Farther hints for restoring animation, and for preserving mankind against the pernicious influence of noxious vapours, or, contaminated air, in a second letter to Dr. Hawes.

5. A Fothergill

FARTHER HINTS

FOR RESTORING

ANIMATION,

AND FOR

PRESERVING MANKIND

AGAINST THE PERNICIOUS INFLUENCE OF

NOXIOUS VAPOURS,

OR,

CONTAMINATED AIR,

IN A

SECOND LETTER TO DR. HAWES.

Ad utilitatem vitæ, omnia consilia factaque nostra dirigenda sunt. Cic.

LONDON:

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A Fothergill

FARTHER HINTS, &c.

DEAR SIR,

THE very obliging terms of approbation which YOU, and the HUMANE SOCIETY have been pleaſed to expreſs concerning my late Hints on Animamation, claim my warmeſt acknowledgments. An enquiry ſo new and intereſting to humanity, deſerved indeed a much abler pen, yet the indulgence which I have experienced from thoſe who beſt know the difficulty of the undertaking, encourages me to reſume the ſubject. That candour which liberal minds are wont to ſhew to every exertion in ſo good a cauſe, muſt plead for the many imperfections of my former, as well as of the preſent letter.

Not long ago any attempt to recover perſons apparently dead would have been ridiculed as viſionary, and abſurd, and the authentic facts which this and other humane inſtitutions have of late years preſented to the aſtoniſhed world, would formerly have been conſidered as entirely ſupernatural. Great and uncommon however as the ſucceſs may appear, yet the art of reſtoring Animation, muſt be confeſſed to be but yet in its very infancy. Its principles being ſtill but little underſtood, the methods propoſed by the different ſocieties are far from being well eſtabliſhed, ſome of them being of a doubtful nature, others very inadequate, and all but too often greatly diſproportionate to our expectations. The improvements which I ventured to ſuggeſt, depend chiefly on a prudent management of dephlogiſticated air, electricity, and heat, three of the moſt powerful agents in nature; and I have the pleaſure to

aſſure

aſſure you that the theory is now capable of being farther illuſtrated by ſome additional facts and obſervations. As truth is the grand object of the preſent inveſtigation, my wiſh is that the plan propoſed may be brought to the touchſtone of experience, that the advantages and diſadvantages being alike fairly ſtated, a true eſtimate may at length be formed.

1ſt, DEPHLOGISTICATED AIR—

its application to medical purpoſes, particularly in RESTORING ANIMATION.

Of the various aërial fluids lately brought to light by experimental Philoſophy, this ſeems to be moſt intereſting to the phyſician, and perhaps beſt intitled to ſtand at the head of this new claſs of bodies, whoſe properties have been ſo ſucceſsfully inveſtigated by the truly ingenious Dr. PRIESTLEY. But in vain does the illuſtrious PHILOSO-

PHER conſume his time, his health, his abilities, in thus enlarging the boundaries of ſcience, unleſs the attentive Phyſician ſeconds his endeavours by applying his diſcoveries to the advancement of the healing art, and to the benefit of Mankind. It is the Phyſician's province to take up the various ſubſtances in nature, where the Philoſopher leaves them, and to avail himſelf of their particular properties for the preſervation of health, or for the cure of diſeaſes. Agreeable to this enlarged idea is that excellent adage,

" *Quo deſinit Philoſophus incipit Medicus.*"

As animal life and flame are alike extinguiſhed by contaminated air, ſo pure air ſeems to be the natural *pabulum* of each, and to preſerve their vigour in proportion to its purity. But what is contaminated air but air loaden with phlogiſton and certain noxious

effluvia ?

effluvia? Or what is dephlogiſticated air, but air diveſted of theſe adventitious matters, and brought to a high degree of purity? By this train of thinking, I was firſt induced to conſider dephlogiſticated air as better adapted than common air for re- kindling the vital flame when nearly extinguiſhed by drowning, ſuffocation, or noxious vapours *. But to determine how far the theory is conſonant to reaſon, it may not be amiſs briefly to conſider the nature and cauſe of death under theſe circumſtances, concerning which

* I am the more confirmed in this opinion now that I find it ſupported by the collateral evidence of other ingenious gentlemen, though very remote from each other. A circumſtance unknown to me till very lately. Thus M. Achard, at Berlin, Dr. Stokes, at Edinburgh, and Mr. John Hunter, in London, without any participation of ſentiments, concur with me in this idea.

which Pathologiſts are ſtill much divided. Mr. Louis, many years ago, endeavoured by experiments to convince the French Academicians, that drowning conſiſted in water being admitted into the windpipe. This concluſion was warmly controverted by M. Senac, Petit, and others, who attributed it to a ſurcharge of blood in the brain, and therefore conſidered it as a real apoplexy. At length Dr. De Haen, with a laudable deſire of clearing up the difficulty, performed a variety of experiments on dogs, by drowning ſome and hanging others, and by examining the internal parts of many of them after death *. The reſult was, that the brain, eſpecially of thoſe which were hanged, was generally found without any appearance of extravaſation that could produce apoplexy; ſometimes however he acknowledges there

* Ratio Medendi cont. P. 2.

were

were evident marks of inflammation, and diſtention, yet theſe he attributes to ſome prior cauſe. On the whole, the reſult cannot be conſidered to be perfectly deciſive. The bronchia of thoſe that were drowned contained a portion of water in a frothy ſtate, tinged with the colouring ingredient, which (in imitation of M. Louis) he had put into the water before the animals were immerſed. The lungs and cavities of the heart were generally diſtended, and what was very remarkable the aperture of the glottis open, and favourable to the admiſſion of a fluid. Thus was the entrance of water into the lungs demonſtrated, and the doctrine of M. Louis apparently confirmed; but whether the water entered in the act of drowning, or after, or whether it was to be regarded as the cauſe or conſequence of death, we are ſtill left wholly in the dark; wherefore an

accurate inveſtigation of the phenomena in the *human* ſubject is yet much wanted, agreeably to what was hinted in my laſt. That the water inſpired in the above mentioned animals, was rather a conſequence ſeems more probable, becauſe the quantity appears to have been inadequate to cauſe death ſo ſuddenly, and in ſome of the caſes was entirely wanting; beſides, in the Hydrothorax, where the lungs are almoſt deluged with water, the diſeaſe does not prove ſo immediately fatal. A ſucceſſive ingreſs and egreſs of air to and from the lungs being eſſential to life, the intermiſſion of it, though but for a few minutes, ſuſpends the action of that organ; hence may be readily underſtood why compreſſing the windpipe diſpatches animals with equal certainty, and nearly in the ſame ſpace of time as ſubmerſion in water, and conſequently why theſe different modes of intercepting

tercepting the influx of reſpirable air into the lungs, equally tend to aboliſh their action and that of the other vital organs. This being accompliſhed, the muſcles become paralytic, and the epiglottis is rendered incapable of performing its office. Is it to be wondered at then, if, in this ſtate, a portion of the fluid in which an animal is immerſed, ſhould inſinuate itſelf into the lungs? This however does not ſeem to take place, at leaſt in the human ſpecies, till the powers of life are entirely ſuſpended, and even then in but ſmall quantity. For if the apperture of the *glottis* ever remained open, as repreſented in DE HAEN's experiments, it is difficult to conceive how the windpipe could eſcape being completely filled with water during ſubmerſion, or why there ſhould be any reſiſtance met with in the introduction of

the catheter into its orifice in the recovery of drowned perſons.

Nature has endowed the interior ſurface of this tube with a peculiar ſenſibility, by which it is rendered "tremblingly alive" to the touch of every fluid except reſpirable air. Hence, if but a drop of water, or any other liquor however mild, by accident gains admiſſion into its orifice, this like a faithful guardian inſtantly gives the alarm, and excites a violent cough to expell it. And there is the higheſt reaſon to believe that in the article of drowning the ſame power is vigorouſly exerted in ſecuring the entrance into the larynx, by inducing a firm conſtriction, which continues till the contractile power of the muſcles is deſtroyed. Therefore although water may find admiſſion after this conſtriction is relaxed, yet, with deference to theſe able Pathologiſts,

thologiſts, this cannot eaſily happen till the vital functions are already aboliſhed, and therefore cannot with propriety be conſidered as the cauſe, but rather as the conſequence of drowning.

Noxious air, that inſidious enemy of life, finds more eaſy admiſſion into the windpipe, and proves more immediately fatal than ſtrangulation, ſubmerſion in water, or even confinement in *vacuo*. This appears evident from the ſudden effects of the Grotto del Cani, fumes of ſulphur, charcoal and other bodies which exhale phlogiſton, or mephitic air. Yet phlogiſticated air, though highly noxious to life, does not ſeem to act by exciting pain, or irritation, when applied either to the internal ſurface of the ſtomach, or inteſtinal canal, but by a peculiar ſedative power on the bronchial and olfactory nerves, by which

which it ſuſpends their influence. Hence the ſymptoms which it produces are of the ſoporific kind, as ſtupor, ſyncope, apoplexy or immediate death. But what is very remarkable when life is ſuddenly extinguiſhed in this way, the body, inſtead of becoming rigid, remains generally quite flexible, as when ſtruck with lightning, which perhaps hereafter will be found to be only a higher ſpecies of phlogiſtication.

