, were ordered to be condemned and executed as murderers.

It was my intention to enter at some length into the merits of this treatment; but the short space of time which now remains to conclude this essay, will for the present prevent my doing it: but, to speak truth, neither that, or the collecting together the many histories which have transpired in its favour, appear

pear by any means really necessary. It may not, however, be unseasonable, just to mention a few circumstances from a very useful work — the *Embryologia Sacra* of Cangiamila — a book highly extolled by the celebrated Van Swieten.

This author relates, that in the city and neighbourhood of Montreal, twenty-one living children had been extracted by this operation in twenty-four years. That in forty-four years, sixty had been extracted at Caltanissetta, and five only were found dead. That in eighteen years, the Cæsarian operation had been performed twenty times in the city of Victoria in Sicily, and in every instance a living child was extracted. And at Sambuca, in Girgenti, eighteen living children were taken from two and twenty women who had died pregnant.

From these and a variety of other cases, which are to be met with in different authors, not a doubt can I think remain,

remain, as to the propriety of having recourse to the Cæsarian operation in every instance where a woman dies in the advanced periods of pregnancy.

The only objection which I am aware can be urged against it is, that it may be performed when the mother is not really dead, but in a recoverable state. As this is a circumstance which may possibly happen, it assuredly requires our most serious consideration ; particularly as we have before remarked the very striking resemblance that exists between syncope (by no means an uncommon occurrence, especially in violent floodings) and actual death. We are, moreover, called upon to be extremely circumspect in this affair, since, as we mentioned in another place, P. Peu, a celebrated surgeon, and of very extensive experience in the practice of midwifery, is said to have performed this operation on a woman whom he thought absolutely dead, but whom the event proved not to be so. These circumstances
cannot

cannot fail exciting our most earnest attention ; but they ought by no means to preclude our having recourse to the operation in those cases where we have sufficient reason to imagine the woman can never recover. By diligently attending to the nature of the disease, and the manner in which the appearance of death has taken place ; and by enquiring whether the person was formerly subject to faintings or hysteric fits ; we shall, I conceive, be enabled to form a just opinion of her real state ; which will, moreover, be confirmed, if, after using the most effectual remedies for a short time, none of the symptoms of life make their appearance.

When the reality of death is determined, it is evident that the sooner we perform the operation, the greater will be the probability of our succeeding. We are not, however, to be deterred from putting it in execution, even if by any means we should be prevented having recourse

course to it so soon as we could wish, since it is highly probable that the fœtus retains its life a considerable time longer than the mother. I have seen strong motions in the fœtuses of many quadrupeds, while they were inclosed in their membranes, several hours after the mothers were absolutely dead. When these motions had spontaneously ceased, they were renewed by electricity, or pricking with the point of a knife, and might be continued for a very considerable space. Many instances are likewise to be found in various authors, particularly in the book lately noticed, where the child survived the death of the mother many hours. In the *Encyclopædia Chir.* Dolæus mentions a case where the child was observed to move in the mother's belly the day after her decease: and the following is quoted by Van Swieten—"A woman with child was stabbed in several places by her husband, out of whose womb a child was taken, by the Cæsarian operation, *forty-eight hours* after her

her death; and though it had been wounded in the foot through the pierced womb, it survived during a quarter of an hour."

Every man who is at all conversant in the practice of midwifery, must several times have seen children restored to life, that were born without the least appearance of any. With nearly equal propriety may we, in the present case, expect that many of those who, when first extracted, do not exhibit any sign of life, may by proper remedies be revived. These remedies are the same in both instances; and the most effectual are found to be—inflation of the lungs—and the proper application of heat: these, with frictions, and the occasional use of stimulants, will, I conceive, effect their intention in every instance where the child is in a recoverable state. I would advise them to be applied in every case where the cuticle is not detached by putrefaction—or where, upon the application of the electrical

8

shock,

shock, the fibres do not exhibit any tendency to contraction ; and their use should be persisted in several hours, as many instances have been known, where a recovery has been effected by long perseverance only.

A P P E N D I X.

The account of the following apparatus was not sent to the Medical Society with the preceding Essay, as it was imagined it might lead to a discovery of the author: but as it was written with that intention, and as it is intimately connected with the subject, it was directed to be published at the same time.

