Observations on apparent death from drowning, hanging, suffocation, etc, &c.; and an account of the means to be employed for recovery. To which are added the treatment proper in cases of poison, with cautions and suggestions respecting various circumstances of sudden danger / [James Curry].

To

The Right Hon.ble Earl Stanhope,

F. R. S. &c. &c.

This little tract is presented,

as a testimony of the highest respect

for his profound Science

and independant mind;

by

The Author

Feby 28th

1815.

OBSERVATIONS

ON

APPARENT DEATH

FROM

DROWNING, HANGING,

SUFFOCATION BY NOXIOUS VAPOURS,

FAINTING-FITS, INTOXICATION,

LIGHTNING, EXPOSURE TO COLD,

&c. &c.

AND AN ACCOUNT

OF THE MEANS TO BE EMPLOYED FOR RECOVERY.

TO WHICH ARE ADDED,

THE TREATMENT PROPER IN CASES OF POISON;

WITH

CAUTIONS AND SUGGESTIONS

RESPECTING

VARIOUS CIRCUMSTANCES OF SUDDEN DANGER.

Second Edition,

CONSIDERABLY ENLARGED, AND ILLUSTRATED WITH COPIOUS NOTES, CASES, AND ADDITIONAL PLATES.

BY JAMES CURRY, M.D. F.A.S.

MEMBER OF THE ROYAL MEDICAL SOCIETY OF EDINBURGH;
OF THE MEDICAL, THE MEDICAL AND CHIRURGICAL,
AND GEOLOGICAL SOCIETIES OF LONDON;
SENIOR PHYSICIAN TO GUY'S HOSPITAL;
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TO

HIS ROYAL HIGHNESS

THE DUKE OF KENT AND STRATHEARN,

VICE PATRON OF

THE ROYAL HUMANE SOCIETY;

&c. &c. &c.

THE Royal Humane Society, the parent of that for the use of which these Observations were originally drawn up, early received the fostering patronage and protection of HIS MAJESTY; whose benevolence of heart, uniformly displayed throughout a long reign, has not only secured the lasting veneration of the wise and good, but even commanded admiration and praise, from those who were nationally and politically his enemies; and justly entitled him, to the rare and enviable appellation of,—A Patriot Sovereign, the Father of his People.

The active part taken by Your Royal Highness, in promoting the success of this and of various other Institutions which have for their object the Public Welfare, whilst it ensures public approbation and respect, must also bring with it that reward which far surpasses either, namely, the conscious satisfaction of doing good. That Your Royal Highness may long live to follow the bright example you have chosen, and continue to exalt the dignity of your high birth by the lustre of your personal virtues, is the earnest wish of

Your Royal Highness's

Most faithful and obedient Servant,

THE AUTHOR.

Bridge Street, Blackfriars,
Dec. 21*st*, 1814.

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APPENDIX.

Containing Notes, Illustrations, Cautions and Suggestions.

CAUTIONS AND SUGGESTIONS.

CORRECTIONS AND ADDITIONS.

Introd. *p.* iii, *line* 1, *for* enjoys, *read* receives.

line 8, *for* Dr. WILLIAM COGAN, *read* Dr. THOMAS COGAN.

iv. *note* * *line* 3, *before* Humane, *insert* Royal.

v. *last line*, *after* diffused, *insert* even among medical men.

vii. *note*, *l.* 9. *after* coal-pit, *insert* however.

Page 6, *line* 2, *after* internal, *insert* and vital.

Page 54, *Note* * *line* 2, *instead of* 20, *insert* 17.

Appendix, Notes 2 and 3 are mingled together.

The mistake mentioned in Note 27. p. 141, shews the propriety of the injunction given by the Edinburgh College of Physicians in their Pharmacopæia, that the TINCTURE and WINE OF OPIUM should be kept in a bottle of a particular *shape*, so as to be distinguishable from every other, even though it were taken from the shelf in the dark.

Page 153, *third line from the bottom, instead of* profess *read* possess.

Page 159, *after the paragraph respecting Medical Coroners, add*, It is scarcely necessary to say, that the persons appointed, besides being good Anatomists, should have been accustomed to examine bodies, with a view to ascertain the complaint under which they had laboured during life; as such persons only can accurately distinguish between spontaneous disease and the effects of injury, between disorder of long standing, and that which is recent; and, in short, can declare, how far the appearances observed were connected with, and the *cause* of, the person's death.

Page 166, *line* 6, *after* Suspended Respiration, *add*, from drowning, hanging, &c.

Page 173, *last line but one*, *after* vol. *insert* 77.

Page 165, *after first paragraph add*, Except to Botanists, no verbal description would be sufficient to point out clearly the marks of distinction between the *eatable* and *poisonous* Mushrooms. Many of my readers then, will be gratified to hear, that Mr. Sowerby, author of the English Botany, has done this, illustrated by coloured figures, in a pamphlet, which is sold separately at the price of one shilling.

INTRODUCTION.

THE time is still within the recollection of many now living, when it was almost universally believed, that *life* quitted the body in a very few minutes after the person had ceased to breathe. Remarkable examples to the contrary, were, indeed, upon record; but these, besides being extremely rare, were generally cases wherein the *suspension*, as well as the *recovery of life*, had occurred *spontaneously*;* they were therefore beheld with astonishment, as particular instances of Divine Interposition, and consistently with that belief, they afforded no ground to hope, that *human* aid could prove at all useful under similar

* Viz. Those cases of seeming death commonly known by the name of *trances*.

circumstances.—Such a view of the matter necessarily checked any rational and premeditated attempt at recovery, even in those cases where the appearance of death was evidently occasioned by the operations of external and assignable causes; and it is probably owing to the rude trials to which fond attachment * may have sometimes intuitively prompted the friends or companions of the sufferer, that we are indebted for the happy discovery of an essential difference between *Absolute* and *Apparent Death.* The success which occasionally attended the artless attempts of uninformed persons, soon attracted the attention of Medical Men, by whom the means for recovery have been improved, and employed with such happy consequences, as to have rendered the matter an object of public concern, and highly deserving of that extensive encouragement

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* How far the proceedings of Elisha (2d Book of Kings, Chap. 4.) in recovering the widow's son gave rise to such trials, is a question which I leave my readers to decide for themselves: it is at least highly probable, as the fact must be known in every CHRISTIAN Country.

ragement and support, which it now enjoys in this and in several other countries of Europe. The first regular Establishment for this purpose, was formed at Amsterdam in the year 1767; and from thence introduced to notice here by the little tracts of Dr. Alexander Johnson, and Dr. William Cogan: but it was chiefly to the zeal and exertions of the late Dr. William Hawes, aided by Dr. Lettsom, and Dr. Cogan, that this country is indebted for the establishment of the present Royal Humane Society, in 1774, and the incalculable benefits which have thence resulted to society, by the preservation of many thousand lives.

To promote the laudable scheme of Recovery from a state of Apparent Death, the Northamptonshire Preservative Society was instituted, October 9th, 1789, through the influence of that genuine philanthropist, my revered friend John English Dolben, Esq.; and although comparatively of a recent date, its minutes afford ample testimony of its beneficial effects. From those very minutes,

however, it appears, that favourable opportunities of recovery have been sometimes lost, owing to want of information in the persons present, with regard to the means that ought to be employed; while the distance from medical aid was so great, as to render every exertion unsuccessful, by the time that such assistance could be procured. But although Medical Men are, from the nature of their studies and profession, particularly qualified for being useful on such occasions, it by no means follows that they are exclusively so; on the contrary, repeated experience has shewn, that intelligent persons, of every description, may readily acquire sufficient information upon the subject, to render them the happy instruments of recovery.* It is chiefly with

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* Mrs. Page, of Hornsey, assisted only by her female servants, and following the brief directions given in the printed card of the Humane Society, recovered a young girl, who had been taken out of the New River, to all appearance dead. It was fully *half an hour* before any signs of life could be observed.—*See Reports of the Royal Humane Society,* for 1787, 8, and 9,—*pages* 11, 12, 13.

Mrs.

with a view to the instruction of such persons, that these observations have been drawn up; and this circumstance must apologize (if any apology be necessary), for the studied rejection of medical words and phrases, and the preference given to such terms as are familiar to the generality of readers.—Some will no doubt think, that I have gone farther into the matter than was necessary in a publication of this nature; and will accordingly expect, that I should give my reasons for treating the subject at such length.

It need scarcely be said, that whatever concerns the preservation of human life cannot be too generally known. On no branch connected with the Science of Medicine, however, is knowledge less generally diffused, than upon that which makes

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Mrs. Caddick, of Tipton, in Staffordshire, also recovered a boy who had fallen into a pond near her house, after *two hours and a half* assiduous employment of the means usually recommended.—*Ibid. p.* 312.

Many similar instances might be enumerated, but it is hoped that these two will be thought a sufficient proof of what has been advanced above.

makes the subject of the following pages; and to this circumstance only, can we attribute the doubts which we have repeatedly heard Professional Men express, with regard to the truth of the greater number of cases where a recovery is said to have been accomplished. Without some general principles to guide us, we must not only trust for all farther improvement to the uncertainty and danger of random experiment, but we cannot even employ to the best advantage, the means which are already known and approved of. To those who are entirely ignorant of such principles, every measure recommended must appear as of nearly equal importance; whence the most trivial may be often employed to the exclusion of those that are absolutely necessary, and to the loss of much time, if not of the very object itself for which all the exertions are made. It may be observed in proof of this, that *inflating the lungs* has long been spoken of as one among the means that ought to be tried;* but it is only within

* The earliest example of its employment in Great Britain

within these few years, that its mode of operation has been clearly shewn, and the necessity for its assiduous employment properly insisted on: and it is, perhaps, to this circumstance chiefly, that we should attribute the greater proportion of successful cases now than formerly.

To point out the necessity for certain measures being pursued in preference to others, is the object of the two chapters on RESPIRATION and ANIMAL HEAT.—In thus undertaking to strip a professional subject

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tain that has come to my knowledge, is a case related in the Edinburgh Medical Essays, vol. v. part 2. Art. 55. —of a collier, who in the year 1732, was restored by *inflating the lungs*, after having lain *half an hour* apparently dead, at the bottom of a coal pit, into which he and several others had incautiously descended, after the pit had been kept closed for two or three days to extinguish a fire that took place in it. From the circumstances of the coal pit, and the very slow manner in which he recovered, it is highly probable he was suffocated by the *Carbonic Acid Gas* formed whilst the coals were on fire, which being much heavier than common air, always occupies the *lowest* place.—*See the Chap. on Suffocation; and Suggestions, Cautions, &c. in the Appendix.*

subject of its technical dress, and explain it in such a manner as to be understood by those who had never made it any part of their study, I was well aware of the difficulties I had to encounter, and am by no means so presumptuous as to think that I have entirely succeeded. For the reasons which are given above, however, I considered the object, if it could be obtained, as of sufficient importance to warrant the attempt; and relying upon this motive being accepted as an apology, I cheerfully submit the performance to the candour and judgment of the public, at the same time expressing a hope, that my endeavours may not prove altogether without their use.

PREFACE

TO

THE SECOND EDITION.

THE first edition of this treatise was printed at Northampton in the year 1792; and being expressly intended for distribution throughout the limits of the Northamptonshire Preservative Society, only five hundred copies were struck off. The greater number of these were sent to the different Medical Practitioners, to the Clergy, and to such other persons as might derive from it the information necessary to render them useful in restoring animation when suspended by various means. Some copies, however, found their way to the Continent, where the work was well received; and a French translation of it was published by Dr. Odier

Odier of Geneva, with a recommendatory introduction, highly flattering to the author. The original impression having been long out of print, and repeated applications made for it to the principal Medical Booksellers, the author has been induced, at their desire, to offer a new edition of it; with such corrections as the later discoveries and improvements in the Chemical part required, and the addition of Notes, illustrative of many collateral points, that serve to extend and confirm the general principles and instructions laid down in the text.

CHAP. I.

OF THE DIFFERENCE BETWEEN ABSOLUTE AND APPARENT DEATH.

1. IN *apparent* as well as in *absolute* death, the breathing is at a stand; the Heart ceases to beat; no motion is observable in any part of the body; and the person is not sensible of pain from pinching, pricking, or even burning his flesh.*

2. The important difference between the two states is this,—that in *absolute* death, the Vital Principle is completely extinguished, whilst in *apparent* death, it only lies dormant, and may again be roused into action, and the person thereby completely restored to life and health.

3. How

* See Note 1. in Appendix.

3. How long a body may continue in this seemingly lifeless condition, and yet admit of recovery, has not been precisely ascertained. In some cases a recovery is known to have taken place even after interment;* and in others the necessary steps to embalming the body, though delayed for several days, have proved that the vital spark was not completely destroyed but by the knife of the operator.† The cases of apparent death occasioned by excessive cold, by the various modes of suffocation, &c., do not, indeed, afford any example of a recovery after so long an interval as that just mentioned; yet in many of them, animation was brought about, after having been suspended for *several hours*, and frequently under the most discouraging circumstances, both with regard to the nature of the accident, and the appearances exhibited by the body. It is therefore with good reason believed, that, in many cases, the body retains its Vital Principle in a greater or less degree, for some time after all the outward signs of life have disappeared, and probably does not part with it entirely, so long as the vital organs continue of their natural warmth; and consequently it would

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* See Note 2. in Appendix.

† See Note 3. in Appendix.

would appear, that, within this period, the only circumstance which precludes the possibility of a recovery, is, such a degree of injury being done to the Brain, Heart, or Lungs, as renders them incapable of having their proper functions again renewed.

4. The importance of this conclusion (the truth of which receives farther confirmation from every day's experience) cannot be too strongly enforced; and the author willingly cherishes a hope, that in thus endeavouring to impress it on the minds of the public, he may animate the humane and benevolent to use every exertion, and not to cease from employing the several means recommended, until *several hours* have elapsed; nor ever abandon a case without trial, unless *indubitable* marks of complete and permanent death *evidently* appear.

Of the Signs of Absolute Death.

5. Various are the appearances which have been pointed out by different writers, as signs of the Vital Principle being *completely* extinguished; particularly in the case of drowned persons. Thus, the cold and rigid state of the body; the livid and contracted, or the black

black and swoln countenance;* the eyes being shrunk, dim, and shrivelled,—or, prominent, bloodshot, or glassy; the pupils of the eyes being greatly dilated or contracted, —or the one being more so than the other;—have all been enumerated, and each in its turn held, as a certain criterion of *Absolute Death*.—Farther experience, however, has happily shewn, that no one of these taken singly, nor even several of them together, can be depended on as infallible;—and that *a beginning putrefaction* of the body, is perhaps the only *unequivocal proof of death* we are yet acquainted with in such cases.†

6. But while I thus insist upon the fallacy of the *ordinary* signs of death, and strongly inculcate, how necessary perseverance is to success, I by no means wish to conceal the uncertainty of a happy termination. In every accident requiring such assistance, circumstances may have occurred which will render all our exertions fruitless. Thus, in the case of drowning, the person in falling into the water, may have struck his Head, Breast, or Stomach, against some hard body;—or, owing to

* See Note 4. in Appendix.

† See Note 5. in Appendix.

to the height from which he fell, the shock at the surface of the water, may alone be sufficient to destroy life entirely.* Preceding disease, intoxication, or exposure to long-continued or severe cold, either before or after the accident, will contribute to the same fatal effect.

7. It is unnecessary, however, to particularize all the *possible* circumstances which may thwart our endeavours; to Medical Men they will, no doubt, readily occur; and to give a mere catalogue of them here, would tend rather to damp, than to animate, the exertions of those who are unacquainted with the nature and effects of such complicated injuries.

8. It is of much greater importance to know, that although the Brain, Heart, and Lungs, remaining sound, and capable of performing their respective functions, is a circumstance absolutely necessary to the being successful,—yet, that a complete recovery has often been effected, in cases where the marks of bruises about the Head and Breast, or the discharge of blood from the Mouth and Nose,

* See Note 6. in Appendix.

Nose, gave great reason to fear that some of the *internal parts* had sustained very considerable injury. Far, therefore, from considering it as presumptuous to attempt a recovery under such circumstances, let us ever hold in view the possibility, that the person

—is not dead, but sleepeth ;

and remember, that even an unsuccessful trial will afford us the heartfelt satisfaction of knowing—that WE HAVE DONE OUR DUTY.

CHAP. II.

OF THE NATURE AND IMPORTANCE OF RESPIRATION; BEING AN ATTEMPT TO EXPLAIN THE MANNER IN WHICH A STOPPAGE OF THE BREATHING, OCCASIONS A SUSPENSION OF LIFE.

9. THE *human* Heart resembles, in its shape, colour, and firm fleshy substance, the hearts of sheep, oxen, &c. Like them also, it is divided

vided lengthwise by a partition in the middle, so as to form two* distinct and separate Cavities or pouches, one of which is situated towards the *right*, and the other towards the *left* side of the body; whence the one is termed the *right*, the other the *left* Cavity of the Heart. During life these two Cavities are continually filling and emptying themselves alternately. Each Cavity is supplied with Blood by large Veins that open into it; and contracting as soon as full, drives this Blood into the great Artery that leads from it.†

10. The great *Artery* that arises from the *left* Cavity of the Heart, gradually divides itself into innumerable branches, which are

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* Strictly speaking, however, there are *two distinct cavities* on *each* side of this partition; the two upper and smaller serving as vestibules to the two larger and lower ones: but as the object is merely to give *a general idea* of the Circulation, I have avoided being minute in the description.

† The sudden jerk with which the Heart contracts and expels the Blood into this Artery, occasions that vibratory motion felt in all its branches, which is termed the *pulse;* the strokes of which exactly correspond with the contractions of the Heart. As the Blood proceeds onwards, and is divided into a greater number of streams, these impulses which it receives from the Heart, become less and less; so that in its return to the Heart through the Veins, it flows in a regular and equable manner.

distributed over all the body, in order to supply the different parts with Blood for their nourishment and growth. From these parts the remaining Blood is conveyed back again by *Veins*, whose branches join with the branches of the Arteries, and whose trunks terminate in the *right* Cavity of the Heart.*

11. But although the Blood which was sent out from the Heart *on one side*, is thus brought back to it *on the other*, still it has not completed the Circuit round which it moves;—for there is no *direct* communication between the two Cavities. To get from the *right* Cavity to the *left*, therefore, and perform the same round as before, the Blood must first pass through *another* great Artery (the PULMONARY ARTERY) the branches of which are distributed solely through the LUNGS, and there join the branches of several large Veins (the PULMONARY VEINS) which open into the *left* Cavity of the Heart.†

12. The

* These two sets of vessels, viz. the Arteries and Veins, may not unaptly be compared to two trees which spring from the Heart as a common root, and are again united to each other at the extremities of their smallest branches. —In the *Arteries*, the blood moves *from the trunk to the branches*, whereas in the Veins, it moves in the contrary direction, or *from the branches to the trunk*.

† The course which the Blood describes in one *entire* Circuit,

12. The LUNGS are composed of millions of little bladders, which communicate with the Wind-Pipe, and are from thence filled with Air every time we inspire. Upon the surfaces of these bladders, (or *air-cells* as they are termed), the ultimate branches of the Pulmonary Artery just described (11) and of the corresponding Veins to which they join, are spread out as fine as human hairs; and of course, the substance which is interposed between the Air contained in the cells of the Lungs, and the Blood circulating through these minute Arteries and Veins that run between them, must be extremely thin: it will not be difficult, then, to conceive, that through so slight a partition as this, the Air and Blood *may* exert some kind of influence upon each other; —and that they actually *do so*, I shall now endeavour to shew.*

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circuit, resembles (if I may so speak) two incomplete circles, a greater and a less, joined together as in the figure 8. The *greater* circle represents its course from the *left* cavity of the Heart through the *Arteries* to the different parts of the body, and from thence through the *Veins* back to the *right* cavity: the *smaller* circle represents its course from the *right* cavity of the Heart, through the Lungs, to the *left* cavity, from whence it at first set out.

* See Note 7. in Appendix.

13. The Blood, when thrown out by the *left* Cavity of the Heart, and in its course through all the branches of the AORTA or great Artery leading from thence to every part of the body, is of a *bright crimson* colour, approaching to *scarlet*; but after it has performed its various offices at the parts to which it was sent, and has passed into the Veins on its way back again, the colour is evidently changed to a *dull red* or *purple*, which *gradually deepens* as the Blood approaches the Heart. In passing through the Lungs, however, the Blood *loses this dark hue entirely*, and when arrived at the *left* Cavity of the Heart, appears of the same *bright crimson* colour as when there before.

14. But when, by any means, fresh Air is prevented from entering the Lungs, the Blood, instead of growing *brighter* in its passage through them, *as it did whilst the breathing went on*, becomes *gradually darker*, and at last *almost black:* In proportion as the *colour deepens*, the *motion* of the *left* Cavity of the Heart *becomes weaker*, and in a little time ceases entirely;—that of the *right* Cavity continuing, (though very slowly and languidly), for a few seconds longer.

15. The Heart being now at rest, the

BRAIN

BRAIN and Nerves are no longer supplied with that regular current of Blood, which enables them to diffuse *Life* and *vigour* over the body; the Animal, therefore, quickly sinks into an *insensible* and *motionless state*, and if left to itself, gradually becomes quite cold;—with the *entire* loss of heat, the Heart loses also its *Sensibility* and *power of contraction*, and *Absolute Death* is the necessary consequence.

16. If, however, *before* matters have proceeded so far, and particularly, if *before* the *warmth* and *sensibility* of the Vital parts are *much diminished*, we alternately inflate and empty the Lungs for some time, so as to imitate the natural breathing,—the Blood stagnating in them, gradually acquires its usual brightness of colour, and moves forward in the vessels;—and *as this change goes on*, the Heart begins to contract, at first slowly and weakly; but afterwards more frequently and strongly;—the other suspended functions are again renewed, and the Animal is at last completely restored to life.

17. Here then (13--16) we see, that as long as the Air is freely admitted to the Lungs, the Blood circulating through them, changes from a *dark red* to a *bright crimson* colour, and the motion of the Heart continues; but that, when

when the Air is excluded, this change no longer takes place, and the Heart very soon ceases to beat. The obvious conclusion is, that THE CHANGE TO BRIGHTNESS IN THE COLOUR, DEPENDS UPON SOME CHANGE IN THE QUALITY OF THE BLOOD, IN CONSEQUENCE OF WHICH, IT AGAIN BECOMES CAPABLE OF STIMULATING THE LEFT CAVITY OF THE HEART, AND EXCITING IT TO CONTRACTION.

18. Here the question will naturally occur to the reader,—In *what* does this change consist, and *how* is it brought about?—Is it by the Air *imparting* to the Blood something that is *useful?* or *imbibing* and *carrying off* from it something that is *noxious?*—for it will presently be shewn, that there are *certain kinds* of Air totally unfit for the purpose of respiration, when breathed by themselves; and that even the same portion* of Common Air, repeatedly breathed, will not support life for more than a few seconds.

19. Notwithstanding what has been already said in the Introduction, I think it right to observe farther here, that neither extreme minuteness,

* The portion of air here meant, is the quantity which can be taken into the Lungs at one inspiration.

minuteness, nor scrupulous accuracy, is to be expected in the view I am about to give of this curious question; my professed intention being, to treat every part of the subject, as far as I am able, in such a way as will best explain to those who are not of the Medical Profession, the *reasons* for the several Measures to be employed in recovery; and thereby enforce the necessity, not only of persevering for a certain length of time, but of pursuing a certain *order* in their application.

20. Of the numerous modern discoveries, by far the most important to SCIENCE IN GENERAL, and to the SCIENCE OF MEDICINE in particular, are those which concern the nature and varieties of AIR. It is now demonstrably proved, that there are *several* kinds of Air, and that the Common Air, or Atmosphere in which we live, is not, as was long believed, a perfectly simple and homogeneous fluid, but a *mixture*, consisting of, at least, *two* kinds of Air possessing very different qualities. Methods have been contrived, of separating those Airs from each other, and examining them apart;—and the following are their *proportions* and *qualities*, according to the latest and most accurate experiments made for this purpose.

21. The first kind, and that which constitutes

stitutes rather *more than three-fourths* of the Atmosphere, is found to be in every respect the same with the Air produced by all animal and vegetable substances during their putrefaction; and as it constitutes an essential ingredient in Nitrous Acid, it has received the name of NITROGENE GAS.*

22. NITROGENE GAS, *by itself*, will not allow a Candle to burn in it, nor will it support the life of any Breathing Animal. When applied to Blood drawn from a Vein, it produces no change in the colour; and when any animal breathes Nitrogene Gas only, the Blood which has passed through the Lungs *retains* its dark colour, the same as when the Wind-Pipe is closed, and no Air of any kind allowed to enter.—IT IS EVIDENT, THEN, THAT THE BRIGHTNESS WHICH TAKES PLACE IN THE BLOOD WHILST PASSING THROUGH THE LUNGS WHEN COMMON AIR IS BREATHED, CANNOT BE OWING TO THIS INGREDIENT OF THE ATMOSPHERE.

23. The second kind of Air, which composes the *remaining fifth* of the mixture, is derived from various sources upon the surface of

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* See Note 8. in Appendix.

of the Globe, but *chiefly* from *growing* Vegetables, which produce it in great abundance; especially when exposed to the Sun's light.* A Candle burns in this Air with a remarkably large and brilliant flame, and an Animal shut up in a vessel filled with it, will live *four* times as long as in an equal quantity of *Common Air*. These properties justly entitle it to the names it has received, viz. PURE AIR, and VITAL AIR; and by the latter of these I shall here denominate it, as more appropriate to the present inquiry, than the term OXYGENE GAS, which was given to it by the French Chemists, and by which it is generally known.

24. The reader will, perhaps, be already convinced, that it is to *this* ingredient of the Common Air or Atmosphere, we must attribute the necessary change of *colour* and of *quality* produced in the Blood during respiration. But what puts it beyond all doubt, is, that if the *dark coloured blood* drawn from a Vein, be received into a phial filled with VITAL AIR, it immediately loses its *dark* hue, and becomes *bright* like that which has just passed through the Lungs; and farther, that, when an animal is supplied with VITAL AIR only,

* See Note 9. in Appendix.

only, the Blood circulating through its Lungs acquires even a *greater brightness* of colour than when *Common Air* is breathed; whilst Nitrogene Gas produces no such change on dark coloured blood.

25. Having thus ascertained, that the necessary change of the Blood in the Lungs, is produced by the portion of VITAL AIR taken in during the breathing; let us next endeavour to determine, *in what* this change consists, and *how* it is brought about.

26. If a moderate sized bladder, having a tube or mouth-piece fixed to it, be filled with *Common Air*, and this air be alternately drawn into the Lungs, and thrown back into the bladder,—in a little time a sense of oppression will be felt in the Chest, which renders it necessary to cease from breathing *this*, and to take in *fresh* Air.

27. Upon examining the Air *now* contained in the bladder, it is found, that the quantity of NITROGENE GAS remains exactly the same as at first, but that almost the whole of the *Vital Air* has disappeared, and that its place is occupied by *another* kind of Air, which, though it differs in many respects from NITROGENE GAS, yet agrees with it in being totally

totally unfit either to support Flame, or to maintain the Life of any breathing Animal.

28. The new Air thus formed in the Lungs, is found to be the same with that which is separated in great quantity from various liquors during their fermentation; also from Marble, Chalk, Limestone, and Shells, during their conversion into quick lime;—and from its being known to exist previously in these matters, so as to make a part of their substance, it at first received the name of *fixed Air*.*

29. *Fixed Air*, however, as it was formerly called, has since been discovered to be a *compound* fluid, consisting of VITAL AIR, and CARBON, or the basis of Charcoal. Between those two matters, namely, VITAL AIR and CARBON, there exists a very strong attraction, insomuch, that when VITAL AIR, comes into contact with any thing that contains CARBON in a *loose* and easily *separable* state, the two unite and form *Fixed Air;* which, from its composition, and its possessing the qualities of an Acid, is now with great propriety denominated CARBONIC ACID GAS.†

30.

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* See Note 10. in Appendix.

† See Note 11. in Appendix.

30. The conversion of VITAL AIR into CARBONIC ACID GAS during the breathing, must therefore (29) depend upon the former meeting, and combining with CARBON; and as it appears (13--26) that at the same time the Vital Air taken into the Lungs, thus attracts CARBON, the Blood passing through them *loses its dark colour*, and becomes fitted to stimulate the *left* Cavity of the Heart,—the natural conclusion is, that THE DARK HUE AND NOXIOUS QUALITY OF THE BLOOD, WERE OCCASIONED BY THE PRESENCE OF CARBON.

31. Upon reviewing what has been said in this chapter, it appears, that the nature and purposes of *Respiration* are briefly these:—DURING LIFE A QUANTITY OF NOXIOUS MATTER IS CONTINUALLY SEPARATED FROM THE SOLID PARTS OF THE BODY, AND, BEING IMBIBED BY THE BLOOD CIRCULATING THROUGH THEM, IS CARRIED TO ITS PROPER OUTLET—THE LUNGS: THERE IT MEETS WITH VITAL AIR, FOR WHICH IT HAS A STRONGER ATTRACTION THAN FOR THE BLOOD, AND UNITING WITH IT, IS CARRIED OFF IN THE FORM OF CARBONIC ACID GAS, LEAVING THE BLOOD PURE, AND CAPABLE OF PERFORMING ITS SEVERAL OFFICES AS BEFORE.

32. VITAL AIR will attract, and combine with,

with, only *a certain proportion* of CARBON (29), just as we see that Water will dissolve only a certain proportion of Salt or Sugar.—The quantity of Common Air drawn into the Lungs at an ordinary breathing, is scarcely half a pint; about *one-fifth* only of which is VITAL AIR (23): the greater part of this is instantly converted into Carbonic Acid Gas, and will not then attract any more CARBON. But as the portion of Blood which has been freed from its CARBON at *one* breathing, immediately passes on to the *left* Cavity of the Heart, and is succeeded by another portion which is equally impregnated with this noxious matter,—IT IS NECESSARY, THAT VITAL AIR SHOULD BE REGULARLY TAKEN INTO THE LUNGS, IN ORDER TO PURIFY THE SUCCESSIVE PORTIONS OF BLOOD AS THEY ARRIVE THERE;—in other words,—THE CONTINUANCE OF THE BREATHING IS NECESSARY TO THE CONTINUANCE OF LIFE.

33. Much more might be added to illustrate and confirm this account of Respiration; but I hope that what is here said, will be sufficient to give my readers a general idea of the matter,—and at the same time establish the following important conclusion;—That—IN EVERY CASE OF APPARENT DEATH, AND ESPECIALLY IN THOSE CASES OCCASIONED BY A STOP

STOP HAVING BEEN PUT TO THE BREATHING, THE INSTITUTING AN ARTIFICIAL RESPIRATION, BY ASSIDUOUSLY INFLATING THE LUNGS WITH FRESH AIR, IS ONE OF THE FIRST, AND MOST NECESSARY MEASURES TO BE TAKEN FOR RECOVERY.

CHAP III.

OF ANIMAL HEAT, AND ITS CONNEXION WITH RESPIRATION.

34. AMONG the circumstances which distinguish the LIVING from the DEAD body, one very remarkable one is, the power possessed by the former, of maintaining a certain degree of Warmth, which, in most instances, is considerably greater than that of the surrounding Air. The use and importance of this Warmth to the living and healthy state, may be inferred from their *constant connexion* with each other; and also from the wonderful steadiness and regularity with which it is kept up, under every Change of Season, and in every Variety of

of Climate;—the quicksilver in a Thermometer placed under the tongue of a healthy person, uniformly pointing to the 98th degree,* whether the experiment be made in Summer, or in Winter, in the scorching plains of Africa, or in the frozen regions which surround the poles.

35. Upon the subject of *Animal Heat*, (as this natural warmth is called), neither the limits nor the intention of this treatise, will permit me to be very minute; but, consistency with my plan, I think, requires, that I should attempt to convey to my readers, *a general idea*, at least, of the matter,—such as I endeavoured to give in the preceding chapter, with regard to Respiration.—For this purpose it will be necessary, first, to state some of the leading and fundamental circumstances respecting Heat in general.

36. The word *heat*, in common language, has a double signification; being used to express both *a Sensation in the Mind*, and *the unknown Principle*, whether it be a substance or a quality, which *occasions* that sensation. By the term HEAT, however, as *here* employed,

* See Note 12. in Appendix.

ployed, I wish my readers to understand, that *Cause* which excites in us the *sensation of warmth*, and which, when operating in a certain degree, produces the various effects of *Fire*.

37. An attention to the phenomena which are constantly presenting themselves to our view, affords convincing proofs, that there actually exists a *Principle* termed HEAT or *Fire*. With regard to the *nature* of this principle, two opinions have chiefly prevailed. According to the first, HEAT is caused by a certain *vibratory Motion* of the particles of matter, and its various degrees depend upon the degrees of this motion. The other opinion is,—that HEAT is neither a *quality*, nor the effect of any *state* or *condition* of matter; but that it is *itself* a MATTER of a very subtile nature, and capable of pervading all other bodies;—that it exists, in a greater or less *quantity*, in every substance we are yet acquainted with;—and, that it can be transferred, to a certain extent, from one body to another.—The first, or *Mechanical Doctrine* of HEAT, most probably arose from observing, that a very high degree of warmth can be excited by hammering a piece of metal briskly,* and

* See Note 13. in Appendix.

and that by the rapid friction between two pieces of dry wood, even actual fire can be produced. The readiness with which the production of Heat, in many cases, was explained by this theory, induced Philosophers to extend it to all others; and accordingly it was, at one time, very generally admitted as universally true. Of late years, however, this subject has been more extensively and accurately inquired into; and the second, which is termed the *chemical* doctrine of Heat, being found most agreeable to facts, has been gradually gaining the ascendency, and is now generally held as fully established.*

38. As the language continually used with regard to HEAT, by no means corresponds with our present state of knowledge upon the subject, it will not, perhaps, be amiss, to premise a few remarks concerning it.

39. The *feelings* of men are their *first*, and, in many things, for a long time, their *only* guides to knowledge. The sensations of *warmth* and of *coldness* are so very dissimilar, and the presence of the one is found so incom-

* See Note 14. in Appendix.

patible with that of the other,* that they were naturally enough conceived to depend upon causes altogether different in their nature, and mutually destructive of each other's powers. Thus, whilst HEAT was admitted as the principle that occasioned *warmth*,—*coldness* was supposed to proceed from an opposite principle, denominated COLD. But the sensations which arise from impressions made upon the senses, differ very much from each other, according to the greater strength or weakness of the preceding impressions. Hence the same substance will often be pronounced *hot* by one person, and *cold* by another; nay, it may readily be so contrived, that the same substance shall communicate these *opposite* sensations to the same person, at the same time. For example—let one hand be immersed in a vessel containing Water as warm as it can easily be borne, and the other in a vessel containing an equal quantity of Water nearly freezing;—if the two Waters be then poured together into a third vessel, and both hands immediately plunged into the mixture, it will feel *hot* to the *cold* hand, and *cold* to the *hot* one. Upon the common supposition, however,

* I must here be understood to mean—*in the same part;* for I shall immediately shew, that *opposite* sensations may occur at the same time in *different parts.*

ever, that COLD and HEAT are distinct principles, both of which have an actual existence, and that their powers are opposed to each other, either it must happen, that the one or the other will predominate, and the mixture feel *hot* or *cold* accordingly,—or, that they will be so equally balanced, as to destroy each other's powers, and the mixture occasion neither the sensation of warmth nor of coldness. But the result is constantly what I have stated it to be; and the conclusion is,—that our *feelings* are inadequate tests of the truth in this matter; and consequently, that the language formed upon those feelings, is improper, and tends to mislead.