Air rendered impure by being often reſpired acquires the ſame deleterious properties, and becomes equally deſtructive to animal life. Hence the lungs ſeem evidently intended to inhale pure reſpirable air, and to diſcharge a proportionable quantity of contaminated air. Now if the mere ſhutting out the former for a few minutes ſuſpends the action of the lungs, the retention of the latter cannot but haſten its final extinction.

tinction. From whatever cauſe reſpiration is ſtopped, a quantity of phlogiſticated air remains ſtagnant in the cells of the windpipe. This by its ſedative power ſpecifically exerted on that organ, by degrees deſtroys the remnant of irritability, and thus, though hitherto unnoticed, probably gives the *coup de grace* in all fatal caſes, at leaſt of the pulmonic kind. Hence perhaps may be explained the diſagreeable ſenſe of ſuffocation which is felt on forcibly holding in the breath for a few ſeconds; and why if this is protracted beyond a certain time, the intolerable anxiety which it excites becomes at length incompatible with life? In this caſe, as in drowning, the lungs ceaſe to expand, the heart to beat, and finally, the machine with all its movements, like a clock whoſe pendulum is ſtopped, remains entirely at reſt.

Yet

Yet renew but the action of the lungs in one, and touch but the pendulum of the other, and all again is life, and motion *.

Theſe

* During this awful pauſe the mental as well as the corporeal faculties are obliterated, and all ideas of conſciouſneſs aboliſhed. Might not a temporary ſuſpenſion of this nature (if it could be ſafely imitated by art) bid fair to produce more laſting and ſalutary changes in certain highly obſtinate affections of the brain and nerves than can be accompliſhed by any ordinary means? If canine madneſs was completely cured by a ſuſpenſion of the functions in conſequence of accidental ſubmerſion, and if VAN HELMONT was able to practiſe this method with ſafety and ſucceſs in ſimilar inſtances *, might not the like happy effects be expected from it in other deſperate caſes of inſanity, epilepſy, or idiotiſm? The ſucceſs of very copious bleeding in certain ſtubborn caſes, perhaps depends in a great meaſure on the deliquium it produces. This has been practiſed on various occaſions without heſitation, and yet it may be doubted whether the patient does not undergo nearly as great a riſque from a ſuſpenſion of life occaſioned by an immoderate loſs of blood, as from ſubmerſion. If any circumſtances can juify the trial of ſuch doubtful remedies, it muſt be the deplorable ones above mentioned, which are ſometimes more formidable than death itſelf. It is ſcarce neceſſary to add that they ought not to be undertaken without the utmoſt circumſpection, at leaſt till the art of reſtoring animation is brought to a much higher degree of certainty.

* Agreeable to what he affirms in his Phyſic refined, p. 281.

Theſe circumſtances clearly point out the principal indication in ſuſpenſions of life, and how neceſſary it is to expel foul air from the bronchial tube by a ſpeedy ſupply of the moſt pure reſpirable air, and by this means to carry on an artificial reſpiration till the natural one can be reſtored.

In caſes of drowning, though the admiſſion of water into the windpipe may not be the immediate cauſe of death, yet may it greatly retard recovery by occupying the bronchial tubes, and by diſtending the lungs. Therefore before this organ is inflated, it would ſeem to be a great *deſideratum* to be able to extract the foul air and frothy fluid by an exhauſting ſyringe, or ſome proper inſtrument contrived for that purpoſe. Till this can be effected, which ſeems to be a work of no ſmall difficulty, we muſt be content to correct or mitigate its

effects in the beſt manner we are able, rather certainly than relapſe into the obſolete and barbarous old method of ſuſpending the unfortunate object by the feet, and violently ſhaking the body with the head downwards. This practice, which uſed to be but too often purſued by the ignorant and vulgar, has of late years been juſtly exploded, as manifeſtly tending to extinguiſh the remains of life, yet ſtrange to tell! has again been recommended by even the learned DE HAEN himſelf*! It is truly mortifying that ſo great and eminent a Profeſſor ſhould, in oppoſition to reaſon, and the repeated obſervations of the ableſt Practitioners, endeavour to revive ſo deſtructive a method, when it appears, even from his own obſervations, that water is not capable of being diſcharged from the lungs in this way. His arguments being chiefly

* Ratio Medendi contin.——Cap. 7.

chiefly drawn from experiments on the canine ſpecies, the practice, it is ſincerely hoped, ſhould it ever be imitated, will be wholly confined to that race of animals.

The noxious air happily can be corrected now that chemiſtry has pointed out its counterpoiſon. As the concentrated acids loſe their corroſive quality when neutralized with an alkali, and as the cauſtic alkali becomes mild by being only ſaturated with mephitic air, ſo the latter, as well as phlogiſton is rendered reſpirable by the addition of a proper quantity of dephlogiſticated air. This then ſeems to be the direct antidote ſupplied by nature for correcting the contaminated air ſtagnant in the bronchial cells, and alſo for inflating the lungs in preference to common air.

But in order to aſcertain this point more fully, the following experiment was performed with the aſſiſtance of an expert, and very attentive practitioner *.

EXPERIMENT.

Having been lately engaged with the ingenious Mr. CAVALLO in procuring dephlogiſticated air by decompoſing nitre with a ſtrong heat, as ſoon as we had obtained a conſiderable quantity, we ſecured it in clean bladders with ſtop cocks, for the following experiment, and for comparing its effects with atmoſpheric air. About this time a litter of four kittens of a month old, which were deſtined to be drowned, preſented themſelves as proper ſubjects for the experiment; in conducting which, each of them was ſucceſſively kept under water till it became motionleſs and apparently dead, which generally

* Mr. BIRKIT, in Great James-ſtreet.

generally happened between the ſpace of three and five minutes. The lungs of one of them was gently inflated with a ſmall portion of dephlogiſticated air from one of the bladders. In the interim, alternate preſſure was applied to the abdomen, as lately directed. The ſame proceſs was tried on another with reſpired air blown from the human lungs. But as the tube could not be introduced into the glottis without ſome difficulty, and loſs of time (a circumſtance which perhaps too often happens in this operation) bronchotomy was performed on the third before the reſpired air was conveyed into the lungs. The laſt being only wrapt in a piece of flannel, was left entirely to nature. After waiting the event, all theſe animals were found irrecoverably dead, except that whoſe lungs had been inflated with dephlogiſticated air. This animal, after the operation had been

continued

continued a few minutes, ſhewed a faint tremulous motion of the under jaw, and began at length to diſcover other manifeſt ſigns of returning life. Theſe increaſed by very ſlow degrees, and when it was more fully recovered, it was reſtored to its dam.

The inferences from hence ſeem obvious, but I forbear drawing any concluſions from a ſingle experiment till opportunity ſhall offer of repeating it on larger animals, and with ſuch accuracy as may exclude every ſuſpicion of fallacy; or rather till others, who are leſs prepoſſeſſed in favour of dephlogiſticated air, and alſo leſs reluctant to experiments of this nature, ſhall undertake this part of the enquiry. In the interim, I am glad to find that Mr. ACHARD has already performed a courſe of ſimilar experiments on birds, and quadrupeds, the re-

ſult

ſult of which affords a degree of teſtimony which appears to be very ſatisfactory. In a memoir, which he preſented to the Royal Academy at Berlin, he relates his having expoſed chaffinches, rabits and mice, in glaſs veſſels, containing different kinds of noxious air which ſoon brought on aſphyxia, or apparent death. In the ſpace of a minute after reſpiration ceaſed, he removed them into veſſels of dephlogiſticated air, when they ſoon revived, but their recovery was rendered more ſpeedy and certain when it was conveyed into their lungs by inflation. And what renders the experiments ſtill more deciſive, he found that common reſpirable air uſed the ſame way, was totally inſufficient to reſtore the vital functions. From the reſult of this ingenious Academician's experiments, it would appear that dephlogiſticated air greatly ſurpaſſes at-

moſpheric air in reſtoring animation when ſuſpended by noxious air, both in birds, and quadrupeds; wherefore it ſeems reaſonable to believe (if there was no deception in the experiments) that it may prove equally ſucceſsful in re-animating the human ſpecies under ſimilar ſuſpenſions.

