

An enquiry into the causes of suspended animation from drowning : with the means of restoring life. by David Hosack, M.D.

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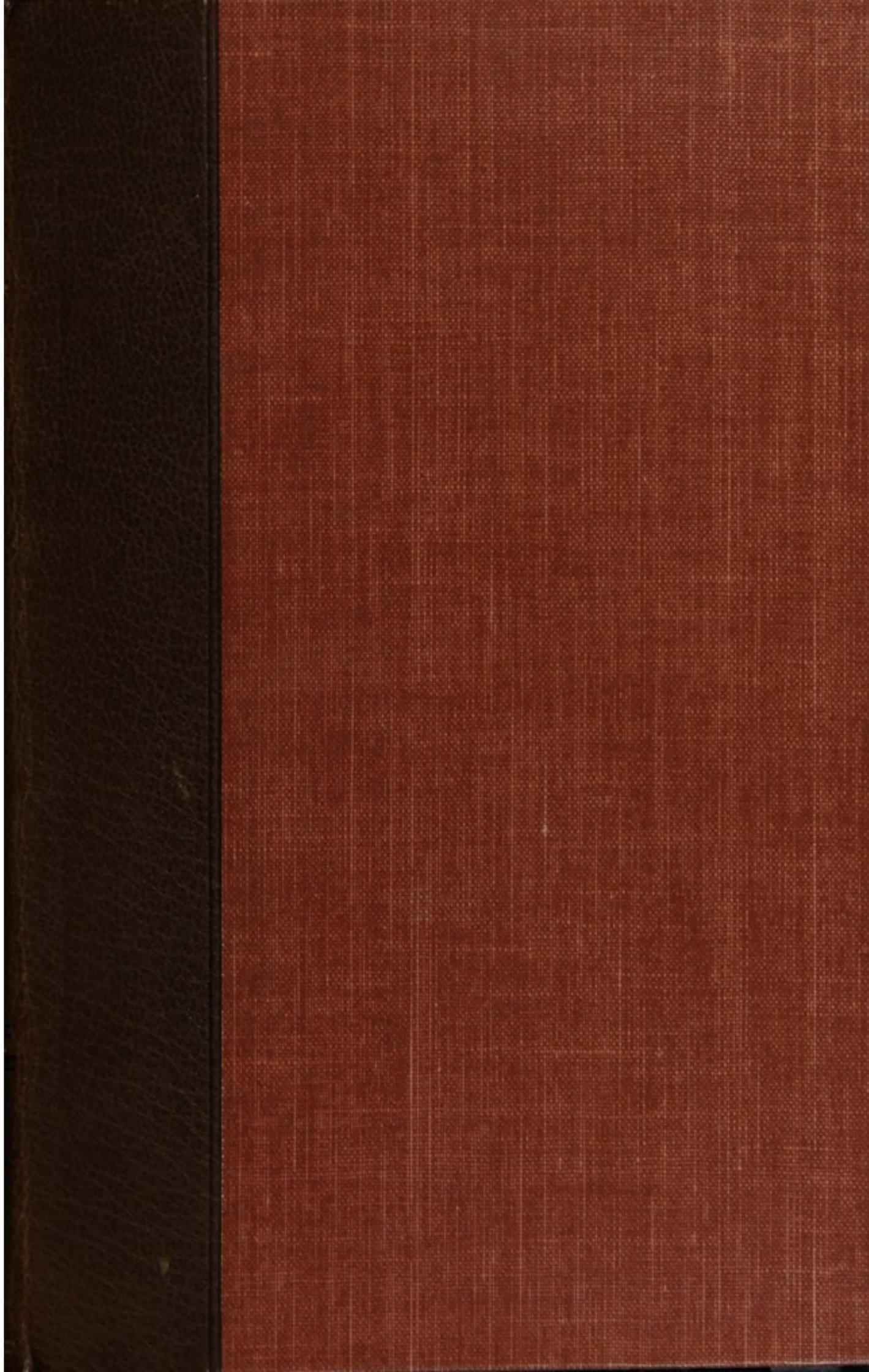
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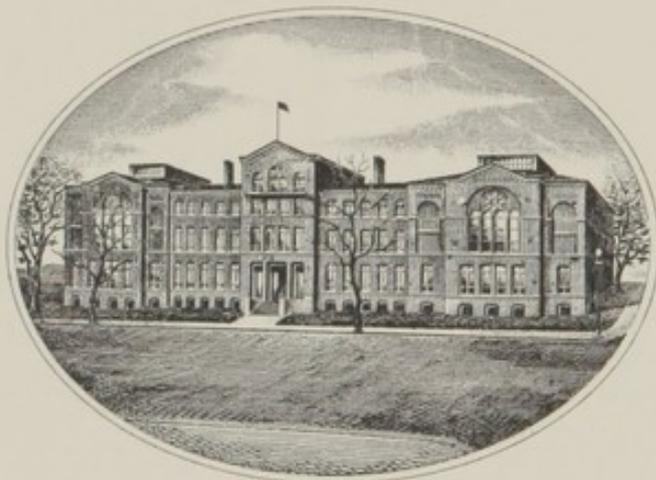
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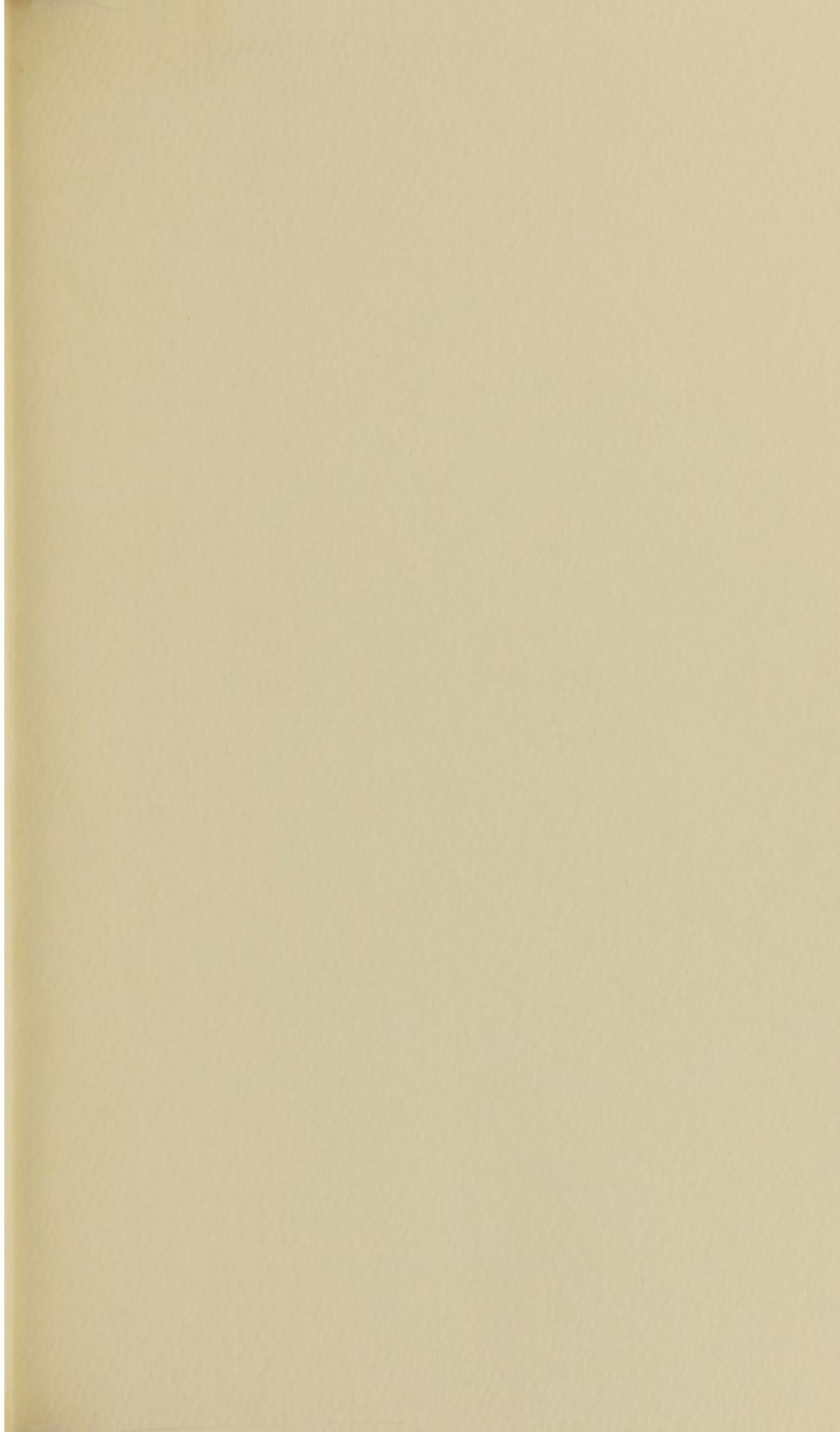