40. In other cases, where our *feelings* have been equally the foundation of the terms used, no such mistake has been fallen into, owing to the more obvious existence of the *principles*, concerned. Thus it is universally allowed, that the state of *light* or *illumination*, and the state of *dampness* or *moisture*, are both occasioned by the presence of their respective *principles*, namely, LIGHT and WATER. But, notwithstanding that the sensations produced by the states of *illumination* and of *darkness*, of *moisture* and of *dryness*, are as distinct, and as opposite to each other, as the sensation arising from *warmth* and that arising from *coldness* are,

yet it has never been imagined, excepting in a figurative sense,* that *darkness* was caused by an opposite principle to LIGHT, or *dryness* by a principle opposed to WATER. On the contrary, the various degrees of *illumination* and of *moisture*, are uniformly attributed to the presence of their respective principles, LIGHT and WATER, in corresponding quantities; and the terms *darkness* and *dryness* merely express states, depending upon the *absence* of those principles to a greater or less degree.

41. The very same reasoning holds true with regard to the terms *warmth* and *coldness*; the former really inferring nothing more, than that the matter of HEAT is present in such quantity, as to produce the *sensation* or *effect* which we often express by that word; and the latter, that it is so far deficient, as to occasion a *different sensation* or *effect*. The confusion of meanings, however, which had before existed, by using the same word to signify both the *effect* and its *cause*, is now completely avoided, by adopting the term CALORIC, first proposed by the French Chemists, *(Calorique)* to

* As in Milton's description of Chaos, where he says,

"*Hot, cold, moist,* and *dry,* four champions fierce,
"Strive here for mast'ry."

to signify the PRINCIPLE which *causes* Heat or Warmth: and, accordingly, I shall henceforth employ it as synonymous with the *Matter of* HEAT.

42. Of such extreme subtilty is the *matter* of HEAT, that it has hitherto eluded all the methods thought of, for ascertaining its quantity by its bulk or weight;* but the property it possesses, of increasing the dimensions of other substances, has furnished us with the means of measuring its *degrees*, with great accuracy, and to a very considerable extent. Upon this property of HEAT, the instrument called a THERMOMETER is constructed; by the aid of which it is clearly shewn, that the states of *Warmth* and of *Coldness* depend upon the same principle (viz. HEAT) operating in greater or less quantity; in other words, that the various degrees of *Cold*, are only so many *low degrees of* HEAT.

43. CALORIC (and, as far as we know, every other matter existing) has the property of uniting with matter of a *different* kind, in such a manner as to have its most striking and characteristic qualities completely suspended,

* See Note 15. in Appendix.

pended, and its presence rendered no longer manifest. When in this *fixed* and *inactive* state, it has received the name of *latent* Heat, or *latent* CALORIC.

44. That any substance should contain HEAT in very considerable quantity, and yet not be *hot*, may at first sight appear very surprising; an example of the fact, therefore, will probably be the shortest and most satisfactory mode of proving its truth.—If, during very cold weather, equal quantities of WATER, and of strong SULPHURIC ACID, (formerly called *Oil of Vitriol*) be put into separate vessels, and examined by the Thermometer, neither of them will shew that it contains more HEAT than the surrounding Air does. But let those two fluids be mixed together, and a degree of warmth, nearly equal to that of boiling water, will be immediately produced. —Here, then, from the union of two *cold* liquors, a great quantity of HEAT becomes suddenly obvious to our feelings and to the Thermometer. The *cause* of this Warmth, however, viz. a corresponding quantity of CALORIC, or the *matter* of Heat, must have existed in one or both of these fluids previous to their mixture; but it existed in a *fixed*, or *latent* state, (i. e. so as not to affect the feelings, or the Thermometer) and was set at liberty,

berty, or rendered *sensible*, in consequence of the two fluids uniting and forming a Mixture, whose power of fixing and retaining HEAT, is *much less* than what the two fluids jointly possessed whilst in a separate state.

45. Owing to the property just mentioned (43 and 44), different adjuncts to the term HEAT or CALORIC, are found necessary, accordingly as it is spoken of with a reference to the *state* alone, or only to the *quantity*, in which it is present in any substance.

46. Thus, *sensible* HEAT, or *sensible* CALORIC, expresses this principle in its *loose* and *uncombined* state, when its presence is shewn by its effects upon our feelings, and upon the Thermometer.

47. *Latent* HEAT, or *latent* CALORIC, denotes the principle in its *combined* and *fixed* state; but capable of being evolved in the state of *sensible* HEAT, whenever the substances containing it, have their retaining power lessened, in consequence of their uniting with other substances; as in the example of the Sulphuric Acid and Water, related above (44).

48. *Absolute* HEAT, or simply CALORIC, expresses

presses the principle with regard to the *quantity* of it contained in any substance, and without any reference to the *state* in which it may be; that is, without considering it either as *latent*, or as *sensible* CALORIC.

49. The *Temperature* of any substance, is the degree of *sensible* CALORIC in that substance, as measured by the Thermometer.

50. CALORIC, when in a *loose*, or *sensible* state, has a constant tendency to diffuse itself equally; so that if a body containing any given degree of *sensible* CALORIC, be placed beside other bodies that have less, it continues to pass out of the former into the latter, until they all become of an equal *temperature*, or degree of *warmth*.*

51. So universally is CALORIC, or the principle of Heat, diffused throughout the Universe, that we are not yet acquainted with any substance, but what contains more or less of it, both in a *latent* and *sensible* state. The *quantity* of CALORIC, however, and also the *proportion*

* From this tendency which *sensible* HEAT or *free* CALORIC has to come to an equilibrium, it has also got the name of *moving*, or, *radiating* HEAT or CALORIC.

proportion of it in those two states, differ very much in different substances, and even in the same substance under different circumstances.

52. The Air we breathe contains a great deal of *latent* CALORIC, even when its Warmth, or *sensible* CALORIC is very small;* but the *pure* or *Vital* portion of the Atmosphere (23), particularly abounds with it; as is shewn by the sudden increase of warmth which takes place, whenever *Vital Air* attracts CARBON from other bodies; for in that case, the *Vital Air* and the CARBON unite, and form CARBONIC ACID GAS (29), which cannot retain as much CALORIC in a *latent* state, as the *Vital Air* did before this union; in consequence of this, a quantity of CALORIC which the *Vital Air* had held in a *fixed* state, is set at liberty, or converted into *moving*, *radiating*, and *sensible* CALORIC, similar to what happens in the experiment I have described (44), of mixing the Sulphuric Acid and Water.

53. The *human* Blood, and the Blood of all breathing Animals, is also capable, under certain circumstances, of holding a quantity of CALORIC in a *latent* state. Thus, as long as the breathing

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* As during frost and intensely cold weather.

breathing goes on in the natural manner, the Blood when thrown out from the *left* Cavity of the Heart, and during its passage through the ARTERIES leading from thence, is found, by experiment, to contain more *latent* CALORIC, than when it has got into the VEINS in its way to the *right* Cavity; although its *temperature*, or quantity of *sensible* CALORIC, is somewhat greater in the latter situation than in the former.* It is, moreover, found, that the quantity of *latent* CALORIC which the Blood has thus parted with in its progress, is in exact proportion to the *darkness of colour* which the Blood has acquired. In the preceding chapter, however, I have shewn, that the *darkness of colour* depends upon the quantity of CARBON, which the blood has imbibed in its course: the conclusion then is, that CARBON has an effect upon Arterial blood, similar to what it has upon *Vital Air* (52); namely, that of forcing it to part with its *latent* CALORIC, in the state of *moving*, *radiant*, *and sensible* CALORIC.

54. The living human body being, in general, considerably warmer than the Air† and other matters

* See Note 16. in Appendix.

† See Note 17. in Appendix.

matters that surround us (34), must be continually imparting some of its Warmth to them (50), and will therefore require *a regular supply* of CALORIC to repair this loss, and keep its temperature up to the standard necessary for health. I have just shewn (53), that the Blood when sent out from the *left* Cavity of the Heart, contains a quantity of *latent* CALORIC, which it gradually parts with, in consequence of imbibing CARBON during its progress;—and hence it appears, that the BLOOD is the *immediate* source, from whence the body is furnished with that regular supply of CALORIC which it constantly requires.

55. The quantity of *latent* CALORIC which is contained in the Blood whilst circulating in the ARTERIES (53), is not very great; and a considerable portion of this quantity is set at liberty, by the time the Blood has got to the *right* Cavity of the Heart; but as the Blood upon its arriving here, is immediately transmitted through the Lungs to the *left* Cavity of the Heart again, in order to be from thence distributed over all the body, and supply the different parts with Warmth as before,—it is obvious, that to fit it for performing this office anew, it must first receive *a fresh supply* of CALORIC or the principle of Heat. Accordingly, it has been ascertained by experiment,

that

that after the Blood has passed through the Lungs, and got to the *left* Cavity of the Heart, it has actually *regained* as much CALORIC in a *latent* state, as it had before given out in a *sensible* one during its progress through the rest of the body.—It only remains, then, to shew the *source* from whence the Blood derives this fresh supply of CALORIC, and to explain *in what manner* the operation is performed.

56. As the Blood was forced to give out its *latent* CALORIC in consequence of having imbibed CARBON, it is plain, that in order to acquire *latent* CALORIC again, it must first part with this CARBON to something else. Now we have already seen (30), that the blood in passing through the Lungs, gives out the CARBON it contained, to the VITAL AIR drawn in at each breathing; and we have likewise seen (52), that when CARBON unites with *Vital Air*, a quantity of CALORIC is immediately evolved. As the *Vital Air*, then, which is taken into the Lungs there, meets and combines with CARBON, a quantity of CALORIC is set at liberty, at the very moment that the Blood, by parting with this CARBON, has recovered the power of attracting more CALORIC, and retaining it in a *latent* state: the consequence is, that THE BLOOD NOW ABSORBS AND FIXES A QUANTITY OF THIS PRINCIPLE, EQUAL

EQUAL TO WHAT IT HAD GIVEN OUT IN THE FORMER PART OF ITS COURSE, AND THEREBY BECOMES FITTED TO PERFORM THE IMPORTANT OFFICE OF SUPPLYING THE BODY WITH WARMTH AS BEFORE.

57. After having thus gone through, in detail, the several steps of this admirable contrivance, by means of which the *living* body is enabled to maintain a degree of Warmth considerably greater than that of the surrounding Air, the reader will, no doubt, wish to see the whole summed up in one short and comprehensive view.

58. From what has been said, then, it appears,—that during the breathing, *pure* or VITAL AIR is regularly taken into the Lungs, where it meets with the Blood returned from the different parts of the body, and deprived of its *latent* CALORIC by having imbibed CARBON: the VITAL AIR having a stronger attraction for CARBON than the BLOOD has, immediately unites with it, and at the same time gives out a quantity of CALORIC, which the Blood (whose capacity for acquiring *latent* CALORIC again, is restored by parting with this CARBON) instantly absorbs, and carries along with it into the course of the circulation, to be there evolved, and diffused over every

every part of the body. In short, THE GENERATION, (AS IT IS CALLED,) OF ANIMAL HEAT, CONSISTS IN AN ALTERNATE DOUBLE EXCHANGE OF PRINCIPLES,—THE BLOOD IN THE LUNGS CONSTANTLY DISCHARGING CARBON AND ABSORBING CALORIC, WHILE IN THE REST OF ITS COURSE, IT IMBIBES CARBON AND SETS THIS CALORIC AT LIBERTY.

59. We now come to a most important part of our subject, namely, the

Application of this Theory of Animal Heat, to the Purpose of Resuscitation.

60. As a certain degree of Warmth is uniformly present while the living functions continue perfect; and as experience has shewn, that these functions are suspended or destroyed by any thing that greatly diminishes this Warmth,—it was very naturally concluded, that *to restore Warmth to the body*, was one of the most *necessary*, and, therefore, ought to be one of the *first* steps taken, in *every case* of Suspended Animation. Agreeably to this opinion, it has, until of late years, been the uniform practice on such occasions, to endeavour, *first*, to *restore the lost Warmth* by the application of Heat to the surface of the body; and to *postpone* almost every other means until this

this was accomplished. But, admitting that the presence of a certain degree of Warmth, which we have shewn to be the *effect* of *some*, is also, in its turn, the *cause* of *other*, *functions* necessary to Life,—and, therefore, that in all cases where the Warmth of the body is greatly reduced, the restoration of it by *external warmth* may be proper;—yet we think it evidently appears from what has been said in this and the preceding chapter, that, when Respiration and Circulation are completely suspended, the *merely restoring Heat* to the body, will *not* renew *all* the functions necessary to Life; and farther, that instituting an *artificial breathing* in the way hereafter directed, and thereby renewing the *motion of the* HEART, and the *natural* process of *Animal Heat*, is by far the most effectual method of restoring both *Warmth* and *Life* to the body; and, consequently, should not be *postponed for a moment* after it can be put into execution. We know, that a mass of matter placed in Air or Water hotter than itself, acquires Warmth slowly, in proportion to the quantity of matter in the mass, and the smallness of its surface. Now the human body, which contains a great quantity of matter under a surface small in proportion, will, even when cooled but a little below its natural temperature, require a considerable time to have that temperature

perature restored by means of Heat applied to the surface. But as every part of the body, from the centre to the surface, is penetrated by innumerable Arteries and Veins through which the Blood circulates, it is evident, that if the Blood, which stagnates in the Lungs in cases of Suspended Animation, be supplied with CALORIC (56), and the HEART be again put in motion (13), the BLOOD containing this CALORIC will be quickly distributed through every part of the body, and the *natural Warmth* be thereby restored, in much less time than by any other mode.

61. It is only, however, against the application of external Warmth, when it tends to *postpone* the *other* and *more effectual* measures for Recovery, that I here object; for I shall by and by shew, how it may be employed without interfering with them;—as I believe, that when used with judgment, it is highly serviceable, by restoring to the Skin the Sensibility which it had lost from being deprived of its Heat,—and thereby, perhaps, restoring Sensibility to the Stomach, and to other important internal parts, in consequence of the Sympathy or connexion subsisting between the condition of those parts and that of the Skin;—a connexion which physicians daily see

see and acknowledge, but have hitherto been unable to explain.

62. I shall now close this, as I did the preceding Chapter, by drawing a practical conclusion, which I trust will appear fairly deducible from the several premises; it is,—That—IN EVERY CASE OF APPARENT DEATH, THE INSTITUTING AN ARTIFICIAL BREATHING, BY ASSIDUOUSLY INFLATING THE LUNGS WITH FRESH AIR, IS ONE OF THE FIRST AND MOST NECESSARY MEASURES TO BE TAKEN FOR RECOVERY.

CHAP. IV.

OF APPARENT DEATH FROM DROWNING, AND THE MEANS TO BE EMPLOYED FOR RECOVERY.

63. FROM considering that a drowning person is surrounded by Water instead of Air, and that in this situation he makes strong and

repeated efforts to breathe, we should expect, that the water would enter and completely fill the Lungs. This opinion, indeed, was once very general, and it still continues to prevail among the common people. Experience, however, has shewn, that unless the body lies so long in the Water as to have its Living Principle entirely destroyed, the quantity of fluid present in the Lungs is inconsiderable; and it would seem, that some of this is the natural moisture of the part accumulated; for upon drowning kittens, puppies, &c. in ink, or other coloured liquors, and afterwards examining their Lungs, it is found that very little of the coloured liquor has gained admittance into them.—To explain the reason *why* the Lungs of Drowned Animals are so free from Water, it is necessary to observe, that the muscles which form the opening into the Wind-Pipe, are exquisitely sensible, and contract violently upon the least irritation; as we frequently experience in the violent cough that is excited, when any part of our food or drink happens to touch them. In the efforts made by a Drowning Person or Animal to draw in Air, the Water rushes into the Mouth and Throat, and is applied to these muscles, which immediately contract in such a manner, as to shut up

up the passage into the Lungs.* This *contracted state* continues as long as the muscles retain the Principle of Life, upon which the power of muscular contraction depends; when that is gone, they become relaxed, and the Water enters the Wind-Pipe and completely fills it.

64. On dissecting the body of a recently drowned Animal, no particular fulness of the vessels within the Skull, nor any disease of the Brain or its Membranes, are, in general, visible; and where such appearances do occur, they are rather the effect of posture, or of some other accidental circumstances, than of the Respiration being suspended.

65. The Lungs also are sound; and the branches of the Wind-Pipe generally contain more or less of a frothy matter, consisting chiefly of Air, mixed with a small quantity of a liquid that is generally colourless, but sometimes of a reddish tinge.

 66. The

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* And to this circumstance it is sometimes owing, that the air blown into the Nostril, in order to inflate the Lungs, cannot enter the Wind-Pipe; in consequence of which another mode of inflation becomes necessary.

66. The *right* Cavity of the Heart, and the trunks of the large internal Veins which open into it, and also the trunk and larger branches of the Pulmonary Artery which carries the Blood from this cavity through the Lungs,—are all distended with dark coloured Blood, approaching almost to blackness. The *left* Cavity of the Heart, on the contrary, is nearly or entirely empty, as are, likewise, the large Veins of the Lungs (the *Pulmonary Veins*) which supply it with Blood, and the trunk and principal branches of the AORTA, or great Artery which conveys the Blood from hence to the various parts of the body.

67. The *external Blood-Vessels* are empty; and the fleshy parts are as pale as if the Animal had been bled to death.

68. When a body has lain in the Water for some time, other appearances will also be observable;—such as, the *skin livid*, the *eyes bloodshot*, and the *countenance bloated* and *swoln;* but these appearances, though certainly unfavourable, do not absolutely prove that life is irrecoverably gone (5).

69. It appears then (64—67), that in the case of *Drowning*, no injury is done to the structure of any of the parts essential to life,

so

so as to render it impossible to restore Animation; but that the *right* Cavity of the Heart, together with the Veins and Arteries leading to and from that Cavity, are turgid with Blood, whilst every other part is almost drained of this fluid.

70. From par. 64 and 66 we see, that the practice of *holding up the bodies of drowned persons by the heels*, or *rolling them over a cask*, is *unnecessary;* the Lungs not being filled with any thing that can be evacuated in this way.* But from par. 66 we farther see, that *such a practice is highly dangerous;* as the violence attending it, may even *burst* some of those Vessels which are already overcharged with blood, (66), and thus convert what was only Suspended Animation, into *Absolute* and *Permanent Death.*

71. The

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* In general, the Water discharged from the Mouth by this treatment, comes from the parts about the Throat. When the quantity, however, is considerable, the greater part must have come from the Stomach. But although a quantity of water lodged in the Stomach, will prevent the Lungs from expanding to their utmost, it appears to have no other bad effect; and it is better to proceed under this disadvantage, than risk the consequences which will probably attend the degree of violence that is necessary to get rid of it.

71. The operation of Inflating the Lungs, is a *perfectly safe*, and *much more effectual method*, of removing any frothy matter they may contain; and whilst it *mechanically* promotes the passage of the Blood through them, also *changes its quality* so as to render it capable of *stimulating* the *left* Cavity of the Heart, and exciting it to contraction. (16)

72. As soon as the body is taken out of the Water, it should be stripped of any clothes it may have on, and be immediately well dried.* It should then be wrapped in *dry warm blankets*, or in the *spare clothes* taken from some of the by-standers; and be removed, as quickly as possible, to the nearest house that can be got convenient for the purpose:† the fittest will

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* The propriety of this step will appear, from what is said respecting the cooling effects of Evaporation, in the Appendix; for it is certain, that the *internal parts* retain a considerable degree of warmth *for some time* after the accident; but these parts will soon be deprived of this, and of their *Sensibility* also, if *Evaporation*, and consequently abstraction of Heat, be allowed to go on from the surface of the body.

† Should the accident happen at a considerable distance from any house, much time may be lost in transporting the body thither. Therefore, if the weather happen to be warm, and the sun to shine out strongly, the body may be

will be one that has a tolerably large apartment, in which a fire is ready, or can be made.

73. The body may be carried in men's arms, or laid upon a door; or, in case the house be at a distance from the place, if a light cart, especially a covered one, can be procured, let the body be placed in it, on one side, upon some straw, with the head and chest somewhat raised; and in this position, a brisk motion will do no harm.—Whatever be the mode of conveyance adopted, *particular care should be taken, that the head be neither suffered to hang backwards, nor to bend down with the chin upon the breast.*

74. When arrived at the house, lay the body on a mattress, or a doubled blanket, spread upon a low table, or upon a door supported by stools; the Head and Chest being elevated by pillows.

75. As the Air of a room is very soon rendered impure by a number of people breathing

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be laid on some dry clothes, and exposed to the sun's rays, to restore its heat, whilst the other necessary steps are taken for promoting recovery.

ing in it,*—for this reason, as well as to avoid the confusion and embarrassment attending a crowd, no more persons should be admitted into the apartment where the body is placed, than are necessary to assist immediately in administering Means for the Recovery: in general, *Six* will be found sufficient for this purpose, and these should be the *most active* and *intelligent* of the by-standers.

76. It will be found most convenient, to divide the Assistants into *two sets;* one set being occupied in *applying Warmth* to the body, while the other institutes an Artificial Breathing, in the following manner.

77. As it seldom happens that a *Case of Resuscitating Instruments* is at hand, no time should be lost in attempting to inflate the Lungs by other means, until they can be procured. Independently of the danger from delay too, I am convinced from repeated observation and experiment, that there are few cases, where the Lungs cannot be inflated by a very cheap and simple instrument, or by a contrivance which can generally be made in *any*

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* If the weather will permit it, the windows of the room should be kept open.

any situation. The *instrument* I mean, is the Box-wood tube described in the plate subjoined; which ought to be a part of every country practitioner's Set of Instruments. I know, likewise, from actual trials on the dead body, that there are few cases where the Lungs cannot be inflated by a person of ordinary strength, blowing through this tube with his Mouth: and should *he* become fatigued, another may take his place; or instead of that, a pair of *common kitchen* or *parlour bellows* may be employed for the purpose; only wrapping a strip of linen, or a piece of broad tape, ribbon, or garter, round the nozzle, so as to make it fit the tube accurately, and prevent the Air from escaping between them.*

78. But

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* Persons possessed of any inventive talent will contrive a variety of expedients for this purpose; but as the hurry, alarm, and trepidation, which prevail on these occasions, is such as to deprive most persons of their ordinary recollection and promptitude, it may not be amiss to suggest a few that are easily obtainable. There is scarcely any respectable house which cannot furnish a *wine-strainer;* the bent tube of which can be introduced into one nostril, while the Assistant blows through the *funnel part,* after taking out the straining dish. There are few country hamlets, or even single houses, that have not a small *horn* (See plate), which is used for suckling children by the hand, when they will not spoon-feed: and hardly

78. But it is not merely blowing into the Nostril or the Mouth that will do, however great the force be that is employed; for unless it be guarded against, the Air, instead of entering the *Lungs*, will pass into and distend the *Stomach*. To avoid this, then, whilst the *first* ASSISTANT sustains the tube in one Nostril and stops the other Nostril with his *left* hand, and with his *right* accurately closes the Mouth;—the *second* ASSISTANT (who ought to be placed on the opposite side, or *left* hand of the body) is, with his *right* hand to press *backwards*, and draw gently *downwards* towards the chest, the upper part of the Wind-Pipe, that part which lies a little below the chin, and

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hardly *any* instance can occur, where a *card*,—a piece of *stiff paper* or *parchment*, or the *sole* of an *old shoe*, cannot be obtained: one or other of these may be rolled up into a conical tube like an extinguisher, and retained in that form by lapping it round with waxed thread or twine. There will be an inconvenience if paper, card, or parchment be used, from its becoming wet, and losing its tubular and conical form; but this may in some degree be prevented, by covering both the small and the wide ends for some length, with sealing wax melted by a candle; in the way often practised for preparing the new tobacco pipes to keep the shank from sticking to the lips.—In the case of *children*, the barrel of a common quill, a reed, or any other small tube will do; and the Assistant's breath prove quite sufficient for the inflation.

and which, from its prominence in Men, is vulgarly called Adam's apple: by doing this, the *Gullet*, or passage into the STOMACH, will be completely stopped up, whilst the *Wind-Pipe* will be rendered more open, to let the Air pass freely into the Lungs.* The *left* hand of this *second* Assistant, is to be spread lightly over the *pit of the Stomach*, ready to compress the Chest and expel the Air again, as soon as the LUNGS have been quite filled: the *first* Assistant unstopping the Mouth or Nostril at that same time, to let the Air escape.—The same operation is to be repeated, in a regular and steady manner, either until *natural* Respiration begins, or until this and the other measures recommended, have been persisted in for at least *Six Hours*, without any appearance of returning life.

79. Very often, the first attempts to inflate the Lungs in this way, do not succeed; owing to a quantity of froth and mucus occupying the Throat. When that is the case, let an Assistant, by means of his finger introduced into the Throat, depress and draw forwards the Tongue, and then, with a piece of sponge, or

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* See the sketch illustrating this, in the plate at the end.

or the corner of a towel, remove any frothy matter that may be lodged about the upper part of the Wind-Pipe.

80. Should it still be found, that the Air does not pass readily into the Lungs so as sensibly to elevate the Chest, immediate recourse must be had to *another* and more effectual method for attaining that object. As this method, however, requires address, and also some knowledge of the parts about the Throat, we would recommend, that when there is not a Medical Gentleman present, the modes already described be tried repeatedly, before this be attempted.

81. Having procured the Case of Instruments from the place where they are lodged, the most dexterous of the Assistants is to pass, the fore finger of his *left* hand, as far into the Throat as he can, and along this direct the end (A), of the flexible tube, (Fig. 5.) pushing it gently onwards until it appears to have got some length into the passage leading to the Stomach. The Ivory Sliding Piece (B), is then to be moved along the tube, as far as the finger will reach, so as to plug up the opening into the Gullet, and thereby prevent any Air from getting into the Stomach, as well as any mis-direction of the next instrument.

82. The

82. The end of the flexible tube may be allowed to hang out of the *right* corner of the Mouth, where it will be least in the way of the Assistant; who is now again to introduce the fore finger of his *left* hand, and with it depress, and draw forward, the root of the Tongue. Then taking the *Canula*, or curved silver tube, (Fig. 1. Plate 2.), in his *right* hand, let him direct the flatted point of it along this finger, towards the left almond of the ear, and between that and the side of the tongue. Having in this way got the point of the Canula *beyond* the root of the Tongue, he should gradually turn the instrument in his hand, and slowly raise the end which he has hold of, so that the point may *gently fall* as it were, rather than be *forcibly pushed*, into the opening of the Wind-pipe.*

83. This being done, one end of the flexible tube (Fig. 2. Plate 2.) is to be introduced into the *Canula*, and the other to be fitted on the nozzle

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* To make the directions delivered in this and the preceding paragraph more clearly understood, I have given a sketch in the Appendix, representing the relative position of the parts concerned; and illustrating the mode in which the flexible tube with the Ivory Slider, and the Silver Canula, are introduced into their respective passages.

nozzle of the Bellows; and the Nostrils and Mouth being accurately closed by the Assistant who sustains the *Canula* in its situation, the operation of inflating the Lungs is to be renewed.—In the present method, there is no occasion to press the upper part of the Wind-Pipe backwards, in order to close the Gullet; that passage being completely stopped by the Ivory Sliding Piece.—To let the Air pass out when pressure is made upon the Breast and Stomach, the Nostrils must be unstopped and closed alternately, by the Assistant who manages that part.

84. When pure Oxygene Gas can be procured, and the Lungs inflated with it instead of Common Air, there can be no doubt of its superior efficacy. It can be conveniently carried to any requisite distance in an oiled silk bag, having a stop-cock fitted to it; and this bag may be used instead of the bellows.*

85. As a quantity of frothy fluid, occupying the *branches of the Wind-Pipe* (65) and preventing the entrance of the Air into the Lungs, is generally the circumstance which renders *this mode* of inflation necessary, the Mouth

* See Note 18. in Appendix.

Mouth should be opened from time to time, to remove this matter as it is discharged.

86. Should it unfortunately happen, that the Lungs cannot be inflated in the manner described in par. 77-8, and that the under jaw is so fixed, as to render the introduction of the Canula impracticable, it has been proposed as a last resource, to perform the operation of *Bronchotomy;* which consists in making an incision into the fore part of the Wind-Pipe. But, besides that this is an operation never to be attempted except by a Medical Man, it has of itself often proved fatal, even when performed by the ablest Surgeons upon living persons, who were in danger of suffocation from disease of the throat. It is one, therefore, which may be entirely excluded from among the means of recovery from Apparent Death by *Drowning.**

Application of Heat Externally.

87. Whilst *one set* of the Assistants are thus engaged in performing *Artificial Respiration*, the *other set* should be employed in *communicating Heat* to the body.—The *Warm Bath* has

* See Note 19. in Appendix.

has been usually recommended for this purpose; but, wrapping the body in *Blankets*, or *Woollen Cloths*, *strongly wrung* out of hot Water, and renewing them as they grow cool, besides being a speedier * and more practicable † method of imparting Heat, has this great advantage, that it admits of the operation of inflating the Lungs being carried on without interruption.

88. Until a sufficient quantity of Warm Water for the above purposes can be got ready, *other* methods of restoring Warmth may be employed; such as, the application of *dry warm blankets* round the body and limbs;—*bags of warm grains* or *sand*,—*bladders* or *bottles of hot water*,—or *hot bricks*, applied to

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* This fact is well ascertained; and what is stated in Note 20. Appendix, respecting the great power of Steam in communicating Heat, will assist in explaining the reason of it.

† To employ the Warm Bath with any tolerable degree of convenience, requires a tin bath, or wooden tub made for the purpose, which cannot always be had; and likewise a much greater quantity of Water than can generally be got ready in a short time. Should the accident however, take place near a Brewhouse, Distillery, Dye-house, Bake-house, Glass-house, or other manufactory, which can supply hot Water, Grains, Ashes, Sand, &c., *any* of these articles may be employed to restore Warmth.

to the *hands*, *feet*, and *under the arm-pits*;— the bottles and bricks being covered with flannel: Or the body may be placed *before a fire*, or in the *sunshine if strong* at the time, and be *gently** rubbed by the Assistants with their *warm hands*, or with *cloths heated at the fire*, or by a *warming-pan*.†

89. The restoration of Warmth should *always be gradual*; and the Heat applied ought never to be greater than what can be comfortably borne by the Assistants. If the

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* The Frictions should at first be *very gentle*, and performed rather with a view to *restore Heat*, than to force the Blood on towards the *right* side of the Heart, which in drowned persons is already too much distended with it (66): besides, that *light and brisk friction* has a more powerfully *exciting* effect upon the Nerves of the Skin, than that which is made with considerable pressure; as we experience in *tickling* the sides of the Chest, or the soles of the Feet, which often excites convulsive motions of the muscles concerned in Respiration, whilst *strong rubbing* produces no such effect. After the Inflation has been continued for some time, *stronger* frictions may be employed, for the very purpose of *impelling the Blood onwards*; as it will then have less opposition to its passage through the Lungs.

† Should the accident happen near a Brewhouse, Distillery, Dye-house, Bake-house, Glass-house, or other Manufactory, whence hot Water, Grains, Ashes or Sand can be procured in sufficient quantity, any of these may be employed for the purpose of restoring Warmth.

weather happen to be *cold*, and especially if the body has been exposed to it for some time, *Heat* should be applied in *a very low degree at first*; and if the weather be *under the freezing point*, and the body when stripped, feel quite cold, and nearly in the same condition with one that is frozen, it will be necessary *at first* to rub it well with *Snow*, or wash it with *Cold Water; the sudden application of Heat, in such cases, having been found very pernicious.* In a short time, however, Warmth must be *gradually* applied.

Application of Stimulants to the Skin.

90. To assist in rousing the activity of the Vital Principle, it has been customary to apply various Stimulating Matters to different parts of the body. But as some of these applications are in themselves *positively hurtful*, and the others serviceable only according to the *time* and *manner* of their employment, it will be proper to consider them particularly.

91. The application of all such matters in cases of Apparent Death, is founded upon the supposition, that the Skin still *retains sensibility* enough to be affected by them. It is well known, however, that, *even during life*, the

the Skin *loses sensibility* in proportion as it is *deprived of Heat*; and does not recover it again, until the natural degree of Warmth be restored. Previous to the restoration of Heat, therefore, to a drowned body, all *stimulating applications* are *useless*; and so far as they interfere with the other measures, are also *prejudicial.*

92. The practice of *rubbing* the body with *Salt* or *Spirits*, is now justly condemned. The *Salt* quickly frets the Skin, and has in some cases produced sores, which were very painful and difficult to heal after recovery. *Spirits* of all kinds, if used in this way, evaporate fast, and thereby, instead of *creating Warmth*, as they are erroneously expected to do, *carry off a great deal of Heat from the body.** Spirit of Hartshorn, or of Sal Volatile,† are liable to the same objection as Brandy or other distilled spirits; and are, besides, very distressing to the eyes of the Assistants. When there is reason to think that the Skin has, in any degree, recovered its sensibility, let an Assistant moisten the palm of his hand with Spirit

* The reason of their doing so will be fully shewn, in Note 17 in the Appendix.

† See Note 20. in Appendix.

of Hartshorn, or *Eau de Luce*, and *hold it closely applied to one part*: in this way evaporation is prevented, and consequently the full stimulant effect of the application obtained. A liniment composed of equal parts of *Spirit of Hartshorn* and *Sallad Oil*, well shaken together, would appear to be sufficiently stimulating for the purpose, and as it evaporates very slowly, will admit of being *rubbed on* without producing cold.—The places to which such remedies are usually applied, are the *wrists*, *ancles*, *temples*, and the *parts opposite the stomach* and *heart*; and of these the two last appear the most proper.

Stimulating the Intestines.

93. The *Intestines*, both from their internal situation and their peculiar constitution, retain their sensibility to Stimulants longer than the other parts of the body; and, accordingly, various means have been proposed for increasing the action of their muscular fibres, in order to restore the activity of the whole System. *Tobacco-Smoke*, injected by way of Clyster, is what has been generally employed with this view; and the *fumigator*, or instrument for administering it, still makes a part of the Apparatus which is distributed by different SOCIETIES established for the recovery of

of Drowned Persons. Of late, however, the use of Tobacco-Smoke has been objected to, and upon very strong grounds; for when we consider, that the same remedy is successfully employed with the very *opposite intention*, namely, that of *lessening the power of contraction in the muscles*, and occasioning the greatest relaxation consistent with Life, it must be acknowledged to be *a very doubtful*, if not *dangerous remedy*, where the powers of Life are already nearly exhausted.*

94. Instead of Tobacco-Smoke then, I would recommend a Clyster, consisting of a pint or more of Water, moderately warmed,† with the addition of two or three *tea*-spoonfuls of Spirit of Hartshorn,—a heaped *tea*-spoonful of strong Mustard,—or a *table*-spoonful of Essence of Peppermint: in defect of one or other of these, half a gill or more, of Rum, Brandy, or Gin, may be added, or the warm Water given alone.—This step, however, need not be taken, until Artificial Respiration has been begun;—for it will answer but little purpose to stimulate the HEART through the medium

* See Note 21. in Appendix.

† Perhaps it should be as warm as the hand of the Assistant can bear without uneasiness.

medium of the INTESTINES, unless we, at the same time supply the *left* cavity with Blood fitted to act upon it; which we cannot do, without *first* removing the collapsed state of the Lungs, and promoting the passage of the Blood through them, by a regular inflation (16).