2. *In preſerving health and in correcting noxious vapours, or contaminated air.*

The importance of dephlogiſticated air in preſerving health, muſt be very apparent to every one who has conſidered its properties. Whence is it that the inhabitants of villages are ſo much more healthy and long-lived than thoſe of large cities, but from the greater purity of the air which they daily breathe? But the purity of the atmoſphere depends upon the proportion of dephlo-

dephlogiſticated air contained in it, and which alone renders it reſpirable. Excluſive of this, the ſuperior healthineſs of one place over that of another ſimilarly ſituated, is moſt commonly indeed attributed to the ſuperior goodneſs of the water. But it ought to be remembered that the excellence of waters depends in a great meaſure on the aërial principle which they contain. Common water abounds with dephlogiſticated as well as atmoſpheric air: if this be expelled by long boiling, the water becomes vapid and unpalatable till it has reabſorbed from the atmoſphere a quantity of air equal to that which it loſt by the action of the fire. On the other hand, the effects of impure air in injuring health, and in deſtroying life, are generally acknowledged, though too little regarded by mankind. Atmoſpheric air is rendered noxious in proportion as it is ſaturated with mephitic

vapours, or phlogiſton, which it derives chiefly from the four following ſources, namely, STAGNATION, RESPIRATION, COMBUSTION, and FERMENTATION.

1ſt, *Stagnation of Air.* The noxious vapours, whether of the fixed or inflammable kind, that often occur in coal mines, deep wells, and ſubterraneous caverns, afford many tragical inſtances of their deſtructive influence. Not long ago eight perſons, in one day, fell victims to the foul air of an old drain, which had been long ſhut up, and was now unfortunately opened in order to its being cleanſed *. Hiſtory abounds with melancholy examples of the like nature.

2d, *Re-*

* At Narbonne, in France.——Vide Journal de Med. Tom. 52, p. 149.

2d, *Reſpiration.* If a healthy man contaminates a complete gallon of air in a minute merely by repeatedly reſpiring it, we may eaſily explain why the air of a parlour is ſo conſiderably injured by company ſitting in it, and that of a bed chamber even by a perſon's only ſleeping in it, agreeable to the obſervations of Dr. PRIESTLEY and Dr. WHITE. Here too we may regret that this unhealthy tendency is not a little increaſed by modern refinement. The mathematical exactneſs with which the doors and windows of elegant houſes are now contrived to ſhut, excludes the neceſſary ingreſs of freſh air. The diminutive ſize of the bed chambers is another capital error, and this is generally aggravated by the pernicious habit of ſleeping with the curtains cloſe drawn. The air thus confined becomes replete with perſpirable matter exhaling from the lungs, and all the inviſible

ducts of the skin, and in this contaminated state is respired for several hours. A circumstance strangely overlooked in health, and but too much neglected in sickness. In putrid and contagious fevers, it renders the room not only very offensive but highly dangerous to the patient, the practitioner, and the attendants. In close crowded rooms deprived of ventilation, when the air becomes phlogisticated to a certain degree, the candles grow uncommonly dim, and we begin to feel a disagreeable sense of oppression, langour and faintness, till fresh air is re-admitted, when these symptoms presently vanish. But should this be neglected till the air is completely contaminated, as in the dreadful scene of Calcutta, the same fatal catastrophe must naturally ensue.

3d, *Combustion*. Flame, and all burning bodies contaminate air in the same man-

ner as reſpiration. If a lighted taper is placed under a large glaſs receiver, its light gradually dwindles till at length it expires, rendering the air highly noxious. This ſhews the abſurdity of attempting to purify peſtilential air by lighting up large fires, which inſtead of correcting its contagious principle ſerve but to injure its reſpirable quality. Hence alſo appears the glaring impropriety of that profuſion of ſuperfluous fires and candles *, which modern luxury has introduced into ball rooms, aſſemblies, and all places of ſplendid entertainment; ſince theſe, by adding to the impurity of the air, already contaminated by reſpiration, cannot but prove very unfriendly to health. This evidently conſpires with other circumſtances in rendering the

* Candles compoſed of wax or Sperma-ceti are found to be more injurious to the air than even the commoneſt ſort made of tallow.

the night air much leſs pure than that of the day. It may therefore ſerve to point out the pernicious tendency of that RAGE FOR LATE HOURS which ſo entirely poſſeſſes the polite world, and which begins to pervade even the inferior ranks of Society. The votaries of faſhion in this country ſeem to vie with each other in converting day into night, and night into day, by reverſing all the ſober rules of their wiſer anceſtors, and in ſetting even nature at defiance.

A large portion of the time deſtined for repoſe is now ſpent in long vigils over the card table, or if it can be ſpared from game, it is devoted to midnight revels, or ſometimes perchance to books and ſerious lucubrations. During this ſolemn period, the animal, and even vegetable tribes, yield to the powerful impulſe of ſleep. The

latter,

latter, inſtead of breathing forth dephlogiſticated air, now ſhed a baleful influence over the creation *. While the external atmoſphere is overſpread with nocturnal fogs and exhalations, the hot air of the room ſhares the unwholſome effluvia, now ſuperadded to the other contaminating cauſes. The night being thus conſumed in watching, the fragrant and refreſhing hours of morning intended for invigorating exerciſes, are ſpent in relaxing ſlumbers, and thus from day to day is the ſame unnatural retrograde courſe of life uniformly repeated. An inconſiſtency certainly unworthy the wiſdom of the ſuperior orders of the community, and particularly of thoſe who preſide over the common weal, and conſider themſelves as complete *connoiſſeurs* in the art of *ſcavoir vivre*. Not only Stateſmen and Senators, but Divines and Philoſophers unite in

* See former letter, p. 34, where it is attempted to explain the reaſon of this ſingular phenomenon.

in thus deliberately yielding up their reaſon and in becoming the willing ſlaves to this tyrannical cuſtom. Nay even Phyſicians, unable to reſiſt its all-faſcinating influence, have been ſaid to have complied with it *ſometimes* (though it is to be hoped *not often*) in direct oppoſition to their own preſcriptions! Above all it is to be lamented that ſo unnatural a habit is ſo much countenanced by the BRITISH LADIES, thoſe ARBITERS of taſte and elegance, who controul even cuſtom, and from whoſe deciſion there is no appeal! Otherwiſe I would beg leave to admoniſh the fair delinquents, that it is not only extremely injurious to their health and vivacity, but alſo to their beauty and lovelineſs. For ſurely it is our duty earneſtly to re-mind them, that whatever is ſubverſive of the former, muſt ultimately prove deſtructive of the latter. Their ſtill perſiſting in ſo pernicious

cious a habit, which their cooler reaſon cannot but condemn, it will then be conſidered as an impeachment of their prudence, as well as a reproach to their underſtanding. On the other hand, could they be prevailed on to unite in oppoſing it, they would take the moſt effectual ſtep towards reforming the age, and eſtabliſhing their own empire on the firmeſt baſis. They might then ſafely rely on their natural complexion without having recourſe to the wretched ſubſtitutes of art. Their native charms would render them infinitely more amiable than the whole tribe of boaſted coſmetics. We ſhould then have much leſs reaſon to regret the rapid decay of genuine beauty, and the total inefficacy of art to repair thoſe ravages which it unavoidably undergoes in thus daily ſacrificing to this goddeſs of folly!——But to return.——

4, *Fermentation.* The proceſſes both of the vinous and putrefactive fermentation, being powerful inſtruments in extricating mephitic air and phlogiſton from animal and vegetable ſubſtances, contribute largely to the contamination of atmoſpheric air. Hence the effluvia which proceed from fermenting liquors, from morbid humours, from putrid animal bodies, and ſtagnant corrupt marſhes, afford numberleſs examples of their deleterious effects on mankind. If the health of the people ought to be an object of the firſt conſideration in every ſtate, and if the purity of the air be allowed to be eſſential thereto, is it not unaccountable that theſe ſhould be leſs regarded in this enlightened æra than in the dark ages of ignorance! The ancients had the wiſdom to place without the walls of their cities whatever might tend to injure the air, or produce putrid or contagious diſeaſes;

diſeaſes; yet now that philoſophy has thrown new light on this ſubject, and the nature of the air is ſo much better underſtood, the moſt palpable nuiſances are entirely overlooked. Is it not ſurpriſing that certain highly offenſive trades, and even ſlaughter-houſes, ſhould be ſuffered, not only within the walls, but near the very center of populous cities! And is it not yet more aſtoniſhing, that the dead bodies of the inhabitants ſhould be ſtill permitted to be buried in church-yards, nay even in the churches themſelves! A cuſtom ſo highly pernicious, ought to be proſcribed in every civilized nation, unleſs the people are determined to perſiſt in expoſing the living to certain danger, in order to render a vain honour to the aſhes of the dead. The highly polluted air of large cities, in conſequence of ſuch horrid nuiſances, has

been already exquiſitely deſcribed by a late eminent Poet and Phyſician. So very *apropos* are the following animated lines in his admired Poem on Health, that I cannot reſiſt the pleaſure of tranſcribing them.