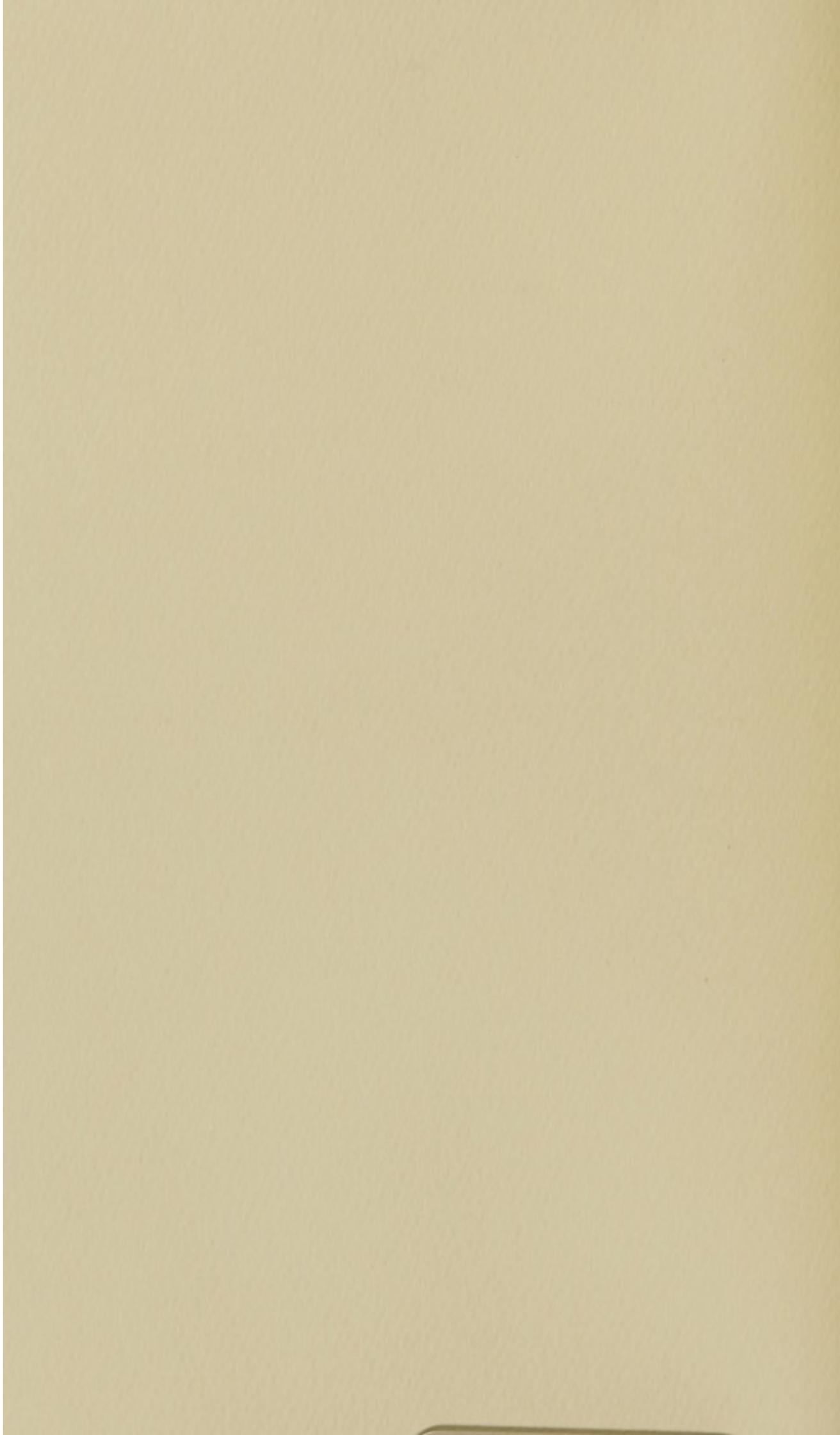
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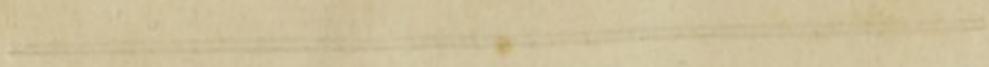




A. Duncan

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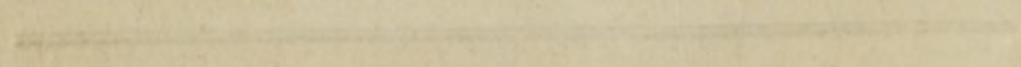
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M E A N S O F R E S T O R I N G L I F E .