Stimulating the Stomach.

95. As the STOMACH is a highly sensible part, and has a great influence upon the Heart and Brain, the introduction of some moderately warm and stimulating liquor into it, seems well calculated to rouse the dormant powers of Life. This is very conveniently done by means of the Syringe and Flexible Tube (Fig. 3 and 4 of Plate 2). The *quantity* of fluid thrown in, ought not to exceed half a pint; and may be either warm Negus, or Water with the addition of one or other of the stimulating matters recommended above (94),—using, however, only *half* the quantities mentioned there.*

Stimulating

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* It will be dangerous to attempt getting fluids down the throat in any other way, until the power of swallowing is pretty well restored.—Where Æther, or Hoffman's Anodyne Liquor, can be had, *one tea-spoonful* of the former,

Stimulating the Nostrils.

96. As soon as the Pulse at the wrist, or the beating of the Heart can be felt, the inside of the Nostrils may be occasionally touched with a feather dipt in Spirit of Hartshorn, strong Mustard, or Aromatic Spirit of Vinegar; it being found by experience, that any irritation given to the Nose, has considerable influence in exciting the action of the Muscles concerned in Respiration.*

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97. When the *natural* breathing commences, the flexible tube and Canula should be withdrawn; and any farther inflation that may be necessary, performed by blowing into the Nostril in the manner first described, par. 77-8.

Blood

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mer, or *two* of the latter, will be a very useful addition to the Water, instead of the remedies enumerated above.

* Some recommend the blowing of a pinch of Snuff or Pepper up the nose. The Pepper may certainly be used with safety, and sometimes with advantage; but the *Snuff*, if it should get back into the throat, and be swallowed when Recovery takes place, may bring on great sickness and disorder, if not fainting and Death (par. 93).

Blood-Letting.

98. Letting blood has been generally thought requisite, in *every* case of Suspended Animation. The practice, however, does not appear to have been founded upon any rational principle at first; and it has been continued more from the force of Custom, than from any experience of its good effects. In the case of Drowned Persons, there is not in general, as in those who suffer from Hanging or Apoplexy, any unusual fulness of the Vessels of the Brain; and the quantity of Blood that can be drawn from the *external Veins* (67) will not sensibly diminish that accumulation of it which *always* takes place *in those near the Heart* (66). Besides, Blood-Letting, which very generally tends to *lessen* the action of the Heart and Arteries in the *living* body, cannot be supposed, unless under particular circumstances, to have a directly opposite effect in cases of Apparent Death; on the contrary, if *generally* employed here, it will often hazard the *entire destruction* of those feeble powers which yet remain; and *to increase and support which, all our endeavours should be directed.* It is proper to remark, however, that *exceptions* to this general interdict of Blood-Letting, may sometimes occur; as in persons who appear to have been very full of blood, or of an Apoplectic

plectic disposition, during life, and in whom, therefore, the Heart and Blood-Vessels are over-loaded and oppressed: in *such cases*, taking away some Blood, by lightening their burthen, enables them to act with greater freedom and force. Previous *Intoxication* likewise, or the head having lain in a depending position (64), may have accumulated an unusual quantity of Blood in the vessels of the *Brain*: this will generally be marked by a purple and bloated countenance; and *here*, taking away some Blood from the vessels of the Head, by the lancet, or by cupping glasses, will be proper.

Electricity.

99. When the several measures recommended above, have been steadily pursued for *an hour or more*, without any appearance of returning life, ELECTRICITY should be tried; experience having shewn it to be one of the most powerful stimulants yet known, and capable of exciting contraction in the Heart and other muscles of the body, after *every other* stimulus had ceased to produce the least effect. *Moderate shocks** are found to answer best,

* Such are those from a jar of twenty-four inches, or thirty inches coated surface, and the discharging electrometer

best, and these should, at intervals, be passed through the Chest in different directions, in order, if possible, to rouse the Heart to act. Shocks may likewise be sent through the Limbs, and along the Spine; but I am doubtful how far it is useful or safe, to pass them through the BRAIN, as some have recommended. The body may be conveniently insulated, by placing it on a door supported by a number of quart bottles, whose sides are previously wiped with a towel, to remove any moisture they may have contracted, which would conduct the Electric Fluid to the floor, instead of making it pass *through the body*.— By experiments made on different Animals, it has been found, that the Blood passes through the Lungs most readily, when they are fully distended with Air; consequently, that if the Lungs of a Drowned Person are inflated, and kept in the expanded state whilst the Electric Shock is passed through the Chest, the Blood accumulated in the *right* Cavity of the Heart and its Vessels, will move forward without any resistance, should the Heart be once brought to contract upon it. As soon as the shock is given,

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meter placed about *one-third* or *half of an inch* from the knob of the jar, or from the prime conductor; accordingly as it is applied to one or the other, in the machine used.

given, let the Lungs be emptied of the Air they contain, and filled again with *fresh Air;* then pass another shock,—and repeat this, until the Heart is brought into action, or until it appear that all farther attempts are useless. —In order more certainly to pass the shock through the HEART, place the knob of one discharging rod above the collar-bone of the *right side*, and the knob of the other above the *short ribs of the left:* the position of the discharging rods, however, may be changed occasionally, so as to vary the direction of the shock.—Two thick brass wires, each about eighteen inches long, passed through the two Glass tubes, or Wooden cases well varnished, and having at one end a knob, and at the other a ring to fasten the brass chain to,—form very convenient discharging rods; and by means of them, the shock may be administered, without the risk of its being communicated to the Assistants, or carried off by the Skin being wet.*

100. From

* I have thought it unnecessary to be more particular upon the employment of Electricity; as those persons who are already acquainted with the use of an Electrical Apparatus, do not require minute instructions; and to those who are altogether ignorant of the matter, no information that I could give here, would be sufficient for the purpose.

100. From the modern discoveries of Galvani, VOLTA, and others, it appears, that *Animal Electricity* is nearly allied in its nature, to what used to be denominated the *Nervous Fluid;* and hence it is *probable*, that the VOLTAIC Apparatus may be both a more *safe*, and more *effectual* means of rousing the dormant PRINCIPLE OF LIFE, than the common Electrical Machine. A Voltaic Trough consisting of *thirty pair of plates*, each *four inches* square, will perhaps be sufficiently powerful for the purpose. It has other advantages likewise, over the Electrical Machine; as, that dampness of Atmosphere, or even wetness of the Skin, does not much impede its influence; and that, by long Conducting-Wires of Copper, it can be so managed, as not to interfere with any other steps that are judged requisite at the same time. To render the transmission of the Electric influence more certain, that end of each conducting-wire which is applied to the body, should have a circular plate of *thick tinfoil* fixed to it, and the surface of this plate in contact with the Skin, be kept wetted with the same liquor which fills the trough.

Management after Recovery.

101. When the patient is so far recovered as to be able to swallow, he should be put into

to a Warm Bed, with his Head and Shoulders somewhat raised by means of pillows. Small quantities of warm Wine-Whey, Ale-posset, or other light and moderately nourishing drink, should now be given from time to time; and gentle sweating promoted, by wrapping the feet and legs in flannels well wrung out of hot water.

102. If the Stomach and Bowels feel distended and uneasy, a Clyster, consisting of a pint of Warm Water, with a table-spoonful of Common Salt, or an ounce or more of Glauber's or Epsom Salt, dissolved in it, may be administered. The *common* practice, in this case, is, to give an EMETIC, and in several instances it would appear to have hastened recovery; but where the powers of the machine are still very weak, the agitation of Vomiting is certainly hazardous; and when an Emetic is judged proper, *Ipecacuanha should always be preferred;* as Emetic Tartar, and Antimonial Wine, have a debilitating influence, that renders them highly improper in such cases.*

103. The

* I have known more than one example, of Children being absolutely destroyed by *small* and *repeated* doses of Antimonial

103. The patient should on no account be left alone, until the Senses are perfectly restored, and he be able to assist himself; several persons having relapsed and been lost, from want of proper attention to them, *after* the Vital Functions were, *to all appearance* completely established.

104. Either owing to the distention which the ARTERIES of the LUNGS have suffered (66),—to the sudden change from great Coldness to considerable Warmth,—or to the general commotion that attends returning circulation, it now and then happens, that the patient is attacked, soon after recovery, with Inflammation of some of the parts within the Chest. This occurrence is pointed out by *pain in the Breast* or *Side, increased on inspiration*, and *accompanied with frequent, and full or hard Pulse*, and *sometimes with Cough*. Here, the taking away some Blood from the arm,

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Antimonial preparations, without either Vomiting or Purging being excited by them; so that they must have acted as a *sedative poison* upon the Vital Principle, and extinguished it without a struggle.—*Ipecacuanha Wine* will oftenest be at hand; but if not, pouring a Wine-glassful of boiling Water upon 20 or 30 grains of the Ipecacuanha in powder, and giving both the substance and the infusion, will render its operation more certain and speedy.

arm, or the application of Cupping-glasses, Leeches, or a Blister, over the seat of the pain, will be very proper; but the necessity for these measures, as well as the time for putting them in practice, should be left to the judgment and discretion of a Medical Person. —Dull pain in the Head, lasting sometimes for two or three days, is by no means an unfrequent complaint, in those who are recovered from this and from the other states of Suspended Animation; and here also, a *moderate bleeding from the arm* with the lancet,—cupping-glasses applied to the nape of the neck, —or leeches to the temples, may prove serviceable.

CHAP. V.

Apparent Death from Hanging, and the Means of Recovery.

105. In *Hanging*, the *external* Veins of the Neck are compressed by the cord, and the return of the Blood from the Head thereby impeded,

peded, from the moment that Suspension takes place; but as the Heart continues to act for a few seconds after the Wind-Pipe is closed, (14), the Blood which is sent to the Head *during this interval*, is necessarily *accumulated there*. Hence it is, that in *Hanged Persons* the Face is usually much swoln, and of a dark red or purple colour; the Eyes are commonly suffused with blood, enlarged, and prominent. On dissection, the *blood-vessels of the Brain* are found *considerably distended*; but, *in general*, no farther marks of disease appear within the Skull.—The Lungs are sound, generally quite collapsed, and free from frothy matter.—The Heart, and the large Blood-Vessels adjoining to it, exhibit the same appearances as in the bodies of Drowned Persons. (66)

106. From the great accumulation of Blood in the Vessels of the Head, many have been of opinion, that *hanging* kills chiefly by inducing Apoplexy; but the following ingenious experiment, made at Edinburgh many years ago, by Dr. Monro, senior, clearly proves, that in Hanging, as well as in Drowning, the *exclusion of Air from the Lungs* is the immediate cause of death. A dog was suspended by the neck with a cord, an opening having been previously made in the Wind-Pipe,

below

below the place where the cord was applied, so as to admit Air into the Lungs. In this state he was allowed to hang for *three-quarters of an hour*, during which time both the Circulation and Breathing went on. He was then taken down, without appearing to have suffered much from the experiment. The cord was now shifted from *above* to *below* the opening made into the Wind-Pipe, so as to prevent the ingress of Air to the Lungs; and the Animal being again suspended, he was completely dead in a few minutes.

107. Upon the whole, then, it appears, that the *same measures* recommended for *drowned persons*, (Chap. IV) are also necessary here; with this addition, that opening the Jugular Veins, applying Cupping Glasses to the Neck, or Leeches to the Temples, will tend considerably to facilitate the restoration of Life, by lessening the quantity of Blood contained in the Vessels of the Head, and thereby taking off the pressure from the Brain. Except in persons who are very full of Blood, the quantity taken away need seldom exceed an ordinary tea-cupful; which will in general be sufficient to unload the vessels of the Head, without weakening the powers of Life.

CHAP. VI.

SUFFOCATION BY NOXIOUS VAPOURS, AND THE MEANS FOR RECOVERY.

108. EVERY kind of Air or Gas, excepting VITAL AIR or OXYGENE GAS, proves speedily destructive of Life, if breathed alone; as not carrying off from the Blood passing through the Lungs, the CARBON with which it becomes impregnated whilst circulating through the body, and, at the same time, supplying that Vital Principle which is necessary to animal existence (23, 32). But although two of these, viz. Hydrogene Gas *(Inflammable Air)*, and Nitrogene Gas, will not support *Life*, yet neither of them proves either so speedily or so powerfully fatal, as the CARBONIC ACID GAS, or Fixed Air (27); which is copiously produced from various sources, as from Cider, Perry, and Malt-liquors, during their state of fermentation,—from lighted Charcoal,—and from Brick and Lime-kilns whilst burning; it is also found to occupy deep vaults, sewers, pump-wells, wells of ships, mines, and other places that have not

not a free circulation of air. In these latter situations, it is commonly mixed with Inflammable and Nitrogene Gasses, and is then rather *less* suddenly destructive, than by itself; for, when attempted to be drawn into the Lungs in its *pure* state, it occasions an instantaneous contraction of the *Glottis*, or passage into the Wind-Pipe, and the animal falls as suddenly as if struck by lightning.*

109. It would appear, however, that the breathing of some of those Vapours is attended with other effects, besides that of merely excluding *Vital Air* from the lungs; for in persons suffocated by them, the Blood preserves its fluidity, the limbs continue flexible, and the body retains its natural, or even a greater degree of warmth, for many hours after death:—the Vessels of the Brain are generally distended with Blood,† as in the case

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* See Note 22. in Appendix.

† The late Dr. Cullen, Professor of Medicine in the University of Edinburgh, when treating upon the subject of Apoplexy in his lectures, used to mention the case of a Brewer, whose practice it was to hold his head over the vats of fermenting liquor, in order to discover how far the fermentation had proceeded; which he knew by the pungency of the Carbonic Acid Gas separated from the liquor

of hanging (105). The Lungs, however, are uninjured; and the Heart and large Blood-Vessels appear in the same state as in Drowned Persons (66).

110. When the accident is recent, and the body retains its Warmth, the application of Cold Water to the Head, Neck, Breast, and other parts, has been found of great service in promoting Recovery.* For this purpose, the body should be stripped naked, and laid in the open Air, upon a door or boards placed in a sloping position, so that the Head and Shoulders may be considerably elevated. The Cold Water is then to be dashed smartly and repeatedly upon different parts, and especially upon those mentioned above, until the temperature of the body be reduced to the natural standard, or until signs of Life appear.

111. If the body, however, be *under* the natural temperature, then it will be necessary to apply *heat*.

112. In

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liquor (108): he would frequently stay so long over it, as to occasion his falling backwards from giddiness; and to this practice the doctor attributed the Apoplexy with which he was afterwards seized.

* See Note 23. in Appendix.

112. In the mean time, the Lungs should be diligently inflated, and the Nostrils stimulated, as directed under the article *Drowning* (77-86, 96).*

113. Where the Veins of the Neck appear very turgid, some Blood may be taken from them by the lancet; or Cupping Glasses may be applied behind the Neck.

114. A violent pain in the Stomach has sometimes taken place soon after Recovery, and been removed by giving a brisk Purgative or Emetic, which evacuated a great quantity of Bile.

CHAP. VII.

SMOTHERING FROM CONFINEMENT UNDER BED-CLOTHES, AND MEANS OF RECOVERY.

115. SOMETIMES from accident, but oftener from culpable inattention, young Children are

* See Note 24. in Appendix.

are not unfrequently smothered in Beds* and Cradles. The lower classes not only *permit*, but, by way of indulgence, even *encourage*, a very improper habit of cats lying in the bed or cradle with young Children; as these animals, from their love of Warmth, almost always lay themselves across the Child's neck, and often either cover the Mouth with their bodies, or press the bed-clothes over it, so as to impede or stop the breathing. When this happens without the Child having been bruised by overlaying, &c., the functions of Life are suspended merely from the *want of Vital Air*. The Vital Organs are found to have sustained no particular injury; the Lungs are collapsed, and the *right* Cavity of the Heart, and the Large Vessels belonging to it, are distended with Blood.

116. If the body be *warmer* than is natural (which is often the case†), it should be exposed to

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* The majority of the labouring class in large towns are *lodgers*, and seldom having more than one apartment, are generally obliged, for the sake of room, to use *turn-up bedsteads*, which are particularly liable to have this accident happen in them.

† This happens partly from the Natural Warmth being retained and accumulated by the bed-clothes, &c., and

to a current of Air, and sprinkled with Cold Water. The Lungs should be immediately inflated, and the body afterwards treated as directed in the case of Drowned Persons.

CHAP. VIII.

TREATMENT OF STILL-BORN CHILDREN.

117. WHEN a still-born Child appears in every respect perfect, and especially when, from the circumstances of the labour, there is reason to believe that the Child has not been *long* dead,* measures may be taken for recovery, with

and partly from the Child having breathed the Carbonic Acid Gas, thrown out from its own Lungs (31), mixed with the Nitrogene Gas which remains after the Vital portion of the Common Air that was contained under the bed-clothes, has been all consumed (26--27).

* Some cases which have come within my knowledge prove, that Still-born Children may be recovered even after *an hour or more* has elapsed from the time of their birth. How much *later* than this a recovery is practicable, future experience

with very great hopes of success. With this view, the Lungs should be diligently inflated, and the heat of the body kept up, by the application of Warm Flannels, or by putting the Feet and Legs, or the whole Body up to the chin, into Warm Water. Moderate frictions with the Naked Hand, and gentle agitations, may also be used; and Stimulating Remedies applied to the Nose, Temples, and Pit of the Stomach.

118. If the *Wooden Tube* (Fig. 1.) be not at hand, the *female Catheter*, (an instrument which every Practitioner in Midwifery is presumed to carry constantly about with him,) will

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experience must determine; but there are several reasons for believing, that the Vital Principle is not so soon destroyed here, *provided the warmth of the body be kept up*, as when Respiration has been *established for a length of time, and then interrupted:* for the new-born Infant which has either not respired at all, or had its breathing suspended very soon after birth, seems in a state of *susceptibility* somewhat resembling that which annually takes place in certain Animals, as the bat, frog, dormouse, &c., from the influence of the Winter's cold; the one requiring only the restoration of that warmth by the return of Spring, the other the application of Air to the Blood stagnating in its Lungs, to restore the Circulation, and with it the balance of functions necessary to Life. See a Case in Note 25. Appendix.

will answer tolerably well for inflating the Lungs in this case: in defect of it, *a joint of reed, the barrel of a quill,* or *piece of stiff paper* or a *card* rolled up, may be employed;—one end being introduced into the Mouth, and the Assistant blowing into the other with his breath,* until the Lungs are expanded; then gently pressing the Chest;—and repeating this, so as to imitate Natural Respiration.

119. Before Children are born, and until they have begun to cry, the Tongue is drawn back into the Throat, so that a kind of *valve*† which is attached to its root, is shut down over the opening into the Wind-Pipe, and the entrance of any foreign matter into the Lungs thereby prevented. A finger should therefore be introduced into the Throat, and the root of the Tongue be drawn forward and this *valve* raised, before we proceed to inflation.

Persons

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* This method from its being very convenient, will, no doubt, be oftenest employed; but that by means of the bellows, though less easy, is certainly preferable, the Air thus thrown into the Lungs of the Child, not being deprived of its vivifying quality, as that in some degree is which has just passed through the Lungs of a living person: hence we may succeed by using *bellows,* after we have failed in the other ways.

† See the Sketch in the Appendix.

Persons who are not aware of this circumstance, will be often foiled in their attempts to expand the Lungs, and instead thereof will fill the Stomach with air: in order still more certainly to avoid doing this, the upper part of the Wind-Pipe should be pressed gently *backwards* and *downwards*, as already noticed in the treatment of Drowned Persons (78).

CHAP. IX.

MEANS OF RECOVERY FROM FAINTING FITS.

120. THESE appear to arise from the energy of the BRAIN being suddenly suspended;—in consequence of which the Heart immediately ceases to beat, and the person falls down deprived of Sense and Motion.

121. When the powers of Life have not been previously exhausted by Disease, Fatigue, or

or Want of Food, a recovery generally takes place after a short interval, and often without any thing being done to promote it. But should this not be the case, the Feet and Legs ought to be immersed in Warm Water, and the Nostrils stimulated by applying Spirit of Hartshorn, &c. to them (96). If these fail, inflation of the Lungs, and the other means already enumerated under the article *Drowning*, should be had recourse to.

122. It is still very common to open a Vein in such cases; and, as far as it affords a proof of Vital power being still present, by its bleeding *freely*, there is no objection to the drawing *two* or *three ounces* of blood: on the other hand, as Fainting oftenest occurs in persons who are ill able to bear the loss of Blood, the taking away *any large quantity*, appears in itself nowise suited to promote Recovery, but rather the contrary, and is now very properly going into disuse.

123. The Faintings which most require assistance, and to which, therefore, I wish particularly to direct the attention of my readers and the public, are those that take place from *loss of Blood*,—*violent and long-continued Fits of Coughing*,—*excessive Vomiting or Purging*,—*great Fatigue*,—or *want of Food*; and

and likewise after Convulsions, and in the advanced stage of Low Fevers.* It is but seldom, however, that any attempt at Recovery is made in such cases; and several reasons may be assigned for this,—particularly, the great resemblance that Fainting Fits of any duration, bear to *Actual Death;* and the firm belief of the by-standers, that the circumstances which preceded, were sufficient to destroy Life entirely. To these may be added another, which has no small share in deterring Medical Men from undertaking any thing that is new or uncommon;—I mean, the dread of being ridiculed by their brethren or the public, should they fail in an attempt which will be oftener believed to proceed from an affectation of singularity, and a wish to attract

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* In no case do faintings happen so frequently and of such long continuance, as in the Hysteric Fits to which Women are subject. It is surprising to see how long such persons will often lie without either pulse or breathing, and yet recover of themselves. In *these* faintings, however, the countenance generally preserves, in a considerable degree, its natural colour and appearance, or becomes alternately pale and flushed, and the body usually maintains its temperature, without any great diminution; whilst in the other and more dangerous ones enumerated above, a death-like paleness and coldness overspread the whole body, and continue until a Recovery is brought about by means of proper remedies.

attract notice, than from a sound judgment, and real knowledge in their profession. To the *doubts* of some, and the *obstinate disbelief* of others, I would oppose the authenticated examples of success which exist upon record, and which, although they do not flatter us with the hope that our attempts will succeed as often *here*, as when the Powers of Life had not been previously weakened, are yet sufficiently numerous to prove, that *such attempts ought to be more frequent;* and that whenever they become so, Society will be benefited by the *preservation of many valuable lives*, and an important addition be thus made to the extent and usefulness of the Healing Art.*

124. In the case of Drowning, Hanging, &c., where the Heart continues to contract for a few times after the Respiration is stopt, the *left* Cavity, together with the vessels leading *to* and *from it*, are found nearly empty (66, 99, 103, &c.). Hence, should it even happen here, as in most cases of Fainting, that the Sensibility of the body returned spontaneously after a certain interval, or, that we could restore it, by means of something which operated *immediately* upon the Brain and

* See Note 26. in Appendix.

and Nerves,—still it would be necessary to inflate the Lungs, and thus supply the *left* Cavity of the Heart with Blood fitted to act upon it, before the Circulation could be renewed, and a Recovery brought about. But in Fainting, the Heart *immediately* ceases to act, so that the Blood which had undergone the necessary change in the Lungs, and got into the *left* Cavity of the Heart and the Vessels belonging to it, remains there, and excites these parts to contract upon it and push it onwards, as soon as they become sensible to its stimulus, by the influence of the Brain and Nerves being restored.—These circumstances explain to us, why persons are more readily recovered from Fainting, than from the other cases of Suspended Animation; and also, why there is seldom any thing more required in this case, than to rouse the Heart to action, by means of Stimulants.

125. The stimulant remedies that may be employed for this purpose, are either *external*, or *internal*. The *external* are, Warm Water, &c. (82, 3, 4), sharp Mustard, Spirit of Hartshorn, or of Sal Volatile, Eau de Luce, and Volatile Liniment (87). Brandy, Rum, or Gin, may also be used externally, provided that care be taken to prevent their evaporating fast (87), and thus counteracting the good

good effects which their *stimulating quality* would otherwise produce: the parts to which these matters should be applied, as well as the best method of using them, have been already noticed (87). Putting the Hands, Feet, and Legs, into Warm Water, or fomenting these and other parts with flannels wrung out of the same, are particularly serviceable in the Faintings which happen in consequence of Great Loss of Blood, Excessive Vomiting or Purging, &c.; and the good effects of this remedy in such cases, does not depend so much upon the water stimulating by its *warmth*, as from a portion of it being absorbed, and carried into the Blood, where it supplies, as to bulk, the fluids that were lost, and gives to the vessels that degree of fulness which they require, in order to keep up the Circulation, and maintain the functions necessary to life.*

126. As

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* There is nothing that refreshes and recruits a person who is exhausted by fatigue, so soon as the Warm Bath; and the sudden and considerable increase of weight which such persons are found to have gained by using it, shews that a great quantity of the water must have been absorbed.

When the fainting proceeds from loss of *Blood*, the Water absorbed in this way will supply the *bulk*, but not the

126. As internal stimulants, from a gill to half a pint of Wine, warmed, and some Sugar and any agreeable Spice added to it;—three or four table-spoonfuls of Brandy or other Spirit, diluted with two or three times the quantity of Water,—or a gill of Mint Water, mixed with a tea-spoonful of Spirit of Hartshorn, Volatile Aromatic Spirit, Eau de Luce, Æther, or Hoffman's Anodyne Liquor, may be introduced into the Stomach by the flexible tube; and when that is not at hand, and the liquid cannot be got down the throat without it, *a double quantity* should be given by way of Clyster.

127. Where excessive Vomiting or Purging has been the cause of the Fainting fit, the return of these, and of the Fainting, is best prevented by giving, according to the age of the patient, from ten to thirty drops of Laudanum, in a glass of Mint Water, Warm Wine,

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the *qualities* of the fluid lost; and if the quantity lost has been considerable, the patient, though he recover from the fainting fit, may afterwards die from the deficiency of that stimulus, which only the glutinous and red part of the blood, can afford. In such cases, and in such only, would the experiment of *transfusing blood from the Vessels of a living Animal into those of a living Person,* promise to be of real use.

Wine, or Brandy and Water,—or administering *a double quantity* in the form of Clyster; but unless in cases of great emergency, this should be left to some Medical Person.

CHAP. X.

INSENSIBILITY, AND APPARENT DEATH, FROM INTOXICATION, WITH THE MEANS TO BE EMPLOYED FOR RECOVERY.

128. FREQUENT dreadful examples have shewn, that Strong Liquors drank in large quantity, will put an end to life *almost instantaneously;* and it would appear that they do this, by affecting the Nerves of the Stomach, in such a manner as entirely to destroy the influence of the Brain. In general, however, the fatal effects of Intoxication are gradual, and do not so much depend upon the liquor acting immediately as a poison, as upon its rendering the person incapable of conducting himself; in consequence of which he falls

down, and lies in some posture that obstructs either the Circulation, the Respiration, or both.

129. Intoxicating Liquors seem universally to produce an increased flow of Blood to the Head; and an accumulation in the Vessels of that part, will occur more readily and to a greater degree, if the person has chanced to lie with his Neck bent, or his Head lower than the rest of his body: in this way, a state of Apoplexy has been often induced.*

130. If the countenance be swoln, and of a dark red or purple hue, and these appearances do not go off upon keeping the body for a short time in an erect posture, it will be proper to take some Blood from the jugular Veins, or apply Cupping Glasses to the Neck.

131. When the Pulse and Breathing continue,

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* The Apoplexy arising from Intoxication, however, may *generally* be distinguished from others, by attending to the smell of the patient's breath; and the distinction, when it can be made, is of consequence; as Emetics, which are of very doubtful tendency in *spontaneous* Apoplexy, are highly useful in that occasioned by Strong Liquors.

tinue, and the body is hotter than natural, cloths dipt in Cold Water, and applied to the Head, Neck, Stomach, and Breast, have often been found serviceable in restoring intoxicated persons to their senses; and these applications will frequently render bleeding unnecessary.

132. But of all the remedies that have been tried in such cases, an Emetic contributes most speedily to Recovery; first, by emptying the Stomach of a great part of the noxious fluid which the person had taken, and, secondly, by producing a more equable distribution of the Blood throughout the body, in consequence of the general agitation which the action of vomiting occasions. For this purpose, three or four table-spoonfuls of Ipecacuanha Wine,—thirty or forty grains of Ipecacuanha in powder,—or a couple of grains of Emetic Tartar dissolved in half a gill of water,—may be administered; and their operation promoted when it has begun, by plenty of luke-warm Water.* Should the person be incapable of swallowing, the Emetic may be introduced into the Stomach by means of the Flexible Tube and Syringe.

 133. Where

* See Note 27. in Appendix.

133. Where the Flexible Tube cannot be procured, or when the Emetic fails to operate, a pint of luke-warm Water, with two heaped table-spoonfuls of Common Salt dissolved in it, should be given in Clyster: and this has been known to empty the bowels, and procure speedy relief, after several other measures had been tried without effect.—It will be necessary to repeat the Emetic or Clyster, if the first that was given has not produced the wished-for operation.

134. The best position for the body to be placed in, is, lying on one side, with the Head and Shoulders raised by pillows.—After the person is so far recovered as to be suffered to go to sleep, he should be carefully watched, lest his Neck be anywise bent, or his Head slip down under the clothes, or hang over the side of the bed (128).* Care should also be taken, that nothing tight be allowed to remain about the Neck.

135. If the Hands and Feet have become cold, they should be put into Warm Water, or wrapped in flannels well wrung out of the same,

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* A Bed-Chair, having cheeks to it, will be the best guard against these occurrences.

same, to be changed for others as fast as they cool. And if necessary, bottles of Hot Water, or heated Bricks, covered with flannel, may afterwards be applied to the Feet, &c.

136. When the ordinary signs of Life have disappeared, the same measures recommended for Drowned Persons, will be proper; observing, however, always to administer a brisk Emetic, or sharp purgative Clyster, as soon as the Pulse and Breathing are *fully* renewed.

137. The chance of Recovery, however, under such circumstances are extremely small; and hence the urgent necessity of *early* and *active* steps being taken. One, highly proper, is, to *force* the person to walk about, if able to move at all; and if not, to *drag* him backwards and forwards by two persons who support him under the arm-pits; and keeping his *head erect*, by a stay or band fastened between his night-cap and the back of his waistcoat. It has not only been *proposed*, but said to have been even *practised with success* in some cases of this kind, to rouse the person to a sense of feeling, by whipping his naked limbs and body with small birch rods: and surely, if a

treatment

treatment apparently so harsh be justifiable in *any* case, it is where it has for its object the preservation of Life.

CHAP. XI.

APPARENT DEATH FROM BLOWS, FALLS, AND THE STROKE OF LIGHTNING; AND THE MEANS TO BE USED FOR RECOVERY.

138. WHEN a person is deprived of Sense and Motion from any of these causes, and does not recover in the space of *a few seconds*, it is commonly supposed, although no marks of violence *appear* on the body, that so great a degree of injury has been done to some of the Vital Organs, as to render a recovery impossible. Such hasty conclusions, however, are extremely improper, as experience has repeatedly shewn them to be false, in each of the several cases.

139. We

139. We frequently see persons stunned by Falls or Blows, continue in a seemingly lifeless state for *several Minutes*, and yet recover without any particular assistance; notwithstanding that they have sustained *evident* and *considerable external injury*. We certainly ought not then, in similar accidents, to be discouraged from attempting a Recovery, by the mere *appearance* of Violence *externally*, when this does not amount to an absolute proof, that Death must inevitably be the consequence of it.

140. In the *absolutely* fatal Cases from LIGHTNING, a subsequent examination of the body has frequently shewn, that the Electric shock had torn, or otherwise irrecoverably deranged, some of the internal Organs necessary to Life.

141. But on the other hand, as considerable laceration and scorching of parts externally have been produced by Lightning, without suspending either the Breathing or Circulation, we ought not to conclude, that such external marks are absolute proofs of fatal injury, when the person is rendered breathless and insensible by the shock; but still hope, that a Recovery is possible, and take measures accordingly. (Note 28. in Appendix.)

142. In

142. In the suspension of life by Falls, Blows, or Lightning, as in the case of Fainting, *both* Cavities of the Heart cease to act *at the same instant;* so that the *left* Cavity, and the Vessels connected with *it*, contain a sufficient quantity of florid Blood (16-17), to renew their contractions whenever their Sensibility is restored. Hence it is, that whatever restores the influence of the Brain over the Heart and the Muscles of Respiration, is found to be the most effectual means for promoting Recovery. Stimulants of every kind, have this tendency in a greater or less degree; but none so much as ELECTRICITY, which, besides being the most powerful means yet discovered for rousing the Vital Principle into action, has this peculiar advantage, that it pervades the inmost recesses of the Animal Frame, and therefore can be made to operate *directly* upon the parts affected.

143. This recommendation of Electricity does not depend upon mere theory, but is drawn from instances of its success in real cases,* as well as in experiments made upon fowls, and other small animals, which after being completely deprived of sense and motion by

* See Note 29. in Appendix.

by a *strong* electrical shock passed through the Head or Chest, were perfectly recovered by transmitting *slighter* shocks through the same parts: and in this way Animation has been suspended and restored alternately, for a considerable number of times. Besides, persons seemingly killed by Lightning, have frequently been restored by the ordinary means used in other cases of Apparent Death;* and from the superior stimulant power of Electricity, there is every reason to think, that it would have been successful in many cases where these alone have failed.

144. But although Electricity ranks first in point of efficacy here, and should always be employed where it can, the other means are not therefore to be neglected. If the body has lost any of its natural Warmth, it will be proper to restore it by the application of Heat to the Skin (87 and Note †); and for the same reason (60), as well as for others that have been already given (16 and 71), Inflating the Lungs will often contribute materially to a Recovery.

145. The

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* See Reports of the Humane Society for 1787, 8, and 9, pages 153, and 155.

145. The Shocks employed should at first be moderate (99 and Note *), and gradually increased in strength as may be found necessary. The Brain, Spinal Marrow, and Heart, are the parts to which they ought chiefly to be applied, as being those primarily affected, and the renewal of whose functions is absolutely necessary to the restoration of Life.—With regard to the mode of using this remedy, I have nothing to add to what has been said in par. 94.

146. To assist the measures recommended above, some stimulant matter (95) may be injected into the Stomach, by means of the Flexible Tube and Syringe, or thrown into the Intestines by way of Clyster (93). Very little benefit, however, is to be expected from these, when Electricity, *duly applied*, has failed of producing any sensible effect.

CHAP.

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* See also Note 30. in Appendix.

CHAP. XII.

OF THE EFFECTS ARISING FROM EXPOSURE TO INTENSE COLD, AND THE TREATMENT NECESSARY FOR RECOVERY.