A P P E N D I X;

CONTAINING

A D E S C R I P T I O N

O F A

POCKET CASE OF INSTRUMENTS,

F O R T H E

RECOVERY OF THE APPARENTLY DEAD.

THAT the principal cause of the want of success in the recovery of the apparently dead, is the length of time that elapses before the proper remedies can be applied, will admit of no doubt. It is equally certain, that this too frequently depends on circumstances wholly out of our power to prevent: but it is no less true, that cases terminating unfavourably often occur, to which, if proper and timely assistance could have been given, it is extremely

tremely probable they might have had a more fortunate conclusion.

With the view of obviating these inconveniences, it was proposed to establish general receiving houses; and was that event to take place, it would undoubtedly be productive of great advantage: still, however, on particular occasions, much time must be lost in conveying the body to those places; and even when there, it does not appear that the Society are yet in possession of a collection of instruments calculated to answer many of the most essential intentions in the method of recovery.

In the year 1775, an apparatus was contrived by Dr. Cogan, which was patronised by the Society: it soon came into common use, and has remained so to the present day. But this, which is certainly preferable to any thing of the kind that had preceded it, either in Holland or France, does not by any means seem calculated to afford that assistance the
nature

nature of these cases really require. Its size is one material objection, occasioning considerable delay in being removed to any distance: but it is liable to another much more so; for it contains little more, of any consequence, than one instrument, the use of which (although the instrument is acknowledged to be perfectly competent to its intended purpose) must be attended with very doubtful, if not very pernicious consequences.

From these considerations it evidently appears, that a regular and complete apparatus, comprehending a collection of all the articles and instruments which are requisite on these occasions, is much wanting; and that if they can be comprised in a case which will admit of being conveniently carried about, it will prove a very considerable acquisition to the resuscitating art.

These desiderata are now, I conceive, accomplished; and I have the pleasure of offering to the consideration of the Society,

a collection which comprehends every article (except an * electrical machine) that appears to me really necessary on any of these occasions, and nearly the whole of them are indispensably requisite in all: these are comprised in a case which may conveniently be carried in the pocket.

In reviewing the various methods requisite to be employed in the recovery of the drowned, our attention was first directed to the consideration of the propriety of drawing off blood. When that question is determined in the affirmative, it was said that the operation would have better effect, if performed in the jugular vein; but as it sometimes happens that no blood is to be procured from that part: and likewise, on account of the stimulus, cupping was recommended. If the pro-

* The electrical machine must be excepted: a very small one would answer for this purpose; but it is impossible to reduce its size so much as to bring it within the compass of this plan.

per

per instruments are not at hand, a sufficient quantity of blood may be drawn off by means of coffee-cups, small gallipots, wide-mouthed bottles, &c. and a common lancet will answer the purpose of a scarificator.

We have endeavoured to shew*, that restoring the suspended action of the lungs is of the utmost importance in our attempts to recover the apparently dead, let the original cause be whatever it might; but that in the case of the drowned, where the suspension of the vital powers proceeds from the stoppage of respiration, we ought, if possible, to be more particularly expeditious in the renewal of it; but as it is an operation which is usually performed with great indelicacy and difficulty, and as it is frequently, at least in the common mode, impossible to perform it at all—we have strong reasons for suspecting that many lives may have been lost for want of

* Page 138, et seq.

proper and convenient instruments to accomplish it.

Well convinced of the importance of this circumstance, several gentlemen have turned their attention towards contriving instruments to effect it. It will be unnecessary in this place to mention them, as they have already been noticed in the preceding essay; (see page 140, et seq.) All that is requisite for me now to say is, that the following instrument (which is indeed one of those there described) has, in every instance wherein I have tried it, answered the purpose very completely.

It consists of an elastic tube about twelve inches in length; to the end of which is fixed an ivory or silver mouth-piece, or any common pair of bellows may be adjusted to it by means of a hollow conical screw; and to the other end an addition of ivory also, of such a form as to enter and fill up a nostril. It is thus used:

A proper person, stationed at the head of the body to be operated upon, passes
the

the appropriated end of this tube into one of its nostrils, and, sustaining it there with the fore-finger, he compresses both nostrils so firmly between the thumb and middle-finger of the same hand, that no air can pass otherwise than by the tube; and the other hand applying the other extremity of the tube to his mouth, he blows with force through the pipe into the nostril of the subject.