" Fly the *rank city*, ſhun its turbid air,
Breathe not the chaos of eternal ſmoke
And *volatile corruption* from the *dead*,
The dying, ſick'ning, and the living world
Exhal'd to ſully Heav'ns tranſparent dome
With dull mortality !—It is not air
That from a thouſand lungs reeks back to thine,
Sated with *exhalations rank* and *fell*,
The ſpoils of dunghills, and the *putrid thaw*
Of *Nature*, when from ſhape, and texture, ſhe
Relapſes into fighting elements :
It is not air,—but floats a *nauſeous maſs*
Of all *obſcene*, *corrupt*, *offenſive* things !"

Dr. ARMSTRONG's Art of preſerving Health.

Air once contaminated becomes totally irrecoverable by any of the remedies which have been found to correct the putridity of other bodies. In vain Dr. PRIESTLEY endeavours to purify noxious air by expoſing

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it to the action of the moſt powerful anti-ſeptics, yet this, he afterwards found, was eaſily accompliſhed by ſimple agitation with water, by a ſprig of mint growing in it; or, in ſhort, by any other means of ſupply-ing it with about one fourth part of de-phlogiſticated air. This being diſcovered to be the principle by which contaminated air may be corrected, we may now com-prehend the ample ſources from whence nature ſupplies it for the purpoſe of puri-fying the atmoſphere. From hence we learn how the vegetable kingdom, together with the ocean, and innumerable rivers, whoſe waters are agitated by the winds, do all contribute their portion of dephlogiſti-cated air for carrying on this grand proceſs. From hence too we may learn to avail our-ſelves of a remedy employed by nature, in applying it to various purpoſes of life, and alſo in ſupplying it occaſionally by art,

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even where nature has denied it. Being capable of forming an intimate union with phlogiſticated air, it meliorates it in proportion to the quantity that is added. This points out the practicability at leaſt of thus correcting the impure air of a cloſe room, agreeable to what was hinted in my laſt. Nor would it acquire ſo large a quantity as might be imagined, ſeeing one fourth of its bulk is found to be ſufficient to reſtore it to the ordinary ſtandard of common atmoſpheric air. Moreover air, when highly contaminated, becomes the lighteſt and riſes to the cieling, while the dephlogiſticated air, from its greater ſpecific gravity, occupies the lower parts of the room* where the company are aſſembled, provided care be taken to prevent its eſcape by the doors,

* This is beautifully illuſtrated by the ingenious Mr. WALKER (in his Philoſophical Lectures) by means of ſoap bubbles containing theſe different kinds of air.

doors, windows or chimney. For this purpoſe no apparatus would ſeem neceſſary, except two large earthen retorts placed in portable furnaces, or rather accommodated to proper fire places in a Pennſylvanian ſtove. By proper tubes with ſtop-cocks, the dephlogiſticated air iſſuing from the calcined nitre, might be conveyed at pleaſure, in copious ſtreams, to all parts of the room. Being ſix times purer than common air, it may be preſumed to prove proportionably more ſalutary and refreſhing, and that without producing fevers, catarrhs, and rheumatiſms, the common effects of the ſudden admiſſion of cold atmoſpheric air when all the pores are open. This might alſo afford a commodious method of exhibiting it to the ſick, and valetudinary who wiſh to reſpire a pure atmoſphere, without relinquiſhing the endearments of ſocial connexions, and without

being

being obliged to ſeek it ſolitary and unknown in a diſtant climate.

A laudable ſcheme of this nature, we are informed, has lately been attempted at Berlin by means of a new ſtove, invented by the ingenious Mr. ACHARD. Nor has the reſult diſappointed his expectation: For he aſſures us "that the ſame ſtove that melts "the nitre warms the apartment, and that "the dephlogiſtication of the air may be "thus carried to any degree that may be "judged expedient, to the great relief of in-"valids, and to the amazing advantages of "health and ſpirits. Hence, ſays he, "nervous and hypochondriacal patients "paſs from a ſtate of gloomy anxiety to "that of chearfulneſs and ſerenity, by "only removing from the common air to "an apartment where the air has been de-"phlogiſticated." In ſhort, it is evident that this pure ſalubrious fluid, by proper

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management, might be applied to the preſervation of human life, not only in crowded hoſpitals and priſons, as mentioned in my laſt, but alſo in a variety of caſes by ſea as well as land, and particularly where ventilation cannot be conveniently obtained, as too often happens on board guardſhips and privateers, where great numbers of impreſſed men or unfortunate priſoners of war, are inhumanly crowded together in cloſe places, till the air becomes highly contaminated, when the jail fever generally breaks out, and by thinning their ranks, releaſes the greateſt part of them from their ſufferings!

Dephlogiſticated air appears to be no leſs applicable in the noted experiment of the diving-bell, or in deſcending into old mines, wells, vaults, and other ſubterraneous caverns, abounding with ſtagnant air, or mephitic vapours, and finally in newly-painted

rooms, in laboratories, ſmelting-houſes, and certain manufactories where charcoal is burnt, and various phlogiſtic proceſſes are carried on, to the no ſmall detriment of the health and lives of the different artiſts.

Dephlogiſticated air ſeems to be peculiarly adapted to the cure of diſeaſes of the lungs, as peripneumonies, eſpecially when the diſeaſe accompanies the meaſles, or confluent ſmall-pox, alſo of aſthmas, catarrhs, and conſumptions. Becauſe in ſuch caſes reſpiration is ſo imperfectly performed that a large portion of the phlogiſticated air which ought to have been diſcharged by expiration, is retained in the blood, and the portion of dephlogiſticated air, which ought to have been inſpired from the atmoſphere is, by the ſame cauſe, greatly diminiſhed. From this retention of phlogiſton the principal phenomena of theſe diſeaſes ſeem to originate, aſſuming differ-

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ent degrees of fever according to its accumulation. This muſt increaſe in proportion as the texture of the lungs is injured by ulceration, or tubercular obſtruction. Hence perhaps may be explained the nature of the hectic fever, the conſtant concomitant of the pulmonary conſumption. From this cauſe probably proceed the ſymptoms which have hitherto been attributed to the abſorption of purulent matter * or obſtruction of inſenſible perſpiration, which ſeem however to be very inadequate to the effect. But whatever ſhare the retention of phlogiſton may be allowed to have in the theory of theſe diſeaſes, one thing at leaſt will be granted in practice, viz. that the air which ſuch patients breathe ought to be rendered as pure as poſſible, which is the main object that is at preſent contended

* This indeed has been lately controverted with great ſtrength of reaſoning in an ingenious eſſay on the phthyſis pulmonalis, by Dr. Reid.

for. Does not experience daily evince that in theſe caſes, a free ventilation, or rather a removal from a foul phlogiſticated air into a much purer and ſerener amoſphere, produces more beneficial effects than all the powers of medicine? In vain were the moſt celebrated pectoral and balſamic remedies adminiſtered in the late Influenza, which continued to run its courſe, while the epidemic conſtitution prevailed. But a ſalutary change in the atmoſphere at length enſued, which deſtroyed the contagious principle or checked its courſe, when the diſeaſe preſently vaniſhed. How far the breathing dephlogiſticated air, according to what was hinted in my laſt, might tend to correct or ſubdue the ſubtile miaſmata which infeſt the wind-pipe, time and experience can alone diſcover. But ſhould the malady reviſit this kingdom after an interval of a few years (as probably

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it may) there certainly could be no harm or danger in making a full and candid trial of this ſimple element, inſtead of obſtinately perſevering in the uſual routine of oily mixtures, and other unavailing modes of medication *.

Dephlo-

* I am glad to find that the propoſal of adminiſtering dephlogiſticated air in pulmonic diſeaſes begins to meet with the approbation of thoſe who ſeem to have conſidered that ſubject with attention. Dr. Reid, in particular, "thinks it is probable to prove a very valuable medicine" *. In theſe caſes it may be reſpired in a room ſtrongly impregnated with it according to M. Achard's method, or by an apparatus lately deſcribed by M. Cavallo †, or by the ſtill ſimpler mode of adapting a glaſs ſyphon to the ſtop-cock of a bladder containing the air. In this way the remainder of the air which was left after the experiment lately mentioned, was inhaled by a hectic patient, who attributed her diſeaſe to the effects of the Influenza. She reſpired it with much ſatisfaction, and, as ſhe *imagined*, with conſiderable advantage till it was exhauſted, when ſhe removed into the country. Indeed the quantity was far too ſmall to determine how far it might have proved really uſeful, for I lay no ſtreſs on the flattering hopes which ſhe formed on ſo ſhort a trial, which did not exceed two days, and which was chiefly meant to aſcertain whether this method of adminiſtering it could be eaſily accompliſhed.

* Eſſay on Phthyſis Pulmonalis, p. 120.

† Who alſo ſtrenuouſly recommends it in theſe caſes, &c.—Treatiſe on Air, p. 560 and ſeq.