147. IN Chap. III. I have endeavoured to explain, in as short and as easy a manner as I could, the method which Nature employs to furnish the living body with HEAT. It was there shewn, that the VITAL AIR taken into the Lungs imbibed a quantity of CARBON, and in return, imparted to the Blood a proportionable quantity of CALORIC, or the principle of Heat. In those Climates and Seasons, in which the temperature of the Air is not many degrees below that of the Blood, the quantity of *sensible* HEAT or CALORIC carried off from the body, would be very trifling, were it not for the copious Evaporation which takes place from the Skin (Note 17. in Appendix); and even then, the quantity of CALORIC absorbed by the Blood in the Lungs, and set at liberty in the course of the Circulation, is sufficient to supply this demand,

demand, and keep up the temperature of the body to its natural standard of 98 degrees, without any *external aid:* hence it is, that the natives of the very Warm Climates generally go with their bodies almost naked; the slight and scanty covering which they employ, being rather worn for the sake of modesty and ornament, than for any other reason. But in a Climate such as ours, and still more in colder ones, the quantity of CALORIC acquired by the Blood during Respiration, would be far from sufficient for the purposes of Life, if no auxiliary means were used. Beside the assistance, therefore, which is occasionally given by means of fires, it is found necessary in such Climates, particularly during the Winter-Season, to wear what is commonly termed *warm Clothing*. It is not, however, from possessing any warmth in itself, that this sort of covering proves useful, but merely from the Wool, or other matter of which it is composed, being a very slow conductor of *sensible* HEAT, and thereby preventing the CALORIC from being carried off by the Air and surrounding bodies, faster than it can be supplied by the process already described;—and, consequently, preventing the Warmth of the body, from being reduced below the degree which is necessary to the due performance of the functions of Life.

148. The

148. The general mildness of the Climate, the influence of fashion, and the inconvenience of very Warm Clothing in many avocations of civilized life, are the principal reasons why the dress worn by the inhabitants of Britain, is ill suited to protect them from the effects of severe Cold. Thus circumstanced as to clothing, we may reckon it fortunate, that in the great and sudden variations of temperature for which this Climate is remarkable, the Cold is seldom so intense, as completely to destroy Life by a *short* exposure to it; and that the opportunities of shelter and assistance are so numerous, as to render Death from this cause, rather an unfrequent occurrence.

149. In many of the more Northern Countries, the Cold is so intense during the Winter season, as frequently to stop the Circulation, and destroy the Life, in such parts of the body as are most exposed to it; and this so quickly, that the sufferer is sometimes not aware of what has happened, until too late to do any thing for their preservation.* The Fingers,

* A Naval Officer told me, that once when walking through the streets of Quebec during the Winter season, he was

Fingers, Toes, Nose, and Ears, are the parts which oftenest suffer from being thus *frost-bitten*, as it is termed. Mortification of the parts affected, is the usual consequence in those cases when proper means are not employed early; and nothing is found to contribute so much to this disagreeable event, as the *sudden application of heat:* even in this Country, it is a matter of common experience that when the Hands or Feet are numbed by Cold, holding them to the Fire, or washing them in Warm Water, is productive of much pain at the time, and not unfrequently of troublesome inflammation, sometimes ending in

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was suddenly accosted by a person belonging to the place, who happened to be passing, and who, to his great surprise, informed him that his Nose was *frost-bitten;* which the person immediately knew, by the peculiar livid appearance which the part assumes in that case, although the Officer himself was not apprized of the circumstance by any uneasy sensation. Putting up his hand, however, he was convinced that what the person said was true, for the part was quite cold, and had entirely lost its feeling; but by rubbing it well with Snow, as he was directed to do, the natural Warmth and Sensibility were restored, and he escaped without any other inconvenience than the loss of the outer skin, which inflamed, and after a few days came off.——Had the friction with the Snow been delayed but a few minutes longer, and still more, had Warmth been applied, there can be no doubt but the Officer would have lost his Nose entirely.

in sores that are very difficult to heal. To avoid all these disagreeable consequences, the lost Warmth should be restored *in the most gradual manner;* beginning first by rubbing the numbed parts well with Snow, or washing them for some time in *very Cold Water*, and afterwards, if necessary, slowly raising the temperature of the Water employed, by adding to it from time to time, small quantities of Warm Water, and continuing the washing, until the parts affected have regained their *natural* degree of heat.

150. Where both the Circulation and Breathing are suspended from exposure to Cold, the same precautions are necessary; for the sudden restoration of Warmth to the body in this case, occasions such a general disturbance in the Vital Functions when they are renewed, as to prove almost instantly fatal. Instead, then, of carrying the body to the Fire, or even into a Warm Room, it should at first be removed to an apartment *without any fire.* The clothes should be immediately taken off, and the whole body be well rubbed with Snow, or washed in very Cold Water.* When this has been continued for

* Where the place affords the conveniency of a bathing tub,

for ten or fifteen minutes, we may begin to increase the temperature of the body slowly, by using Water made gradually warmer than the first, by repeated small additions of *hot* Water to it.

151. In the mean time, the Lungs should be diligently inflated in one or other of the methods already described (77 to 85).

152. As soon as the Circulation and Breathing are restored, the sufferer should be laid between the blankets in bed, in a well-aired, but *not a warm room;* and particular care taken, not to give him any *strong* or *hot liquors,* as these will readily excite a feverish state, accompanied, perhaps, with Inflammation of some internal part, which may prove fatal. Weak Wine-whey, with the cold just taken off, will in general be a very proper drink; as it will tend to bring on a gentle perspiration, and thereby serve to prevent the danger just mentioned.

153. If

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tub, the body may at first be immersed up to the neck in *cold* Water; the temperature of which can be afterwards as gradually and slowly raised as we please, by adding *warm* Water to it.

153. If the person, previous to his exposure to the Cold, has been exhausted from Want of Food, a small piece of Bread, sopped in the yolk of an Egg beaten up with a little Milk and Sugar, and a tea-spoonful or two of Brandy, or half a glass of Wine, added to it,—should be given, and occasionally repeated, until the patient's strength is so far recruited, as to admit of the cravings of appetite being gratified with safety.

154. But if (as often happens) Intoxication has had a considerable share in the business, an Emetic, or a purgative Clyster, given as soon as the Pulse and Breathing are re-established, will often assist in restoring the Senses, and obviating any danger (128—137, and 141) which might otherwise arise from the liquor drank: the propriety of this measure, however, will depend so much upon the circumstances of the case, that we could wish it to be always referred where it can, to the judgment of a Medical Man.

APPENDIX.

CONTAINING NOTES, ILLUSTRATIONS, CAUTIONS AND SUGGESTIONS.

Note 1. *On* * *page* 1. In fact, some of the persons restored have suffered much inconvenience afterwards, from their feet being actually scorched by applying bricks, &c., too hot; although quite insensible to the injury at the moment: nor can this be wondered at when we know, that the same thing has happened in the Cold Stage of an Ague, notwithstanding the patient was very sensible to his sufferings from the *disorder* at the time.

Note 2. *on* * *page* 2. "William Earl of Pembroke *died suddenly,* April 10th, 1630. When the body was opened in order to be embalmed, he was observed, immediately after the incision was made, to lift up his hand." *Granger's Biographical History of England, Vol. I. p.* 330.

Vesalius, the celebrated anatomist, who was physician to the Emperor Charles V. and to his successor Philip II., met with a similar circumstance in the case of a Spanish Nobleman, whose body he was employed to open, in order to discover the disease of which he

died. The nobleman's relations represented him as a murderer, and it was with difficulty that Philip rescued him from the Inquisition, upon condition that he should make a pilgrimage to Jerusalem. In returning, the ship was cast away on the island of Zante, where the unfortunate Vesalius perished from hunger.

A correspondent of the late Dr. Hawes assures us, that there was then living in Hertfordshire, a lady of an ancient and honourable family, whose Mother was brought to life *after interment*, by the attempt of a thief to steal a valuable ring from her finger. (*See Reports of the Royal Humane Society for* 1787-8-9, *p.* 77.) Whether it was the same or not I cannot say, but Lady Dryden, who resided in the Southern part of Northamptonshire, in consequence of some such event having occurred in her family, expressly directed in her will, that her body should have the throat cut across previous to interment; and to secure this, bequeathed fifty pounds to an eminent physician, who actually performed it.

Such cases of suspended life, and subsequently resuscitation, however, are extremely rare, and never occur except in those instances where the Apparent Death was *sudden, spontaneous*, and not preceded or attended by any circumstances that could account for it. Nervous and highly hysterical females, who are subject to fainting fits, are the most frequent subjects of this kind of Apparent Death; in which the person seems in a state very nearly resembling that of *hybernating* animals, such as the dormouse, bat, toad, frog, &c., which annually become insensible, motionless, and *apparently dead*, on the setting in of the Winter's cold, but spontaneously

spontaneously revive upon the returning warmth of Spring. Here, by some peculiar and yet unknown circumstance, the Vital Principle has its *action suspended*, but neither its *existence destroyed*, nor its organs injured, so as absolutely to prevent recovery, if not too long neglected.

Note 4. *on* * *p.* 4. The *black and swollen countenance* generally depends, at least in recent cases, upon the head lying, either during submersion, or afterwards, *lower* than the trunk of the body. It is also readily produced, by holding the drowned person up by the heels, rolling the body over a cask, or carrying it with the head hanging down. *See Trans. of Royal Humane Society, Vol.* 1. *p.* 102. At page 15 of the same vol., however, we have an instance of *recovery* of a Child smothered in a turn-up bed, notwithstanding this appearance was present.

Note 5. *on* † *p.* 4. See a Case of Recovery from Drowning, after all signs of Life had been suspended for *more than three quarters of an hour;* and where not only the *pupils were dilated*, but where the eyes had *entirely lost their lustre.—Trans. of Humane Society, from* 1774 *to* 1784. *p.* 87.

At p. 98-9 of the same vol. is a Case of Recovery where the *eyes were glassy*. It is worthy of remark too, that this appearance of the eyes continued for some time after the circulation and breathing had been in a great measure restored: a convincing proof in itself, that it is not a consequence of the Vital Principle being destroyed. Dr. Houlston of Liverpool, who relates the case, adds, that along with the *fixed state and glassy appearance of the eyes*, there were evident signs

signs of *oppressed Brain*, which were relieved by taking away some blood, and giving a purgative clyster. Query, Is the appearance of the eyes mentioned here, a *consequence of oppressed brain*, and indicating the propriety of blood-letting from the head?

Note 6. *on* * *p* 5. In several instances where sailors have fallen into the Water from the tops and yards of ships at anchor, every endeavour to restore life has proved ineffectual, notwithstanding they were instantly picked up by boats along side, and immediate assistance given. Of the injury which may be sustained from such accidents, independently of the submersion, I had occasion to be a witness while returning from Bengal, in 1787. Whilst almost becalmed near the equinoctial line, one of the men belonging to the middle night-watch, being sent aloft, lost his hold, and fell over the main-topsail yard. Luckily for him, the ship happened to pitch forward at the instant, and the main-topsail thereby bellying out, threw him completely overboard. The alarm being given by a midshipman who heard the plunge, and saw him rise again, the sails were instantly laid aback; and a boat which hung in slings upon the ship's quarter, was quickly manned and sent after him. The boats-crew directed by his shouts, and favoured by some moonlight and a smooth sea, in a short time took him up, and brought him on board. He was immediately put into his hammock, and had some grog given to him. Next morning I found him spitting up blood, and complaining of deep seated, obtuse pain in his chest, together with general soreness over his body. His pulse being full, some blood was taken from his arm, a blistering plaster applied to his chest, and his bowels opened with Caster Oil.

Oil. The spitting of blood abated by these means; and at last entirely ceased by the use of Nitre, and forbidding Spirits and Salt meat; but it was several weeks before he was able to return to his duty. Had this man been brought on board in an *insensible* state, the appearance of blood issuing from the mouth, would have completely discouraged any attempt at Resuscitation.

In the Trans. of the Royal Humane Society, from 1774 to 1784, p. 45-8, is related the case of a man, who fell from the fore-topmast-head of a ship in the Thames, first striking upon the fore-top, and next upon the gunwale, before he reached the water; a height of not less than sixty feet. He was *eight minutes under water*; and *twenty more elapsed* before any means were employed. When taken up, a large lacerated wound appeared on the scalp, which bled copiously; and one leg was much bruised: yet his recovery was perfect.

Note 7. *on* * *p.* 9. In fact, the operation of Vital Air upon Blood may be demonstrated to take place even through so thick an intermedium as a common bladder; for if a portion of coagulated black blood be tied up in a wet bladder, and this bladder be hung in a vessel containing Vital Air or Oxygene Gas, the blood will soon become of a bright crimson next the bladder, and at the same time the Oxygene Gas will be found more or less converted into Carbonic Acid Gas, in consequence of having imbibed Carbon from the Blood.

Note 8. *on* * *p.* 14. This species of gas was first discovered by Dr. Priestley, and received from him the name of *Phlogisticated*

Phlogisticated Air; from his belief that it was Common Air changed in its properties, by being combined with the imaginary principle termed *Phlogiston.* The French Chemists in their indiscriminate rage for change, hastily and improperly denominated it *Azotic Gas* (from the Greek privative α, and ζωη, life) because when breathed alone it deprived animals of life; a quality, however, which it has in common with every other kind of air, except that which will be described in the next paragraph: for, that it is not *positively* noxious is proved, by its forming nearly *four-fifths* of the atmosphere which we constantly breathe. The late Mr. Cavendish having discovered that this gas is the basis of Nitrous Acid, very properly gave it the name of NITROGENE GAS (from Νιτρον, Nitre, and γενναω to produce) and by that name Chemists in general now distinguish it.

Note 9. *on* * *p.* 15. To Dr. Priestley, along with a multitude of other discoveries which reflect honour alike upon his Name and Country, we owe that beautiful one, of the mutual support which the Animal and Vegetable Creation afford to each other; viz. that Animals, whilst dissolving and putrifying after death, set loose in the Atmosphere a great quantity of NITROGENE GAS, which if augmented beyond its due proportion would tend to destroy those that still live; but that this gas is greedily absorbed by *growing* Vegetables, which retain and fix its basis as a part of their substance, whilst they give out in exchange, a quantity of VITAL AIR that, in its turn, is necessary to the maintenance of RESPIRATION and ANIMAL LIFE. By this wise provision, a steady balance is preserved in the proportion of the two principal ingredients of the Atmosphere, viz. VITAL AIR, and NITROGENE GAS:

so

so steady indeed is this balance, that Sir Humphry Davy could not, by the nicest tests, discover any greater difference between samples of atmospheric Air brought, (in hermetically sealed bottles,) from the most distant and different climates, than between two portions of air taken at the place of experiment.

Note 10. *on* * *p.* 17. This circumstance affords a very neat and satisfactory mode of shewing the formation of Carbonic Acid Gas, by the union of VITAL AIR and CARBON in the Lungs during Respiration. Water will not dissolve above one-thousandth part of Marble, Chalk, or Limestone in their ordinary state; but when these are converted into *quicklime*, by a long continued red-heat, which expels the Carbonic Acid, and deprives them of from one-third to one-half their former weight, a considerably greater portion dissolves in water, so as to form Lime Water; and the Lime thus dissolved is again thrown down in the form of Chalk by the addition of Carbonic Acid Gas, so as to leave the water quite pure and tasteless. Let a glass tube of half an inch or an inch diameter, and bent into the form of a V or U, have so much Lime Water poured into it, as will fill the angle of the tube, and rise a little way into each leg. If through this water we repeatedly *draw in* Common Air into the Lungs, we shall observe no change; for the air of the general Atmosphere contains very little Carbonic Acid Gas. But if instead of drawing Air in, we *exspire* or blow Air *from the Lungs* through the Syphon, the water contained in it will speedily become of a milky whiteness, by the separation of the Lime, in consequence of its imbibing the Carbonic Acid Gas which had been formed in the LUNGS, by the VITAL AIR attracting CARBON from the Blood.—In defect of a glass

a glass tube, the experiment may be made with a common tea-pot, by pouring into it as much Lime Water as will just cover the grating of the pipe; only here the change of colour in the water will not be seen in the progress of the experiment.

Note 11. *on* † *p.* 17. In the progress of discovery with respect to Airs or Gasses, it soon became evident, that the term *Fixed Air* first given to this Gas by Dr. Black, was not exclusively characteristic of it; for every species of air was found to combine with various matters, so as be *fixed* in them, and become a part of their substance. The French Chemists, therefore, very justly changed its name, to the peculiar and appropriate one of CARBONIC ACID GAS; and by this it is now universally denominated.

Note 12. *on* * *p.* 21. The scale here meant is that of Fahrenheit, according to which all the Thermometers used in Britain are graduated; although it is very universally allowed, that it would be much better to make the *Zero*, or 0, begin at the *freezing point of water*, which is uniform; instead of placing it at the variable temperature produced by mixing Common Salt with Snow, which in Fahrenheit's time was believed to be the Maximum of *coldness*.

Note 13. *on* * *p.* 22. This is often practised by country farriers, if suddenly called on to light their forge during Summer, when they have no means of obtaining a piece of burning coal or wood. A small bar or rod of iron is laid upon the Anvil and hammered briskly by two persons, for a minute or two, in which time it becomes of a dull red heat, sufficient to inflame coal when assisted

assisted by a gentle blast from the bellows: even short of redness, it will light a Sulphur Match, and thus answer the purpose.

The rudest nations constantly practise the mechanical mode of lighting their fires. The wandering natives of Australasia or New Holland, pick up any small and short cylindrical piece of wood they can find, and holding it upright, with the lower end placed in the hollow of another flat piece laid horizontally, they roll rapidly backwards and forwards between their hands, until smoke issues; when dry grass is applied, which by a continuance of the whirling motion soon takes fire. The Esquimaux of Labrador have a still more certain and expeditious mode. They carry with them a short cylindrical piece of wood pointed at both ends, and two flat boards with handles; each board having a small hollow place in its centre to receive the pointed ends of the cylinder: one of these boards being laid upon the ground, the cylinder is placed upright with its pointed end in the hollow, and the opposite end received into the corresponding hollow of the second board, which is pressed moderately downwards by the person who stands and holds it. A second person sits down on the ground, and makes two or three turns round the cylinder with a thong of seal skin, one end of which he takes hold of in each hand; then drawing these ends alternately and briskly, such rapid friction is excited as to kindle the pieces of wood in a few seconds. *See Ellis's Voyage to Hudson's Bay.*—The effect of these contrivances may at any time be demonstrated, by pressing a sharp edged piece of dry wood, against another whilst it is whirled round in a common turning lathe.

Note

Note 14. *on* * *p.* 23. This theory, however, is not free from its difficulties; and has lately been opposed by some eminent philosophers (*See Count Rumford's Essays*, and his Paper *in the Phil. Transact.; and Sir Humphry Davy's Elements of Chemical Philosophy, Vol.* 1. 8*vo.* 1812.) But, on the other hand, the *mechanical* doctrine is as much if not more embarrassed; and if *motion*, whether projectile or rotatory, be in truth the *immediate* cause of the phenomena we observe, it will still be found necessary, in order to explain their propagation through empty space, to consider this as the motion of some *peculiar subtle principle*, and not that of common, tangible, and ponderable matter. If I may be allowed to offer an opinion upon so abstruse a point, I would say that the ELECTRIC PRINCIPLE appears better entitled to be held as the *grand agent* here, than any other with which we are acquainted; for if we see it produce (as most certainly we do) that precise influence which has been conceived to be, not only characteristic of, but even *identical* with, the immediate or *proximate* cause of *sensible heat, or warmth*, viz. "the power of repulsion," (*Elements of Chemical Phil. Vol.* 1. *p.* 74 *and* 80), we must necessarily conclude, that it is the *efficient* cause of Heat or Fire. But, as we likewise see, that it produces this repulsion between bodies in a very remarkable degree, without occasioning at the same time any sensible change in their temperature, the legitimate inference is, that *heat* or *warmth*, and the "power of repulsion" are *not* identical; but are both *effects*, which *may* and *do* take place separately. For example, although an increase of temperature in bodies, is *very generally* attended by an obvious repulsion between the heated particles, as shewn by their expansion, yet the reverse of this *sometimes* happens;

happens; as in the cooling of Water, melted Iron, and Sulphur, which *expand* considerably at the moment when their heat is *reduced* to that point at which they become solid: and upon this property depends the fulness and sharpness of the impression which the two last receive when cast in moulds. On the other hand, the incohering particles of matter, both solids and fluids, can be made to *repel* each other to a considerable distance, without any the smallest sensible increase of temperature. Now, as these very different effects, namely, repulsion of particles *attended with* increase of heat, and repulsion of particles *without* any such increase, take place separately, the "power of repulsion" cannot be considered as identified with Heat or Warmth, in any other way than as both resulting from one and the same cause, viz. the Electric influence; and as being different *effects* of this influence, according to its various and yet unknown modes of acting.

Against the fact of Water, Sulphur, and Cast Iron, *expanding* at the moment of cooling down to the point of congelation, which I have taken as an illustration of my argument, it may be objected, that this is a peculiar case, in which the particles on becoming solid, assume a new arrangement that requires greater space than they occupied before; but this objection is completely done away, by another fact, which was first observed by the Florentine Academicians, and has since been confirmed by M. Mairan, M. De Luc, Sir Charles Blagden, and Dr. Hope of Edinburgh; it is, that the specific gravity of Water is greater at the temperature of 40°, than when cooled down to that of 32°; in other words, that the Water *expands* instead of *contracting* by these

eight

eight degrees of *reduction* in its heat. HEAT, then, and "the Power of Expansion" are *not inseparable*, and consequently cannot be *identical*.

Note 15. *on* * *p.* 27. If CALORIC be, as probably it is, one of the least ponderable matters existing, this very circumstance renders it difficult, if not, perhaps, impossible, to ascertain what its relative gravity is. The very same difficulty attends Light; the *materiality* of which, is not, I believe, doubted by any one at present.

Note 16. *on* * *p.* 32. Mr. Coleman, now Professor at the Veterinary College, in a suite of ingenious experiments on this subject, made upwards of twenty years ago, found the blood *four degrees* warmer after it had got to the *right* Cavity of the Heart, and had acquired its dark venous hue, than it was when in the *left* Cavity of the Heart, and before it had imbibed any CARBON. This excess of *sensible heat* in the *Venous* Blood, is what raises the temperature of the breath above that of the Air which is inspired; and perhaps is necessary to convert into vapour, the great quantity of watery fluid which constantly exhales from the surface of the lungs. The opinion of the ancients, then, that *the air cools the blood*, is in so far perfectly correct; for we see, that whilst it imparts Caloric in a *latent* state, it receives back a portion of the same principle in the state of *sensible* heat.

I do not know of any individual chemical Experiment, which distinctly shews this *alternate* change of capacity for CALORIC that takes place in the Blood during its circulation; but we may fairly infer its occurrence in many instances. Thus when we see, the great quantity of

of CALORIC suddenly evolved by mixing Sulphuric Acid and Water, we must conclude, that an equally rapid absorption of CALORIC, and consequent production of Cold, would take place, provided we could separate these two fluids, without the aid of heat to detach the Water in the form of Steam or Vapour. Again, in the dissolving of Saltpetre in Water, by which a quantity of CALORIC becomes *fixed* and *latent* in the solution, we should no doubt observe an equally speedy re-appearance of this *Caloric* in its *sensible* state, if we had any means of separating the Saltpetre from the Water, without having recourse to slow evaporation for that purpose.

Note 17. *on* † *p.* 32. In some places within or near the tropics, the heat of the air is, at times, equal to, or considerably beyond, that of the human body. This excessive heat, however, does not continue long, and its influence upon the body is greatly diminished by the copious perspiration, and consequent Evaporation of moisture from the Skin.

As the production of *Cold* (i. e. the diminution of *sensible heat)* by Evaporation, is intimately connected with the present subject, and also serves to explain many curious facts which it would otherwise be impossible to comprehend, I shall endeavour to give a concise view of the principles upon which it is accounted for.

I. It is a matter of common observation, that when Water is exposed in any temperature above that of freezing, it gradually flies off in an invisible Vapour; and, that the greater the warmth to which it is exposed, the faster does it evaporate.

II. If

II. If we pour Water upon any heated body, as upon a heated plate of Metal, we find that the Metal cools much sooner than it would otherwise have done; and this in exact proportion to the quantity of Water that evaporates from its surface in a given time.

III. Again, If a very thin phial containing Water, be kept wetted on the outside with Æther (which evaporates faster than any fluid that is yet known), the Water within will, in a short time, be so far deprived of its *sensible* CALORIC, as to congeal into ice. This experiment was first made by Dr. Cullen, at Edinburgh, in 1755; but by calling in the assistance of the Air Pump, Mr. Leslie has of late carried the frigorific effect of evaporation with water so far, as actually to freeze Quicksilver; which requires a temperature of-40, i. e. 62 degrees below the freezing point of water: and Dr. Marcett has recently shewn, that this may be still more easily and speedily effected by the joint use of the Air Pump and Ether (*Nicholson's Journal, Feb.* 1813).

IV. Another proof of the effect of Evaporation in carrying off *sensible* CALORIC, appears in this;—That if Water be enclosed in a very thick and strong metal vessel, whose lid is screwed down so close that no steam can escape (as in the instrument called Papin's Digester) —and this vessel be set upon the fire, the Water within may be made so hot, as to melt a piece of Lead suspended in it,—which requires a degree of heat equal to 540 degrees of Fahrenheit's thermometer: and provided the vessel could be made strong enough not to burst from the force with which Water expands under very great heats, there is no doubt but the Water might be heated

heated equal to red-hot iron—If, however, instead of the lid being screwed down, the top of the vessel be left quite open, so that the vapour or steam can fly off readily, the water, from being cold at first, will gradually acquire *sensible* CALORIC, until it has received a quantity sufficient to raise the thermometer to the 212th degree; but here it becomes stationary, nor will it grow hotter though we increase the fire ever so much; and the reason is, that the *lower* part of the water begins now to be converted into *Steam* or vapour, which mounts up to the surface in the form of bubbles, and flies off, carrying with it the additional CALORIC, as fast as it passes from the fire through the bottom of the vessel.—The agitation which the Steam occasions in the Water whilst ascending through it, is called *boiling*; and the degree of heat at which it takes place in *open* vessels, that have a free communication with the air, is termed the *boiling point*.

V. It appears, then, that the degree to which Water can be heated, depends upon the obstacles which oppose the escape of the Vapour or *Steam*; for I have shewn (IV), that in *close* vessels it can be rendered extremely hot; but that in *open* vessels, where the pressure of the Atmosphere is the only obstacle to be overcome, it cannot be raised above 212 degrees; and if this pressure also, be taken off, by placing the vessel under the exhausted receiver of an Air-Pump, the water will then boil briskly with a degree of warmth no greater than that of the human body (viz. 98°), and will evaporate faster than if it had been kept in the open air.—This last fact clearly proves, that the only circumstances necessary to Evaporation, are, that *sensible* or *radiant* CALORIC should be applied, and room given for the

Steam or Vapour to expand in, and occupy: of course it proves, that although AIR can dissolve and suspend a quantity of Water, in the same way that many fluids can dissolve and suspend others that are heavier,—yet that *Air* is not absolutely necessary to the formation of Vapour, as is commonly supposed; and that its power of dissolving Water, depends *chiefly* upon its *warmth*, i. e. upon the quantity of *sensible* CALORIC which it contains.

VI. The facts mentioned (I. II. III. IV. V.) all shew, that when Water flies off in the form of *Steam* or Vapour, it carries away with it a great quantity of *sensible* CALORIC; and the operation of distilling, in which the CALORIC and Water are again separated from each other, affords us an easy method of ascertaining both the *quantity* and the *state* of the CALORIC so carried off. Thus, it is found, that a pint of Water raised in Steam from the boiler of the distilling apparatus, will, in its passage through the worm, communicate to 100 pints of Water contained in the worm-tub, as much CALORIC as will increase its temperature *eight* degrees. Now, it is evident, that the quantity of CALORIC which thus diffused over 100 pints of water, renders every part *eight* degrees hotter than before, would, if accumulated in *one* pint, raise its temperature no less than *eight hundred* degrees,—which is equal to the temperature of red-hot Iron. But the Temperature, or *sensible* CALORIC, of the *Steam*, will by no means account for all this quantity of CALORIC which is communicated to the Water in the worm-tub; for if we suspend a Thermometer in the head of the still, or insert it into the tube leading from thence to the worm, the steam passing over it will never raise the quicksilver higher

higher than the boiling point of water, viz. 212°. The greatest part of the CALORIC, then, which the Steam contains, is in a *latent* state: whence it appears, that Steam consists of Water and CALORIC *chemically* combined together.

We can now easily account for the great quantity of *sensible* CALORIC which disappears during Evaporation; as we here see that it becomes *latent* CALORIC, and in that state forms one of the component parts of the Steam.

The cooling power of Evaporation, seems to be practically known to the inhabitants of most warm countries, and has long been employed by the natives of India, for a variety of purposes, and among others, for that of procuring two of their greatest luxuries, viz. *Ice* and *Cold Water*. To obtain the former, a number of shallow pans, made of a very porous earth, and filled about an inch deep with water, are placed, during the night, in an exposed situation, where there is a free circulation of air. The water transuding through the pores of these vessels, keeps their bottom and sides constantly wet; and the evaporation from thence, and from the surface of the water, occasions a degree of cold sufficient to form a thin plate of *Ice* in each pan before morning.—To cool their water for drinking, they put it into porous earthen bottles, called *gugglets*, and hang these in a current of air: part of the water sweats out through the bottle, and being quickly converted into Vapour, carries off a great quantity of sensible Caloric from the remainder within. The earthen vessels employed as Wine-Coolers in this country, are so much less porous than the Indian *gugglets*, as to have very little effect; and, besides that

it is much simpler and less expensive, covering the decanter with a case made of coarse red callico which is kept wet, will answer the purpose much better.

It is also a practice in India, to sprinkle the floors with Water, and to hang up before the doors of the apartments, thin screens called *tatties*, made of sweet-smelling grass, which are kept constantly wetted by persons stationed there for the purpose. By means of this contrivance, the rich and luxurious European seated within, enjoys the grateful coolness of his native climate, during the intense heats of a Bengal summer, when the thermometer frequently stands many degrees above the temperature of the human blood. Persons who cannot afford this expense, would inevitably sink under the effects of the excessive heat at those times, were it not for the increase of perspiration which then takes place, the Evaporation of which from the Skin, assists in keeping the body at its proper and healthy temperature.

Laundresses know by experience, that if they hang out clothes to dry during frost, those which are wrung out of the *hot suds*, freeze much sooner than those which are *quite cold;* the *warmth* of the former favouring *Evaporation*, and thereby abstracting *sensible* CALORIC the faster.

Seamen have a practice which is a very delicate test of the cooling effect of Evaporation. When it is so calm as not to affect the lightest vane, they wet a finger and hold it up; and on whatever side they perceive a sensation of coldness, from that they conclude with certainty the Wind will come.

The

The principles delivered above, afford a ready solution to these and to many other circumstances where evaporation is concerned;—as, why persons who are shipwrecked, may perish from cold in a few hours, by being exposed to the spray of the sea, although the air at the time be moderate in its temperature;—also, why one feels less chilly and cold upon coming out of *salt*, than out of *fresh* water, at the same temperature, (the former not evaporating so fast as the latter):—they also explain the sudden and dangerous cooling of the body that frequently follows the wearing damp or wet clothes, lying in damp sheets, or sitting in rooms newly washed; together with many other occurrences which observation and experience will suggest to the reader.

Note 18. *on* * *p.* 52. Unless a public or private Chemical Laboratory be in the neighbourhood, there will be little chance of procuring Oxygen Gas; as, beside the *materials* from which it is extracted, it requires an *earthen retort*, and a *pneumatic trough*, together with a varnished silk bag furnished with a stop-cock, as indispensable parts of the apparatus. The Salt termed OXYMURIATE of POTASH contains one third its weight of Oxygen, which is converted into Oxygen Gas or Vital Air, by merely exposing this salt to a red-heat in an earthen retort: and the Air thus obtained is very pure. It may also be procured, by pouring three pounds of Sulphuric Acid, upon four pounds of Manganese (or as it is called by the miners, *Black Wadd*), in a glass retort, then applying the flame of a lamp to the bottom of the retort, and receiving the gas, by passing it through water, into an inverted receiver: when got in this mode, however, it requires to be well washed by agitation with water, to free it from a portion

tion of Sulphuric Acid with which it is contaminated, and which would prove highly pernicious when applied to the lungs.

Note 19. *on* * *p.* 53. In a tract entitled " Observations on Animal Life and Apparent Death, by John Franks, Surgeon, 8vo. Lond. 1790," the author says, that " when the late Mr. Justamond (Surgeon to the " Middlesex Hospital) lived on the terrace, Palace " Yard, Westminster, a boy who had been drowned in " the Thames was brought to him. He made an open- " ing into the Wind-pipe in order to inflate the lungs; " but the discharge of blood which ensued, was such as " gave him no chance of succeeding in the recovery; for " he could not prevent the blood from pouring down " into the lungs."

Although nothing is said here about the pulse, yet from the blood flowing so copiously, there is reason to believe that the heart had begun to act; and therefore to conclude, that life was in fact *destroyed* by this operation, which *might* have been saved without it.

Note 20. *on* † *p.* 57. As this treatise is intended to be as generally useful as possible, I still employ the *old* names in preference to the *new* ones; because, from their having been nearly fifty years in use before the change took place in the London Pharmacopœia of 1788, they had become familiar to the *public* as well as to the faculty; whilst the reformed names are little known to the older practitioners, and are familiar to those only who have received their medical education very recently.

Note

Note 21. *on* * *p.* 59. There are few persons who have not experienced the pungent impression of tobacco-smoke upon the nostrils, as well as the violent fits of coughing which it excites, when drawn into the lungs. It was probably owing to these effects, that the Dutch, who universally smoke tobacco, and among whom the practice of *resuscitation* was first regularly established (see the Introduction) were led to the blowing of tobacco-smoke into the *nostrils* and throat of drowned persons. (*See the Cases published by the Amsterdam Society, as translated by Dr. Johnston and Dr. Thomas Cogan*); and, either from its real or its *fancied* utility in this mode, were led, by an easy, though hasty and incorrect analogy, to conclude, that it must prove equally, if not more effectual, when applied still more copiously to the surface of the intestines: for we are told (*Reports of the Royal Humane Society, for* 1775, *p.* 79), that the brass box of the fumigator used by the Dutch, holds three quarters of an ounce of tobacco; and Dr. Cogan thought he had improved upon this, by having one made to hold just double the quantity. That the analogy was *hastily* drawn, may be inferred, from the very *opposite* effects which are well known to arise from Carbonic Acid Gas, accordingly as it is applied to the organs of *digestion*, or to those of *respiration*; thus when this Gas applied to the *Stomach*, as evolved from an effervescing draught, or from any of the Vinous or Malt liquors which yield it copiously, it proves gratefully cordial and exhilirating to persons in health, whilst it often abates vomiting, and removes faintness in those who are sick; but apply this same Gas to the *Lungs*, undiluted with Oxygene Gas or Vital Air, and we find it one of the most speedy and fatal poisons known (*See par.* 108 *of this Treatise*).

So

So far then, the employment of the Tobacco-Smoke Glyster appears *doubtful;* I shall now proceed to shew that it is *dangerous.* The distressing sickness, vomiting, faintness, and cold sweats, which are brought on in persons who swallow a small portion of Tobacco for the first time, are too well known to require any proof of them here; and an infusion of Tobacco in water, administered by way of glyster, has been found one of the most powerful means yet discovered, for inducing that complete prostration of strength, and relaxation of every muscle, which favours the attempts of the surgeon to reduce the most dangerous ruptures. But notwithstanding the hazard of delay in these cases, is acknowledged to be such as might warrant considerable risk in the means employed, yet even under the most cautious management, the Tobacco Glyster has so often proved fatal, as to occasion its entire disuse with some of the most eminent surgeons in London: I have known it destroy life in twenty minutes after it was administered; although there appeared no reason to believe, that death would have ensued in less than eight and forty hours, had the rupture even continued unreduced. The Abbe Fontana observed (see his work entitled EXPERIMENTS ON POISONS), that a small quantity of the Essential Oil obtained from Tobacco by distillation, when applied to wounds, speedily and completely palsied the limbs of several animals upon which the experiment was tried. With such facts as these, then, before us, can we rationally suppose, that tobacco smoke, which contains this poisonous Essential Oil converted into vapour by the heat employed, should yet prove a *beneficial stimulus* to the intestines of a person in whom the chief functions of life are completely suspended, and the Vital Principle itself is nearly extinguished?