The medical director, standing at the right side of his charge, must keep the mouth perfectly closed with his left hand, while with his right, making a suitable pressure on the prominent part of the windpipe, he prevents the air passing into the stomach; till finding the lungs are properly distended, he is to press strongly upon the chest, removing at the same time his left hand from the mouth, so as to let the air pass out: when by these means the lungs are compressed, the same process is immediately to be repeated, that,

as

as far as can be, the manner of natural respiration may be imitated.

If any difficulty should arise in distending the lungs, it must proceed either from water in the windpipe, or a contraction or adhesion of the epiglottis. We have already, at page 120, pointed out the method of discovering when the first circumstance occurs; and if my experiments and reasoning are to be depended upon, we have shewn the inutility, as well as impracticability, of removing it when it does take place. When the latter is the case, we shall generally remedy the inconvenience by bringing the tongue forwards, which being connected with the epiglottis, by almost inelastic ligaments, must of course be elevated. Should further impediments however occur, the pipe for the nose is to be removed, and the crooked tube bent like a male catheter, recommended by Dr. Monro, and mentioned by Mr. Portal, Mr. le Cat, and others, is to be screwed on
the

the tube in its place: this is to be introduced through the mouth, or one nostril, into the glottis, when, on blowing through the mouth-piece, or applying the bellows, the lungs will be dilated.

This last instrument is likewise much better accommodated for inflating the lungs, when in such cases trachæotomy is performed, than the common dissecting blow-pipe, the implement generally had recourse to.

The introduction of stimuli into the stomach is deservedly reckoned a material part of the process: these may very conveniently be exhibited by means of a funnel and an elastic pipe. Should any obstruction occur to the entry of the medicine, it will be overcome by applying the mouth to the funnel, and blowing upon the liquid, which will then readily pass into the stomach.

If my objections against the use of the fumes of tobacco are founded on just principles, the apparatus in common use for
that

that purpose will of course become unnecessary: a large bladder, fastened to an ivory tube, which may instantly be connected to a proper pipe, will be sufficient therefore for this purpose; and a clyster may immediately be formed, by mixing some of the vegetable essence with a large quantity of warm water.

But, even supposing I may be in error, and that the fumes, either of this or any other vegetable, may be of greater service than a diluted solution of their essential oil, still I do not see the least occasion there can be for a case so large and cumbersome: if the bowl which holds the fumigating substance is sufficiently large to contain fuel for a very few minutes, it is surely competent to our purpose; for nothing can be more absurd than the idea of keeping the bowels in a state of most violent distention for two or three hours, without any intermission! If therefore it be judged necessary, a fumigator of such a size is occasionally added, without materially increasing

creasing the bulk of the case : and this may be connected to any *common pair of bellows*, by means of a hollow conical screw, or it may be worked by a blow-pipe.

The degree of vital or natural heat remaining in the body, and the degree of artificial heat which is proper to be applied, cannot be ascertained or regulated with sufficient precision without the assistance of a thermometer : one constructed upon Mr. Hunter's principle is therefore provided for these purposes.

It may not, in this place, be amiss to observe, that simple frictions with flannels, cloths, &c. appear to be nearly, if not equally efficacious, as when any stimulating medicine is had recourse to.

Proper vials, containing essence of any aromatic vegetables, as camomile or peppermint — and the volatile alkali — and likewise emetics — are ready for immediate use.

ON account of the commodious size of the case, and the variety of instruments it contains, a little management is requisite in order to adapt them to answer their different purposes : this may at first appear a trifling objection ; but a little attention to the following directions, and the annexed plates, will immediately remove it.

WHEN air from the lungs of a healthy person is to be used, that end of the ivory or silver mouth-piece which is marked (1) is to be screwed to the large flexible tube where it is marked (2) ; the pipe for the nostril (3) being at the other end, the instrument is complete. See Plate III. Fig. 1.

When atmospheric air is to be used, the conical part of the hollow steel screw (marked in the plate 4) is, by means of the brass winch (6), to be firmly screwed

Pipe for the Nostril

3

The elastic blow-pipe for the lungs.