Dephlogiſticated air might probably be rendered very conducive to the preſervation of our countrymen againſt the miaſmata of ſultry climates: particularly in thoſe inhoſpitable tracts of the torrid zone, whoſe ſickly atmoſphere is fraught with contagion and death, and on whoſe ſhores it is unſafe for an European to ſleep, even for the ſpace of a ſingle night! Humanity claims our utmoſt exertions to diſcover ſome more efficacious method than is yet known towards the prevention or cure of theſe peſtilential diſeaſes, which here continue to reign uncontrouled, and to depopulate whole provinces! Although the eſſence of that ſubtile venom which produces them, remains totally unknown, yet as it is confeſſedly the offspring of noxious or putrid effluvia, it might not be improper to aſcertain how far this and other aërial fluids could avail.

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If the contagion is received with the air in the act of reſpiration, as moſt writers aſſure us, might not the breathing this pure air ſeem to afford the moſt likely means to counteract its influence? Or if it proceeds, as others imagine, from a putrid ferment in the alimentary canal, might not the liberal exhibition of fixed air (whoſe ſuperior antiſeptic power is well known in ſuch caſes) prove yet more ſucceſsful*?

It is now time we ſhould conſider whether ſome material objections may not occur to the uſe of dephlogiſticated air. The marine ſcurvy, mentioned in my laſt, though a highly putrid diſeaſe, may perhaps be thought to afford an evident inſtance of this kind, be-

cauſe

* Many examples of which are to be met with in the writings of Dr. PRIESTLEY, Dr. DOBSON, M. CAVALLO and others. A ſtriking inſtance of its recent ſucceſs after bark and elixir vitrioli had failed, was lately communicated to his Excellency Prince Gallitzin, the Ruſſian Ambaſſador at the Hague.—See Lond. Med. Journal, Vol. 4, part 1ſt.

cauſe patients labouring under it, on being ſuddenly removed from cloſe cabins into a purer air upon deck, have been known to expreſs extreme uneaſineſs, and then preſently expire. But here it may be doubted whether the fatal event was not rather owing to the ſudden motion of the body, a circumſtance ever to be guarded againſt in theſe caſes. A more evident and weighty objection is that of certain aſthmatic patients, who breathe with more eaſe and freedom the foggy phlogiſticated atmoſphere of London, after being accuſtomed to it, than the ſerene piercing air of a village. Peculiarities of this kind proceeding from long habit or peculiar idioſyncraſy may indeed furniſh exceptions, but can never invalidate a general rule. Thus city valetudinarians often find themſelves worſe on their firſt removal into a champaign country, yet afterwards experience all the advantages that can

reſult

reſult from breathing a purer air. However, as extremes are generally dangerous, it may not be adviſeable, to make the tranſition too ſuddenly from a phlogiſticated to a dephlogiſticated medium.

The greateſt obſtacle to the uſe of dephlogiſticated air, is the difficulty of obtaining it, eſpecially in ſuch large quantities as would be neceſſary for reſpiration, and the various purpoſes to which it is applicable. This, ſuperadded to the prejudice which ever attends the introduction of a new remedy, muſt be acknowledged to afford no ſmall diſcouragement to its uſe, and will, I foreſee, deter the faculty from adopting it, at leaſt till its virtues ſhall be more generally underſtood. This difficulty might be ſoon obviated, if chemiſts who are poſſeſſed of laboratories, with all the requiſite utenſils, would undertake to prepare it according

to the process which has been accurately described by M. CAVALLO*. It might thus be obtained in almost any quantity, and kept in readiness; by which means its use might be rendered as familiar as that of fixed air, or any other chemical fluid, and its efficacy finally determined. He estimates the quantity capable of being contained in a very large bladder as sufficient to sustain respiration about a quarter of an hour. It may indeed be made to go farther than usual by means of lime water, or caustic volatile alkali, which tend to absorb the mephitic acid as fast as it is emitted from the lungs, but whether it can be thus rendered 30 times longer respirable, as M. FONTANA asserted, has not been yet clearly determined.

Having had no opportunity of preparing a fresh quantity of dephlogisticated air for repeating

* Treatise on Air, p. 564.

repeating the experiments, or inſtituting other enquiries into its medicinal powers, which were intended; the farther proſecution of the ſubject muſt be left to thoſe who have leiſure and abilities more adequate to the taſk.

Where dephlogiſticated air cannot be artificially prepared, yet the danger of unhealthy ſituataions may be much diminiſhed by improving the natural means of purifying foul air; particularly by paying greater attention to ventilation, by means of the Pennſylvanian air ſtoves, or by ſmall ventilators in the upper parts of doors and windows. By cultivating in ſuſpected rooms aquatic plants or other ſucculent or aromatic vegetables, that yield dephlogiſticated air very copiouſly *. By

 agitating

* Such as mint, angelica, Indian-creſs, &c. &c.

While writing this, I am favoured with the following obſervation by a very ingenious Practitioner at Boerhamwood,

agitating fair water, and expoſing it to the air; alſo lime water to abſorb mephitic vapours; and laſtly by frequent admiſſion of the ſun-beams, by whoſe emanations plants and water yield forth their dephlogiſticated air

wood *, whom I have the pleaſure to find concurs with me in earneſtly wiſhing to counteract the deſtructive effects of contaminated air, eſpecially in populous cities.

" Among the plants, ſays he, which I ſhould prefer for " this purpoſe (and which will thrive in almoſt any ſoil or " ſituation) are the large annual *ſunflower* †, the *angelica*, " and the *common gourd*. The firſt is eligible on account " of its exceſſive perſpiration, being in 24 hours 19 times " greater than that of a man. The *angelica*, is a hardy " perennial plant and well adapted by reaſon of its luxu- " riant growth, eaſy propagation, and ſtrong aromatic " odour. The *gourd* is alſo of quick growth, and per- " ſpires abundantly, and may be farther uſeful in co.er- " walls, pales, &c. But beſides the perſpiration of " plants, they have yet another valuable property, which " is that of greedily imbibing foul phlogiſticated air, " which they appear to receive by a ſeries of veſſels dif- " ferent from thoſe through which they expire their ſa- " lubrious effluvia."

* Mr. S. Saunders, late of Barnet.

† Flowers, even of the moſt fragrant kind, have indeed been accuſed by Dr. INGENHOUZ of injuring the air, but I am glad to find that they have been ſince acquitted of this charge by the reſult of later experiments; ſo that the ſunflower here recommended by my learned correſpondent, may ſtill prove an important acquiſition in the above intention.

air more plenteouſly. In the dark they emit noxious air, as has been already noticed, nor can any degree of heat without light, force them to part with dephlogiſticated air, or contribute to purify air that is contaminated. Light then ſeems to be more conducive towards diffuſing this vivifying principle through the atmoſphere than heat. Who has not experienced the exhilerating effects of bright ſunſhine compared with the langour and oppreſſion occaſioned by an equal degree of warmth in a hot-houſe, or during the ſultry darkneſs of a thunder-ſtorm? The intimate connexion that ſubſiſts between dephlogiſticated air and the rays of light, ſhews that the latter is not leſs eſſential to animal than vegetable life, and may alſo afford a new explanation why the preſence of the ſun gladdens all nature, and why a general gloom and melancholy overſpreads the creation when he withdraws his

his enlivening rays, or undergoes an eclipſe. And finally, why phyſicians err who indiſcriminately deprive their patients of the chearful beams of day, ſince by ſhutting out light (unleſs where it is too powerful for the organs of viſion) they not only injure the air, but alſo add to the horror of a ſick room.

Thus it appears that the air which we breathe, is liable to be influenced by a variety of cauſes *. That many of thoſe are more within human power, even in

* Among theſe, planetary influence ought perhaps to have been enumerated, ſince to this cauſe, epidemic and contagious diſeaſes have frequently been attributed. Its ſphere of action however being ſo remote, and ſo infinitely beyond our reach, it was purpoſely omitted. That the ſuperior planets under certain aſpects, when their united rays fall fully on the earth, may tend to phlogiſticate its atmoſphere, and affect the weather is by no means improbable. Whether the late remarkable conjunction of Jupiter and Saturn, might not thus contribute to this diſtemperature of the air, which produced the Influenza, I leave others to determine.

in the worſt ſituations, than has been commonly imagined. That finally, its noxious qualities might be often prevented, or at leaſt greatly diminiſhed by the attentive interpoſition of a well regulated police, or more properly by a BOARD OF HEALTH appointed for that purpoſe.

3. ITS IMPORTANCE IN CHEMICAL INQUIRIES.

Dephlogiſticated air may alſo be rendered farther ſubſervient to the views of the accompliſhed philoſopher in analyzing and calcining bodies, and in expediting various other chemical proceſſes. It is evidently a a principal agent in the detonation of nitre, the exploſion of gunpowder, and aurum fulminans. The intenſe heat which it gives to ignited charcoal diſſolves a conſiderable rod of iron in a few ſeconds, and reduces ſpeedily into a fluid form ſome of the

moſt

moſt refractory ſubſtances, not even excepting the Platina. Being the only ſupporter of heat, and of flame, it evidently nouriſhes volcanos and other ſubterraneous fires, and may perhaps afford a new and ſatisfactory ſolution of the long controverted queſtion concerning the warmth of certain mineral ſprings, ſuch as Bath, Buxton, Aix-la-Chapelle, &c. Whether this ſubtile fluid is not in reality the elementary baſis of atmoſpheric, and other aërial ſubſtances, and whether it may not be conſidered as contributing to the principle of light, of colour, and of acidity, may be worthy the reſearches of experimental Philoſophers. In the interim, the ſplendor which it imparts to burning bodies, the florid colour it gives to blood, and to the calces of metals, and the acid taſte to aqua-fortis, at leaſt ſerve to countenance this opinion.