BY DAVID HOSACK, M. D.

Utilia selegit, sic utile.

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—1792.—

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BY DAVID GREEN, M.D.

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1854

INTRODUCTION.

AS the celebrated Doctor Rush observes, “the present is an age of great improvement. While the application of reason to the sciences of government and religion is daily meliorating the condition of mankind, it is agreeable to observe the influence of medicine in lessening human misery, by abating the mortality or violence of many diseases.” Of the truth of this progress of the healing art, we cannot produce a more happy instance than the late improvements for the recovery of the drowned.* It is now but little more than twenty years since the first association for this purpose was formed at Amsterdam, and but fourteen since the first existence of that in London; and yet near one thousand persons have been preserved from death by those two institutions.—Societies for the same benevolent purpose have been established at Paris, Venice, Hamburgh, Milan, and in our own country at Philadelphia and Baltimore. From their reports it also appears, that a very large proportion, not less than three fourths, of
persons

* In the following pages the terms suspended animation, death, and drowned, are made use of promiscuously.

persons apparently dead, have been recovered; and that this recovery may be effected after they have been a long time, even hours, in that situation.

Unfortunately, however, in this city we cannot yet boast of such success. To what must we attribute this? I suspect in some measure to our want of perseverance in the use of those remedies which are known to be effectual, and to the unhappy prejudice which prevails among many of our citizens in favour of that most pernicious practice, rolling the body upon a barrel, and holding it up by the heels, immediately upon taking it out of the water; which is done with the view of discharging the water they suppose to have been swallowed. It is at present, however, well ascertained, not only by dissections of drowned men, but also from a variety of experiments upon other animals, that there is very little and frequently no water found either in the lungs or stomach; except in the former, where there is generally found more or less froth, which I conceive does not arise from any water taken in, but is generated there, as in some other diseases where respiration is suspended, or even where it is irregular, as in epilepsy, &c. But admitting there is water both in the lungs and stomach, there could not possibly be devised a method which is more destructive of life, especially in its latent state, than either rolling upon a barrel or hanging by the heels.

Without

Without particularly enumerating the consequences of these practices, suffice it to remark, that there is scarcely a single instance known of a recovery after these measures have been used. To remove this unhappy prejudice, however, as also the more generally to diffuse among our citizens a knowledge of the most effectual means of recovery, nothing can more immediately contribute than the establishment of a society for this express purpose, which I am happy to add is now in agitation, and which, I hope, will meet with the countenance of the citizens at large.

The first part of the paper is devoted to a general
 consideration of the subject, and to a statement of the
 objects which it has in view. It is then divided into
 three parts, the first of which contains a description
 of the nature and extent of the disease, and the
 second a statement of the symptoms which attend it.
 The third part is devoted to a description of the
 treatment which is to be pursued, and to a
 statement of the success which has attended it.
 The paper concludes with a few remarks on the
 prevention of the disease, and on the means
 which are to be pursued for its cure.



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S U S P E N D E D A N I M A T I O N , &c.

THE most distinguished writers upon this subject are Doctors *Cullen*, *Goodwin*, *Kite*, and *Coleman*: the three last of whose performances met with so much applause, that each was honoured with a *medal* from the Humane Society of London; but notwithstanding the reputation these performances met with, still each of them I conceive is liable to exceptions: these I shall endeavour to point out, by an enquiry into the nature and operation of the *causes* to which they have differently ascribed death from drowning, and thence deduce some principles upon which to found a more certain mode of recovery than has yet been suggested. To do this more clearly, I beg leave to premise the following first principles as relative to animal life:—

1st. That

1st. That in every animal there is a *living* or *vital* principle, or what Doctor Cullen calls a “certain condition in the nerves and muscular fibres, by which they are sensible and irritable, and upon which the action of the heart itself depends:” as to the seat or source of this principle there have been different opinions;* thus much, however, we know as applicable to our present purpose, that in many instances it subsists for some time after respiration and the circulation of the blood have ceased. It is also well known, that while it exists it is capable of being restored to all the purposes of life, hence (as we are credibly informed) several persons have been restored after hours continuance under water.†

2d. That

* Some have supposed it to reside in the nervous-system; but others, with perhaps more probability, that it resides in the blood; among whom are Harvey, the discoverer of the circulation, and John Hunter, the present celebrated anatomist of London.

† See Medical Commentaries, vol. xvi. p. 190.

In the New-York Magazine, vol. ii. p. 624, there is also an instance of a recovery after the person had been at least an hour under water, and that principally from injections of tobacco smoke.

Northcote, in his Marine Practice, observes, that he has “generally been able to bring about the recovery of those who had been but from four to twenty minutes in the water.” He also adds, that “he has known numerous instances of recovery though they had appeared to be dead for even five or six hours.”

Dr. Cullen likewise observes, “that it has often happened that though means employed for one hour have not succeeded, the same continued for *two* or *more* hours, have at length had the wished-for effect.”

2d. That for the support (if not the very existence) of this vital principle, are necessary,

1st. Heat ;

2d. Respiration ;

3d. A regular circulation of the blood ; and,

4th. A due excitement of the brain and nervous system.

Such is the connection between these different functions,* and such is their mutual dependence upon each other, that it is difficult, if not altogether impossible, to determine which is the cause or which the effect. This much, however, I believe is certain, that they are all essential to animal life, and that the one cannot exist without the other.

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Hence

It should therefore be a constant rule (and which I hope our citizens will more particularly observe than they have hitherto done) that the proper means should be employed for several hours together ; and if we can credit a case recorded in a European Magazine, we should not despair of success even at the end of *twelve* hours ; an instance is there recorded of a man who had lain that length of time in the water, and yet was recovered by the warmth of sheep-skins.

* From the importance of heat in the animal œconomy, and its equal importance with the vital functions, I have classed them together promiscuously ; for to have considered heat as distinct from, and unconnected with, those functions, would not only have destroyed the arrangement I have endeavoured to preserve, but also would have rendered the principles upon which I account for suspended animation less intelligible.