Most

Most persons, I believe, would be satisfied with the arguments here offered, as quite sufficient to explode the use of Tobacco-Smoke as a means of resuscitation from apparent death; but the matter appeared to me of sufficient importance, to demand that the question should be laid at rest for ever. I therefore applied to Mr. Brodie, whose late investigations of the effects exerted on the Animal System by different kinds of poison, have opened to our view an entirely new and extensive field of research, which in his hands promises to lead to discoveries of the greatest value, both in physiology and in practice. Equally impressed as myself with the necessity of finally deciding the question, he most readily and obligingly acceded to my request; and the following is the result of the trial which he made for that purpose.

EXPERIMENT. "The fumes from about *three* "*drachms* of tobacco were injected into the rectum of "a dog: the injection was continued till the whole of "the tobacco was consumed, a period of twenty-five "minutes. In ten minutes the animal was in a dozing "state, with tremulous contractions of the voluntary mus-"cles. The pulse was somewhat lower than is usual in "a dog, but otherwise natural. He continued in this "state till the tobacco was consumed, except that once "he was sick and vomited. After the experiment was "concluded, he lay for some time quiet, in a half dozing "state, from which he gradually recovered.

"The Tobacco fumes in this experiment seemed to "act as a narcotic. If a larger quantity of Tobacco "had been employed, it is not improbable that the "effects would have been similar to those produced by

"the

" the Empyreumatic Oil in my former experiments.* We " must recollect, that under any circumstance, only a very " small quantity of Empyreumatic Oil is to be procured " from *three drachms* of Tobacco; and that where the " Tobacco is actually in a state of combustion, probably " a considerable proportion of the Empyreumatic Oil " which is drawn off, is consumed by the too great heat.

" We learn from the experiment, that a certain quan- " tity of the *fumes* of Tobacco may be injected into the " intestines of an animal, without materially disturbing " the functions; but I am at a loss to understand, on " what principle this practice has been recommended " for the recovery of persons apparently dead. I see " no reason for believing, that Tobacco Fumes have the " power of exciting the action of any organ. They seem " to impair the functions of the brain, and I suppose, " in certain constitutions, and in a larger quantity, would " destroy those functions altogether. If an *Infusion* of " the same quantity of Tobacco had been injected, I " have no doubt (from my former observations) that it " would have proved fatal. The difference in the ef- " fects produced by the Infusion and the Empyreumatic " Oil, is curious; and I propose, at some future period, " to institute a series of experiments, with a view to " the further elucidation of this subject."

The difference between the operation of the Empyreumatic Oil, and the Infusion, to which Mr. Brodie here alludes, and which was first discovered by himself, is not less curious than unaccountable; it is this, that the Oil destroys life, by acting upon the *Brain*, inducing

* Viz. Violent Convulsions and Death. See Phil. Trans. for 1811, Part 1st.

cing convulsions of the voluntary muscles, and suspending the motion of the diafragm, by which the alternate dilatation and contraction of the chest are maintained; the Heart continuing to act as long as it is supplied with blood: whereas the Infusion acts directly upon the *Heart*, occasioning a palsy of it, and thereby completely stops the circulation of the blood.—See his valuable papers already referred to. *Phil. Trans. for* 1811-12.

Note 22, *on* * *p.* 73. As, upon examining the lungs of animals killed in this sudden way, no more Carbonic Acid Gas is found in them, than in those of animals that were hanged or drowned, there is reason to believe, that this Gas destroys life by some peculiar action upon the *Nervous System*, altogether independently of the blood. This idea corresponds with an observation made many years ago by the celebrated Dr. Black, of Edinburgh; who remarked, that birds exposed to its influence, were not so speedily killed when their nostrils were stopped with suet, as when they were left open, so as to receive the impression of this gas in its passage through them. See *Black's Lectures on Chemistry; edited by Professor Robison*, vol. ii. p. 87.

Note 23, *on* * *p.* 74. Possibly the first hint of this was taken from what appears to have been long known and practised by the people who live in the neighbourhood of the *Grotta del Cane*, situated on the border of the Lago di Agnano, between Naples and Puzzuolo. This grotto is an artificial excavation in the sandy earth of a small hill, about four feet wide, twelve feet in length, and six feet high at the entrance, but becoming lower as it proceeds inwards. The floor, which is nearly horizontal, is covered, from six to twelve inches deep, with

with a *Mofeta*, or natural Carbonic Acid Gas, that immediately extinguishes flame, and speedily suffocates any breathing animal held under it. Dogs are usually the subject of this experiment, which is often repeated to gratify the curiosity of travellers. If the animals which have been thus deprived of sense and motion, be immediately removed into the open air, they gradually recover without any assistance; but their recovery is found to be much expedited, by plunging them several times in the adjoining lake. (*See the Abbé Nollett's Account of this Grotto in the Phil. Trans. vol.* 47, *for the years* 1751-2, *p.* 48.) Such vapours are found to issue from the soil in all volcanic districts; and are said to have derived their name from the Syriac word MEPHE', signifying *to blow*. They were well known to the Romans, who erected a temple to the Goddess MEPHITIS, in full belief that her influence might preserve from suffocation, the workmen employed to clean out or repair the vast Cloacæ, or sewers, which carried off the filth from that great city, and in which such noxious vapours generally accumulate.

We often find a remarkable agreement between the popular practices of countries so very distant and dissimilar, as to render it scarcely probable that the one copied from the other. An instance of this occurs in a paper contained in the Phil. Trans. vol. 69, for the year 1779, p. 325, entitled "An Account of the manner in which the Russians treat persons affected by the fumes of burning Charcoal, and other effluvia of the same nature; By Matthew Guthrie, M. D." As, from the frequency of the accident, the practice is very common, and often successful, I think the description of it may afford greater encouragement to imitation, than if

it

it were proposed or recommended by scientific or medical men alone.

" People of condition in this country (says Dr. G.) " have double windows to their houses in winter; but " the commoner sort have only single ones, which is the " reason that during a severe frost, there is an incrusta- " tion formed on the inside of the glass windows. This " seems to be composed of condensed breath, perspir- " ation, &c. as a number of people live and sleep in " the same small room, especially in great cities."

" When a thaw succeeds a hard frost of long duration, " and this plate of ice is converted into water, there is " a principle set loose, which produces all the terrible " effects upon the human body, which the principle emit- " ted by Charcoal is so well known to do in this country, " where people every day suffer from it. However, the " Russians constantly lay the blame upon the stove when " they are affected by the thawing of the crust, as the " effects are perfectly similar; and they cannot bring " themselves to believe, that the dissolving of so small " a portion of ice can be attended with any bad conse- " quence, when they daily melt larger masses without " danger: yet the oven does not all account for the com- " plaints brought on at this period; for upon examination " they generally find every thing right there, and still the " *Ugar*, or hurtful vapour, remaining in the room.

" As the effects of both are similar, and likewise the " mode of recovery, I shall only give a short account of " the operation of the principle emitted by the burning " Charcoal, and of the method of bringing those to life " who have been suffocated by it.

" Russian

" Russian houses are heated by means of stoves or ovens " in the following manner. A number of pieces of wood " are placed in the *peech* or stove, and allowed to burn " until they fall into a mass of bright red cinders; then " the vent (or flue) is shut up, and likewise the door of " the *peech* which opens into the room, in order to accu- " mulate the heat: this makes the tiles of which the *peech* " is composed, as hot as desired, and sufficiently warms " the apartment; but sometimes a servant is so negligent, " as to shut up the *peech* before the wood is sufficiently " burnt, for the red cinders should be turned over from " time to time, to see that no bit of wood remains of a " blackish colour, but that the whole mass is of a uniform " glare, as if almost transparent, before the openings are " shut, else the *Ugar* or Vapour is sure to succeed to " mis-management of this sort, and its effects are as " follows.

" If a person lay himself down to sleep in the room " exposed to the influence of this vapour, he falls into so " sound a sleep that it is difficult to awake him, but he " feels (or is sensible of) nothing. There is no spasm " excited in the wind-pipe or lungs to rouse him, nor " does the breathing, by all accounts, seem to be parti- " cularly affected: in short, there is no one symptom of " Suffocation; but towards the end of the catastrophe, a " sort of groaning is heard by people in the next room, " which brings them sometimes to the relief of the suf- " ferer. If a person only sit down in the room, without " intention to sleep, he is, after some time, seized with " a drowsiness and inclination to vomit. However, this " last symptom seldom affects a Russian; it is chiefly " foreigners who are awakened to their dangers by " nausea; but the natives, in common with strangers,

" perceive

" ceive a dull pain in their heads; and if they do not
" remove directly, which they are often too sleepy to do,
" are soon deprived of their senses and power of motion,
" insomuch, that if no person fortunately discover them
" *within an hour* after this worst stage, they are irrecover-
" ably lost: for the Russians say, that they do not
" succeed in restoring to life those, who have been *more*
" *than an hour* in a state of insensibility."

" The recovery is always attempted, and *often* effec-
" ted, in this manner. They carry the patient immediately
" out of doors, and lay him upon the snow, with nothing
" on him but a shirt and pair of linen drawers. His
" Stomach and Temples are then well rubbed with snow,
" and *cold* water or milk is poured down his throat. This
" friction is continued with fresh snow, until the livid hue,
" which the body had when brought out, is changed to
" its natural colour, and life renewed; then they cure
" the violent head-ach which remains, by binding on the
" forehead a poultice of black rye-bread and vinegar."

" In this manner the sufferer is perfectly restored
" without inflating the lungs, as is necessary in the case
" of drowned persons; on the contrary they begin to play
" of themselves, as soon as the surcharge of *carbon* (in
" this case at that time synonymous with *phlogiston*)
" makes its escape from the body."

Although Dr. Guthrie attributes the same effects as here described, to a noxious principle set loose by the thawing of the thin crust of ice which covers the windows of the middling and lower classes, yet he offers nothing like a proof of this; and as the accident is acknowledged so often to follow a slight mismanagement

of

of the stove, and the stoves are in use when the thaw commences, I am much more disposed to consider the latter as *always* the cause of the accident; more especially as, from the sudden and great change both in the temperature and dryness of the external air, the draught of the stove will be much diminished, and consequently the wood be more slowly and less perfectly converted into red-hot cinders; an effect which we very often observe even in this country, where the cold is neither so intense, nor the change to warmth so remarkable, as in Russia.—I am doubtful how far the "pouring cold water or milk down the throat," which forms a part of the treatment described, can with safety be attempted, until respiration, and the power of swallowing, are renewed.

Dr. Guthrie very justly remarks, that "It is worthy of "observation, how diametrically opposite are the modes "of restoring to life those who are drowned, and those "who have it suspended by the fumes of charcoal; the "one consisting in the internal and external application "of *heat*, and the other in that of *cold*. It may be al- "leged (he says), that the stimulus of the Cold produces "Heat, and the fact seems to be confirmed by the Rus- "sian method of restoring circulation in a frozen limb, "by means of friction with snow. But what is singular "in the case of people apparently deprived of life in "the manner above described, is, that the body is "much warmer when first brought out of the room "than at the instant life is restored, and that they awake "cold and shivering. The colour of the body also is "changed from a livid red to its natural complexion, "which, together with some other circumstances, would "almost lead one to suspect, that they are restored to

"life

" life, from the snow and cold water some how or other
" freeing them from the load of *carbon* (phlogiston) with
" which the system seems to be replete; for although
" the first application of cold water to the human body
" produces heat, yet if often repeated in a very cold at-
" mosphere, it then cools instead of continuing to heat,
" just as the cold bath does when a person remains too
" long in it."

As affording at once not only a striking proof of the efficacy of cold water externally applied, in the instance of suffocation from burning charcoal, but also giving encouragement to persevere in its use for a length of time, I have thought it worth while to transcribe the following case.—The cook of a gentleman of Nancy in France, having gone to sleep in a chamber where there was a brazier of lighted charcoal, was found the next morning in a state of insensibility. The first medical practitioner who attended, considered it as a state of apoplexy, and having employed the means usual upon such occasions without success, gave it up as a lost case. At two o'clock in the day, M. Harmant, the family physician, arrived, and on examination found the face livid, and somewhat swollen; the eyes half open, bright, and prominent; the mouth closed, teeth clenched, the neck enlarged, the belly considerably tumid, and neither pulse nor respiration. Concluding these appearances to have arisen from the vapour of lighted charcoal, he immediately ordered the body of the person to be placed upon a seat in the court-yard, by the side of a fountain, and began by dashing glass-fulls of cold water in his face, which, after some time, produced a slight hiccup. This became gradually stronger and more frequent, attended with slight relaxation of the

jaw, and apparent effort to respire. Some snuff was blown into the nostrils, with the effect of making him move his head, and his hands as if he wished to raise them to his nose. The dashing the cold water was persevered in, and at the end of *three hours* slight vomiting was induced. Frothy matter was at length thrown up; the body began to be agitated; and all the limbs, particularly the fingers and toes, became violently contracted. At last he uttered a cry. The weather being severely cold, the attendants and friends insisted upon removing the patient into a warmer place, with which M. Harmant was obliged, however reluctantly, to comply; and he was accordingly carried into the kitchen. Here, what M. H. had feared and predicted, took place; the patient relapsed into his former insensibility, and the windows and doors were obliged to be opened, to obtain as much cold as possible. The dashing on cold water was again renewed, and at the end of *three hours more*, the patient began to cry out with violence, and was seized with universal trembling; he was then put to bed. M. Harmant visited him again, and found him sensible, but with distension of the belly, and occasional shiverings; for which he prescribed a clyster, a *ptisan*, and a *vulnerary mixture*, with Hoffman's Anodyne Liquor. The patient passed a good night; in the morning the pulse was more regular, the head-ach and shivering abated, and there only remained a sensation of fatigue, and a small distension of the abdomen. *Trans. of Royal Humane Society, Vol.* 1. *p.* 139.

Note 24, *on* * *p.* 75. M. Sage, a French Chemist, having observed that the lungs of animals killed by plunging them into the gas arising from fermenting liquors,

liquors, had a sensibly acid taste and smell, concluded that this must arise from the Carbonic Acid remaining in them, and proposed the employment of the Caustic Volatile Alkali in order to neutralize it. He accordingly made a number of experiments before M. Romé de l'Isle, M. Faujas de Saint Fond, and other men of science; in all of which he affirms, that the Volatile Alkali was attended with the most astonishing success, in restoring those animals whose respiration was suspended by Carbonic Acid Gas; whilst concentrated Vinegar, so often employed for the same purpose, is highly injurious.—There is something plausible in the theory, but I much doubt whether the Volatile Alkali acts in any other way than as a mere stimulus to the nerves spread out on the nostrils, which by sympathy, influence the diafragm and other muscles of respiration, so as to excite their action; as we observe to take place in the coughing and sneezing occasioned by irritating the nostrils. Should its employment be adopted, it may be conveniently done by pouring some Spirit of Hartshorn or Sal Volatile into the bellows made use of; or the wooden tube may be lined with a piece of blotting paper, and this moistened with either of the liquids mentioned: the Air blown into the lungs will necessarily carry some of the alkaline vapour along with it.

I am decidedly of opinion, however, that much more advantage is likely to accrue, from inflating the lungs with Oxygen Gas, as was successfully practised by my friend Dr. Babington, in a very interesting case which is recorded in the first Vol. of the Trans. of the Medical and Chirurgical Society of London.

Note 25.—In illustration of what is said in *Note*, *

p. 77, the following case was related to me many years ago, by Mr. Locock, Surgeon to the Northampton General Hospital, a gentleman whose abilities and veracity are equally estimable. He was called out in the night, and in the depth of winter, to attend a woman in labour at several miles distance. Upon his arrival at the place, he found the poor woman flooding fast, and already greatly exhausted by loss of blood. He therefore proceeded to deliver the child, which appeared to have died but very shortly before; and as the mother's situation now demanded all his attention, he gave the child to a woman in attendance, with orders to *take care of it*. It was fully two hours before the hemorrhage ceased so far that he could quit the bed-side, and enquire after the child; when he found that the woman who took it from him, believing it irrecoverably gone, had laid it naked upon a table in a wash-house. Although little hope could be entertained of restoring it after so long an exposure, in such a place, and during cold weather, he directed it to be brought to him, and placing it upon his knee before the fire, he gently chafed it with his hands, and applied to its stomach a compress moistened with warm brandy. He persevered in this, occasionally inflating the lungs, for more than half an hour, when the appearance of some bleeding from the umbilical cord, seemed to bespeak a remnant of vitality still existing. In a short time after, a tremulous motion was perceptible about the heart; and on renewing the inflation of the lungs, slight catches began in the chest, which gradually became sobs, and at last a distinct cry. A little warm milk was now got down by tea-spoonfuls; and before he quitted the house, the child was completely recovered.

Note

Note 26, *on* * *p.* 83. The following cases, selected from among the number of successful ones which I have read or heard of, afford the most striking proofs that can be given, of what I have endeavoured to urge above.—

In the year 1784, at a meeting of the *Physical Society*, held at *Guy's Hospital*, London, the following case was related by the late Dr. Hawes.—The doctor was desired to visit a literary gentleman, of a middle age, who had laboured under a slow fever for about nine days before. Excepting debility, there was no urgent symptom present, nor did the doctor apprehend any danger. About three hours after his visit, however, he was sent for in a great hurry, and upon his arrival, found the gentleman without pulse or breathing, and was told he had been in that state at least *a quarter of an hour*. The Feet and Stomach were immediately fomented with hot Brandy, and about half a pint of Madeira Wine poured down the throat. After some time, a tremulous motion was observed in the under-lip, and soon after the patient began to sigh; the Artery of the wrist could now be perceived to beat, and by continuing the above means, the gentleman became quite sensible, and at length perfectly recovered.

At a meeting of the same *Society* in the winter of 1785, a Medical Gentleman related the following instructive Case, which happened *in his own family*.—A child, who had for some time laboured under a cough, was suddenly attacked with difficulty of breathing, and *to all appearance died*. The gentleman immediately inflated the lungs, and by persisting in this for a considerable time, recovered the child. A similar state of Suspended Animation

Animation took place *three* or *four times*, and Inflation was as often had recourse to with the same success; but the attack happening unfortunately to recur whilst the gentleman was from home, the proper measures were not taken, and the child was lost.

The last case we shall take notice of, is chiefly important, as shewing that it is often within the power of the *ordinary attendants*, to pursue with success the means necessary for recovery.

Dr. Engleman, in a treatise upon this subject, relates the case of a Woman, who, after being happily delivered, fainted suddenly, and lay for *more than a quarter of an hour apparently dead*. A Physician was immediately sent for; but the Maid-Servant becoming impatient at his delay, extended herself upon her mistress, and applying her mouth to her's, blew in as much breath as she could. In a little time the exhausted woman awaked as out of a profound sleep, and proper things being given to her, she soon recovered. The maid being asked how she came to think of this expedient, said, that at *Altenburg* she had seen it practised by Midwives upon Children with the happiest effect. It is impossible to read this case, and not be struck with the great resemblance which it bears, to what was practised by Elisha upon the child of the Shunamite, as recorded in 2 Kings, chap. iv.—*And he went up, and lay upon the child, and put his mouth, upon his mouth, and his eyes upon his eyes, and his hands upon his hands; and he stretched himself upon the child, and the flesh of the child waxed warm, and he returned and walked in the house to and fro, and went up and stretched*

stretched himself upon him; and the child sneezed seven times, and the child opened his eyes.

Note 27, *on* * *p.* 89. A gentleman who was subject to colicky pains of the stomach, and accustomed to take Tincture of Rhubarb in Peppermint Water, to relieve them, being severely attacked when walking from a neighbouring parsonage into a market town in Northamptonshire, and seeing a druggist's shop, he went in and asked for an ounce of Tincture of Rhubarb and some Mint Water. The dose was accordingly measured out, and he drank it off immediately. Fortunately for him, he was too familiar with the taste of Rhubarb to mistake any other medicine for it; and the taste of what he had just swallowed was so very different, as to challenge his notice and remark; upon which the druggist, with equal surprise and consternation, discovered upon looking at the bottle, that he had given him Tincture of Opium instead of Tincture of Rhubarb. He acknowledged his mistake immediately, and took the gentleman to an Apothecary close at hand, who administered several doses of the Sulphate of Zinc to the amount of twenty grains or more, together with repeated draughts of warm water, but without any sensible effect; so that after the lapse of an hour I was sent for, and being in the town, I arrived at the house in a few minutes. I found the gentleman in great alarm, but excepting what might be inferred from the want of operation from the remedy taken, I could not perceive that the Laudanum had yet produced any sedative effect; for his pulse instead of being slower, was quicker than ordinary. The Sulphate of Zinc having failed, I had recourse to the Sulphate of Copper (formerly called Blue Vitriol) which is usually

usually accounted one of the most effectual emetics, the solution of it generally exciting vomiting almost as soon as it reaches the stomach. Half a grain was dissolved in a table-spoonful of water, and repeated three times, at the interval of five minutes. As neither vomiting nor sickness was excited by it, I did not venture to carry its employment farther. From the stomach having resisted these medicines, it was evident, that the Laudanum had begun to induce torpor of that organ, and it became an object of the utmost importance, to rouse it to empty itself, before it had lost its sensibility entirely; and, if possible, by means which might not injure it in case of recovery. In this difficulty I had recourse to Ipecacuanha in a much larger dose than ordinary; as large doses are not found to operate more violently than moderate ones, nor to produce, like Emetic Tartar, great debility afterwards; or irritate the stomach, as the Sulphates of Zinc and Copper would probably do, if persisted in. As Ipecacuanha when taken in substance does not act until an infusion has been formed in the Stomach, in order to avoid the delay which this would occasion, I directed *three drachms* of the powder to be put into a china bason, and half a pint of boiling water poured upon it, stirring it round until it became cool enough to swallow. One third part of this, together with the powder in it, was then immediately given, and the patient had scarcely time to walk twice the length of the room, before he vomited most copiously a fluid which smelt strongly of the Laudanum; and there was every reason to believe, that he had completely emptied his stomach of *all* its noxious contents; for although he drank warm water and threw it up again several times after this, it came off quite clear, and void of all smell.

Not

Not the least drowsiness, or head-ach ensued; and the only inconvenience he felt was a general languor, which went off in a few days; together with a soreness of the stomach, the removal of which was obviously assisted by restricting him to the use of mild mucilaginous diet, such as arrow-root, tapioca, sago, &c.

In the Spring of 1814, a young man of the medical profession, drank at once *eight ounces* of Laudanum, expressly to destroy himself. Being observed by his servant, assistance was immediately sought after, but notwithstanding the active and judicious measures employed by Mr. Anderson of Fleet Street, Surgeon, who administered several doses of the Sulphate of Zinc in solution, no vomiting was excited. When I got to the house, the voluntary power of swallowing was gone; but we succeeded in *pouring* down his throat an infusion of Ipecacuanha and several tea-bason-fulls of warm water. The stupefactive influence of the Opium, however, had already gone so far as entirely to suspend that contraction of the abdominal muscles which is the efficient cause of vomiting, and the unfortunate man expired in about an hour and half after committing the rash act.—It has occurred to me since, in reflecting upon this case, that under similar circumstances, the poison might still be evacuated, by filling the stomach pretty full with warm water, either in the way practised here, or by the aid of the elastic tube and syringe (see the Plate); and then, whilst one person supports the patient in a chair with his body bent a little forward, another assistant, seated on his right side, to hold one hand against his back, and with the other to press the stomach backwards and upwards, at short intervals, just

at

at the moment when the breath is expelled from the lungs, so as *mechanically* to imitate the spontaneous contraction of the abdominal muscles which occurs in ordinary vomiting.

Mr. Brodie has clearly proved, that Alcohol (and consequently all Spirits, Wines, and Malt Liquors as containing it), together with several other Vegetable poisons (among which we may enumerate Opium) destroy life by operating on the Brain, so as to suspend that voluntary motion of the diafragm which keeps up respiration; whilst the Heart and Arteries remain capable of continuing their action as before. Having ascertained also, that the action of the Heart, and the Circulation of the blood, might be maintained for a considerable time after the Woorara (one of these poisons) had produced its full effect (in occasioning stupefaction), it occurred to him, that, in an animal under the influence of this or of any other poison that acts in a similar manner, by continuing the *artificial* respiration for a sufficient length of time after *natural* respiration had ceased, the Brain might recover from the impression which the poison had produced, and the animal be thereby restored to life. Accordingly, upon trial with the Essential Oil of Bitter Almonds, and the Woorara, in a rabbit and in a cat, after the animals had ceased to breathe or move, the lungs were alternately inflated and emptied by means of a pair of bellows, in one case for *sixteen minutes*, in the other for *two hours and forty minutes*, by which the sensibility and power of voluntary motion were renewed to such a degree, that the animals recovered perfectly afterwards. He therefore concludes, that—" It is probable this method of treat-

" ment

" ment might be employed with advantage, for the re-
" covery of persons labouring under the effects of
" Opium and many other analogous poisons."

It appears that similar experiments have been successfully made at Paris by M. Delile. *See Mr. Brodie's Papers in the Phil. Trans. for* 1811 *and* 12.

It is proper to remark here, that as the functions of the Brain are indispensably necessary to the generation or evolution of Animal Heat, no heat is produced so long as these functions are suspended, notwithstanding the action of the Heart and the Circulation of the blood are kept up by artificial respiration. It is therefore requisite, that the body upon which such means of restoration are employed, should be kept during the time, in a medium as nearly as possible equal to the natural temperature of 98°; as the Nervous System loses its susceptibility to receive impressions, in proportion as it becomes cold.

Note 28, *on par.* 141. *page* 93. On the 17th of September, 1780, as James Adair, Esq. an elderly gentleman, was standing at the window of his house at Eastbourne, observing a thunder-storm, a violent flash of fire forced asunder his hands which were clasped, and threw him several yards within the room, upon his back, with both his legs upright in the air; in which position he remained for a long time, perfectly sensible, but unable to speak or open his eyes: nor had he power to move any of his limbs for a considerable period afterwards. The right sleeve of his coat, waistcoat, and shirt, were rent on the inside of the arm, from the shoulder to the wrist: the right side of his small-clothes was

torn

torn in the same way, and part of each of the brass buttons melted; as were the pendant, snap-stud, and part of the steel chain. His right arm, right side, and thigh, were miserably scorched, and the flesh torn; the foot of his right stocking torn in several places, and one of his toes split almost to the bone. A key and pen-knife in the breeches' pocket of that side, had several marks of fusion on them; and every pane of glass in the window at which he was standing, was shattered to pieces.—Notwithstanding all these marks of violence, his breathing was not suspended, nor any future injury sustained. *Phil. Trans. for the year* 1781, *Vol.* 71, *p.* 42.

It must be observed, however, that there is an essential difference, both as to nature and operation, between the *two* kinds of fire which occur in a thunder-storm; and a knowledge of this distinction is necessary to explain the difference of their effects. The thunder-*stroke*, as it is termed, is that narrow zigzag lightning which in its passage through various bodies, generally rends, perforates, or otherwise injures them. This takes place before any rain falls. The other kind, viz. the *flame* or *blaze*, is of much greater extent, but much less destructive; being the sudden combustion of the Oxygen and Hydrogen Gases contained in the atmosphere, which are set on fire by the former passing through clouds charged with both these principles, and immediately combine together so as to form the water which then falls in heavy rain. This kind never rends or penetrates bodies; but merely scorches their surface, sets them on fire if inflammable, and occasionally suffocates animals, by depriving them of the vital portion of the atmosphere:—No doubt, however, they often act together, as appears to have happened in the following case.

A boy

A boy was struck down by a flash of lightning near Hoxton (in the suburb of London) and lay exposed to the rain at least an hour, until his companions brought his friends from White-lion Street, who carried him home on some boards, apparently dead; the body being *stiff*, and universally cold, the fingers and toes *contracted*, the eyes sunk, and the countenance livid. Being stripped of his wet clothes, he was put between hot blankets, strong friction applied, and twenty ounces of blood taken away from his arm at two bleedings!! In half an hour, interrupted respiration commenced, without inflating the lungs; in an hour more, regular pulsation and breathing were established, together with the power of swallowing. Considerable fever ensued, which was removed by cooling remedies and purging; and in a week he was quite well. *Trans. of Royal Humane Society, vol.* i. *p.* 198.

Although, from a mark resembling a bruise appearing upon one arm, it would seem that the *electric stroke* passed either into or out of the body at that spot, yet from the completeness of the recovery, and still more from the body being *stiff*, and the toes *contracted*, it is probable that *this* had not done much injury to the vital principle; and that the suspension of life proceeded from *suffocation*, in consequence of the boy having been involved in the electric *blaze*, and thereby deprived of the *Oxygen gas*, or *Vital Air*, which is destroyed in the combustion with *Hydrogen Gas* or *Inflammable Air*, and converted into Water:—for where men or other animals are killed by the *stroke*, their limbs remain quite *flexible*. Possibly this may be a test, whereby we can decide whether the Vital Principle be entirely destroyed or not.

The

The case just related offered no satisfactory reason for the large bleeding employed; for although we are told, that considerable fever ensued, yet such an event could not possibly have been foreseen whilst the circulation was scarcely begun.

Note 29, *on* * *p.* 94.—M. Abilgard affirms, from a number of experiments, that fowls struck down by an electric shock through the head, (so strong that they died if nothing farther was done,) were completely recovered again by a similar shock through the *breast and back*. A second shock given to the *head* had no effect in bringing them to life; whereas the shock passed through from the breast to the back, restored them, even after blood had flowed from their mouths and nostrils in consequence of that sent through the head. *Vide Collectanea Societatis Medicæ Hauniensis, tom.* 2.

There is reason to believe that the heart is chiefly supplied with nerves from the Spinal Marrow; and hence perhaps the greater efficacy of the electric shock passed *through* or along *it*. But where such means are employed for the recovery of persons apparently dead, I would advise, that the shocks through the chest and along the spine should at first be *gentle*, and gradually increased in strength until some obvious effect ensue from them, or until they fail in any degree of strength that can be administered.

Note 30, *on* * *p.* 96.—With a view to impress more strongly upon the minds of our readers, the practicability of recovering persons under the circumstances of apparent death mentioned above, we have subjoined the following cases.—

A lad

A lad in perfect health, fell from a two-pair-of-stairs window into an area, and was taken up to all appearance dead. Upon the strictest examination, no mark of violence could be discovered either upon the head or any other part. After a variety of means had been tried by a surgeon without effect, the lad was pronounced dead, and sent home. A gentleman, past whose house he was carried, happening to inquire into the circumstances of the case, wished to try the effect of Electricity. After four small shocks had been given, the lad shewed some signs of life, and by continuing them, he gradually recovered; so that in less than two hours, he was able to walk about the house.—*Reports of the Humane Society for* 1787, 8, *&* 9, *p.* 329.

A case nearly resembling the above, is related in the reports of the same Society, for the year 1774. A child three years' old, fell from a-one-pair-of-stairs window, upon the pavement, and was taken up without any signs of life. A medical practitioner being sent for, he declared that nothing could be done, and that the child was irrecoverably dead; but a gentleman who lived opposite to the place, proposing a trial with Electricity, the parents consented. At least twenty minutes elapsed before he could apply the shock, which he gave to various parts of the body without any appearance of success. At length, on sending a few shocks through the *Chest*, a small pulsation became perceptible; 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 she was restored to perfect health and spirits in about a week.

Russian

Russian method of restoring a person apparently dead from the united operation of Cold and Spirituous Liquors.

Mr. Bell, a Scottish gentleman, who accompanied, in the quality of Surgeon, the embassy sent by Peter the Great to the Emperor of China, in the years 1715—18, says, that in returning through Moscow to Petersburgh, in December, 1718, "one of the people belonging to "the escort, hoping to banish all feeling of the intense "cold which then prevailed, drank a large quantity of "Spirits, which produced a drowsiness that ended in "sleep in an open sledge. On arriving at a village, "the person was found stiff, and apparently quite dead; "but being carried to a brook hard by, and plunged "several times in the water, and then rubbed with snow "and brought into a warm room, with proper regimen, "he soon recovered, and was able to proceed the next "day."

He adds the following very useful remark;—"I "have often observed in other instances, that *the use of* "*spirituous liquors in cold weather, is the worst of re-*"*medies;* for although they warm at first, they leave a "chillness behind them, not to be got clear of for a "considerable time. I have found *by experience*, no-"thing preferable to weak, warm liquors, mixed with *a* "*little* spirits. The Russian travellers carefully avoid "the excessive use of brandy in strong frosts." *Travels from Petersburgh to diverse parts of Asia, by John Bell, Esq.* 8*vo. Vol.* i.

Russian mode of treating parts mortified from Cold.

It is not often that parts are frost-bitten so as to mortify,

tify in Great Britain; and as when they are, surgical aid can readily be obtained, I thought it unnecessary to say any thing of the treatment proper for it. But the following is so simple, and its efficacy so strongly attested, that even professional men may be gratified by knowing it. Mr. Eton, in his book entitled "A Survey of the Turkish Empire," after some account of the state of Surgery among the Turks, says—"On this occasion I "cannot help mentioning the treatment of parts frozen, "in Russia, not by the Surgeons, but by the common "people, the success of which I was an eye-witness to "in several cases, as well as to the failure of the com-"mon method of treating frozen parts by the most "able surgeons of the army. I shall simply relate the "facts I allude to.

"After Ochakoff was taken, I received into my sub-"terranean lodgings as many prisoners as it would con-"tain, all of whom were either wounded or had a limb "frozen. Among them were two children, one about "six, the other about fourteen years of age: the latter "had one of her feet frozen to the ancle; the other, all "the toes and the sole of one foot. The second day "the parts appeared black (the first day they were not "much observed). The French Surgeon, whom Prince "Potemkin had sent for purposely from Paris, and "who was a man of note, ordered them to be con-"stantly bathed with warm camphorated spirits. The "elder was removed to the hospital, when a mortifica-"tion began; the younger I kept, and as we removed "into winter quarters, I carried the child along with "me. The mortified parts separated, the bones of "the toes came off, and after a considerable time the

" sores healed. I should have said, the surgeon was " for immediately amputating both the limbs.

" In a subterraneous room not far from mine, were " several women, whose feet had been in like manner " frozen; but as no surgeon attended them, the Rus- " sian soldiers and waggoners undertook the cure. It " was also the second day when they applied their re- " medy, and the parts were perfectly black. This re- " medy was *goose-grease*, with which the parts were " smeared warm, and the operation often repeated; " their directions were, never to let the parts be dry, " but always covered with grease. The consequence " was, that by degrees the circulation extended lower " down, and the blackness decreased; till, last of all, " the toes only were discoloured, and at length circula- " tion was restored to them.

" I can account for this no otherwise, than that the " fat kept the pores shut, and prevented the air from " promoting putrefaction; in the mean time the vessels " were continually absorbing part of the coagulated " blood, till by degrees the whole circulation was re- " stored. It is known that extravasated and stagnated " blood will remain a long time in the body without " putrifying, if it be not exposed to the air. I conclude " also, that in these cases of frost, the mortification first " begins on the surface, which is in contact with the " air.—I only meant, however, to relate facts, and " leave it to others to account for them.