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If dephlogiſticated air is ſo eſſentially neceſſary to animal life, and ſo very important to mankind, in various other reſpects, it may be aſked why nature did not ſupply us with it in its genuine ſtate, without that alloy of phlogiſton with which atmoſpheric air is conſtantly debaſed? To which it may be anſwered, that it would have been incompatible with the peculiar ſtructure of vegetables, which require a daily ſupply of phlogiſton as abſolutely neceſſary to their growth and nutrition. For plants are diſcovered to dwindle and grow ſickly in dephlogiſticated air, and to revive and flouriſh when removed into impure air. Therefore the air which they receive in a phlogiſticated ſtate, after it has anſwered this end, is reſtored to men in a more pure and reſpirable form. Hence the more air is imbibed by vegetables the more pure it becomes for animals, and the more frequently

it is reſpired by animals the more nouriſhment it yields to vegetables. Hence too the common atmoſphere, in its preſent conſtitution, proves congenial to the vital principle of both. And it is no leſs obſervable that the ſame air which preſerves them during life, deſtroys them after death, by exciting putrefaction and reſolving them into their firſt principles. In the living ſtate, the vital power reſiſts this action of the air, but when life is extinct both animals and vegetables yield to the general law which haſtens their decay, becauſe dead ſubſtances would only encumber the creation, whereas by ſpeedy diſſolution their particles of matter again become fit to aſſume new forms and undergo new combinations.

With what admirable œconomy has the Divine Architect eſtabliſhed this reciprocal intercourſe between the animal and vegetable kingdom! By what elegant

ſimplicity of deſign are the different parts of nature thus rendered at once ſubſervient to the mutual benefit of each other, and to the general well-being and harmony of the whole!

2d, ELECTRICITY—*Its extenſive influence—its application to medicine—particularly in* RESTORING ANIMATION.

Electricity claims the attention of the Phyſician, as well as the Philoſopher, in proportion as it may affect the health and well-being of mankind, by its extenſive influence through the various parts of nature. In the atmoſphere its effects are awfully ſublime and magnificent in the phenomena of thunder, lightning, and the aurora borealis. It moreover ſeems to influence materially the ſtate of the weather in the formation of hail, rain, ſnow and me-

teors. Atmoſpherical electricity therefore ought probably to be conſidered as the baſis of meteorological ſcience. Though hitherto it has been little noticed, except in thunder ſtorms, yet mankind are perhaps not leſs intereſted in its more ſilent variations than in thoſe of the magnetic needle, or the viciſſitudes of the winds, or temperature, all which have been diligently obſerved, and minutely recorded.

In the bowels of the earth the electric principle ſeems to be no leſs active in the production of earthquakes and volcano's than in the mineralization of ores, and foſſils, while on its ſurface it is acknowledged to promote the vegetation of plants, and the incubation * and growth of animals.

In

* By the application of electricity, in a certain determinate degree, to impregnated eggs, we are informed that incubation was ſo remarkably accelerated, that the chickens were hatched in about 48 hours.——Mem. de l'Acad. des Scien. de Berlin, 1778.

In medicine, it preſents us with a more ſpeedy and powerful ſtimulant, and at the ſame time more manageable than any hitherto diſcovered. With reſpect to the preſent ſubject, whoever conſiders its effects in increaſing the action of the heart and arteries, in accelerating the circulation of the blood, and conſequently in promoting the progreſſive motion of all the animal fluids, will ſcarcely heſitate to acknowledge it as a ſuitable agent for reſtoring ſuſpended animation. Among the chief ſtimulants recommended for exciting the vital organs are neutral and volatile ſalts, together with friction, emetics, and ſternutatories. Theſe have, it is true, been employed with conſiderable advantage, but their power, it muſt be acknowledged, is of a limited nature, and is alſo weak and ſuperficial when compared with that of electricity.

It is to be regretted indeed that the comparative merit of electricity in theſe caſes, has not been oftener put to the trial. There are not wanting however ſome inſtances of its effects, which are ſufficient to claim our attention.

" The electrical ſhock was tried upon the " body of J. Lawſon, *four hours* after he was " taken out of the water, every other me- " thod having been tried in vain. The effects " it produced were of ſuch a nature as to " evince how beneficial it may prove in " more favourable circumſtances. The " firſt ſhock excited a pulſation in the tem- " poral artery; the next diffuſed a florid " colour over the face, and occaſioned the " blood to flow in a copious ſtream and to " a conſiderable quantity from an orifice, " which had been opened in the jugular " vein at the beginning of the proceſs,

" without

" without a drop having iſſued from it *." Four hours being elapſed before electricity was tried, it will not appear wonderful that no farther progreſs could be made towards reſtoration. In caſes of drowning, indeed, the recovery ſeems to be more difficult than in other accidents. This difficulty is yet more obſervable in the canine than in the human ſpecies. De Haen, in his numerous experiments on theſe animals, was ſcarcely able to recover above one in eighteen. All the approved modes of treatment (we are told) proved extremely unſucceſsful, and among the reſt, electricity. Are we to conclude from thence that all human efforts to reſtore drowned perſons are fruitleſs, and that electricity is equally ineffectual? By no means; the former concluſion is contrary to experience, and alſo flatly contradicted by the authentic Reports of

* Reports of the Humane Society, 1775, page 77.

of the Humane Society, and other ſimilar inſtitutions in various parts of Europe. The latter ſeems to be no better founded, ſince it appears, even from the Profeſſor's own account, that the electrization in general was but very imperfectly performed; the fluid, through inattention to conducting bodies, being inadvertently diſſipated. His want of ſucceſs therefore, ought by no means, to diſcourage other expert electricians from attempting to aſcertain its efficacy by a more accurate, and ſatisfactory courſe of experiments. Till this is accompliſhed, the Medical Aſſiſtants may be deterred from availing themſelves of this remedy in thoſe unfortunate accidents wherein it is particularly indicated.

" Catharine Sophia Greenhill, on fall-
" ing from a one pair of ſtairs window up-
" on the paved ſtones, was taken up to all
" appearance

" appearance dead. An apothecary being
" ſent for, he declared nothing could be
" done for the child. Mr. Squires, who
" lives oppoſite to where the accident hap-
" pened, finding the caſe hopeleſs, with
" the conſent of the parents very humanely
" tried the effects of electricity. At leaſt
" *twenty minutes* had elapſed before he
" could apply the ſhock, which he gave
" to various parts of the body without any
" apparent ſucceſs; but at length, upon
" tranſmitting a few ſhocks through the
" *thorax*, he perceived a ſmall pulſation:
" Soon after the child began to ſigh and to
" breathe, though with great difficulty,
" and at length was reſtored to perfect
" health and ſpirits *."

Thus was the child happily recalled from premature death, who muſt infallibly have

 periſhed,

* Reports of the Humane Society, 1774, p. 32.

periſhed, had it not been for the timely and prudent uſe of electricity. Had Mr. Squire even neglected tranſmitting the electrical fluid through the thorax, after it had failed in other directions, the event would ſtill probably have proved fatal.

Here it may be proper to remark, that the ſucceſs of electricity depends greatly on the mode of conducting the operation. According to the ſtrength and direction of the electrical current, it may be made to produce different, or even oppoſite effects. Thus Dr. ABILGARD, in his celebrated experiment on fowls, was enabled alternately to ſuſpend or reſtore animation *. However ſurpriſing, or even incredible, the reſult of this experiment may appear to ſome perſons, yet a very ingenious ELECTRICIAN †, aſſures me, that ſome time ago

* Mentioned in the former Letter, p. 22.