Hence then must appear the absurdity of an attempt to explain the cause of death from an interruption of any *one* function exclusive of the rest.

The importance of *heat* in the animal œconomy, and as immediately connected with life, has ever been admitted; nay, so intimately are they blended, that the least change of temperature produces, like heat upon the mercury of a thermometer, a similar change upon the principle of life: For instance, when the body becomes but a few degrees warmer or colder than its natural standard (from 96 to 98 deg. of Fahrenheit,) the principle of life becomes proportionably weakened, and upon an increase either of heat or cold life is totally extinguished. To produce some familiar examples of the truth of this we need but mention the different states of the human body in the different seasons of the year, and in different climates; the suspension of the living principle in those animals which are in a state of torpor during the winter; and lastly, its immediate operation upon the different functions of the animal œconomy, *natural* as well as *vital*; hence then the immediate importance of heat in restoring life in cases of suspended animation, whether from *drowning* or from whatever cause it may arise.

2d. *Respiration.*

2d. *Respiration.* To *live* and to *breathe* are synonymous. It is not my intention to investigate the *physical cause* of respiration (for such an attempt in the present imperfect state of physiology would be as absurd as an attempt to explain the cause of death, from an interruption of the mere *act* of respiration;) but to point out its connection with the other functions, and thereby with the living principle. #

In the lungs (the organs of respiration) there are two sets of blood-vessels, the bronchial and the pulmonary; the first, from their size and distribution, are by all admitted as expressly for the purpose of nourishing the lungs; it is also as universally admitted, that the blood, in its passage through the pulmonary artery, is destined to undergo some changes, or to acquire certain essential properties from the action of the air, which it has lost, and at the same time to part with some impurities which it has acquired, in its circulation through the other parts of the body: this is evident not only from the action of air upon the blood out of the body, but also from the changes which is observable immediately upon its passing through the lungs into the left auricle of the heart, viz. from a dark blackish colour to a bright and florid red; as also from the effects of suspended respiration, and breathing an impure
air.

air. In this *change* it is by many supposed resides its property of stimulating the heart to action; but whether it arises from new properties which the blood absolutely receives from the air, or merely from parting with the phlogiston it acquires in its circulation, or both, we cannot pretend to determine, neither is it necessary for our present purpose. In demonstrating the effects of respiration upon the blood, and upon the action of the heart and arteries, it at the same time shews its connection with the *nervous* system; for it is impossible to conceive of the action of the heart exclusive of its *nervous* and muscular fibres as the *medium* of that action. This connection, however, will be more directly pointed out when treating of the brain and nerves.

From the above uses of respiration and pure air, we learn another indication in the recovery of the drowned, viz. to restore the *respiration*, as necessary to that state of the blood which is essential to its circulation and the tone of the moving fibre.

3d. The *circulation of the blood*. This fluid has with great propriety been termed the *magazine* of nourishment: in order therefore to afford a constant and regular supply to the different and minute parts of the system, it is necessary it should be in constant circulation: to this end also it is essential that the
heart

heart and vessels should have a due degree of *tone*; for this they are again dependent upon the state of the nervous system, and that upon a healthy state of the blood, upon respiration, and heat. Flemyng, in the introduction to his *Physiology*, compares the body to a *circle*: we here see the beauty and propriety of his comparison.

A more immediate connection, however, between the circulation of the blood and the living principle, is observed in cases of hemorrhages and suspension of the *circulation*, whether throughout the system or confined to a particular part. We also observe it in a variety of diseases, particularly fevers; and hence learn a third indication in the recovery of the drowned, (independent of those already mentioned) viz. *to restore the circulation*.

4th. The *brain and nervous system*. Notwithstanding the important uses of *heat*, *respiration*, and the *circulation of the blood*, in the animal œconomy, still the brain and nerves are indispensibly necessary. Upon these organs we are immediately dependent for *sensation* and *motion*; this is evident from the following simple experiment, viz. that if a nerve is tied or cut, the part to which it is destined is immediately deprived of its sensibility and power of motion. Although we cannot explain in what way
sensation

fenfation and motion are communicated, whether by a *subtile fluid* contained in the nerves, (fupposing them *tubular*) or by *vibration* (fupposing them elastic cords) or as *electric conductors*; ftill we have fufficient *data* for concluding that they are immediately connected with the other functions, and thereby with the living principle. The following familiar examples I prefume will render this connection fufficiently obvious. 1ft. The operation of different fubftances, which act directly upon the brain, fuch as opium, the fumes of burning charcoal, and choak-damps. 2d. The operation of cold. 3d. The paffions of the mind. The fatal effects of all thefe caufes, and of their immediate action upon the brain and nervous fystem, are too well known to require further demonftration. We hence learn a *fourth* indication in the recovery of drowned perfons, viz. *to reftore the action of the nervous fystem.*

Having thus far eftablifhed the importance of all the vital functions in preferving the *living principle*, with their *mutual* dependence upon each other, we will be the better able to point out the errors into which the different writers upon the fubject of drowned perfons have fallen, as alfo the more fatisfactorily to explain the caufes of death and mode of recovery.

Doctor

Doctor Cullen, in his very valuable letter to Lord Cathcart, hints at the connection I have endeavoured to illustrate, expressing himself as follows:—

“It is probable that the death which ensues, or seems to ensue in drowned persons, is entirely owing to the stopping of respiration, and to the ceasing in consequence of the circulation of the blood, whereby the body loses its heat, and with it the activity of the vital principle.” As the Doctor supposed the vital principle to reside in the nervous system, he hence probably has taken no *direct* notice of the suspension which takes place in the brain and nerves, as one of the causes of death; for it is unquestionable, that the debilitating passion of *fear*, with the *chill* occasioned upon suddenly falling in the water, and the *pressure* of the water itself,* must also tend to destroy the tone of the heart, and consequently of the extreme vessels, and *that* independent of the contraction which necessarily takes place in those vessels from the sudden application of cold. Although the Doctor has said but little in explaining the cause of death, his directions for the recovery

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* If a man's body sustains, as philosophers in general suppose, sixteen ton weight of the *common atmosphere*, and that *its* gravity compared to water, is as one to one thousand, (which is proved by experiment to be the case) it naturally follows, that the pressure upon a drowning man is by no means an inconsiderable cause of death, especially when we observe, that he is already debilitated by *fear* and the *chill* of the water.

of the drowned are upon a much less contracted plan, and have been found of much more general use, than any which have been proposed since his time.