" This is a general practice of the peasants through- " out all Russia; but if a part is discovered to be fro-

" zen

" zen *before the patient comes into a warm room,* the " frost may be extracted by plunging the part in cold " water, or rubbing it with snow till the circulation " returns."

Cursory Remarks on Sudden Death.

I HAVE often heard it remarked by old physicians, how much more frequent Palsy, and nervous complaints in general, had become within the last fifty years. My own observation has not been sufficiently long to decide this, although I am inclined to believe it true. But however it may be with regard to *palsy,* I think that an experience of thirty years, has enabled me to verify the remark in respect to *sudden death;* scarcely a day passing now, in which we do not find one or more events of the kind recorded in the public papers; nor are they the old and enfeebled alone who perish in this way; on the contrary, we oftener witness the apparently healthy and robust suddenly snatched from their families and friends, in the midst of every enjoyment that the world could afford. I wish that I was prepared to offer any thing decisive, either with regard to its prevention or its cause; but although this is not the case, yet on a subject of such acknowledged importance, even conjecture may not be without its use; nor is it possible to estimate the benefit which may ultimately result, from calling to the question, the attention of those who profess ability and opportunities sufficient to determine it.

No doubt, in the number of those who die suddenly,

immediate cause of death must be considerably different, both in its nature and seat. Of these, however, there are *two*, which are especially alleged to operate, viz. disease of the heart, whether from enlargement, ossification of its vessels, &c. or, the bursting of a blood-vessel, more especially in the brain. But neither of these can be supposed of frequent occurrence, and we must look for some other cause of so common an event. Perhaps there is no description of disease which (whatever be the reason) has increased so much in proportion to others, as that of the stomach; and as this organ not only suffers violently from disorder in itself, but partakes of the disturbance in other parts, often even to a greater degree than those parts themselves, I am inclined to consider it as the seat of that sudden orgasm, by which so many are unexpectedly snatched away. More than ten years ago, when I resided in Old Broad Street, I was called in a great hurry, to see a man who had been taken ill in Grace-Church Street; but although I went thither as fast as I could walk, he was quite dead before my arrival. He was a stout looking man, about forty years of age; and I learnt that, while crossing the street, he was suddenly attacked with violent pain at his stomach. He was assisted into a neighbouring stationer's shop, and seated upon a pile of paper, but the pain increasing rapidly, he died in a few seconds. The body was taken away by his friends, so that I could not get an opportunity of examining it.—From this period, I made a point of inquiring in every case of sudden death, where I could obtain any account of the sufferer's previous state of health, and I found that in most of them, complaint had been repeatedly made of transient pain at the stomach shortly before the fatal event. Not long after the case related above, a girl about seventeen years

of

of age, came into the hospital under my care, on account of simple fever, from which she became convalescent in about a fortnight by common purgatives, and diaphoretics. When sitting at the fire about eleven o'clock in the forenoon, she suddenly complained of violent pain of the stomach, for which the Sister of the ward gave her some Peppermint Water, and after going to bed, she became gradually quite free from it. The next day, however, when sitting up as before, she was again attacked in the same way, but with so much greater violence, that when they were proceeding to undress her, for going to bed, she said they need not give themselves the trouble, as she should not live; and in fact she died before they got her stays taken off. I eagerly seized this opportunity of endeavouring to ascertain the cause, by an examination of the body, in which I was assisted by my colleague Dr. Cholmeley. The body was below the middle size, but remarkably well formed, and appeared in every respect that of a person who had enjoyed natural good health. The head, chest, and abdomen were successively opened, without the least trace of inflammation, rupture of vessel, or other organic disease being perceptible, Nothing unusual appeared within the Stomach. Upon cutting open the intestines along their whole tract from below upwards, nothing particular was observable, until we came to the duodenum; in which, a little way below the opening of the *ductus communis choledochus*, we found, in one clot as it were, about an ounce of a very thick and viscid matter, of a deep green colour, the rest of the duodenum being quite free from any thing of the same kind. Upon examining the Gall-bladder, it was not only empty, but as free from bile as if washed out, for it was quite white. It was clear, then, that the clot of dark green viscid

viscid matter which lay in the duodenum, was inspissated bile, which had occupied the gall-bladder, but was forced out under the influence of the violent pain and spasm that preceded death. Here a question of great importance arises, viz. whether the expulsion of this matter into the duodenum, was the *consequence* or the *cause* of the fatal result: as upon the decision of this point, will turn the theory of the case, and the employment of remedies to obviate the danger, where the preceding symptoms give any warning of it. As large quantities of bile often pass through the intestines and are evacuated by stool, without ultimate bad consequences, the greater number of practitioners in this country will be disposed to attribute very little influence to the small portion which was thrown out from the liver in this instance; but those who have attended to the powerful effects produced by morbid bile, as shewn in Cholera Morbus, in bilious Colic, and in the convulsions which frequently kill children whose stools are green and pitchy; and who have also witnessed the sudden and surprizing relief obtained either by carrying it off, by correcting its quality, or rendering the stomach and intestines less sensible to its baneful operation; will attach very different ideas to it. It is well known that yellow bile when mixed with acids out of the body, becomes more or less green, and hence it has generally been believed, that the green colour of bile evacuated by vomiting or purging under disease, *always* depends upon the bile meeting with an acid in the stomach or intestines. But admitting that this may be often the cause, yet as bile is generally more or less green whilst in the gall-bladder, and before it can have come into contact with any acid matter, and as I have repeatedly observed even portions of the *substance* of the liver of a deep green hue,

hue, I am convinced that it is frequently secreted of this colour, under a state of irritation of that organ; and then exerts an extremely acrid and deleterious impression upon the alimentary canal, especially when, as in the case just related, it is suddenly applied in a very concentrated form. The sensibility of the Stomach is universally admitted, and it is well known, that death has immediately followed a blow of no great force given to it. But although I have used the word *stomach* as a general term to denote the seat of the mischief, I do not confine it entirely to that individual organ, but consider the numerous and extensive *plexus* of nerves adjoining, and which have an intimate connexion with, and influence upon the Diafragm, Heart, &c. as necessarily, and perhaps chiefly concerned; for in the instance described, the fatal impression was primarily made upon the *duodenum* alone, and could only have been extended to the vital organs, by the sympathy arising from nervous communication.

Such is a brief sketch of my *theory* upon the subject; and the *practice* I would recommend is in perfect accordance with it. The chief indication is, to evacuate whatever morbid bile may be accumulated; but although this may perhaps be successfully done either by vomiting or purging, and by the common remedies employed for these purposes respectively, yet of the two I consider *purging* to be both the safer and the easier mode. Nor is it a matter of indifference what articles we employ; for the saline cathartics, though gentle and quick in their operation, often do no more than merely empty the intestines, without discharging bile, especially where it is inspissated by delay in the gall-bladder or ducts of the

the liver. The mode which I think preferable to all others for this purpose, is, in the first place, to give from fifteen to twenty drops of the Tincture or Wine of Opium, in order to diminish any morbid sensibility of the stomach and intestines, and thereby prevent the irritation which might arise from acrid bile suddenly poured into them. Along with the opiate, but still more securely after the interval of an hour, and when its sedative influence has begun, from one to three grains of Calomel may be administered, with a view to elicit the excretion of bile, which this remedy is known to do in a degree superior to all others. After a lapse of six or eight hours, at which time the effect of the opiate is going off, some cathartic should be given; and as the most effectual in this case, I prefer the Compound Colocynth Extract, on account of its greater power as a *Cholagogue*, or evacuant of bile; although, after such preparation, any of the ordinary purgatives *may* perhaps answer:—the dose of the Extract is from ten to twenty grains. The success of this, or of any other remedy given, will be ascertained, not only by the relief which the patient experiences in his general feelings, but also by the quantity and appearance of the bile evacuated.

Although myself satisfied of what I have advanced here, by facts, both direct and collateral, too numerous to be detailed on the present occasion, I by no means expect that others will admit it without farther evidence. This I wish to be derived from their own observation; and accordingly, to the Medical Profession of the United Kingdoms, who now possess an embodied aggregate of talents and of science, such as no other country can boast, nor even this at any former period, I willingly refer

refer the question; in perfect confidence, that the investigation will be prosecuted with equal industry and zeal, and the decision dictated alike by candour and by truth.

I cannot dismiss this subject, without noticing what I consider an important defect in the police of Great Britain, compared with that of France; and what, if supplied, would not only render the evidence upon many criminal trials clear and satisfactory, but would contribute more than any thing else, to throw most important light upon the nature and cause of various kinds of sudden death. It is, the appointment of Medical Coroners, or rather, as the duty of a Coroner requires a knowledge of law, the appointment of a Medical Assessor to each Coroner; together with a legislative enactment, that no person dying suddenly should be interred, without a previous inspection of their body, and an investigation of the cause; a statement of the particulars to be drawn up in writing, signed by the Medical Officer, and afterwards published.

Treatment necessary in Cases of Poison.

THE object of the NORTHAMPTONSHIRE PRESERVATIVE SOCIETY, was not confined to diffusing information, and offering rewards, for the recovery of persons apparently dead, but, agreeably to its title, extended to the *preservation* of human life, from various cases of imminent danger, and among others from that by Poison. I accordingly subjoined a few general directions upon this head; and as these are easily put in practice,

practice, and if duly attended to, may be the means of saving many who would otherwise fall victims to their unfortunate mistake,* or rash design, I have thought it right to repeat them in this edition.

ARSENIC, CORROSIVE SUBLIMATE, and OPIUM, are the three articles, the poisonous effects of which will most frequently call for assistance. Of these, Arsenic is by far the most dangerous, not so much from its effect as a chemical acrid in corroding the coats of the stomach, as from its peculiarly deleterious influence upon the nerves of that organ; for it has been found (*See Mr. Brodie's Experiments in the Philosophical Trans. for* 1811-12) even when applied externally and to distant parts, to inflame and injure the stomach nearly as much as when taken internally. Reason tells us that when a person has swallowed any thing poisonous, the most speedy way to get rid of it is by exciting vomiting, and thus discharging it from the stomach. Arsenic indeed of itself generally occasions vomiting, and that too of a violent kind; but if vomiting be not excited by other means than this poisonous Mineral, the stomach will probably be so much injured, as to render a recovery doubtful. As soon, therefore, as the accident is discovered, the person should be made to swallow from forty to sixty grains of Ipecacuanha infused in hot water as already directed (p. 142); or in defect of this, a wine glass-full of Ipecacuanha Wine, or half a drachm of White Vitriol, dissolved in a gill of warm water; and also farther endeavour to excite vomiting, by tickling the throat with a feather. In the mean time, however, in order

* White Arsenic has been frequently swallowed through mistake for Nitre, or Cream of Tartar; and Yellow Arsenic, for Flowers of Sulphur, or Powdered Brimstone.

order to sheathe and wash out the poison, he should drink plentifully of warm Milk, Gruel, Barley or Rice-water, mixed with Sallad Oil, fresh-butter, melted Lard or Suet, or of fat broth, and repeat these draughts as long as any sickness or reaching continue; nor is it prudent to abstain from drinking at times, so long as any of the poison may be supposed to remain behind.—Pains in the bowels succeeding to the vomiting, give room to suspect that some of the Arsenic has passed that way; in which case, clysters composed of a pint or more of warm gruel, &c. with a wine glass-full or two of Castor Oil, or of warm water with an ounce or two of Epsom or Glauber's Salt dissolved in it, should be administered, and afterwards followed by repeated injections of the same kind of articles recommended to be drank.

In a case where several persons were poisoned by Arsenic put into flour, and where milk was copiously swallowed, a medical gentleman who attended, observing that the milk was always thrown up after some time in the state of curd, had the curiosity to break these, when he found that many of them contained a coarse particle of the Arsenic as a nucleus. This suggested to me, that it might be extremely useful to use *new*, or at least *rich* milk, which contains a larger quantity of cheesy matter; and to mix this, just before swallowing, with some cheese-runnet, which would ensure its coagulation in the stomach, and by thus enveloping particles of the Arsenic, assist in carrying it off with more certainty.

When CORROSIVE SUBLIMATE has been taken, the same means should be used as soon as possible to evacuate it; and as this article is more readily decomposed

posed than Arsenic, we may at the same time give a tea-spoonful of Salt of Wormwood, Salt of Tartar, or Pearl Ash, dissolved in a pint of warm water; which will combine with the Acid and render the poison nearly inert. Where the salts just enumerated are wanting, luke-warm water poured on some Potash, or wood-ashes, and then strained off, may be used instead.—By such means, if early employed, we shall frequently succeed in preventing the fatal consequences, and always mitigate, at least, the sufferings which the patient would otherwise undergo.

LAUDANUM.—I have already treated pretty fully upon the treatment proper when this article has been taken, and have only to add, that Acids have been affirmed to possess considerable power in lessening its stupifying effects. Of this I have no experience: but as no apparent harm, and some eventual benefit may arise, there is no objection in giving several wine-glass-fulls of Vinegar, or Lemon-juice, mixed with an equal quantity of water.

It is well known to medical men, that when either Emetic Tartar, Antimonial Wine, Ipecacuanha Wine or Powder, is given joined with Opium, each counteracts the effect which the other would have had if given by itself; the Opium generally preventing the Emetic Tartar, &c. from exciting vomiting; and these again, in their turn, suspending the stupifying operation of the Opium—the result generally being, that they operate on the skin, and induce profuse sweating. When, then, notwithstanding vomiting, &c. the stupefactive influence of the Opium taken in large quantity begins to take place,

place, it would be very proper to throw up two or three ounces of Ipecacuanha Wine, or the strong Infusion, in clyster: the Antimonials seem less proper from the debility they occasion.

STRONG MINERAL ACIDS, such as Oil of Vitriol, Aqua-fortis, and Spirit of Salt, when swallowed, almost instantly corrode the mouth, throat, gullet, and stomach; so that the chief mischief is generally done before any assistance can be given. Drinking copiously of Water, as being the speediest, is generally the most efficient remedy; but advantage may still be obtained by neutralizing these liquids, and the most simple and effectual means of doing this is by giving plentifully of Magnesia. In an accident of this kind, which happened many years ago near Guy's Hospital, my friend Dr. Babington being fortunately on the spot, carried a bottle of calcined Magnesia with him, and gave some of it in milk or water, to a little boy who had swallowed a quantity of Oil of Vitriol. The relief to pain was almost instantaneous, and by mild mucilaginous diluents afterwards, the boy recovered.

EMETIC TARTAR is never used as a poison, and cannot be readily mistaken for any article that would be given *largely* as Medicine. But, as I have already noticed (* p. 67), it is occasionally attended with fatal effects when given in *repeated small doses* to children; and I observe

observe that Mr. Brodie has made it the subject of direct experiment, from which it appears to act as a *sedative*, both upon the Heart and Brain, but chiefly upon the latter; inducing palsy, drowsiness, and at last complete insensibility. As an additional proof of its specific operation, it produced the same symptoms when applied to a wound, as when taken into the stomach. *Phil. Trans. for* 1812.

These remarks are by no means intended to preclude its employment, but merely to caution against the indiscriminate use of it, under the common, but false impression, that it not only possesses a specific febrifuge virtue, but is harmless in any dose that does not excite *violent* Vomiting or Purging. Like Mercury, Digitalis, and other active remedies, it produces the best effects when judiciously exhibited; and is dangerous only in unskilful hands.

CANTHARIDES, or SPANISH FLIES, if swallowed even in the quantity of a few grains, have been known to bring on inflammation of the stomach, intestines, kidneys, and bladder, and thereby occasion death. As we are not acquainted with any remedy that, when taken into the stomach, can deprive these of their acrid quality, our object should be to evacuate them as speedily as possible by vomiting; and afterwards swallow runnetted milk, as directed p. 161, or such other article as may envelope them, so as to protect the stomach and bowels from their acrimony. Gum-Arabic dissolved in water and drank largely, will assist in lessening their irritation upon the kidneys and bladder, as we often experience in strangury from a blistering-plaster.

Poisonous Mushrooms, Roots, and Berries.

CHILDREN and labouring persons are generally those who suffer from poisonous Roots and Berries; but no one is free from danger who eats *field* Mushrooms, as, besides the mistake often made by those who collect them, it is alleged, that even the *eatable* kind shews deleterious properties in certain seasons.

The disturbances produced by various articles of the poisonous kind, differ considerably as to their symptoms, and perhaps even the same article may occasion different effects in different persons, according to their constitutional character, or some peculiarity of disposition attached to individuals. Although several vegetable poisons excite inflammation of the Stomach, yet, in general, the Nervous System alone is affected, as shewn by violent Spasms of the Muscles, Convulsions, Stupor, and Delirium which often resembles Insanity; and these effects are, in general, either greatly mitigated, or entirely removed, by evacuating the article swallowed. Hence, as we do not know any antidote against these poisons individually, and if we did, could not always ascertain the particular one taken, the first, and indeed almost the only step in such cases, is, to induce *vomiting* as speedily as possible. For this purpose, perhaps any of the ordinary Emetics may be employed; and as the saving of time is of the utmost importance, that which is nearest at hand may on this account be preferred. But where a choice does not occasion delay, I would recommend the Infusion of Ipecacuanha already mentioned, (p. 142) as at once the safest and most effectual; the dose being regulated by the age of the patient.

Of

Of the Operation of Bronchotomy for the Removal of Foreign Bodies which have slipped into the Wind-Pipe, and threaten Suffocation, or other dangerous consequences, if not speedily removed.

ALTHOUGH I believe that there is no case of Suspended Respiration, where the Lungs may not be inflated by the air being blown through the *nostrils*, and the upper part of the Wind-pipe being at the same time pressed backwards, so as to close the gullet, and prevent the Air from passing into the stomach; yet as there are other cases which necessarily require Bronchotomy (such as foreign bodies accidentally slipping into the Windpipe) I think that these Observations would be defective in their principal object, were I to omit the directions given by Mr. Coleman, by which that operation is rendered much more simple and safe, than the mode generally inculcated by preceding writers.

It is proper to remark, that several parts of this extract infers, that the operation is performed in order to inflate the lungs; whereas I consider it as only necessary to remove portions of food, or any other body that may have accidentally got there, which are too large to be expelled again by coughing; or where inflammation, &c. of the chink of the Glottis, prevents the air from being drawn in and expelled again freely, and thereby threatens suffocation.

" We are advised by authors, (says Mr. Coleman) to " begin it by a longitudinal incision immediately below " the Cricoid Cartilage; and when the Trachea is met " with, to divide it between the rings.

" The

" The performance of this operation, according to " this plan, can scarcely be attended with danger, when " attempted by *a skilful anatomist;* but it may be " embarrassing to a medical assistant, who is obliged " hastily to perform it when, perhaps, he may not per- " fectly recollect the situation of the vessels; and it is " to be remembered, that haste is always particularly " necessary upon these occasions. Allowing, however, " that the operation is ably performed, great inconveni- " ence must follow from the situation of the wound; " for in the recovery of the drowned, hanged, and suf- " focated, the head is, and always ought to be, kept a " little elevated, the consequence of which must be " that the aperture in the Trachea then becoming the " most depending part, the flow of Blood that follows " the operation, will principally enter it, and thus pre- " vent artificial respiration from being properly carried " on. This is not a theory founded upon hypothesis, " but on facts; as we have seen two cases wherein this " accident actually happened.

" Another inconvenience attendant on this mode of " operating, is, that from the Trachea at this part being " covered with so much integuments, the pipe for in- " flating the lungs cannot be properly received; and " should a recovery be effected, the patient must be un- " der the necessity of keeping his chin directed con- " stantly downward, in order to approximate the carti- " lages, a position that is not only very disagreeable, " but to be continued almost impracticable.

" In order, therefore, to render the operation more " simple, less dangerous, and to prevent the Blood

" from entering the Air-Tube; I conceive it more eli-
" gible to divide the Thyroid Cartilage; and that in-
" stead of the incision *first* being *longitudinal*, and
" *then transverse*, *both* the integuments should be cut
" through *longitudinally* at once.

" Several are the advantages derived from this mode
" of operating. *First*, no danger can then arise from
" want of anatomical knowledge. *Secondly*, the co-
" vering being here very superficial, little Blood will be
" lost, and the little that does escape, cannot get into
" the Wind-Pipe. *Thirdly*, the curved pipe can be
" very well secured, in order to carry on inflation and
" collapse. *Fourthly*, if our attempts to recover be
" successful, keeping the head naturally erect, will be
" the best position to approximate the divided carti-
" lage; and lastly, that the Recurrent Nerves are in no
" danger of being divided. The only inconvenience to
" be dreaded from this manner of operating, is, that of
" committing an injury on the Sacculi Laryngis, and
" thus to incommode the Voice; but these are secured
" from danger by cutting through the middle of the car-
" tilage; and an union will be as completely effected,
" as if the Trachea itself had alone been divided.

" The surgeon standing on the right side of the pa-
" tient, should perform the operation by putting the in-
" teguments on the stretch with the thumb and fore-
" finger of the left hand, a longitudinal incision is then
" to be made immediately over the thyroid cartilage,
" into which may be inserted the curved pipe that was
" intended to be introduced into the trachea by the
" mouth."

Many

Many cases are recorded, where foreign bodies, have slipped into the Wind-Pipe, and in some proving speedily fatal, in others remaining for a long time, and occasioning great distress; and in others again, successfully removed, by means of a pair of forceps introduced into an opening made in the trachea. Dr. Odier, in a Note to his translation of these Observations, relates the case of a fine healthy child between four and five years old, who suddenly fell dead at school, without uttering a single cry, making the least convulsive struggle, or shewing any previous symptom of illness. The Doctor was immediately called in, along with a Surgeon; but having no clue to direct the treatment, their attempts at restoring him proved unavailing. Upon examining the body afterwards the passage into the Wind-Pipe was found completely stopped up by a kidney-bean; and it was then recollected, that the child had been playing with some of these beans just before, though he was not observed to put any of them in his mouth. Had the nature of the accident been understood at first, there was good reason to hope that the operation would have succeeded in preserving his life. *Observations sur les Morts Apparentes, traduites par Louis Odier, Docteur et Professeur en Medicine, à Geneve; An.* 1800.

CAUTIONS AND SUGGESTIONS UPON VARIOUS CIRCUMSTANCES OF DANGER TO LIFE, CONNECTED WITH THE OBJECT OF THESE OBSERVATIONS.

Best Mode of avoiding Danger in a Thunder-Storm.

WHEN persons are overtaken by a Thunder-Storm, al-

though they may not be terrified by the Lightning, yet they naturally wish for shelter from the Rain which usually attends it; and therefore, if no house be at hand, generally take refuge under the nearest Tree they can find. But in doing this, they unknowingly expose themselves to a *double danger*; *First*, because their clothes being dry, their bodies are rendered more liable to injury; for as Water is a very ready conductor of Electricity, the Lightning often passes harmless over any substance whose surface is wet; and, *Secondly*, because a *Tree*, or *any elevated object*, instead of warding off, serves to attract the Lightning, which in its passage to the Earth, frequently rends the trunk and branches, and kills any Animal or Person that happens to be close to it at the time. A melancholy example of this (one of many that might be quoted) took place in the Earl of Aylesford's park, at Packington, near Birmingham, in September, 1789. Thomas Cawsey, of London, a farrier, who was travelling to Birmingham, being caught in a violent thunder-storm, took shelter under a large tree in the park. The lightning soon after struck the tree, and in its passage along it to the ground, killed this unfortunate person. Lord Aylesford afterwards humanely erected a monument upon the spot, with an inscription warning others of the great danger to which they expose themselves by taking shelter under Trees during a Thunder-Storm. Instead, then, of seeking protection by retiring under a Tree, Hay-rick, Pillar, Wall, or Hedge, the person should either pursue his way to the nearest House, or get to a part of the road or field which has no high object to attract the Lightning towards it; and remain there until the Storm has subsided. It is *particularly dangerous* at such times, to stand near Leaden Spouts, Iron Gates, or Pallisadoes; metals of all kinds having

having so strong an attraction for Lightning, as frequently to draw it considerably out of the course which it would otherwise have taken; and it is entirely owing to this, that metallic rods and chains, are useful as Conductors. Excepting a house, any open space about 50 or 60 yards from a conducting body, is considered as the most secure. Even within doors, there is danger of sitting near a Window, Fire-Place, Bell-Wire, or under the chain of a Chandelier, when the Lightning approaches.

How to estimate Danger in a Thunder-Storm.

MOST persons can distinguish between the noise of distant Thunder, and of that which is near them: from the former having a deep, hollow, and rumbling sound, continuing for several seconds; while the latter is almost a single sharp clap, or like the discharge of a platoon of musquetry immediately over-head. But there are comparatively very few who are aware, that by attending to the interval between the flash and the report, they may accurately measure the distance of the Lightning, and thereby calculate their degree of safety or of danger: for it is the Lightning which does the mischief; whilst the Thunder is merely the sound occasioned by the Air rushing in from all sides, to fill up the *vacuum* created by a quantity of Oxygen and Hydrogen Gases being set on fire by the electric spark, and suddenly condensed into Water, which immediately afterwards falls in rain: and the lengthened peal is the echo of the first clap, reverberated from different clouds; just as we observe the explosion of a single cannon, multiplied by surrounding hills. LIGHT moves with such prodigious velocity, that any flash which occurs within

our

our atmosphere, reaches the eye without a sensible interval; whereas SOUND moves so slowly, that we can easily calculate its progress, and consequently measure the distance of the Lightning from whence it proceeded. It appears from accurate experiments, that SOUND moves through 1142 feet in a second of time, and of course, through an English mile, or 5280 feet, in about four seconds and a half. If, then, from the instant the flash strikes our eyes, we can deliberately count *four* at the same rate that the pendulum of a common clock beats, we are sure that the Lightning is nearly a mile distant; nor is it until the interval is *less than two seconds*, that any danger from the Lightning can arise.

I may here remark, that the value of Conductors has been doubted or denied, from want of knowing a circumstance attending Lightning, which was first pointed out, and most luminously explained, by the present Earl Stanhope; it is, that at the same time that a cloud *sur*charged with electric matter, gives off a part of this to the Earth at one spot, the Earth, at a certain distance from this, in its turn, communicates a portion of electric matter to the Atmosphere, so as to establish an equilibrium. This has been termed by Lord Stanhope, *the Returning Stroke;* and it is obvious, that against this, a Conductor elevated in the Air will afford no protection. Many years ago, whilst riding from Thrapston to Kettering in Northamptonshire, a violent thunder-storm which crossed my road about five or six miles before me, gave me an opportunity of contemplating this phenomenon in a most distinct and beautiful manner. As the storm proceeded in its route, and the zigzag lightning descended to the Earth at intervals from the *van*

of

of the storm-clouds, I saw, after each discharge, the *returning stroke* communicated from the Earth to the *rear* of the clouds. Instead, however, of darting with the velocity of the *forked* lightning, this rose with about the apparent rapidity of a sky-rocket, its progress from the surface of the Earth to the clouds being perfectly distinct. It differed also in its *form;* for it appeared undulated, like a broad crimped ribbon, and almost always bent a little from a straight line, owing perhaps to the different density of the strata of Air through which it had to pass, or to the *negative* cloud which it afterwards joined, not being exactly perpendicular to the spot from whence it issued. The *colour* varied considerably, some of the *streams* (as I would call them) being of a deep colour like burnished Copper, and others like pale Gold; but none of them having the dazzling blue tint, which the zigzag lightning commonly displays. But although, from the difference described, it is probable that this *returning* stroke is not so concentrated, and consequently not so destructive, as the *direct* one, yet an event which occurred near Kettering during the storm, shews that it will destroy life; whilst its direction from below upwards, explains a circumstance that appeared otherwise difficult to account for: a farmer's boy, who had hold of a horse by the halter, and had retired under a high wheat hovel for protection, was killed, together with the horse, at the same time that the stack of grain was set on fire in the *lower part,* just over where the boy and horse stood.—Another instance of fatality from the *Returning Stroke,* is described by Mr. Brydone in the Philosophical Transactions, vol. ; and no doubt such events are much more frequent than is at present conceived.

Danger

Danger from the Air of deep Wells, Mines, &c.

It has been already remarked (p. 72.) that deep Vaults, Sewers, Pump-wells, Wells of Ships, Mines, and other places that have not a free circulation of air, and especially if long shut up, are generally occupied by vapours which soon prove fatal to persons breathing them. The property which these vapours have, however, of extinguishing flame (par. 22 and 27), affords a ready means of detecting their presence, and thereby avoiding the danger which might ensue from an incautious exposure to them. When such places, therefore, are opened to be cleared out, or repaired, a lighted candle should be let down slowly by means of a cord, before any person is suffered to descend; and if it be found to burn freely until it gets to the surface of the water, or other matter covering the bottom, the workmen may then venture down with safety. But if, without any accident, the candle becomes extinguished in its descent, and continues to be so in repeated trials, we may then be assured, that the air of the place is *highly* noxious. In that case, if the Well, &c. cannot be left open to the Atmosphere for a sufficient length of time to purify it, some means should be employed to expel the Noxious Vapour. For this purpose it has been proposed, to *blow* a stream of air down to the bottom of the well, &c. by means of a pair of smith's bellows, having a leathern or canvass tube or hose fastened to their nozzle, and long enough to reach to the surface of the water. But besides that this is an inconvenient apparatus, it has been found on trial to require a *prodigious force* to drive air through a tube of any length; and I have much doubt whether the expedient was ever tried by those who proposed it. It is much more practicable

ticable to *draw* the noxious air *up* from the bottom by *suction*, than to drive it out by forcing fresh air *down* into the place; and with this view, an instrument nearly resembling the common Winnowing Machine, has been employed with success. The drum or case, however, of this instrument, has no opening at the axle, as in the winnowing fan; but instead thereof, a wooden tube or trunk is fixed to the under side of the drum, like the tangent to a circle; the middle part of this trunk being cut away, so as to apply to, and close an aperture of corresponding size made in the circular rim or barrel of the drum: the two ends of the trunk projecting in opposite directions. As the drum is thus shut up on all sides except the apertures of the tube, it necessarily follows, that when the leaves of the fan within are put in motion, by turning the crank or handle, the air is *drawn* into one end of the tube, and *driven* out of the other. To one aperture of the wooden tube, a hose of two or three inches diameter, and made of leather, sail-cloth, or other flexible, but air-tight material, is to be accurately fastened; the hose having small hoops of rattan, ozier, or ash, placed within it, at intervals of five or six inches, to keep its sides from collapsing; and being of sufficient length to reach the bottom of the Well, &c. One end of this being let down into the Well, and the winch of the machine turned, so as to drive the air within the drum out of the open end of the wooden trunk, there is no means of supplying the vacuum thus produced, but by the hose, through which the Foul Air accordingly rises from the Well, and is thus carried off.

It appears to me, that by such an Apparatus, constructed upon a large scale, and moved by sails like a horizontal

horizontal or vertical Wind-Mill, the air might be constantly drawn from the deepest recesses of a Coal-Mine, and the dreadful accidents attending such places, which have of late been so frequent and destructive, might be much diminished, if not entirely prevented. As the *mine-damp*, as it is commonly denominated, is chiefly Hydrogen or Inflammable Gas, the apparatus might be rendered more uniformly and powerfully operative, by fitting to the *vent-end* of the wooden trunk, a cast-iron tube several feet in length, the extremity of which should pass *nearly through*, but still terminate *within*, a furnace; the fire of which, by keeping the iron tube red-hot, would not only create a strong draft or current of air drawn from the Mine, but would have its combustion aided by the inflammable air issuing from the end of the tube.

The common belief, that foul air collects in Wells, Mines, &c. only in length of time, has been productive of much mischief, by encouraging masons, miners, &c. to descend without fear, because they themselves, or others, had done so without injury the day before. The following remarks upon this subject appear to me highly deserving of attention. Mr. Webster, an American gentleman who has written a work in two vols. 8vo. called "The History of Epidemics," and containing much curious matter; afterwards, in a paper published in the New-York Medical Repository, Vol. v. p. 25, observes,—"It is a common opinion, that mephitic "air in wells and vaults is generated *slowly*, and is to "be ascribed to the stagnation of the air in covered "places. I have ventured in the Appendix to my "History, to call in question this opinion, and suggest, "that the deleterious gas is produced *suddenly*. The "following

" following case is in proof of that opinion. In July, " 1770, a man in Boston (U. S.) entered a cistern to " cleanse it, and instantly fell dead. The cistern had " been entered a few days before without inconvenience. " In August, 1774, a boy went into a well about twelve " feet deep, at Danbury, State of New York, to get a ves- " sel that had fallen in. He instantly fell motionless and " died. This well was open and used. On examina- " tion it was found, that all the wells in the neighbour- " hood were filled with the noxious vapour. As these " wells were open, and as the inhabitants generally use " a bucket to draw water, we have full evidence that " the wells must have been filled *suddenly*, or *in a* " *short time*, and nearly at the same time; for the " action of the bucket speedily dissipates and mixes the " vapour with the air."—(And with the Water also, for Water readily attracts and absorbs it. C.)

" These facts (he continues) with those related in the " Addenda to my History, seem to prove, that the " Carbonic Acid Gas, called (choke) *damp* or Me- " phitic Vapour, is not generated *slowly* by a chemical " process; and that stagnation in a well is not at all " essential to its existence."

Although Mr. W. is wrong in alleging that the production of such gases is not by a *chemical* process, this does not lessen the truth and value of his observations, which apply in an especial manner to Coal-Mines; where the inflammable gas is often set loose and explodes, even whilst the Miners are at work as usual; and if we take into account Sir H. Davy's late discoveries respecting that grand agent in the operations of Nature, viz. the *Electro-Chemical Influence*, which is continually

continually transmitted, in various degrees, between the Earth and Atmosphere, we can not only satisfactorily explain the *suddenness* of such occurrences, but be convinced, that no *occasional* or *temporary* ventilation of Mines, can guard against the destructive consequences of *fire-damp*, or Inflammable Gas; whilst that which I have proposed, seems more likely than any other to answer the purpose.

It is the universal opinion, as far as I have heard it noticed, that the extremely offensive smell of sewers and drains, which occasionally occurs, is owing to the wind setting into their out-lets, and driving back the stench upon the houses with which they communicate. But if this were the case, we should have the nuisance as often as the wind came from the same quarter in warm weather; on the contrary, it is by no means so frequent as the blowing of any particular wind, and indeed commonly takes place only when the air is close and sultry, and when there is scarcely a breath of wind stirring. I have no doubt then, that the evolution of this fetid vapour, depends upon the operation of the same agent which produces the mephitic and inflammable gases above noticed; viz. the *Electro-Chemical Influence*.

As the shaft of a Well resembles the cavity of a piece of ordnance, I conceive it possible to expel all the air from it by means of gun-powder. Where a Well then, requiring to be cleansed or repaired, is ascertained, by letting down a candle, to contain *noxious* air, I would propose the following method: it is cheap, easily executed, and free from any danger that I am aware of. Tye up strongly in one parcel, and in several folds of stout paper,

paper, from one to two or three ounces of Gun-Powder. Make a hole through the paper, and into that insert a match, made by moistening a piece of soft blotting paper, or thick, well beaten cord, in a strong solution of Saltpetre, and afterwards rubbing its surface over with bruised gun-powder, and drying it. Make fast the packet thus prepared, to a cord of sufficient length, and having lighted the match, lower it down gradually until within a few inches of the water, and suspend it there. As soon as the match has burnt down to the packet, the powder will explode, and drive out a quantity of the noxious vapour, which occupied the space above it; and if several such packets be fixed to the same cord, so as to be situated at regular intervals from the bottom to the top of the well, and these be contrived, by the length of their respective matches, to explode in quick succession from the bottom upwards, it appears practicable to empty the well of all its noxious vapour at once. The smoke from the powder, will soon subside; but no one should attempt to go down, until a candle is found to burn freely at the surface of the water.