The mouth piece of the elastic -
blow-pipe & occasionally the funnel
to convey medicines into the stomach

2

1

16 Elastic-tube of blue-leather for conveying fumes into the Intestines.

15

Elastic-tube of black-leather for conveying medicines into the Stomach -
- or occasionally a blow-pipe for the fumigator.

10

9

8

The Fumigator.

20

19

18

17

Winch for the screw.

6

The hollow connecting screw.

4

5

Pipe for the rectum

12

An Instrument to pass beyond the Glottis.

7

Bladder & Pipe.

11

Fig. I.

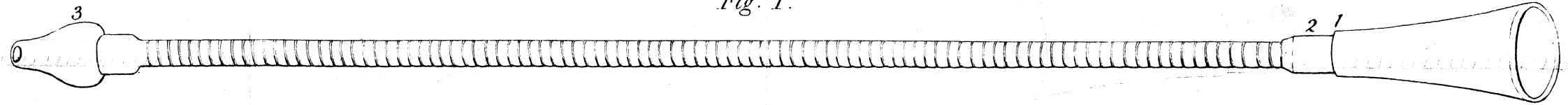


Fig. III.

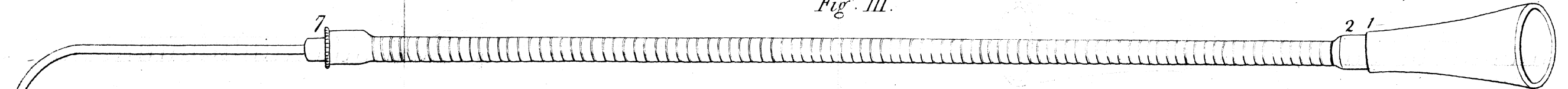


Fig. II.

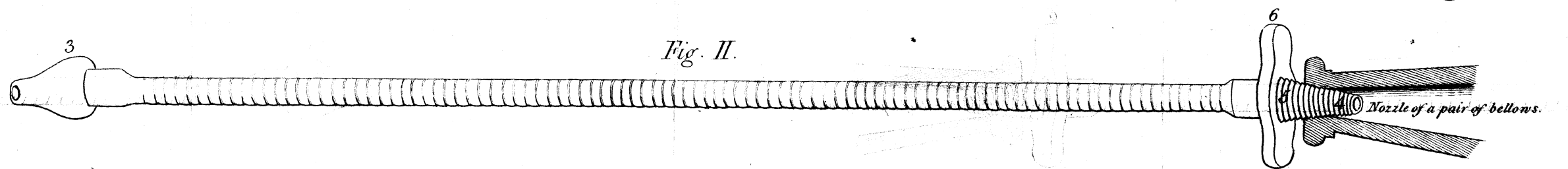


Fig. IV.

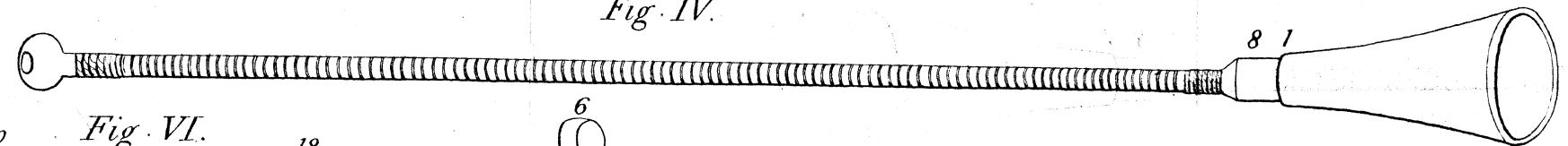


Fig. VI.