Doctor Goodwin, who was the next writer of distinction upon this subject, from a variety of experiments concluded that the cause of death was an immediate want of pure or vital air, exclusive of any immediate effects from the loss of *heat*, the state of the *circulation*, or of the *nervous system*. The experiments from which he more immediately drew his conclusion, were those which related to the chemical action of the air upon the lungs in respiration.

The present prevailing opinion of the chemists, as to the composition of common atmospheric air, is, that it contains nearly two thirds of what Doctor Priestley calls *phlogisticated*, and Monsieur Lavoisier *mephitic** air, and one third of *dephlogisticated* or pure air. When it is inspired into the lungs, and again expired into a receiver, it is found that the quantity of dephlogisticated air is diminished, and that the quantity of the phlogisticated is increased. He also found from experiment, that the diminu-

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* For the noxious effects of mephitic, or fixed air, see Medical Commentaries, vol. iii. p. 256; and Ingenhouse's Experiments.

tion of the former, and the increase of the latter, even in a single respiration is considerable;* and that this diminution of the one, and increase of the other, are constant and successive in the same quantity of air frequently respired. Since, therefore, these changes are constant and uniform, they must, he thinks, be connected “with some corresponding changes in the lungs equally constant and uniform; and there is, he observes, no substance in those organs in which we can expect to find such corresponding changes, except in the blood which circulates through them.” From the experiments we have here alluded to, Doctor Goodwin infers, “that a quantity of dephlogisticated air is separated from the atmospheric air in the lungs by respiration, and a quantity of fixed or phlogisticated is added to it; that the dephlogisticated air exerts a chemical action on the pulmonary blood, in consequence of which that blood acquires a florid colour; that, in ordinary respiration, this florid colour is seen distinctly as the blood passes into the left auricle, and that the heart then contracts with its natural force and frequency; that when respiration is suspended the florid colour is gradually diminished, and the

C contractions

* The late Doctor Keil has calculated that not less than 29 ounces of this mephitic air is emitted from the lungs of one man in twenty-four hours.

contractions of the auricle and ventricle soon cease; and finally, that this cessation of contraction arises from a defect of a stimulating quality in the blood itself." Hence he with great propriety concludes, that the chemical quality which the blood acquires in passing through the lungs, is necessary to keep up the action of the heart, and consequently the health of the body. We here see he had no idea of the intimate connection and mutual dependence which subsist between the different functions, or if he had, it was so distant that it had no effect in directing his plan of recovery, which was merely to restore the *beat* and *respiration*, without any view to the direct restoration of the circulation of the blood, or the tone of the nervous system, pointedly dissuading from *bleeding*, *friction*, and *succussion*, as being suggested by "a false notion of the nature of the disease," and also from all *stimulating applications*, as being the result of a "mistaken opinion of the principal seat of life, and an ignorance of the most effectual means of soliciting the principle of life into action;" at the same time, however, he allows, that as some of these practices are now introduced on the authority of several learned societies, *experiment* alone ought to decide concerning their efficacy. Notwithstanding these defects in Doctor Goodwin's Treatise, I conceive he has thrown more light upon the
subject,

subject, as investigating the causes of death, than any beside.

Kite, whose performance next followed Doctor Goodwin's, is also entitled to great credit. He introduces the subject by pointing out the difference between suspended animation and death, as depending entirely upon one circumstance, "the presence or absence of the *principle of irritability*, or what amounts to the same thing, *the vital principle*." He then proceeds to investigate the "internal immediate cause of death, and the manner in which it is effected in those who die by drowning." After stating and attempting to refute the different opinions which had been advanced relative to this subject, he adopts the following, viz. "A contraction of parts about the *larynx*, preventing the air from passing into or out of the lungs." He next enters upon the enquiry, in what manner this stoppage of respiration acts so as to occasion death? He rejects the idea of Goodwin, that the inclosed air becoming *phlogisticated*, thereby produces death; or that the *congestion* of blood which takes place in the heart and lungs should occasion it. He then advances his own opinion, which is, that it acts by inducing *apoplexy*. To enter upon an examination of the different arguments which he brings forward in support of this opinion, would be not only tedious but uninteresting—

ing—*uninteresting*, because there is such a connection (as I have already pointed out) between the *nervous system, the circulation of the blood, respiration, and beat*, that there can be no doubt but more or less obstruction in the vessels of the head must take place, whether it is occasioned by the *phlogiston* retained in the lungs acting upon the brain and nerves, by a *mechanical obstruction* of the jugulars, or any other blood vessels, or even by *loss of beat*; for the one can as effectually produce it as the other: hence then it necessarily follows, especially as the pressure of the water alone, or a mechanical interruption of the *act* of respiration, independent of its effects upon the blood, is insufficient of itself to produce apoplexy, that all the proofs Mr. Kite can possibly advance, however specious their appearance, must be defective, unless he can first demonstrate that it is of no consequence whether we breathe a pure or impure air; and that there is no connection between the different functions, as necessary for the living principle, which is impossible. This partial explanation of the cause of death does not however influence his practice in the plan of recovery as might be imagined, for he has directed almost every remedy that has been prescribed by different writers, let the cause of death they espouse be what it may. We will now lastly make some remarks upon the
theory

theory advanced by Doctor Coleman, which is the last performance that has appeared upon this subject.—

He attributes death in all cases of suspended animation, whether from “*drowning, hanging, or noxious air, to a collapse of the lungs, producing a collapse of the pulmonary vessels, with want of latent heat in the blood.*” To establish this opinion, he begins by describing the common effects of drowning; after noticing the successive *expirations*, and the fruitless efforts to *inspire*, which take place in the act of drowning, he observes, that on opening the chest the two *venæ cavæ*, the right *sinus venosus, auricle, ventricle*, and *pulmonary artery*, are found loaded with blood; the left *auricle* nearly distended, the left *ventricle* about one half; the *aorta* and its branches containing a quantity of blood, which, in all its appearances, resembles *venous*, the lungs in a state of collapse, containing a small quantity of water in the form of *froth*, but very trifling when compared to the quantity of air expelled from the lungs in the act of drowning.” From this general account it appears, that the quantity of blood contained in the right side of the heart after drowning, is greater than that in the left, in the proportion, as the Doctor afterwards found, of three and one-eighth to one and five-eighths. The same effects he observed
after

after *hanging*, and also after death from *noxious air*; which last circumstance I suspect rather tends to refute than establish the Doctor's opinion; for in hanging there are not those "*frequent expirations and fruitless attempts to inspire*" which he describes in drowning; of course it is uncertain whether the lungs are in a state of *inspiration* or *expiration* at the moment the rope closes the wind-pipe; therefore, the conclusion of Doctor Coleman is not always just, neither can it be in case of death from *noxious air*, for air ever so impure will be capable of distending the lungs; and even should it not possess its natural elasticity, still it will serve that purpose, at least there will be a sufficient distention to prevent a collapse of the blood vessels, and an interruption of the circulation, if it depended merely upon the *act* of respiration (independent of any changes the blood undergoes in its passage through the lungs) which at present is not admitted.