Danger from Lighted Charcoal, Fermenting Liquors, &c.

PERSONS whose business requires them to attend upon large quantities of fermenting liquors, as Ale, Cider, Perry, Wine, &c. or work in close places with lighted Charcoal, frequently experience head-ach, giddiness, and other disagreeable effects of the Carbonic Acid Gas given out; and often have their health impaired, and their lives endangered, by a continuance of the employment. In some cases, perhaps, the danger cannot be avoided, except by going into the open air as soon

as head-ach or giddiness begins, and drinking a glass of cold water, and also washing the face or neck with the same. Thus it is probable, that such a degree of ventilation as would carry off the Carbonic Acid Gas produced by fermenting liquors, would greatly impede if not entirely stop the progress of fermentation, and spoil the liquor; but in the case of persons whose work requires charcoal fires, as Wool-Combers, there can be no good reason for placing the charcoal in a round pan or grate, in the middle of the floor, (as I am told is the custom) instead of setting it under the chimney, the draft of which would serve to carry off the noxious vapour, and keep the apartment more wholesome. In great porter-breweries also, it has more than once happened, that several people have lost their lives in attempting to clean out the large reservoirs in which the liquor is kept. It would be very practicable to clear these vessels of the Carbonic Acid Gas speedily and completely, by laying an air-tube or hose, one end of which communicated with the bottom of the vessel, and the other with the trunk of the Ventilator already described. Nay, they might even be emptied, by simply opening a plug-hole, or cock, placed close to the bottom; as this Gas, from its specific gravity being considerably greater than that of atmospheric air (as 47 to 34), would run off like water.

Although the portion of Air which has passed only *once* through the Lungs has not the whole of its Vital or Oxygenous part converted into Carbonic-Acid Gas, yet it is so far deteriorated as no longer to support flame. Dr. Woollaston, who to profound science joins an uncommon fertility of invention, has devised two very simple, neat, and satisfactory experiments to shew this.

Roll

Roll up half a sheet of letter-paper into a tube about the size of the finger, apply one end to the mouth, and the other near to the flame of a candle, then, making a deep inspiration, ex-spire the Air through it from the lungs; although this be done so gently as not to affect the flame by the *force* of the breath, it will nevertheless almost immediately extinguish it. What shews the effect still more strikingly, is, that by continuing to breathe upon the ignited wick, this will instantly become dim, and die away much quicker than if left to itself; although, as every one knows, a smart blast of atmospheric air put in motion by the mouth, will always brighten the snuff, and often rekindle the wick. By means of the same tube, breathe into a tumbler, or finger-glass, two or three times, and then plunge a piece of lighted paper, or a small taper into the air so collected, and it will be immediately extinguished.

Danger of Sleeping where there are Plants in Flower.

SOME persons are so fond of odoriferous plants and flowers, as to have them in their bed-chamber. This, however, is a dangerous practice, many of them being so powerful as to overcome the senses entirely. Even plants that are not in flower, and have no smell, yet injure the Air during the Night, and in the absence of the Sun, by impregnating it with Nitrogen and Carbonic Acid Gas; although in the day-light they rather improve the Atmosphere, by yielding Oxygen Gas. (*See par.* 28, *and Note* 9.)

A melancholy proof of this occurred in October, 1814, at Leighton-Buzzard, in Bedfordshire. "Mr. Sherbrook having frequently had his Pinery robbed, the gardener

gardener determined to sit up and watch. He accordingly posted himself with a loaded fowling piece, in the Green-house, where it is supposed he fell asleep, and in the morning was found dead upon the ground, with all the appearance of suffocation, evidently occasioned by the discharge of *mephitic gas* from the plants during the night." *Observer of* 16*th, and Times of* 17*th October,* 1814.

It is not said that any attempt was made to restore him, although assuredly proper in such a case.

Exposure to intense Cold.

CAPTAIN COOK in his first voyage of discovery, was accompanied by Sir Joseph Banks, who, though then a young man, and in possession of a noble fortune, quitted the allurements of a great metropolis, to brave the hardships and dangers of a voyage round the World in pursuit of science. Sir Joseph was attended by Dr. Solander, a Swedish physician, and eminent botanist. In the month of January, 1768, these two gentlemen, together with several others, besides servants, went on shore in the Island of Terra del Fuego, which forms the southernmost extremity of South America. Although this island abounds with volcanos (whence its Spanish name of Terra del Fuego, or Land of Fires), and it was then the middle of Summer in the Southern hemisphere, the cold was very severe; and the party having penetrated to a considerable distance from the shore in search of new plants, were overtaken, on their way through a marshy ground, by violent blasts of wind and snow, which they could scarcely contend against. Having at last attained the high ground, where they collected many

rare

rare plants, they prepared to return about 8 o'clock in the evening; and Dr. Solander, who, from having crossed the snowy mountains which divide Sweden from Lapland, knew that extreme cold, when joined to fatigue, occasions a drowsiness that is not easily resisted, intreated his companions to keep in motion, however disagreeable it might be to them; for, said he, "Whoever sits down will sleep, and whoever sleeps will "wake no more." Notwithstanding this, however, the cold became so intense, that he himself was the first to yield to it, and in spite of all remonstrance, lay down upon the snow, and at last fell asleep, as did also a negro servant.—After incredible suffering and exertion, and spending the night with all the horrors of death from cold, hunger, and fatigue, the party succeeded in getting back to the shore next day at one o'clock; excepting the negro already mentioned, and another black who was left with him whilst the rest advanced: these two unfortunate men being unable to walk, (and the others, after every effort to carry them, reduced to nearly the same state,) were from necessity abandoned to perish. Mr. Buchan, one of the gentlemen, and a sailor, were with much difficulty saved.

So valuable a caution could not be too generally known, and I accordingly inserted it in the printed Sheet of Instructions distributed by the Northamptonshire Preservative Society, and directed to be hung up in Public Houses, Mills, Kilns, &c. where it might be often read by most of the middling and lower classes. In the winter of 1795, a poor woman set out, in a sharp frosty morning and fine clear sky, to walk from Kettering to Northampton, a distance of about 15 miles, and chiefly unenclosed country. When about half way, and at least

a mile from any house, the snow began to fall, and so thick, that she could no longer see the road. She therefore got near some high bushes, which afforded a partial shelter; but seeing no prospect of the storm ceasing, and feeling much benumbed by the Cold, she at first gave herself up for lost. Fortunately at this time she recollected the direction given, to *keep constantly in motion*; which she did, by pacing, with quick, short steps, round a small circle, and (to avoid exhausting herself) calling out only at intervals. After persevering thus for several hours, and when the evening began to close, her shouts were luckily heard by a shepherd, who had come out in search of a part of his flock; and she was thus rescued, without suffering any farther inconvenience than from the fatigue and fright: but it is highly probable, that if she had sat down, and once become benumbed and drowsy, she must have perished.

Danger from Riding on the Shafts of Carts, &c.

THE practice of carters, waggoners, and dray-drivers, riding upon the shafts, is frequently attended with dreadful accidents both to themselves and others, especially when, overcome by fatigue or intoxication, they fall asleep, and leave the horses to their own guidance. Remonstrance is useless, and even punishment inadequate to correct the inveterate habit. Iron spikes, fixed on the flat part of the shafts where these persons seat themselves, would no doubt be an effectual, but not a very safe remedy. Whether the following expedient will answer the purpose sufficiently, may be soon determined by the trial; it has at least the recommendation of being safe, easy to execute, and of small expense.—Let a piece of ash, oak, or other firm wood,

wood, from eighteen inches to two feet in length, be planed up to three equal sides, each about two and a half, or three inches broad. When one of these sides is nailed along the upper and flat part of the shafts, where the driver is wont to sit, the piece of wood will then present a sharp ridge, upon which it will be scarcely possible for a person to rest himself, though but for a few seconds.—To prevent this ridge from being cut or broken down, two pieces of iron hoop should be nailed along each side, so that their edges may join at top, or the piece may be crossed by several straps of iron, which, while they in some measure answer the same purpose, will also serve to keep the wood fast upon the shaft.

Of searching for Drowned Bodies.

It has repeatedly been found, that the bodies of persons drowned in small rivers or ponds, are much sooner discovered and taken out by means of common rakes, or of hooks fixed on poles, than by the usual drags; which are best suited to those places where the water is broad and deep, and where Boats can be had to make use of them. But such instruments are objectionable, from their sharp points being liable to wound the body, especially if naked; and as, on the other hand, the loss of even a short period may occasion the failure of all attempts at recovery, a tolerably good *hand-drag* may be speedily made, by heating the prongs of a common pitching fork, and bending them down at the shoulders into the shape of a muck-drag; then, to prevent the points from wounding the body, they should be turned upwards and outwards, in the manner of a fish-hook; and if twisted a little awry towards

wards the shaft, they would have a greater chance of catching the clothes, yet not tear the flesh.

If the body cannot be reached by a person standing on the bank, and there is no Boat at hand, this instrument may be converted into a *hauling-drag*, by tying a stick horizontally across the shoulders of the bent prongs, to keep them from turning over; then making the shaft fast to the middle of a rope, of sufficient length to allow of the drag being pulled from bank to bank, in a zigzag direction, and thereby leave no part of the water unsearched.

Precautions, &c. at Skating-Places.

WHERE deep ponds or rivers that freeze over in the winter, are much resorted to by skaters, long ropes, fir planks, and several hand-drags, should be kept ready in a house or tent near the place, so that they may be speedily got at when wanted. When ice gives way under a person, even though he do not sink beneath it, it is scarcely possible he can get out without assistance, unless the water be very shallow. A long deal should therefore be shoved close to the edge of the opening in the ice; and upon this, one or more persons may stand pretty securely to help the other out. But if the ice be so weak as to render this dangerous, a plank or pole should be pushed to the person to support himself. In the mean time, the end of a long rope should be carried round the place, by a light boy on skates, so that the person may become enclosed in its bight or doubling, and by shifting it under his arms, or between his legs, give a secure hold whereby he can be drawn out. Should no one venture to carry the rope round in the

manner

manner proposed, I consider it very practicable to throw a two pound shot *by the hand*, along the ice, from one side of the Serpentine River in Hyde Park, to the other, and thereby carry across with it the end of a coil of whip-cord, which is fastened to the shot, by means of a plug driven tight into a hole drilled in its side. The rope being tied to the other end of the cord, is then *drawn* across; after which the ball is to be trundled back on the other side of the opening, so as to carry first the cord, and afterwards the rope, round the person who has fallen in.—A ladder, made of light *deal*, will be found very convenient in enabling the person to get out, where the water is not too deep for it to reach the bottom; and even where it is, a cross-piece of three or four feet long, made fast near one end, will prevent it from sinking below the ice: The steps of this ladder instead of being round, should be flat, three or four inches broad, and with their edges placed up and down in respect to the sides; so that when laid down on the ice, a person may stand or walk steadily upon them, and thereby render it equally useful in that way as a plank.

When a person has unfortunately got away from the place where he fell in, and it becomes necessary to search after him with the hook mentioned above, (p. 185) or to break the ice in order to recover the body, several long planks, or a large door, or window-shutter, should be laid down, for those to stand upon who are employed in this; for even thin ice will support a very considerable weight, provided this be made to bear upon a large surface. A gentleman who had sufficient presence of mind to recollect this circumstance, and courage enough

to

to make the best use of it, was thereby the means of saving his companion, under whom the ice had given way whilst he was skating in Hyde Park. There being no ropes or planks immediately at hand, the person who had fallen in, could not have supported himself until they were brought, had not the other assisted him in the following manner. Having ventured as close to the opening as he dared to go on his skates, he lay down upon the ice, and then gradually shoved himself near enough to reach out his hand to his friend, who was thus kept from sinking until proper assistance came.

Life-Buoys.

HARBOURS and Bathing Places should always be provided with these. But although their utility is universally acknowledged, it appears that they are often wanting, from the notion that only block-makers can properly construct them; when, in fact, a common liquor-cask of from *three* to *five* gallons measure, can be fitted up to answer the purpose completely, and at very little expense, by any person who knows how to tie a rope. The sketch contained in one of the plates, will give a pretty correct idea of the contrivance I propose. A cask of the size mentioned is to have from six to eight half-inch ropes placed lengthwise, at equal distances round it, and joined together at each end into one loop. To keep these steady in their places, they should not only be let into notches made at equal distances in each chime, but be crossed and firmly united with other ropes, passing circularly round the middle and ends of the cask. These circular ropes should be thicker, and at each point of junction with the others, should be formed

formed into loops, about twelve inches circumference, and projecting from the cask, so as to afford a sufficient number of holdings that can scarcely be missed.

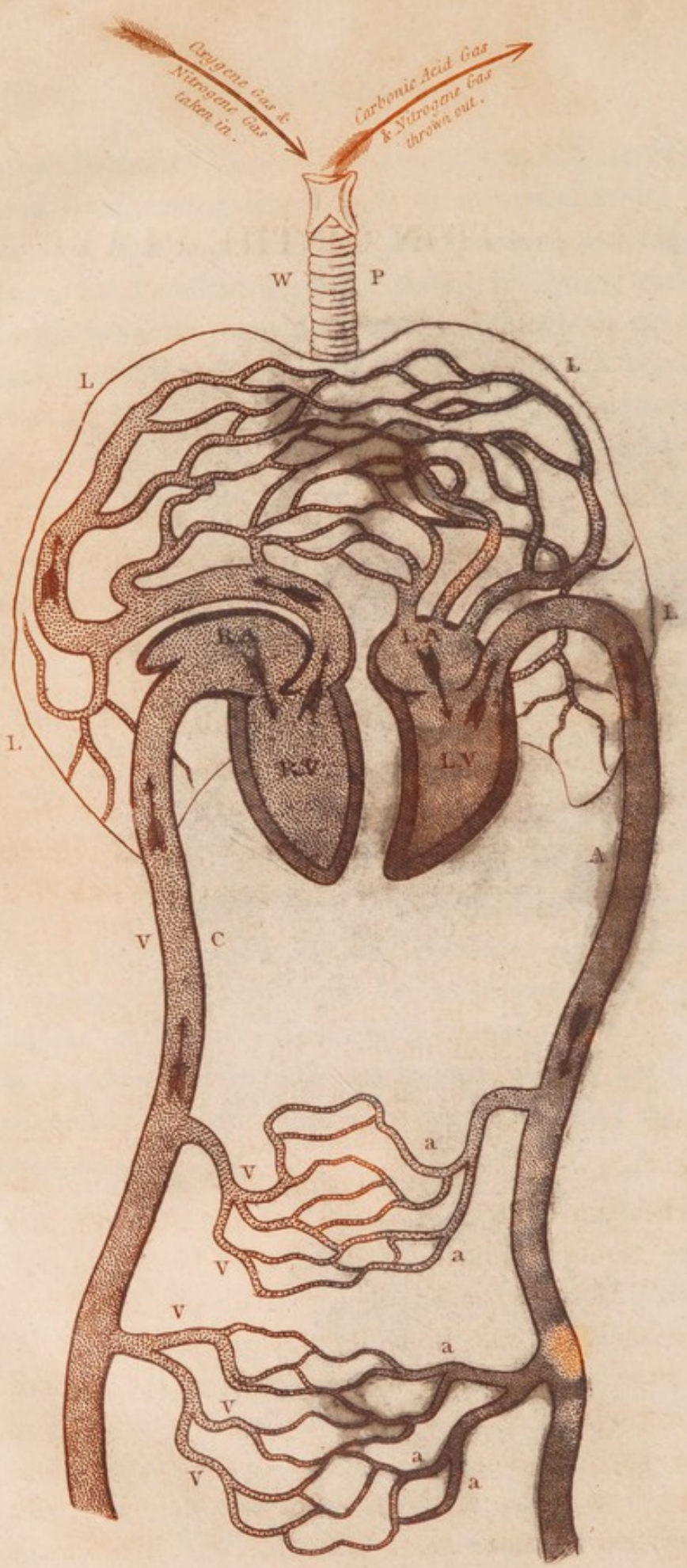
By this simple contrivance alone, the buoy, when launched by a towing rope, will be found in most cases quite sufficient to keep a person afloat. But at sea, or in other circumstances where the person may become so fatigued, as to be unable to support himself by his hands until assistance is procured, a still farther security would result from attaching to each of the large *end-loops*, a ladder, made of rope for the sides, and pieces of *heavy* wood for the steps ; which, by sinking perpendicularly in the water, will offer a resting place for his feet. The ladder may either be made with *two* side ropes, and *one* row of steps, as at A ; or, for greater safety, with *three* sides and three rows of steps as at B ; or, lastly, with *four* side-ropes, and *four* rows of steps, as shewn at C. Farther, to avoid any chance of failure, by the foot passing through the ladder, and thus getting entangled ; a kind of floor may be formed at each step of B and C, by a piece of strong canvass, or sail-cloth, sewed to the wooden rounds, or by a close network of strong cord worked between them.

CONCLUSION.

THOSE whose reading keeps pace with the daily progress of discovery and improvement in this branch of knowledge, may think that I ought to have introduced the experiments of Mr. Brodie, which oppose the *Chemical*

mical theory of Animal Heat. It was not, however, from being unacquainted with these experiments, and still less from any doubt of their accuracy and importance, that I omitted to notice them; for I have in fact, during fourteen years past, publickly taught in my lectures, that although the Blood parting with Carbon and receiving Caloric in the Lungs, may be purely a *chemical* process, yet, that the counterchange, in which the Blood again imbibes Carbon, and sets loose the Caloric in the state of Sensible Heat or warmth, is effected by a peculiar power of the Nervous System, to which I gave the name of the CALORIFIC FUNCTION. This doctrine I deduced from the remarkable difference of temperature, which occurs, both generally and locally, during Fever and Inflammation; and illustrated it by cases, which could not be at all explained on the commonly received Chemical theory, but which admitted of a clear and satisfactory solution upon the principle mentioned. I considered, however, that the introduction of a theory, which would only have served to render the explanation of Respiration and Animal Heat more complex and less intelligible to the majority of readers, whilst it left the practical instructions unchanged, would not have promoted the main object of a treatise intended for popular use.

FINIS.


Oxygene Gas &
Nitrogene Gas
taken in.
Carbonic Acid Gas
& Nitrogene Gas
thrown out.
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EXPLANATION OF THE PLATES.

PLATE I.

In par. 9, page 6-7 of these Observations, it was stated, that—"The human heart, like that of oxen, sheep, &c. is a firm, fleshy, or muscular substance, divided lengthwise by a partition, so as to form *two* distinct and separate cavities or pouches, which, from their situation, are denominated the *right* and *left* cavities of the heart." That—"During life these two cavities are continually filling and emptying themselves alternately; each being supplied with blood by several large Veins which open into it, and contracting as soon as full, drives this Blood into a single great Artery that leads from it." Farther, par. 10, that—"The great Artery which arises from the *left* Cavity of the Heart, gradually divides itself into innumerable branches, which are distributed over all the body, in order to supply the different parts with blood, for their nourishment and growth. From these parts the remaining blood is conveyed back again by corresponding Veins, whose branches join with the branches of the Arteries, and whose trunks terminate in the *right* Cavity of the Heart." Lastly, par. 11, that—"Although the Blood which was sent out from the Heart *on one side*, is thus brought back to it *on the other*, still it has not completed the circuit round which it moves; for there is no *direct* communication between the two cavities. To get from the *right* Cavity to the *left*, therefore, and so perform the same round as before, the Blood must

first pass through *another* Great ARTERY (the PULMONARY ARTERY) the branches of which are distributed solely through the LUNGS, and there join corresponding branches of several large VEINS (the PULMONARY VEINS) which open into the *left* Cavity of the Heart."

In this way, then, the entire circuit of the Blood may be aptly compared to two *nearly* complete circles, a greater and a less, joined together as in the figure 8; and each circle again formed of two trees springing from the Heart as from a common root, and joined together at their extreme branches; the greater circle being that which beginning at the *left* Cavity of the Heart, distributes Blood to every part for various useful purposes, and then returns the remaining portion to the *right* Cavity; whilst the *lesser* circle is that which sends this Blood through the LUNGS only, in order to undergo a certain purification, and then transmits it, so purified, to the *left* Cavity, to perform the same offices as before.

The plate exhibits, not an actual representation of the arrangement which really exists, but *a diagram*, intended to give to those who are unacquainted with Anatomy, a general idea of the *Circulation of the Blood*, and of the important change which it undergoes by the act of Respiration, during the living and healthy state of the human body.

In the sketch the letters *L*, *L*, *L*, *L*, mark the general outline of the LUNGS, which consist of millions of little bladders, or air-cells, not larger than grains of sand,—each communicating with others, and all ultimately with the Wind-Pipe, *W*, *P*, so as to allow the Air to pass freely *to* and *from* every individual cell,

cell, in the alternate acts of Inspiration and Exspiration. Between these Air-Cells, which are composed of exquisitely thin, transparent membranes, the extreme branches of the Pulmonary Artery are spread out as fine as human hairs, and must, consequently, have very fine coats; so that the portions of Oxygenous or Vital Air successively inspired, are thus brought *nearly* into contact with the Blood of the PULMONARY ARTERY, from which it attracts the CARBON that impregnated it, forms with it Carbonic Acid Gas; thereby changing its Colour from a *dull red* to a *bright crimson*, and along with this change of *colour*, altering its *qualities* also, so as to re-fit it for performing its different purposes as at first (par. 13).

The Blood, now made *florid* and *pure* by the influence of the Air, passes successively into larger and larger channels, and is at length poured through *four* large Veins (the PULMONARY VEINS) into the *left* Cavity of the Heart, or Left VENTRICLE, as it is called, marked *L, V*. This cavity contracting as soon as full, drives its blood into *One* large ARTERY, called the Aorta, and marked *A*; through the progressive and ultimately minute divisions of which (marked, *a, a, a, a, a,*) it is distributed to every the most remote part of the body, and supplies them with the portion required for their nourishment and growth, as well as for the formation of various fluids necessary in the Animal Œconomy, such as the Saliva, Tears, Bile, &c. &c. It is during its passage through these minute and extreme branches of the AORTA, that the Blood evolves its *fixed* CALORIC in the state of Sensible Heat, and at the same time imbibes CARBON (par. 53); in consequence of which it loses its *bright crimson* hue, ac-

quires a *dull purplish red*, and passing into corresponding Veins, is conveyed through them to the *right* Cavity, or Right VENTRICLE of the Heart, marked *R, V*. The *right* VENTRICLE, like the *left*, contracts when full, and impels its dark coloured Blood into a single large Artery (the PULMONARY ARTERY) the minute branches of which ramify solely between the air-cells of the LUNGS,—where it is exposed to the influence of the Air,—parts with CARBON,—changes to a bright crimson colour,—absorbs Caloric,—and thus becomes again adapted to fulfil all its former offices.

In reality, the *two* Cavities of the Heart are closely joined to each other, and merely divided by a partition between them; but in order to impress more strongly upon the minds of those who are ignorant of Anatomy, the important fact, that the Blood cannot get from the *right* Ventricle to the *left*, without first passing through the LUNGS, I have represented them in the sketch, as separated from each other. To avoid the confusion, too, which such readers might have experienced by mentioning every part concerned, I have described the Heart (par. 9) as consisting of only two Cavities or VENTRICLES, a *right* and a *left*; and in fact these form the great bulk of the Heart, and are the most essential parts of it; but as the Ventricles would be some time in filling, if the Blood directly entered them at the slow rate in which it moves through the Veins that supply them, each Ventricle has attached to it a *smaller* pouch or cavity, which, from the shape and position somewhat resembling the ears of a dog, have been called the *right* and *left* AURICLES, and are marked *R, A*, and *L, A*. The AURICLES, like the VENTRICLES, are fleshy or muscular, and by their contracting

tracting *suddenly*, assist in filling their respective VENTRICLES with the least delay possible. Besides, as the two VENTRICLES are so closely united, that part of the one forms a part of the other in its substance, so, to prevent the unavoidable opposition and impediment that each would have occasioned to the other had they contracted in succession, they *both* contract at the same moment. During the *contraction* of the two VENTRICLES, the *two* Auricles are *filling* themselves, and then pour their contents into the emptied Ventricles; so that, in this way, the motions of the Auricles and Ventricles regularly alternate.

It is farther obvious, that if there were nothing to hinder it, part of the Blood would regurgitate, or flow in a backward course, under the strong contraction of the Ventricles; but to prevent this, there are Valves or floodgates, placed at the openings through which each receives its Blood from the Auricle; and similar ones at the mouth of the AORTA and PULMONARY ARTERY, so as to resist all backward course of the Blood, and keep the current in its proper forward direction, as denoted by that of the arrows placed in the several parts of the sketch.

The two large arrows represented, one as *entering*, the other as *coming out of*, the Wind-pipe, have their respective explanations affixed to them; the one indicating that *Oxygen Gas* and Nitrogene Gas are *taken in*, the other that *Carbonic Acid Gas* and Nitrogene Gas are *thrown out*; by the Oxygen combining with and carrying off Carbon, whilst the Nitrogene Gas passes *in* and *out* again, without any sensible change either in quantity or quality.

There

There are perhaps few of my readers who will not be at once pleased and astonished to hear, that from a laborious train of experiments, made by Messrs. Allen and Pepys, (two very able chemists,) with a most correct apparatus, and every possible attention to accuracy, it has been ascertained, that the quantity of Carbon thrown out in the form of Carbonic Acid Gas, from the Lungs of a grown person in twenty-four hours, is equal to somewhat more than *eleven ounces* of solid Charcoal! a quantity which is perhaps greater than all the solid matter taken as food by many persons within that period.—It has long been conceived, that Carbon was a *compound* body; and these experiments appear to me to amount nearly to a proof of that conjecture.

PLATE II.

Fig. 1. Represents the Box-wood tube for inflating the lungs. *A*, the conical or funnel-shaped stem, the lower end of which screws or plugs firmly into the conoidal plug *B*; and their bores or calibres join, as represented by the dotted lines. In the original form of the instrument, these two parts were in one continuous piece, and in a straight line with each other. But I found a great inconvenience in that form, as it required the person using it, if he employed his breath for the purpose of inflation, not only to lean over the body, however low it may be placed, but to keep his head constantly turned to one side, in order to apply his mouth to the wide end of the tube, at the time that the other was introduced into one of the nostrils; a position which soon became extremely fatiguing. The present disposition

Fig . 3 .

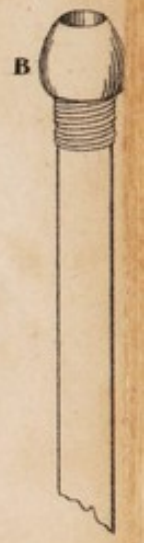

Fig . 1 .

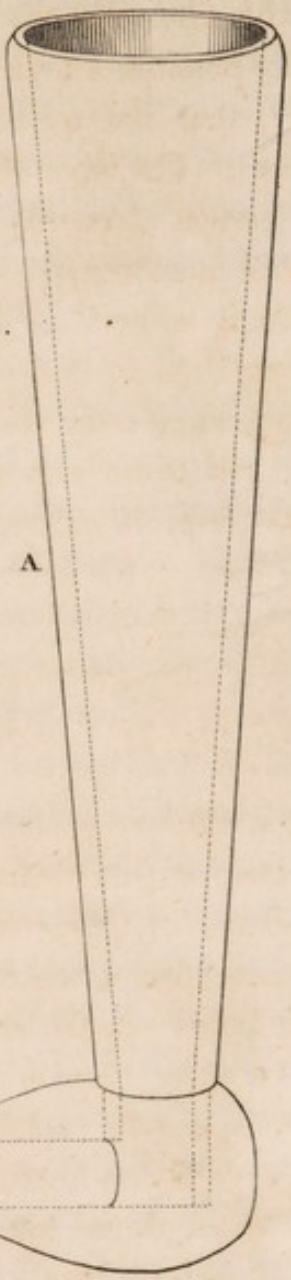

Fig . 2 .

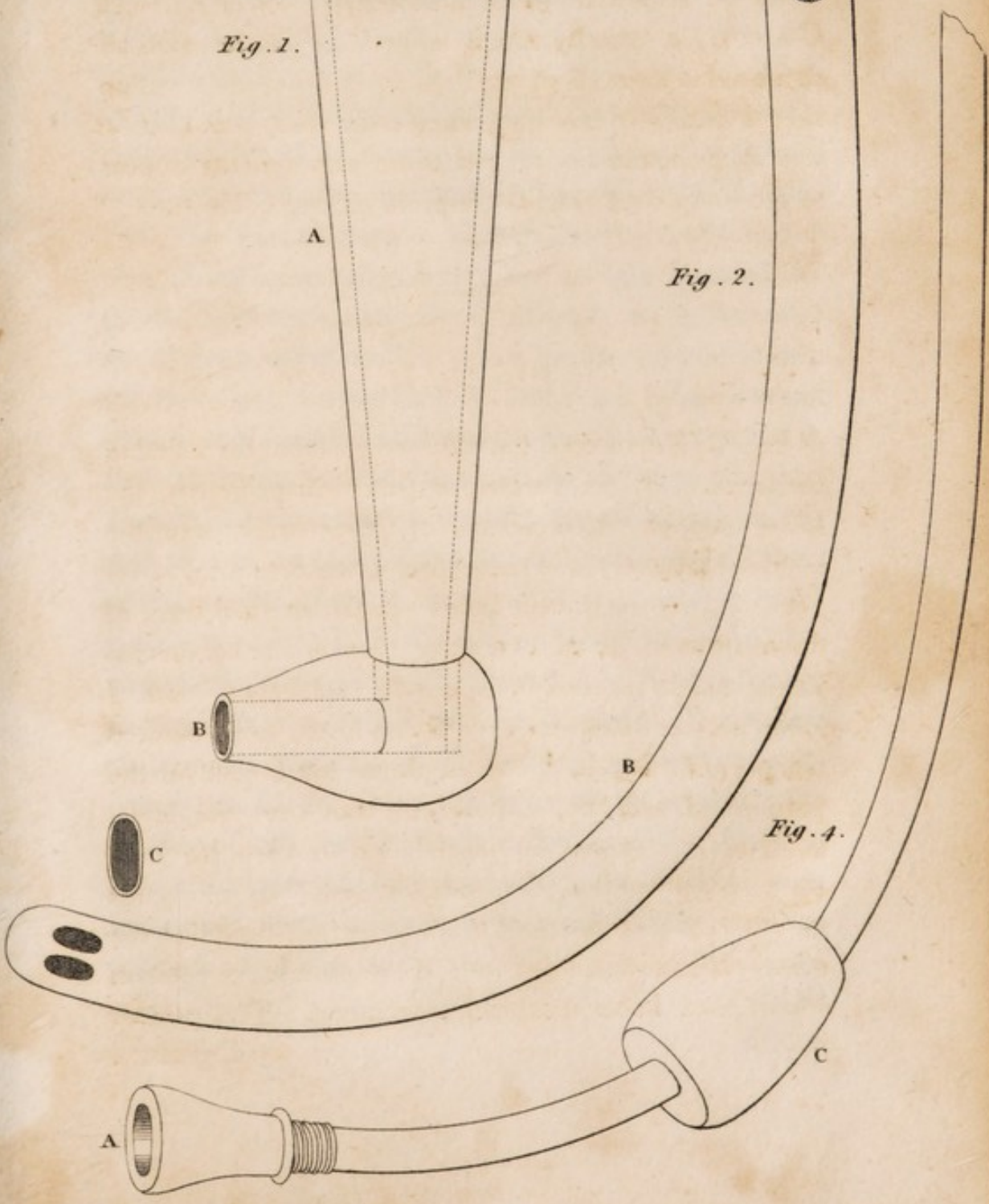

Fig . 4 .

disposition of the plug and stem completely obviates this objection, and also renders it more convenient for that Assistant who manages the bellows, to stand on one side of the body, and introduce their nozzle into the wide end, whilst a second Assistant keeps the tube in its place, closes the other Nostril and Mouth, and presses back the cartilages of the Wind-pipe, so as to close the Gullet, and prevent the air from passing into the Stomach instead of filling the Lungs. *See par.* 77. *and Plate* 4, *Fig.* 1.

Fig. 2. An instrument of this kind was originally proposed by Mr. Coleman, as an improvement upon a much narrower one invented by Mr. Kite, of Gravesend. In Mr. Coleman's Canula, however, the end *c* was left open, so as to expose the delicate chink of the glottis, or entrance into the Wind-pipe, to be wounded by its sharp edges, and the voice thereby injured in case of recovery. To avoid this, therefore, I had the end closed and rounded off, while openings were made in the sides near the end, to allow the air to pass readily. I made the curvature of the tube to correspond exactly with that of the mouth and throat, by bending a leaden model to the parts in the dead body, until I could readily introduce it, in the manner described in par. 82. and additionally explained in Plate V. Fig. 1. As a farther accommodation, I had the Canula made of a *flatted* shape, from the letter *B* of the figure, to the end, so as exactly to fit the oblong aperture of the Glottis: the section of this part is shewn at the letter *c*. The Canula is all made of silver, except the top *A*, which is of brass, and has a screw upon it, which screws into the aperture *A* of Fig. 3.

Fig. 3.

Fig. 3. Is a conical mouth-piece made of brass, with an elbow which screws on the end *A* of the Canula. The wide end is intended to receive the nozzle of a pair of *common kitchen bellows*, which are not only the most readily procured, but from their size and strength, much more effectual than the small ones that usually compose a part of the Resuscitating Apparatus: in truth the latter are nearly useless, as I never saw a pair in any Case of Instruments, that were not so weak in the leather, as to let the Air escape through it readily, when any resistance was opposed to its passage into the Lungs. The nozzle of the bellows should be wrapped round with a piece of wetted linen, or even paper, so as completely to plug up the conical passage of this mouth-piece, and prevent the Air returning back when the inflation is making. To avoid the inconvenience of alternately drawing back the nozzle of the Bellows, or unstopping the nostril or mouth, to let the Air pass out from the Lungs, I had an oval aperture made on one side of the Canula, as represented in the plate; this aperture can be immediately closed or opened as required, by the point of the finger of the Assistant who holds the instrument steady, and keeps the mouth and nostrils shut; closing it when the Air is required to enter the Lungs, and opening it when this air is to be expelled again, either by the spontaneous contraction of the Lungs and Chest, or by compression made on the Stomach by an Assistant, as directed par. 78.

Fig. 4. of Plate II, represents another instrument proposed by Mr. Coleman, for the double purpose of closing the Gullet, and thereby preventing Air getting into the Stomach; and, if necessary, for injecting a stimulating or cordial remedy into the Stomach, (par. 93. 95.)

93. 95.) It is composed of a spiral wire of Brass or Steel, covered with varnished leather; and having at one end a brass mouth-piece, to screw or plug on the pipe of a syringe: and on the other, a small globular knob of Ivory, to prevent any injury to the throat, &c. in its introduction into the Œsophagus, or Gullet. To stop this latter passage, there is a conoidal slider of Ivory, *c*, which is directed to be pushed on with the fore-finger, after the tube is introduced, and thereby to fill the Œsophagus, as represented in Plate IV. Fig. 1.*

As both the Canula with its mouth-piece, and also this Flexible Tube with its Ivory stopple, were given in the former edition of these Observations, and are referred to in the present, I have thought it right to retain them among the Apparatus represented; but I believe that neither will be of much use, from the rigidity of the muscles in the greater number of cases of drowning, locking the jaws so close, as to render it impossible to introduce either of them with certainty and safety into its proper passage. Beside which, I have met with *no* case wherein the Lungs may not be certainly and easily inflated, by blowing Air through the Wooden Tube fixed in the nostril, while the other nostril and the mouth are closed, and the Cartilages pressed backwards and downwards, as already described.