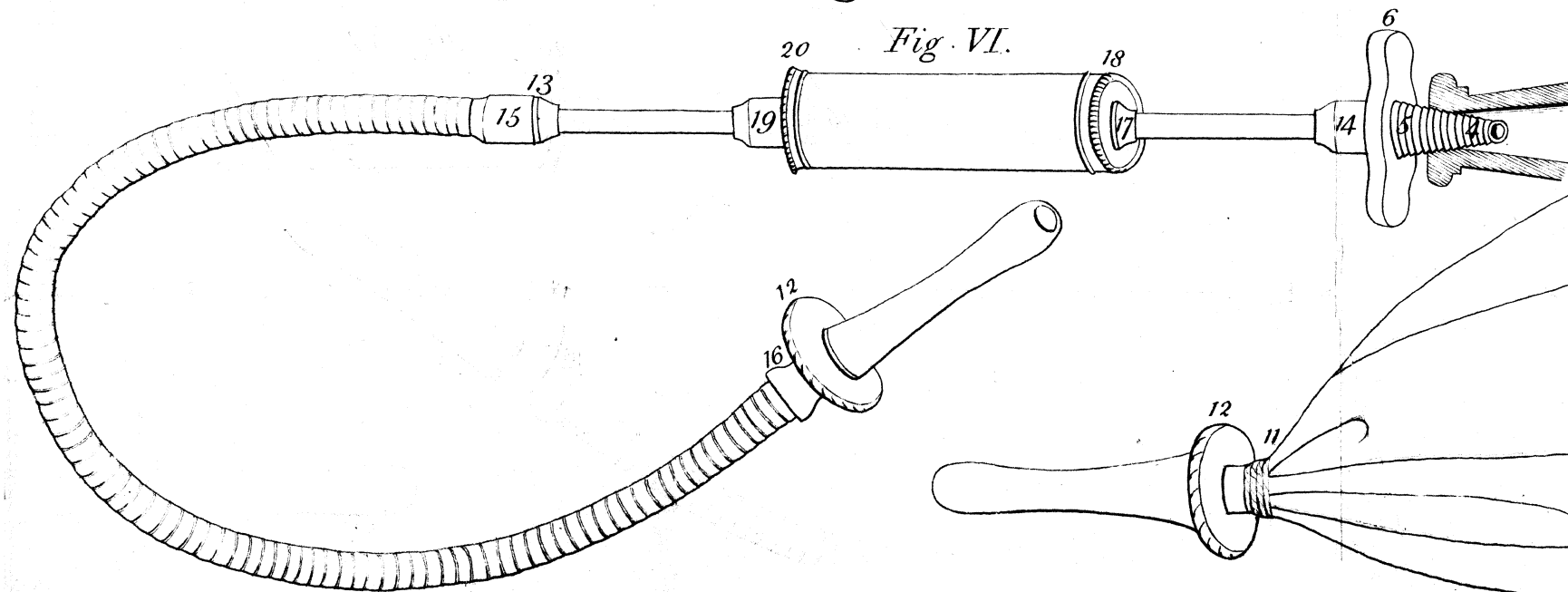
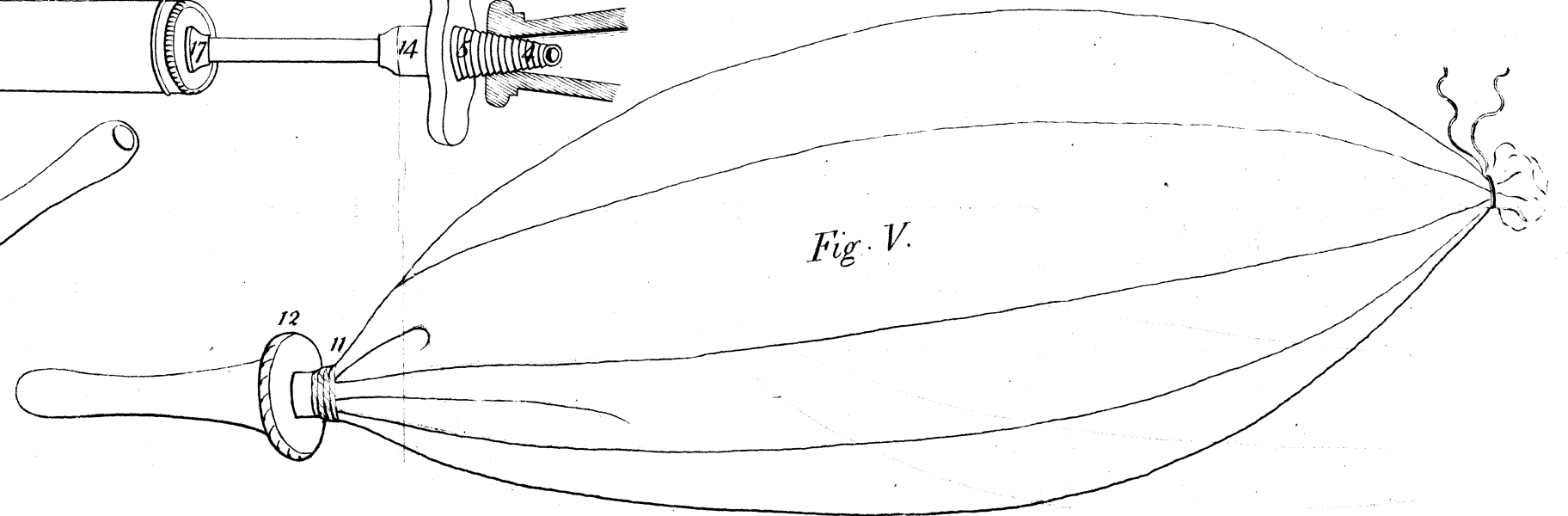