† Mr. Partington, in Cavendiſh-ſquare.

ago he repeated it with ſimilar ſucceſs, particularly on a large turkey. Very lately he has afforded me ocular demonſtration of this ſingular fact in a young quadruped of the canine ſpecies; a ſmart ſhock or two being made to paſs through its head, it immediately became motionleſs, and to all appearance dead. In this ſtate, electricity was uſed in different degrees, and conveyed in different directions. When it was gently tranſmitted through the region of the heart and lungs, oſcillations of the muſcles immediately enſued. What ſeemed very worthy of attention, the vital organs were thus more certainly excited, and more vivid motions produced by ſlight than by rougher ſhocks; the latter appearing rather to retard than to promote recovery. When the operation was ſuſpended for a few minutes, or its direction altered to remote parts, the animal always relapſed into its quieſcent ſtate, and

as conſtantly revived, on its being repeated in the ſituation above mentioned. By repeating at intervals, ſparks or very minute ſhocks, it was at length completely revivified. Thus the vital organs are, under certain circumſtances, more powerfully agitated by very ſlight than by very ſtrong *ſtimuli*. Hence tickling the ſoles of the feet produces convulſive laughter, while rubbing them ſtrongly, occaſions no ſenſible effect. Thus the heart palpitates on ſight of a ſpider, which remains tranquil in the midſt of a bloody engagement. And thus the lungs are thrown into vehement agitation by a drop of water, or a portion of inſipid phlegm, which bear the loudeſt exertions of the voice with impunity.

In order then to give electricity its utmoſt power in reſtoring animation, it would ſeem neceſſary that it ſhould not only

only be applied to the thoracic viſcera, but that the utmoſt care ſhould be taken to adjuſt its tone, or (if I may be allowed the expreſſion) to bring it into perfect uniſon with the vital organs. The due medium for this purpoſe may be difficult to determine *a priori*, though it may be aſcertained by dint of repeated trials. Accordingly the experiment failed in two inſtances of drowned animals, nor is this to be wondered at, when we conſider the feeble ſtate of the vital principle of life in theſe very young creatures. However, if but one caſe in ten of apparent death, among the human ſpecies that reſiſts the ordinary means, could be reſtored by electricity, it would ſtill certainly merit our attention.

The experienced Practitioner above mentioned farther informs me, that he has found

found electricity to be one of the moſt ſpeedy and certain methods of removing the ſyncope, and fainting occaſioned by ſudden emotions of mind; alſo of the unfortunate accidents of perſons ſtruck by lightning. Thus may electricity prove a moſt uſeful *remedy* even of its *own exceſſes*. Nor is there any real inconſiſtency in this, ſeeing its effects may be ſo greatly diverſified, according to the mode of applying it. Thus it may be cauſed to paſs ſilently along an iron wire, to viſibly ſhorten or elongate the ſame, or finally to diſſolve it, according to circumſtances. The ſame apparent difficulty occurs in various other inſtances. Thus a ſtrong current of air extinguiſhes the burning taper, while a gentler breeze rekindles it. Exceſſive cold benumbs the limbs, and yet the application of ſnow reſtores them to ſenſe and feeling. But it is

needleſs to have recourſe to analogical reaſoning, when facts can be produced.

The following account communicated by a friend relates to a caſe of public notoriety. " On Thurſday the 18th of June, 1782, " in the ſevere thunder-ſtorm, a houſe in " Gravel-lane, Southwark, was ſtruck " with lightning, and an elderly man was " thrown with violence from his chair, " and taken up for dead. In this hopeleſs " ſtate electrization was performed by a " ſkilful Practitioner of Guy's Hoſpital, " by which remedy the man was at length " entirely reſtored."

In caſes of apparent death from lightning, the unfortunate objects are too often deſerted, when they might probably be recovered by inflating the lungs, or purſuing

ing the general plan propoſed in ſuſpenſions of life from other cauſes *.

The Humane Society have recorded a very remarkable inſtance of this, in the caſe

* Forty years have now almoſt elapſed ſince the probability of reſtoring perſons apparently dead from *this* and *other* cauſes, was ſuggeſted by my late truly VALUABLE FRIEND, Dr. JOHN FOTHERGILL! Prompted by the nobleſt of all motives, an ardent zeal of preſerving his fellow-creatures from premature death, he diſcovered uncommon ſolicitude to animate others to the ſame laudable purſuit. The obſervations which he communicated to the Royal Society *, at a time when the ſubject was ſo litt'e underſtood, do honour to his humane feelings, and likewiſe exhibit an early ſpecimen of that *medical acumen*, by which he was afterwards ſo eminently diſtinguiſhed. His idea of the "poſſibility of ſaving a great many lives without riſking any thing" has ſince been very amply confirmed by experience; and if his hint for inſtituting experiments on condemned malefactors, had been properly attended to, the art of reſtoring animation would probably have made a much greater progreſs, and it can hardly be doubted that acts of atrocious villainy would have been more effectually repreſſed.

* Now inſerted in the firſt volume of his works, with ſuitable notes, by the learned Editor, Dr. LETTSOM.

caſe of Peter Lucas, a youth of eighteen, who was brought home ſeemingly dead in conſequence of a ſtroke of lightning. By the uſe of bliſters, volatiles, and ſtrong friction aſſiduouſly purſued, under the direction of Mr. Milward, the young man was at length happily reſtored *. Whether electricity be not applicable to almoſt every caſe of ſuſpended animation; and whether there be any inſtance that excludes it, except that which proceeds from profuſe hemorrhage, muſt be left to future obſervation to determine. Likewiſe whether the effects of poſitive electricity be eſſentially different from thoſe of the negative; as the former, *ceteris paribus*, appears to be weaker than the latter. This apparent difference however probably depends on the following circumſtance. In poſitive elec-

* See Reports of the Humane Society for 1773.

tricity, the fire is preſented to the patient, in a pencil of diverging rays, and is diffuſed over a conſiderable ſurface, by which its action is rendered milder. In the negative, it is made to iſſue from his body, in converging rays, as from a point, by which it is of courſe felt with more poignancy *.

3d, HEAT—*Its efficacy in reſtoring animation—particularly illuſtrated in torpid animals.*

Heat is ſo eſſential to animal life, that without it, the embryo in the fecundated egg, would for ever remain in an inanimate ſtate. By a certain degree of heat it is called forth into being, whether this is communicated

* The moſt commodious apparatus I have yet ſeen, for exhibiting medical electricity, in every poſſible direction, and even without an aſſiſtant, is that lately contrived by Mr. NAIRNE, mathematical-inſtrument maker.

nicated by the hen during incubation, or by an oven heated to the ſame ſtandard, namely, about 106 of Farhenheit's thermometer. Hence the myriads of animated beings, which, from imperceptible ova, are uſhered into exiſtence by the ſummer's ſun.

Heat is no leſs neceſſary to viviparous than to oviparous animals. The human heat amounts to 98° of Farhenheit's thermometer; this being congenial to the healthy ſtate of the body, points out the degree which ſeems beſt adapted for reſtoring animation. Accordingly the efficacy of the warm Bath has been experienced in various caſes of apparent death, eſpecially from drowning. Its ſucceſs probably reſults from ſtimulating the cutaneous nerves, and preventing the coagulation of the blood, which is ſo ſoon apt to commence on its total ſtagnation.

When the warm Bath cannot be ſpeedily procured, a partial application of heat may prove very beneficial. Hence a warm ſunſhine has more than once, afforded an uſeful auxiliary on thoſe occaſions. This circumſtance might be improved when the weather is favourable, by collecting the ſolar rays in the focus of a lens or ſpeculum, and directing them with more or leſs intenſity, upon different parts of the body. This method of applying heat (ſo far as I know) has never yet been ſuggeſted with this view, though it may evidently ſupply a ſtimulus of the moſt powerful kind. By thus directing the concentrated rays, with due caution, on the eye, the pupil would not fail to contract, if the muſcular fibres of the iris retained even the ſmalleſt degree of irritability. Might not this afford a method of diſcovering whether any remnant of life yet remained in the other parts of the body, and

con-

conſequently lead us to a new criterion between real and apparent death?

The wonderful influence of heat in rouzing the dormant powers, and in renewing the circulation of the ſtagnant blood is finely illuſtrated by its effects on torpid animals, which ſleep during the cold and rigorous ſeaſon of winter, and regularly awake on the approach of the genial warmth of ſpring. M. BUFFON, in his natural hiſtory, relates many curious particulars concerning this claſs of animals. He obſerves that the German Marmot, a rat of this kind, almoſt as big as a rabbit, is known to ſhut itſelf up under ground on the approach of the cold ſeaſon, where it falls aſleep, becomes ſtiff, and feels as cold as ice. When opened, the inteſtines ſhew no ſigns of irritability, even on the appli-

cation of ſpirit of wine, or oil of vitriol.
" It is curious, ſays the Hiſtorian, to ob-
" ſerve him paſſing from the torpid to an
" active ſtate. He firſt loſes the rigidity of
" his limbs, ſtretches out his legs, fetches
" a deep ſigh, yawns and opens his mouth,
" and utters rattling ſounds like a man in-
" toxicated. Such are the inconveniences
" he undergoes from a ſudden and forced
" reviviſcence, which is probably per-
" formed in a ſlow and imperceptible man-
" ner, when left in his hole. Warmth
" accelerates, and cold retards his reſtora-
" tion, and the change is obſerved to keep
" pace with the degree of temperature.
" But what is very ſingular, he does not
" become ſtiff and torpid when expoſed to
" a degree of cold equal to freezing, pro-
" vided he is kept in the open air inſtead
" of a cloſe place."