Again—Doctor Coleman found, from his own experiments, that the irritability of the heart and intestines ceased sooner in animals destroyed by *noxious air*, than those by hanging or drowning, which is an additional proof that mephitic or noxious air acts *primarily* upon the *nervous system*, (thereby occasioning death) and of consequence that it is not from a collapse of the lungs and blood vessels. Thus

far

far then Doctor Coleman's reasoning from analogy is defective, especially as we can account for the causes of death from *hanging* and *noxious air* upon different, and I presume much more rational principles.

He next proceeds to the establishment of a second cause, viz. "The want of *latent* heat in the blood." Had he inverted his order, and made this last the *primary* cause, he might perhaps have been much nearer the truth; but to prove that the want of latent heat is an additional cause of death, which he attempts more by ingenuity of reasoning than experiment, he lays it down as a first principle, that the chief use of respiration is for the generation of heat. He then attempts to prove "that this heat, by being evolved in a sensible form, keeps up the irritability of the whole animal; that the blood contains more or less latent heat in proportion to the degree of sensible warmth applied to the surface of the body; that as soon as the blood has undergone a change of colour in the lungs, it is rendered fit for supporting the heat and irritability of the system; and that heat is not only evolved from the blood as it passes through the capillaries, but that the same process continues through the whole circulation; and that the stimulus which excites the heart to action is the same in all its cavities, and is principally distention."

diftention." But to proceed to his plan of recovery, which is,—1st. By artificial *inflation* of the lungs; and, 2d. Electricity. He opposes the practice of *inflating* the lungs, and immediately after pressing the chest, thereby *expelling* the air, which has been so commonly recommended. Until, however, the Doctor better establishes his opinion that death is occasioned by a mechanical *collapse* of the blood vessels of the lungs, and that the state of the blood and circulation do not depend upon the changes that fluid undergoes from coming in contact with the air, I confess I cannot but doubt the necessity or use of this his supposed improvement.

2d. Electricity. The importance of this remedy has been warmly urged by Doctor Coleman, but particularly the *electric shock*, as being best calculated to rouse the system into action. But let us enquire if this mode of administering electric fire in drowned persons is not attended with danger? In the first place I observe, that in every drowned person there is an over-diftention of the *heart* and *neighbouring vessels*, as also of the vessels of the *brain*; and, 2d. that the vital principle is already *suspended*. It is now a natural question, Is there no danger to be apprehended from the suddenness of an electric shock, of rupturing a blood vessel? Again, Is it not probable, that the suddenness of an electric shock would

would rather *exhaust* than give *tone* to the vital principle? I grant it may give *action* to the muscular fibre, from which Doctor Coleman infers its use; but this action, I suspect, like that produced from a stroke of lightning, would be attended with *absolute death*. Independent of these dangerous consequences, to get an electrical apparatus in readiness requires a considerable length of time, especially upon a damp day; in which time the latent spark of life may be entirely destroyed. I do not assert that electricity can never be of service, but that administered as above, it will be attended with the disadvantages I have noticed: if, however, it can be serviceable in any way whatever, it most probably might be so, by laying the body upon an *insulated stool*, and charging it *gradually* with the electric fire; and, perhaps, after a little time, by drawing sparks from it; but still I would not exclude the other remedies I have recommended, particularly *tobacco smoke*.*

Having thus established the *connection* of the different functions with each other, and the importance of each in preserving the principle of life; as also having pointed out the errors into which the different writers have fallen, the following conclusions naturally arise:—

D

1st. That

* See page 32.

1st. That in every drowned person there is an interruption or suspension of *all* the vital functions, which takes place nearly at one and the same time.

2d. That this suspension of the different functions, and not of any *one* in particular, is the cause of death.

3d. That the indications of recovery, (to arrange them in the order they were suggested in the enquiry upon the different functions) are,

1st. To restore *the heat of the body*. For this purpose it must be immediately stripped of its wet cloaths, and with warm cloths wiped until it is perfectly dry: It is then to be exposed to a gradual uniform degree of heat, at first somewhat below the natural standard, for sudden violent heat, like an electric shock, would rather exhaust than increase the tone of the moving fibre. This may be done in a variety of ways:

1st. By placing it before the fire.

2d. Exposing it to the sun if it shines hot.

3d. By the heat of another person's body.

4th. If in the neighbourhood of a brewery, distillery, or any manufactory, where a sufficient quantity of warm water may be immediately procured,
by

by immersing it in a warm bath, or by covering it in warm grains, warm ashes, warm sand, or salt.

5th. By rubbing it with coarse warm cloaths, and applying warm bricks, bottles of warm water, or bags of hot salt to the feet.

2d. To restore the *respiration*, and thereby communicate *pure air* to the blood. This is to be done by repeatedly *inflating* the lungs, and as often *pressing out* the air, thereby imitating the alternate motions of the chest in natural respiration: to effect this, the lungs may be inflated, either by the air, directly from another person's lungs, or by means of a tube inserted into one of the nostrils; or, lastly, by inserting it into the trachea, and annexing a bellows, which last method I should prefer,* and with

* The advantages of this mode of inflation, in preference to the others mentioned, are obvious. First, The air is thrown directly into the lungs, whereas, by the other methods, much of it necessarily passes into the stomach. Second, The atmosphere contains a proportion of *pure air*, (see page 16.) whereas that blown in from the lungs of another person, is totally *impure*, and therefore must render the blood less fit for circulation than before.

I am aware of an objection which may be made to the common bellows, that it must be removed after every inflation. This, however, is obviated by the new-constructed pair by John Hunter, which consists of *two separate* cavities; upon *expanding* them when applied to the wind-pipe by means of a tube, one cavity may be filled with the *common air*, and the other with *impure air* from the lungs; and upon shutting them again, the *common air* may be thrown into the lungs, and the *impure* contained in the

with the following directions given by Doctor Monro, it may be accomplished without much difficulty:—"The surgeon should place himself on the right side of the patient, and introducing the fore-finger of his left hand, at the right corner of the patient's mouth, he should push the point of it behind the epiglottis, and using this as a directory, he may enter the *tube* which he holds in his right hand at the left corner of the patient's mouth, till the end of it is passed beyond the point of his fore-finger;" the bellows may then be annexed by means of a screw, and continued as long as may be necessary. This method will have another advantage, that it supercedes the necessity of bronchotomy, in as much as air may thereby be thrown into the lungs, as effectually as by an opening into the wind-pipe.*

3d. More

other cavity, be discharged into the atmosphere. *Query.* Would not this instrument be a very useful addition to the common apparatus for the recovery of the drowned?