Fig. V.



screwed into the nozzle of any common pair of bellows : — the ivory or silver mouth-piece (1) of the large red flexible tube, is then to be removed, and the other end of the conical screw (marked in the plate 5) is to be fitted in its place. See Plate III. Fig. 2.

Should any particular impediment to the inflation of the lungs, render it necessary to have recourse to an instrument to pass beyond the glottis—or should it become necessary to perform the operation of trachæaotomy — the pipe for the nostril (3) is to be removed, and the instrument shaped like a male catheter (7) is to be screwed in its place. See Plate III. Fig. 3.

For injecting fluids into the stomach, the ivory or silver mouth-piece of the inflating instrument (1) is to be screwed on the small black leather tube, where it is marked (8) — the mouth-piece is to serve as a funnel. See Plate III. Fig 4.

*

For

For the injection of watery clysters, the small tube (11), connected to the bladder concealed in the head of the case, is to be introduced into the opening of the large clyster-pipe (12), which is then ready for immediate use. See Plate III. Fig. 5.

When the smoke clyster is preferred, the conical part of the hollow steel screw (4 in the plate), is, by means of the winch (6), to be firmly screwed into the nozzle of any common pair of bellows, in the same manner as when atmospheric air is to be thrown into the lungs. — The cylindrical part of the screw (marked 5 in the plate), is then to be connected with that end of the fumigator nearest the lid, marked (14):—to the other end of the fumigator (13) the blue leather tube is to be affixed by means of the screw (15), and the other part of the tube (16) is to be introduced into the pipe for the rectum (12), when the instrument will be perfect. See Plate III. Fig. 6.

If

If the conical screw should be employed in inflating the lungs — or if for any reason it is not convenient to use the bellows — the fumigator can then be worked with the mouth. When this may be the case, the only alteration required will be, that the ivory or silver mouth-piece of the inflating tube (1) should be united to the black leather tube at (8), or the fumigator at (14), in lieu of the cylindrical screw*.

To render the case more compact, the fumigator is taken to pieces ; but is readily put together again, by connecting the numbers (17 with 18) and (19 with 20).

* The most effectual and expeditious method, by far, of lighting the herbs in the fumigator, is by directing the flame of a candle on them, by means of a blow-pipe : the crooked silver tube (7) will answer that purpose. Phosphorus and matches are provided, in case a light cannot otherwise readily be procured.

IT is surely unnecessary to remark, that every one who presumes to take upon himself the important office of directing the remedies that are to be used for the recovery of the apparently dead, should be provided with every instrument that can be necessary to second his intentions: this part of our profession is, under the most favourable circumstances, sufficiently beset with difficulties; and it is easy to conceive what must be the event in those cases, where any of the more essential remedies are omitted.

I cannot in justice conclude without mentioning, that Mr. Savigny, the very ingenious and celebrated instrument-maker, has spared neither time, attention, or expence, in rendering this case as complete as its nature will permit.

F I N I S.

DIRECTIONS TO THE BINDER,

for placing the PLATES, &c.

Plate I. - - *to face page* 192

II. } - - - - 270
 III. }

Half Sheet of Letter Prefs, marked

N° 1. - - *to face page* 193

Whole Sheet D°, marked N° 2. - 196

Plan of a general Table (a large
 whole Sheet Copper Plate, with-
 out a Number) *to follow the pre-
 ceding Whole Sheet,*

Half Sheet of Letter Prefs, marked

N° 3. - - *to face page* 197