In high northern latitudes, it is aſſerted by travellers, that eels, during the cold ſeaſon, are ſent to diſtant places in a frozen ſtate, and are afterwards by immerſion in cold water, gradually reſtored to life *. Theſe inſtances afford ſtriking examples of what I lately hinted concerning the remarkable attachment of the vital principle to muſcular fibres even long after motion and ſenſation have ceaſed; and at the ſame time ſtrongly evince the powerful influence of heat in rouzing it into action. The uſe however of heat in the recovery of perſons apparently dead, requires much prudence and circumſpection in its application. If applied too haſtily, or in too great degree to perſons

* The term *cold* water, probably implies the temperature to be but a few degrees above the freezing point. Otherwiſe the tranſition from congelation would appear too great, ſince water heated only to the temperature of human blood, ſcalds fiſhes to death.——See Martin's Eſſ. Med. and Phil. p. 243.

ſons frozen, inſtead of re-animating the latent principle of life, it preſently extinguiſhes it, by producing gangrene and ſphacelus. In ſuſpenſions occaſioned by the fumes of burning charcoal, or mephitic air, the application of cold is found to be ſalutary, while heat proves injurious, and even brings on a relapſe after a conſiderable progreſs has been made towards reſtoration *. Whether other exceptions may not occur to the uſe of heat in reſtoring animation, muſt be decided by future obſervation. In the mean while, the judicious Practitioner will make the proper diſtinction between the effects of heat applied medicinally and thoſe of hot phlogiſticated air occaſioned by the accidental cloſeneſs of the room, or ſuperfluous number of uſeleſs ſpectators. Becauſe the latter circumſtance muſt ever

* See Reports of the Humane Society for 1776.

ever retard the desired recovery from whatever cause life is suspended.

The theory of animation is a wide field abounding with new objects, which engage our attention at almost every step, but the present excursion will only permit us to take a short and transient glimpse of those that appear to be most interesting. To other observers who may be inclined to take a larger range, and to contemplate them at leisure, these cursory hints are chearfully offered, hoping they may tend, in some measure, to facilitate their researches. Before we can expect to complete our views on this subject, many difficulties still remain to be explained, concerning which we can now only offer probable conjectures. Such however may not be without their use, if they lead to farther investigation. Therefore the following queries relating to some

of the principal *deſiderata*, are humbly ſubmitted to the candid reader, either to be adopted or rejected, according to their veriſimilitude.

QUERIES.

1. If plants cannot thrive without phlogiſton, nor animals ſubſiſt without dephlogiſticated air, is it not evident that the former may be conſidered as eſſential to the principle of vegetation, and the latter to that of animation?

2. As dephlogiſticated air is inhaled with atmoſpheric air into the lungs, and finds an eaſy paſſage from thence into the blood veſſels (as appears from the more florid hue which the blood acquires in its courſe through that organ) may not theſe two oppoſite principles, viz.

phlogiſton

phlogiſton and dephlogiſticated air, be intended to counteract and balance each others effects in the ſyſtem?

3. So ſtrong is their chemical affinity that they quit all other ſubſtances to unite with each other. May not the colliſion reſulting from their mutual union, in the body, be the cauſe of animal heat, as it is acknowledged to produce flame and combuſtion out of the body?

4. Though irritability is ſaid to be a property inherent in living ſolids, yet it requires to be continually ſupported by dephlogiſticated air received into the lungs, ſince it ſoon forſakes the muſcles when reſpiration is ſuppreſſed. Does not this diſcover the ſource from whence the principle of irritability derives its energy?

5. Does not this moreover ſeem to ſhew, that the nervous influence, which is conſidered as the proper medium of motion, and ſenſation, depends eſſentially on dephlogiſticated air for its ſupport and activity?

6. As the blood is generally allowed to be the fountain of life, and as dephlogiſticated air is continually paſſing into the blood veſſels, does not the latter ſeem better calculated to actuate the vital organs than the electrical principle, which is ſo liable to be diſſipated every moment, by the general conducting power of all the animal fluids?

7. Dephlogiſticated air being rendered effete by its union with the phlogiſton of the blood, requires to be conſtantly evacuated, and renewed from without. Does not this ſhew the great importance of the lungs,

and

and why the blood requires to be inceſſantly fanned by this pneumatic engine, and why if this operation is ſuppreſſed, its animating principle, like expiring embers, fades, languiſhes, and becomes extinct?

8. Does not this alſo explain, why the new-born infant, having once reſpired air, is ever after under a neceſſity of continuing that proceſs to the laſt moments of life?

9. Does not the phlogiſtication of a portion of air by paſſing the electric ſpark through it, point out the cauſe why a ſtrong flaſh of lightning, by ſuddenly contaminating the vital *aura*, deprives the muſcles of irritability, and conſequently deſtroys at once, all ſenſe and motion?

10. May not the torpid ſtate which the marmot, and other dormant animals undergo

in

in their cells, and not in the open air, be owing, in a great meaſure, to the ſedative effects of the ſtagnant atmoſphere which ſurrounds them, when ſhut up, and which becomes highly phlogiſticated by their reſpiration?

11. Should this ſuppoſition be confirmed by future obſervation, will it not ſuggeſt an additional argument for the uſe of dephlogiſticated air, and free ventilation, in the recovery of perſons apparently dead?

12. If animal life ſubſiſts till the natural heat is extinguiſhed, might it not be of conſequence, to aſcertain with preciſion, the degree of temperature of animals in the torpid ſtate, and alſo in the ſuſpenſion of life from drowning and other cauſes?

13. Might not the difference of temperature that obtains between this, and the entirely

entirely inanimate ſtate, though too minute to be diſtinguiſhed by our ſenſe of feeling, become ſufficiently evident by the thermometer, ſo as to afford a more certain teſt of the preſence or abſence of life?

Farther objects of enquiry might be here ſuggeſted, but I have already treſpaſſed too long on your patience, and perhaps indulged ſpeculation beyond what may be thought conſiſtent with the prudential maxims of ſound policy. Formerly indeed whoever preſumed to think for himſelf, or to ſtep out of the common road of practice, with a view towards the advancement of the healing art, expoſed himſelf to the keeneſt ſhafts of criticiſm. Though it is to be hoped the preſent age is too enlightened, to diſcourage liberal enquiry, yet ſtill there are not wanting certain brethren, who

have ever been accuſtomed to pace it along the beaten track, in all the trammels and accoutrements of ſyſtem; and to ſpurn at others as innovators, if they but attempt to throw off the ſhackles, or to introduce any uſeful improvements. From ſuch men, I expect no quarter, becauſe their unfortunate bias diſpoſes them to be captious, and like the jaundiced-eye, obliges them to view objects through a falſe medium. Should they indiſcriminately condemn the preſent Hints, I ſhall by no means diſpute the juſtice of their ſentence, becauſe no one perhaps can be more truly ſenſible of their imperfections, or at the ſame time more ready to acknowledge them, than the Writer. If thoſe however, who undertake to criticize, would but deign candidly to point out the exceptionable paſſages (which may poſſibly be more numerous

rous even than he imagines) he will be extremely willing to profit by any remarks they may contribute to the improvement of his plan. He will even liſten to ſuch ſtrictures as may ~~be~~ tend to ſap its foundation, provided it can be proved to be groundleſs, and that a better may be eſtabliſhed in its room. For weak and untenable is the citadel whoſe walls are unable to ſuſtain a hoſtile aſſault without being diſmantled. In ſhort, if what he has offered in favour of dephlogiſticated air, electricity and heat, as deduced from their known properties, and the experiments of the moſt eminent Philoſophers, be not well founded, the ground-work, as well as the ſuperſtructure, will be in danger of being demoliſhed. Even then, he will have ſtill one conſolation at leaſt, viz. that of falling with ſuch very reſpectable company. Happily, in the interim, the parties concerned can ſuf-

fer no injuſtice by ſubmitting the deciſion to the candour and indulgence of an IMPARTIAL PUBLIC;

To WHOM I am, with the utmoſt reſpect,

Dear Sir,

Your's very ſincerely,

A. F.

London,
May, 27, 1783.

THE END.

ERRATA.

P. 56, l. 23, for *juſify*, read *juſtify*.
---, 24, for *it*, read *they*.
73, 2, dele *it*.
76, 23, after *vain*, add *did*, and dele *s* in *endeavours*
78, 8, for *acquire*, read *require*.
81, 4, for *caſes*, read *ſituations*.
83, Note, after *this*, add *generally received opinion*.
91, l. 9, read *ſituations*.
92, 7, read *earneſtly*.
94, 22, Note, for *this*, read *that*, and omit *thus*.
95, 8, ~~three~~ Italics inſtead of Small Capitals.
99, 12, omit *and well being*.
103, 20, after *and*, add *is*.
109, 12, omit *of life*.
112, 9, for *zeal of*, read *zeal for*.
119, 16, read *great a degree*.