In addition to this improvement for inflating the lungs, was it not a tedious operation, perhaps it would even be a desirable object to separate from the atmosphere, the *dephlogisticated* or *pure air* alone. In some instances we are informed it has been done with success, and perhaps merits further attention. See Encyclopædia, article *dephlogisticated air*.

* For the effects of *artificial respiration* in supporting life, see Doctor Hale's *Statistical Essays*, vol. i. p. 255.

3d. More immediately to restore *the circulation of the blood*. This will be in part effected by the last and following indication, but more immediately by *blood-letting*, which belongs to the present.

Whether *bleeding* be proper in the recovery of the drowned, has been a question of much dispute; but without entering into a particular detail of the arguments advanced for and against it, I am disposed to advocate its propriety for the following reason, that it serves to *renew* and *regulate* the circulation, which it does by *lessening* the quantity of blood in the heart and vessels, and thereby adding to their *momentum*, or in other words, their disposition to contract: this I conceive is absolutely necessary in the present instance, where both the heart and larger vessels are distended, and where there is a deficiency in the extremities. The objection so commonly urged, that the blood is the source of heat (which it is our first object to restore,) and that in proportion to the quantity of blood we take away, so in proportion we lessen its heat, or counteract the means of restoring it, I conceive to be no better founded than Doctor Coleman's objection to tobacco smoke "in suspended animation, because it is of injury in *syncope* and *typhus fever*;" for it is well known, that in many diseases where there is a suspension of the vital functions, with loss of heat, &c.

that

that blood-letting is the only remedy, as in some species of syncope, violent falls, &c. and even in some diseases where this suspension does not take place, we observe the same effect from blood-letting, viz. that of *regulating* the circulation, as in inflammations of the *abdominal viscera*, particularly the *stomach, intestines, bladder, &c.* They are uniformly attended with a *small tense* pulse at the wrist, owing to the greater determination of the blood to the inflamed parts: immediately, however, upon opening the vein, it is as generally observed that the pulse rises, and in a short time becomes *full*. To what are we to attribute this circumstance? Surely to the determination of the blood to the surface and extremities, thereby lessening the quantity in the inflamed vessels: and may not the same effects follow in the present instance? Coleman himself, who so warmly opposes blood-letting, acknowledges that the *irritability* of the heart, or in other words, a disposition to contract, continues some time after the functions are suspended, and that the heart and larger vessels are overcharged (independent of the fullness of the vessels of the brain, which bleeding unquestionably will relieve,) it therefore follows as a natural consequence, if the analogy mentioned between a suspension of the functions in the above state of syncope, &c. and the suspension which follows

lows drowning, be well founded, that blood-letting is equally proper in the one case as in the other. Great caution, however, is to be observed in the use of this remedy, lest we take away a greater quantity of blood than is sufficient to answer the above intention, and run into the opposite extreme: to which last circumstance I am in some measure disposed to attribute the causes of the objections which have been urged to this remedy. But to proceed to the fourth indication, viz. To restore the tone and action of the *brain* and *nervous system*, or, in the words of Doctor Cullen, to restore the tone and action of the *moving fibre*. This may be accomplished by the following means:—

1st. Stimulating applications to the surface of the body and extremities, some of which have been already noticed. To those may be added, rubbing the wrists and palms of the hands and lower extremities with spirits of wine, hartshorne, or, which perhaps is most powerful, the spirits of sal ammoniac.

And, 2d. By exciting the action of the intestinal canal, which may be done by, first, pouring warm wine, the spirits of sal ammoniac, or perhaps brandy with laudanum,* into the stomach; the quantities of
which

* From the good effects of laudanum, (especially when given

which are to be determined by the judgment of the physician. Second, by warm stimulating clysters, either of simple warm water, or mixed with wine or spirits, or, upon which we are to place more reliance; *injections of tobacco smoke*. I am aware of the objections made to this last remedy, that it is a “poison which operates by producing such an extreme degree of debility as no powers of life can support;” and as Doctor Coleman more particularly observes, “we might with as much propriety recommend it in syncope or typhus fever, as in suspended respiration from drowning; and that by distending the intestines it prevents the easy descent of the diaphragm.”

With all due deference to the assertion and opinion of Doctor Coleman, I conceive it necessary, before we reprobate this debilitating poison, *tobacco smoke*, first to prove that the same debilitating effects will be produced upon a *drowned person* as upon one in the use of all his functions, and who has never been accustomed to its use. Analogy proves that they are not the same, and that good effects may be produced in the one instance but not in the other; for *spirituous liquors* and *opium* produce the same delirious

with brandy or spirits) in suspended animation from drinking *cold water*, it is probable it may also be serviceable in suspended animation from drowning. See Rush's Medical Observations.

rious and debilitating effects upon a person unaccustomed to their use and in health; whereas it is well known to every physician, that the same person when debilitated by disease, can use them without those consequences, and with advantage. A man who in health cannot drink three glasses of wine without inconvenience, when labouring under a typhus or nervous fever, it is well known can drink a bottle a day without knowing from his feelings whether he has taken a single draught. The same thing is observed in the use of that deleterious poison *opium*; therefore it is presumable, from a parity of reasoning, that tobacco, however destructive in health, like spirituous liquors, may have good effects in suspended animation, especially when we add that there is scarcely a substance in nature which so immediately *stimulates the moving fibre*, as is evident from its immediate efficacy when taken into the stomach,* or thrown into the bowels by clyster, in case of costiveness.