But although the Flexible Tube is of little value as a conductor of the Ivory Slider for the purpose of stopping

* For the sketch given here, I am indebted to my friend, Mr. Charles Bell, whose pencil so ably depicts whatever his correct anatomical knowledge suggests to him as capable of additional illustration in this way.

ping the Gullet, it may be of considerable service for injecting Cordials, &c. into the Stomach, and even, perhaps, in some cases, for drawing Laudanum, or other narcotic poisons, *out* of that cavity, when the power of swallowing and vomiting is lost. For this purpose, however, the tube should be at least sixteen or eighteen inches in length, so as to reach completely to the bottom of the Stomach; and to insure its more easy introduction, it should have a long flexible *stilet* of Whalebone, or Wire, introduced into the end *A*, and reaching nearly to the end *B*, which will give it the degree of stiffness necessary to render it manageable in the hand, yet allowing it to bend to the curvature of the mouth and throat. See Plate IV. Fig. 1.

PLATE III.

The utility of injecting various fluids into the Intestines, is too well known to require argument in favour of it here; but all the instruments I have seen for this purpose, are liable to considerable objections; the most common, viz. the bladder and pipe, being so from its perishable materials, and the Machines from their clumsiness, or risque of hurting the parts concerned. I have, therefore, drawn the figure of a Syringe, which I conceive free from every objection to which the others are liable; and the instrument, which has been made very correctly according to the design, by Mr. Laundy, Surgeon's Instrument Maker, St. Thomas's Street, Southwark, is found to answer the purpose in every respect.

Fig. 1. *A*, *A*, *A*, *A*, are the sides of a brass or copper cylindrical

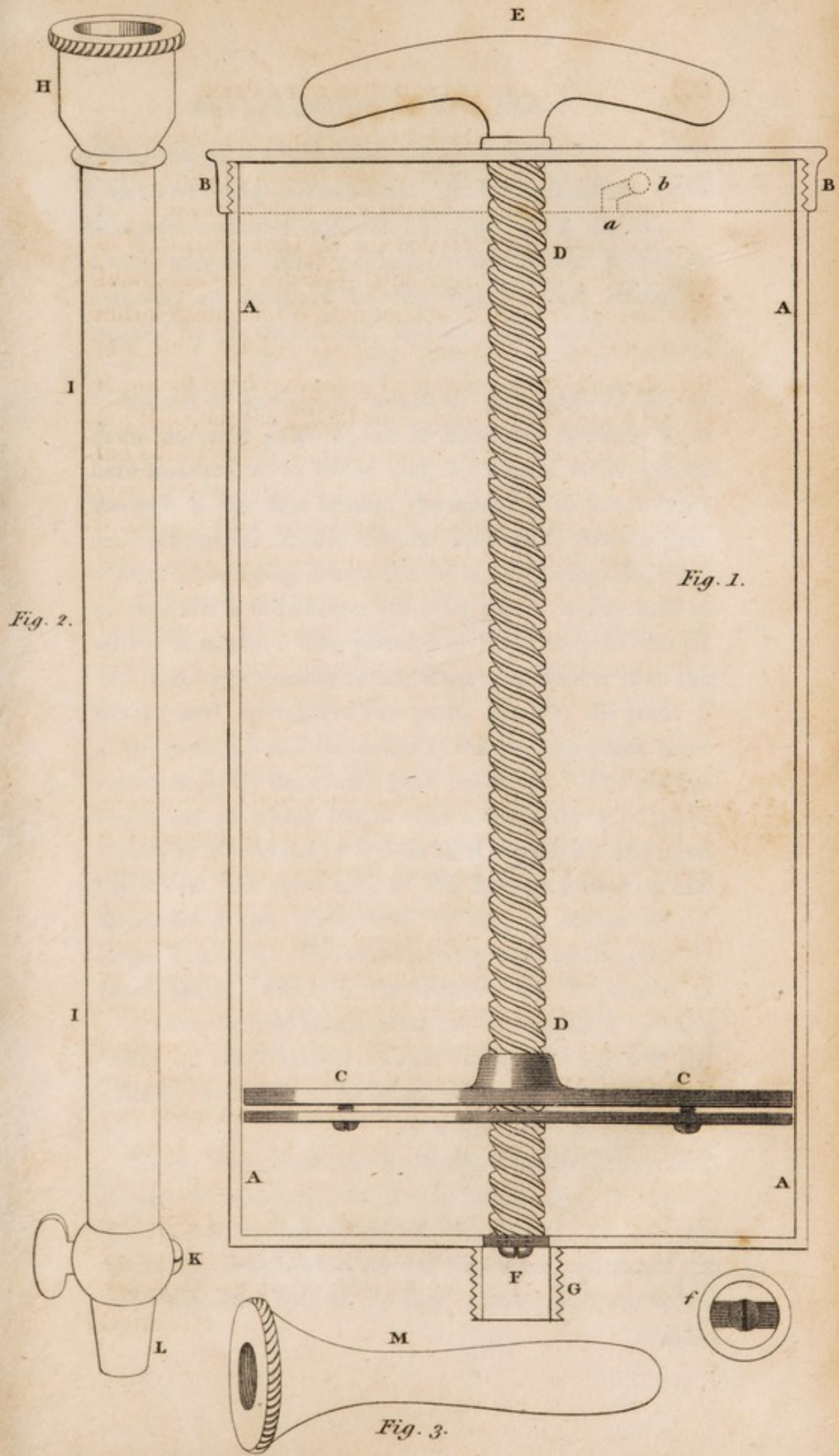

Fig. 1.

Fig. 2.

Fig. 3.

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cylindrical tube which forms the body of the Syringe, the lower end being closed with a circular plate of the same thickness soldered on, and the upper by a cap *B*, *B*, which may be either made to screw on the barrel or cylinder, or fastened by two notches and studs, as marked by the dotted line, and the letters *a*, *b*.

Instead of having the shank of the piston *D*, *D*, to *draw out* and *push in*, as in common syringes, it is here fastened at its lower end, by a pivot which passes through a bar that crosses the aperture in the bottom (as represented in the circular section *f*) and is prevented from being drawn out by a screw nail, the head of which is a little larger than the pivot, or the hole in which it works. The piston-rod fits closely to the lid *B*, *B*, by a projecting collar, somewhat thicker than the shank; and upon these two parts, namely, the pivot *F* at the bottom, and the collar at the lid, the shank turns round easily by the crutch-head handle *E*. The piston-rod is cut its whole length with a treble-threaded swift screw, in a reversed or *left-handed* direction; and upon this screw, the valve *c*, *c*, of the Syringe moves up and down by means of its nave or nut, as shewn at the lower letter *D*. The valve is composed of two circular brass plates, which screw together by the screws at *c*, *c*, so as to hold firmly between them what is called a collar of oiled leather, which makes the valve fit the cylinder so closely as to be air-tight.

Now, from a moment's attention to the description, it will be obvious, that if the piston-valve fit tightly, instead of turning round in the barrel or cylinder when the crutch-head of the piston-rod is turned, it will keep its position in that respect, and *ascend* or *descend*

descend along the rod, accordingly as the handle is turned *backwards* or *forwards;* and thereby first *suck up,* and afterwards *expel,* any given quantity of fluid, from a spoon-full, to as much as the Syringe will hold when the valve is drawn quite up to the lid.

On the lower end, over the aperture through which the fluid enters and comes out, is soldered a short pipe *G.* furnished with several threads of a common male screw, which screws into the Brass head *H,* of the Flexible Tube, Fig. 2. This tube, (which is made of spiral wire, and both lined and covered with varnished, japanned, or water-proof leather,) is about six or seven inches long; the other end is fitted up with a brass stop-cock, so as to prevent the escape of a single drop of the liquid, until the cock is turned for the purpose. Projecting from the bulb of the stop-cock, is a conical brass pipe *L.* which plugs firmly into the broad and milled end of the *Ivory* pipe *M,* Fig. 3.

Having now described the several parts of the instrument as clearly as I can, it only remains to direct the mode of using it. The cross or head of the piston-rod is to be turned in the usual way, viz. from *left* to *right,* until the valve has descended as low down as it can go, which will be until the heads of the screws *c. c.* touch the bottom plate. Then screw the brass cup *H,* of the Flexible Tube, Fig. 2, upon the short pipe *G,* and having firmly plugg'd the Ivory pipe *M,* upon the brass tube *L,* turn the stop-cock *K,* so as to leave the passage open.

Pour whatever quantity or kind of fluid is intended to be used, into a bason, which may be placed in boiling-hot water until the fluid acquires a due warmth; then

then immersing in it the end of the Ivory Pipe, turn the handle of the piston *backwards*, or from *right* to *left*, by which the valve will *rise* along the screw, and the liquid enter and fill the Syringe, until the latter be quite full, or the former all sucked up. Then turn the stop-cock *K*, so as to close the flexible tube, and the instrument is ready for use. To inject the fluid, the piston-head is to be turned *forward*, or from right to left, by which the valve will *descend*, and the fluid issue through the flexible tube and its Ivory Pipe.

Remarks. Although I may, perhaps, have overlooked the defects, and exaggerated the advantages of the present contrivance, yet I would say, that I have seen no apparatus so well calculated to fulfil all the intended purposes as this. Being composed of sheet Copper or Brass (tinned within) it may be made at once strong and light; its length is not above eight inches from the handle of the piston, to the bend of the flexible tube when this is screwed on; and as the piston merely *turns round* instead of *drawing out*, the length of the instrument is not increased by filling the cylinder. The common large pewter Syringe, when the handle is drawn back to charge it, measures nearly eighteen inches in a straight and inflexible line; which, consequently, renders it extremely clumsy and unmanageable under bed-clothes; whereas invalids may not only *charge* this Syringe without any particular assistance, but may also employ it themselves, either when in bed or up, with as much ease and certainty as when aided by another. The common bladder not only soon becomes offensive and bursts, or the tying gives way, and thus incommodes as well as disappoints the patient; but, without particular care, a quantity of air is always included,

included, and this when thrown into the Intestines, immediately irritates them to contract and expel the whole, without bringing away any thing else; and this consequence is farther promoted, by the *quickness* with which, as a test of dexterity, the liquid is usually forced up, which always excites a corresponding strong effort in the intestines to reject it. The Common Syringe is liable to the same objection, of too quickly impelling its contents, and sometimes letting them run out. Whereas this one is subject to neither inconvenience; for without palpable mismanagement (by continuing to turn the handle after all the fluid is drawn into the syringe) not a bubble of air can get admission; and the fluid *cannot* be in any case *suddenly* expelled; for the motion of the screw, though powerful, is steady and slow, whereby the intestines are made to yield gradually and more permanently to the distension.

This Syringe, from the circumstance of its moving power being a screw, exerts a force, both of *suction* and *expulsion*, far greater than can be obtained by any other mode of construction; and accordingly renders it peculiarly fitted, not only for throwing any fluid *into* the Stomach, but also for drawing any fluid *out* of it, by the long Flexible Tube, Fig. 4. Plate 3. By these two instruments, a quantity of Water, &c. may not only be easily injected, in order to dilute any poisonous matter previously swallowed; but I think it even practicable to *draw this fluid back again*, and thereby lessen the effect which would necessarily follow its remaining there: as for example, in cases of Laudanum or Spirituous liquors being taken in such large quantity, as to suspend the power of swallowing and vomiting.

To

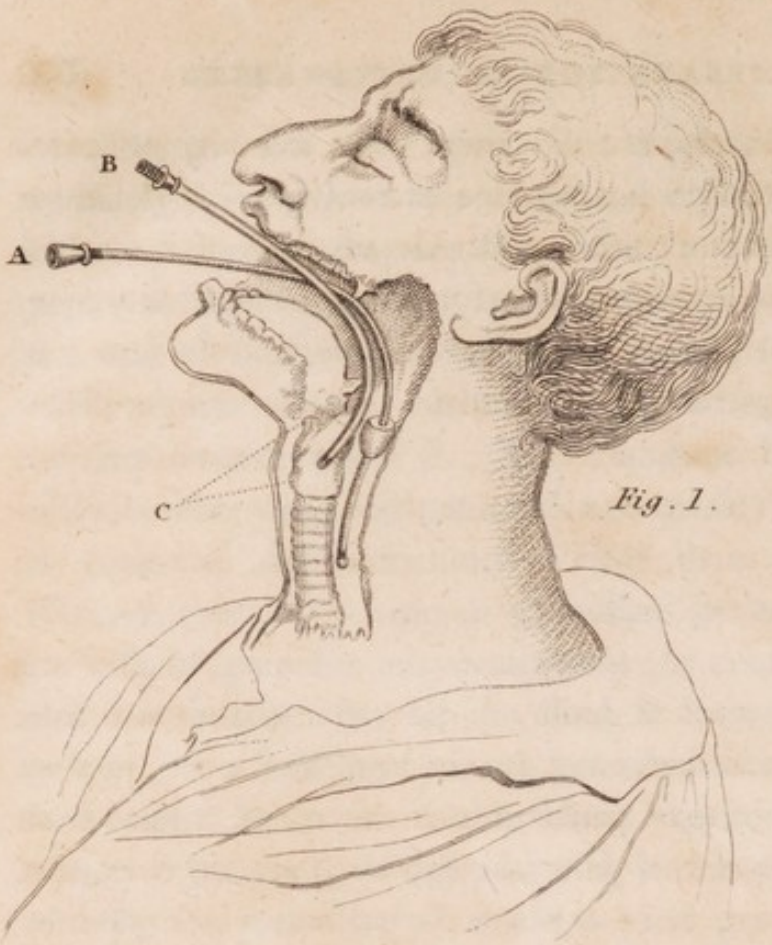


Fig. 1.

C.B.delin.t

Fig. 3.

Fig. 5.

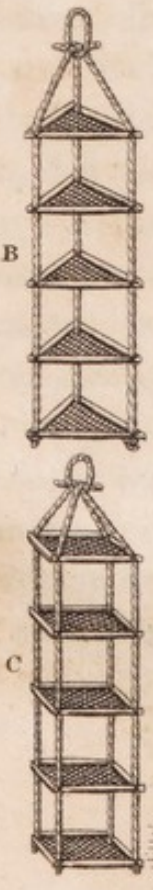
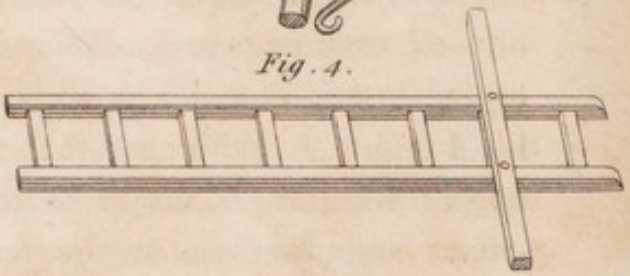


Fig. 4.



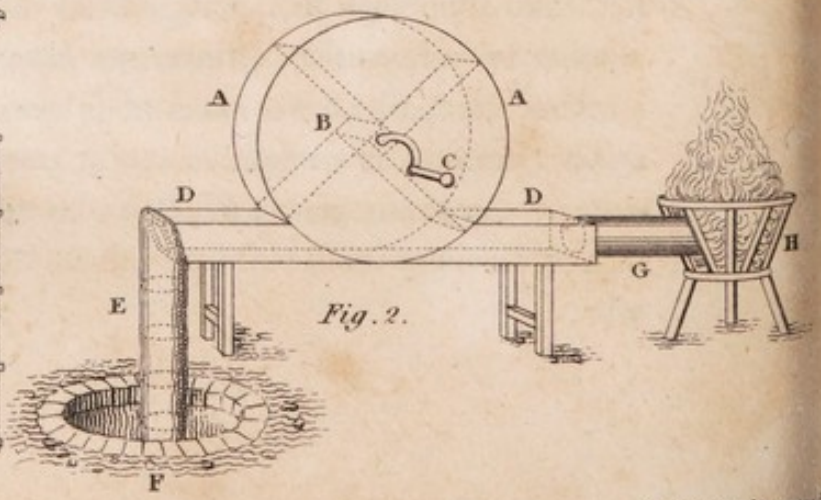


Fig. 2.

I.C.inv.t et delin.

G. Gladwin sculp.

To avoid any injurious impregnation from the Copper or Brass of the Syringe barrel, it should be well tinned throughout the inside: Or to those who do not regard the additional expense for obtaining at once security and elegance, the instrument may be made of plated Copper, which now rivals Silver itself, both in appearance and utility.

PLATE IV.

FIG. I.—In order more clearly to explain the directions given in par. 81-2-3, for using the long Flexible Tube and Silver Canula already described, a sketch is here given of the parts about the throat, to shew the relative situation of the Wind-pipe and Gullet. The skin and muscles, &c. are represented as cut away on one side, so as to display the several passages. *A* is the Flexible Tube, shewn as introduced beyond the Wind-pipe into the Gullet, and the Ivory slider or stopple pushed on into the beginning of the latter passage. *B* is the Silver Canula, having its smooth and rounded extremity in the Wind-pipe. At the bottom of the Tongue is seen a small body projecting, which is the Epiglottis, or Valve that shuts down upon and closes the entrance into the Wind-pipe, as often as the tongue is drawn back in the act of swallowing either food or drink; to facilitate and secure which, the top of the Wind-pipe is drawn upwards at the same moment, so as to meet the valve. (*See also par.* 119.)

The dotted lines marked *c*, point out the projecting part of the Wind-pipe, vulgarly called Adam's Apple, which is to be *pressed backwards* to shut the Gullet, and

at

at the same time *drawn downwards*, to remove the opening of the Wind-pipe from the Valve, and thus let the Air blown through the nostril pass freely into the Lungs. (*par.* 78.)

The remaining figures in this Plate represent several contrivances for preserving persons from danger of various kinds; but which will perhaps be found to have few claims either to ingenuity or utility. Such as they are, however, I offer them with due deference; well knowing, that in a country which, like England, excels all others in the talent for invention and improvement, a crude suggestion thrown out by one person, will often be expanded into a valuable discovery by the genius and industry of others.

Fig. 2. The frequent and destructive explosions which have within these few last years taken place in various Coal-Mines in the North of England, the number of useful lives lost by them, as well as the consequent irremediable distress of husbandless wives and fatherless children, naturally claim pity and attention; and accordingly, a benevolent *few* have formed a Society to promote the discovery of means calculated to lessen or prevent such calamities in future. But, alas! what are we to think of the public philanthropy and spirit, when we learn, that notwithstanding the enormous opulence of Mine-Owners, and the serious losses which *they* must sustain by such accidents, yet that *funds* are still wanting, sufficient to offer premiums which may stimulate ingenuity to exertion, and reward time and labour spent, in devising successful expedients for the purpose! I have seen an ingenious contrivance of a lamp, which having no free communication with the

the Atmosphere, was to be fed with Air from time to time by a pair of bellows. But it appears to me, that, besides its allowing the Hydrogen Gas, Inflammable Air, or Fire Damp, to accumulate in the Mine, and at last *suffocate* the workmen, it will inevitably be fed, on many occasions, by such a mixture of Oxygene and Inflammable Gases, as will take fire and explode from contact with the flame in the lamp, and thereby immediately fire the whole Mine when it is charged to the utmost, and consequently cause proportionally greater destruction.

What I propose for trial, as being at once simple in design, cheap in execution, and offering some prospect of advantage, is rudely sketched in Fig. 2, and will be readily understood from what I have said in pages 174, 5 and 6. *A*, *A*, mark the drum or barrel, the circumference of which is enclosed by a circular hoop of wood, and the sides by two flat round ends; *D*, *D*, is a square trunk fixed to the lower side of the drum, and allowing air to pass into or out of it, through the opposite ends *D*, and *D*. In the axis of the drum, a square wooden axle is placed, which turns round on two iron gudgeons, or pivots, that pass through the opposite heads. This axle has a thin flat leaf or fan nailed to each of its four sides, and projecting at right angles to each other, so as nearly to touch both the circular rim and the two flat heads; so that when turned round by a winch outside, the leaves of the fan give motion to the air within, by *driving* a portion of it *out* of the end *D*, *G*, of the wooden trunk *D*, *D*, and *drawing in* an equal quantity through the other end *D*, *E*. Over the latter aperture is closely fastened one end of the *hose*, or flexible tube, made of sail-cloth or

painted canvass, and its sides kept from collapsing by hoops of cane, &c. placed within, as represented in the sketch. The other end of this is then let down to near the bottom of the Well, so that the supply of air to the machine, can only be made through it, and thus the *foul* air which exists there, be drawn out. The drum and its square trunk should be mounted on a frame, so as to place the winch or crank at a convenient height to be turned by the hand.

Such is the contrivance I offer for exhausting Wells, Vaults, &c. of *foul* air; and for this purpose, the machine need not be larger than that used for winnowing grain; but I am induced to believe, that a similar instrument *upon a large scale*, worked by Wind or Steam, and with the alterations and additions I shall now describe, might be employed with considerable effect, in clearing Coal-Mines from Inflammable Gas, or Fire Damp, and thereby lessening or preventing the loss of lives and property which now so often occurs. The alteration is this. Instead of the perishable hose of canvass, which would last but a little while in such situations, let the tube going down into the Mine be made of coarse pottery-ware,* such as are now frequently employed for water-pipes. These being made in pieces, could be jointed, so as to reach any length; and as they admit being formed with elbows, they could

* I had at first thought of Cast Iron, as the material for forming these tubes, as it could be made of any required size, or figure, and at even less expense than wood; but I casually read a remark in some work lately, which stated, seemingly upon the ground of experience, that this material was quickly destroyed by rust in mines; and I was thereby induced to give up my first idea, and substitute pottery instead.

could be adapted to all the branchings and windings of the Mine; their joints being made air-tight, so as to leave no source of supply to the Exhausting Machine, except through the open extremities, which should terminate at the roof of the Mine, in every part where Inflammable Air is likely to collect. In addition to this, which would still leave the Ventilator effective only by its *mechanical* operation, I propose, that the peculiar properties of the Gas itself, viz. its lightness and inflammable quality, should be made to assist in its removal. For this purpose, let a cast-iron tube *G*, of adequate length, width, and thickness, be fixed to the *issuing* end of the wooden trunk, and let the extremity of this tube enter some way into a furnace, or grate, in which fire is constantly to be kept burning. The iron tube thus kept red-hot, would not only produce a draught of Common Air through it to supply the fire, but, when the only source of supply is from parts where Inflammable Gas abounds, will, by the burning of this Gas as it issues from the end of the tube, create an *additional* demand to that made by the motion of the *fan*, and thus draw this light gas from the deepest recesses of the Mine, while the heavier Atmospheric Air will naturally descend down the shaft, to supply its place; and thereby a constant succession of *fresh respirable air* be furnished to the workmen, at the same time that they are freed from the danger of suffocation or explosion by the Inflammable Gas, to which they would otherwise be exposed.

FIG. 3. Represents the HAND-DRAG, into which, on a sudden emergency, a common pitching fork may be

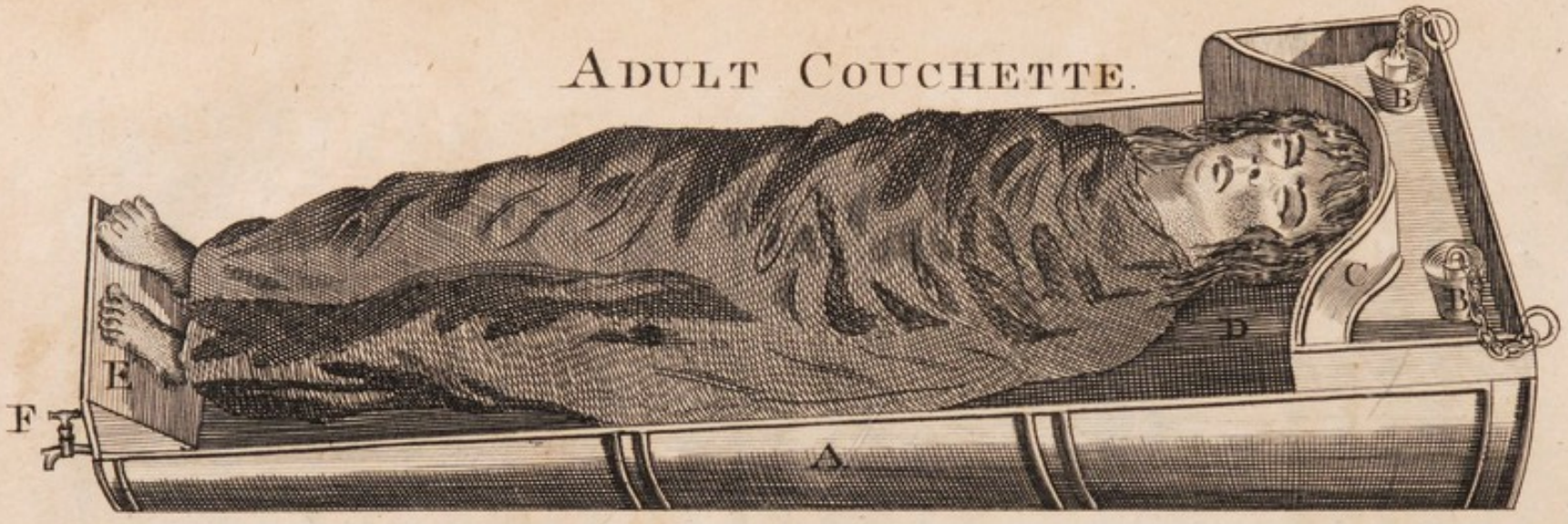
be converted, by heating the prongs red-hot, then bending them down at the shoulders, and afterwards turning the points *outwards* and *upwards*, so as to give a chance of catching the clothes without wounding the body. When used by a rope, a piece of wood like the shaft, and about two feet long, should be tyed fast across the prongs to prevent them from turning over, and thereby keep the hooked points in contact with the bottom of the river or pond.

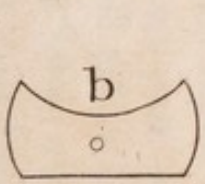
Since my attention has been turned to this subject afresh, I have conceived that a Hauling-Drag might be contrived, much more safe and effective in its use than any I have yet seen; but I have not yet had time to complete my ideas upon the subject, so as to put them into the hands of a workman in order to form a model. I hope, however, that this will soon be the case, as the large premium annually offered by the Society for the Encouragement of Arts, proves that such a thing is generally considered as an important desideratum, by those who are best able to appreciate its value.

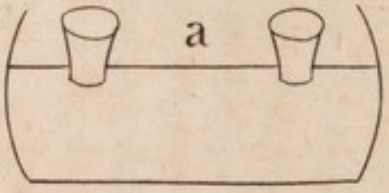
FIG. 4. Represents a LADDER made of deal, for assisting persons who have fallen through the ice: see page 187. The cross-bar to prevent it from falling through the opening of the ice, may be fastened on, either by a rope, or by iron pins as represented in the figure. But it has occurred to me since the sketch was made, that it would be best to employ iron pins, and to have one of these made with an eye and spring lynch-pin at one end, so as to admit of being taken out when not required for use, and thereby turning the bar lengthwise,

in

ADULT COUCHETTE.







A.—*The* MACHINE.
B.B.—TWO APERTURES *for conveying water to the inside.*
C.—A GUARD *to prevent the water running upon the Body laid upon the Tin.*
D.—*The upper surface of the Tin.*

INFANTS.

E.—*The cavity continued in order to give heat to the feet.*
F.—A BRASS COCK *to let off the water.*
a&b.—SECTIONS *of the* MACHINE.
C.—*One of the Tin Supporters soldered within.*

in a line with the side of the ladder; which would render it more convenient to carry and put away, when not in actual use.

FIG. 5. Is a sketch of the LIFE-BUOY mentioned in pages 188-9; and requires no particular description after what has been said there. It is only necessary to observe, that eight semicircular notches should be cut in each chime of the cask, to keep the longitudinal ropes steady, and at equal distances. If thought advisable, instead of the hand-loops being made of *inch-rope*, which will not of itself be buoyant when wet, and is also unpleasant to grasp for any length of time, half-inch or smaller rope may be used, and this covered with wooden *roundlets*, either cylindrical or oval, which are considerably lighter, and easier to hold by: these will also necessarily keep the loops open, so as to be more readily caught hold of.

PLATE V.

This plate, (the use of which was obligingly granted to me by the Committee of the Royal Humane Society) requires little explanation beyond what appears on the plate itself. The COUCHETTE is made of tin-plate, and for an adult should be full seven feet in its extreme length; and tapering gradually from two feet at the head, to twelve or fourteen inches at the feet. The lower bottom is quite flat, and the upper one, on which the body (wrapt in a blanket) is laid, should be a little hollowed, so as to fit the rounding of the body. These two bottoms or floors, should be about six inches

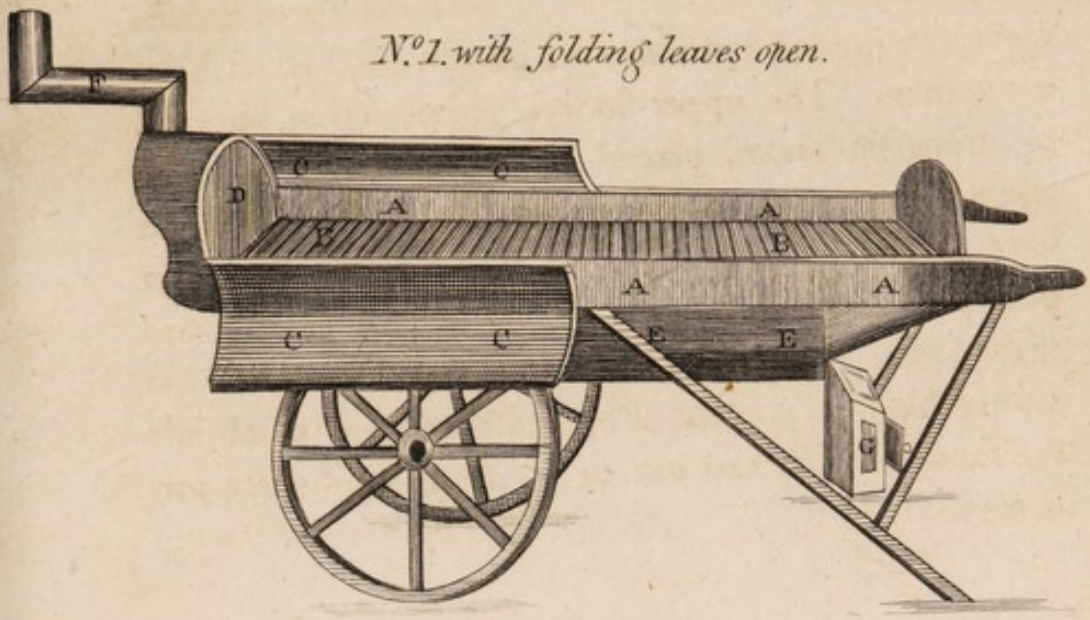
inches asunder, so as to contain between them a sufficient quantity of hot water to preserve its warmth for some time. The upper floor is supported at intervals by strong tin plates, placed like the bridge of a violin, and soldered both to it and the bottom: these should have arched openings made in them, to let the water pass freely into every part of the cavity. To guard against rust, it should not only be painted outside, but also within, by pouring a quantity of thin paint into the funnels *B B*, and turning it about until every part is covered.

PLATE VI,

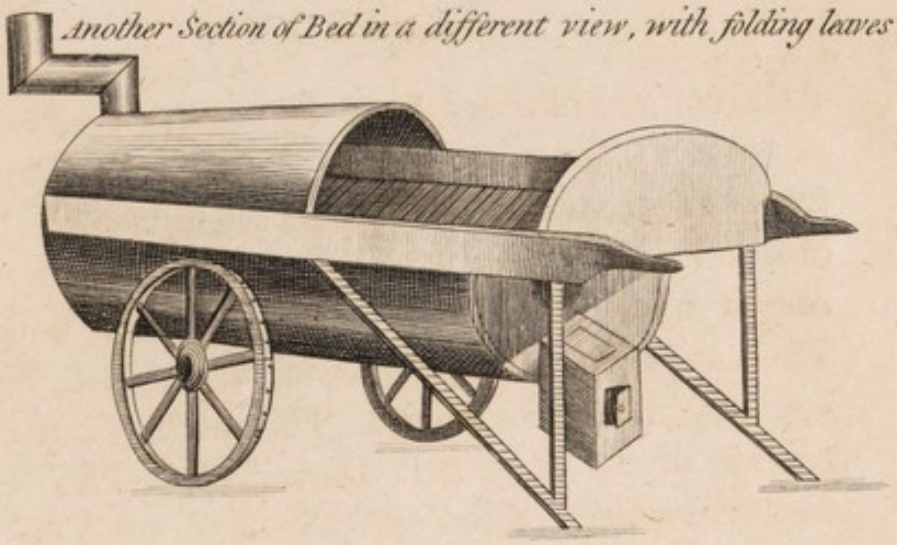
And last, was obtained from the same source, and represents a light Caravan, or PORTABLE BED, for transporting, with expedition and safety, the body of a drowned person, from a remote river or canal, to the nearest house where proper assistance can be given. The explanation contained in the plate itself, renders any thing more unnecessary. This machine is the contrivance of the Rev. Mr. Davies, of Leicester; and displays ingenuity as well as philanthropy. I can suggest no improvement except in adding another pair of folding flaps to come as high as the chin, or even to cover the head, during the time the body is removing from one place to another: and to have both sets made of *flat* boards, joined by hinges, so as to let them either fold over and meet with the opposite ones, or to hang down perpendicularly, and thereby out of the way, when the body is required to be uncovered.

The

N.º1. with folding leaves open.



Another Section of Bed in a different view, with folding leaves closed.



N.º1.

A. *Frame of Deal 6 Feet long.*

B. *Strong Sacking nailed to one side, and corded to the other.*

C. *Two folding leaves of Deal dovetailed & curved to increase the warmth by meeting at top.*

D. *Tin warmed by contiguous pipe for the feet.*

E. *Belly of the Bed made of Tin inclosing a pipe along the Bottom: the Tin nailed to the Frame on both sides, every way excluding the external air.*

F. *Funnel or Pipe about 2 ½ Inches diameter of sheet Iron; joints very well fitted; bent to enter a Chimney in any ground floor room.*

G. *Fire place.*

When used in open air, there is another piece of pipe fitted to the end, to carry the smoke further.

The following remarks upon it are given in the Reports of the Royal Humane Society.

1. " Its principal object is to afford a general and sufficient warmth to the body.

2. " It holds the body in a convenient situation for employing inflation, friction, or any other means of recovery.

3. " It is so light, that any person can wheel it about with the body placed in it.

4. " It is sufficiently narrow to enter the ground-floor apartment of any house where there is not a sharp turning.

5. " When an accident calling for its use occurs, a few shavings, or chips, &c. lighted in the fire-place, will warm the bed by the time it has been wheeled down to the river side. The Resuscitating Apparatus, blankets, cloths, &c. can be carried in it.

6. " Standing on two *wheels* and two *feet*, like a wheel-barrow, the bed is raised about two feet and a half from the ground, which is a convenient height for all the operations required."

J. M'Creery, Printer,
Black-Horse-Court, Fleet-street, London.