The remark of Mr. Coleman, that we might recommend its use in typhus and syncope with as

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much

* I am acquainted with a lady, who when occasionally costive, has recourse to a pipe of tobacco; and before she uses it one minute, it has the desired effect; and that too, although she never swallows the smoke—A proof of its stimulating effects upon the nervous system.

much propriety as in the recovery of drowned persons, I consider equally futile with that already noticed; for in both *typhus* and *syncope*, vomiting and purging, (which generally follow the exhibition of tobacco) according to my idea of those diseases, would be extremely injurious, whereas I conceive they may be of great service in the recovery of a drowned person, in as much as vomiting directly serves to regulate the different functions,* and open bowels afford the chest a more free action, independent of its stimulating effects upon the moving fibre, which is the great object of Doctor Coleman's warm encomiums upon the use of electricity. It remains to consider his last objection to the use of tobacco smoke, viz. "That it distends the intestines, and thus prevents the easy descent of the diaphragm." I am disposed to think it would have a directly contrary effect, and instead of preventing, *promote* the action of the heart and diaphragm, for we well know that the diaphragm is plentifully supplied with *nerves*, as all, more or less, daily experience, from *sneezing*, *hiccup*, &c. and that tobacco acts chiefly by stimulating the nervous system, as was just demonstrated; it therefore follows, by a natural and necessary consequence, that by distending the intestinal canal, it comes in more immediate contact

* See Cullen's First Lines, vol. i.

contact with the diaphragm, heart, and lungs, and thereby can more directly communicate its warmth, and renew their action; the consequences of which are generally *vomiting* and *purging*, which directly evacuate the water that may have been swallowed, and the fœces with which the intestines may be loaded; if, however, further experience should prove that the distention of the intestines with a warm stimulating *air* is of injury, it can with ease be obviated, by having recourse to clysters made of an infusion of tobacco, which can almost as readily be procured as the smoke.

HAVING thus finished what I proposed, it may not be improper to recapitulate the causes of death and means of recovery, as in the following table, which I shall arrange in the order they were suggested:—

1st. Fear, Chill, and Pressure of the water.	} Producing debility in the nervous system, with a loss of tone in the ex- treme vessels, and to- gether with the
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2d. Want

- 2d. Want of vital air, and perhaps more or less collapse of the lungs. } A congestion of blood in the heart, lungs, brain, &c. and thereby universal debility, followed with a suspension of the vital principle.

Indications of Recovery.

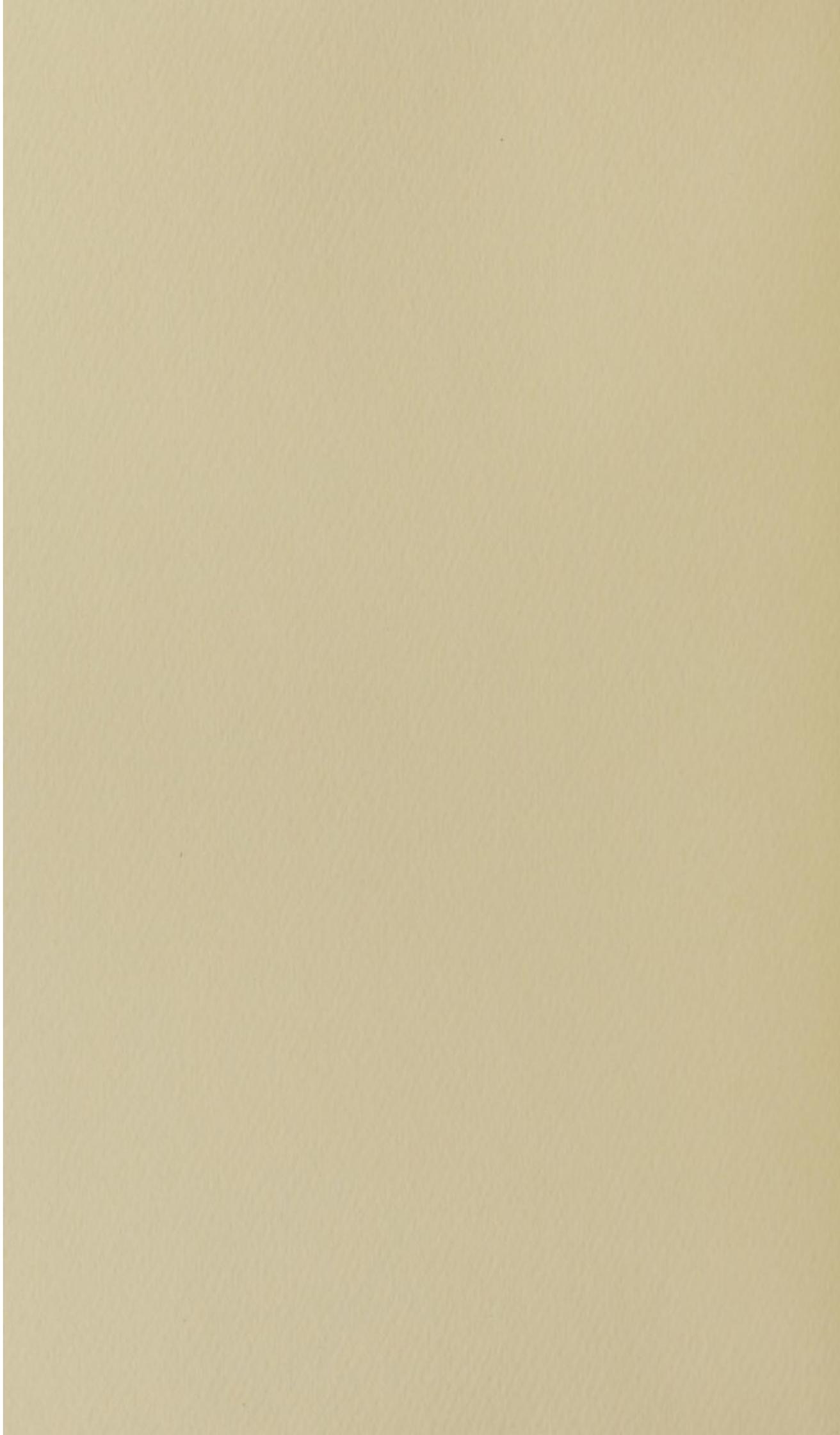
- 1st. To restore heat to the body. } 1st. By placing it before a fire. 2d. Exposing it to the sun. 3d. Heat of another person's body. 4th. Warm bath, warm grains, ashes, sand, or warm salt. 5th. Friction with warm cloths. 6th. By applying warm bricks, bottles of warm water, or bags of warm salt to the feet.
- 2d. To restore the respiration, & thereby communicate pure air to the blood. } By artificial respiration, to be done directly by the mouth, or by a tube inserted in one of the nostrils; or, lastly, by passing a tube into the wind-pipe, and then annexing a bellows.

3d. To

3d. To restore the circulation of the blood. } By bleeding.

4th. To restore the tone and action of the nervous system. } By pouring warm stimulating liquors into the stomach, and by warm stimulating injections, particularly of tobacco smoke.

F I N I S.



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