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ON THE PRACTICAL USE

OF

INHALATIONS,

IN DISEASES OF THE

THROAT AND CHEST.

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PHYSICIAN TO THE DISPENSARY OF SAINT LEONARDS-ON-SEA.

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TO

SIR ASTLEY PASTON COOPER, BART.,

D.C.L., F.R.S.,

SERGEANT SURGEON TO THE QUEEN,

&c. &c.

MY DEAR SIR ASTLEY,

THE expression of my just veneration, for a long life of practical benevolence and usefulness, and of undiminished zeal and success, in investigations which tend to the perfection of curative art, affords me sufficient gratification, in the privilege of thus publicly addressing you.

But, as you have been pleased to approve the method of aiding the removal of disease, recommended in these pages, it is with that additional pleasure, which springs from the well-founded attachment of an old pupil, that I inscribe to you, to whom I am so much indebted, this humble attempt, to render inhalation more generally understood, and more systematically employed.

I am,

MY DEAR SIR ASTLEY,

Yours most sincerely,

JOHN HARWOOD.

West Villa, St. Leonards-on-Sea,
1st October, 1839.

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INTRODUCTORY NOTICE.

During late years, having witnessed much greater benefits to result, from combining the use of inhalations with other means, in the treatment of diseases of the organs of breathing, than I formerly obtained from the influence of medicine taken by deglutition only, I am induced to publish the following brief remarks on that subject; believing that they may assist the reader, in estimating, justly, the advantage of thus conveying remedies to the immediate seat of disordered action.

Regarding inhalation therefore as a valuable auxiliary method of treatment, and as being especially beneficial in diseases of the mucous membrane, which lines the several parts of the air-passages, it is my wish to offer some intelligible reasons for its employment; and likewise to explain, what I have found to be the most successful and easy mode of conducting that process.

And it is hoped, that this latter attempt may prove the more useful at this time, from the increasing employment of inhalation, by physicians who have devoted the greatest attention to pulmonary diseases; and who being, therefore, the most aware of the frequent futility of an entire dependence on other methods of treatment, have endeavoured thus safely to extend the resources of medicine.

PREPARING FOR PUBLICATION,

BY DR. HARWOOD.

ILLUSTRATIONS,

OF THE

EFFECTS OF INHALATION;

IN DISEASES OF THE

THROAT AND CHEST.

ADDENDUM.

The reader may please to add, page 13, line 2, after the word "inspiration," during which, if, at first, necessary, the nostrils may be compressed.

ON INHALATIONS, &c.

The advantage of uniting every useful aid, in the removal of diseases of the organs of breathing, is sufficiently obvious; and in employing inhalations with more general methods of treatment, the chief objects which I have myself sought to attain, are as follow.

First, the removal or mitigation of affections of the internal surface, of the several parts of the air-passages; which complaints are usually attended with tedious and distressing coughs, and either arise from atmospherical influences, or from less obvious causes, or are induced by influenzas, measles, or other disorders.

And, secondly, the alleviation of that inflammatory or irritable condition of the bronchial tubes, which often accompanies tubercular consumption; whence a hope is afforded of arresting the progress of that disease, by the substitution of a state of quiescence, for that of tubercular development.

In consequence of the very great importance of these objects, I have long been induced to combine the use of inhalation, with other means, in the treatment of complaints of the throat, as those of the larynx and trachea; in the various disorders of the bronchial membrane,

including asthma; and likewise, in certain diseases of the substance of the lungs.

Independently of the well-known frequency of consumption, so greatly do other complaints of the organs of breathing prevail in England, that they are almost constantly presented to our notice; the "bronchial diseases" being either attended with their characteristic winter coughs, or combined with disorders more purely asthmatic, or productive of difficulty of breathing; whilst, by their frequent recurrence, they themselves often gradually assume the asthmatic character, induce that affection in each of its several varieties, or accelerate the progress of consumption: which disease, some of them very closely resemble.

Before proceeding to the chief subject of these pages, it is therefore desirable to say a few words concerning the situation of disease, and the membrane which is affected, in laryngeal, tracheal, and bronchial complaints; and especially, that portion of it which forms the seat of the latter.

It may then be remembered, that the delicate mucous membrane of the organs of breathing, lines every portion of the air-passages, and is continuous and identical throughout its whole course. The word "bronchial," also, by its derivation from the word βρογχος, the trachea, properly belongs equally to every portion of the internal tracheal surface: as that of the larynx, which is the upper portion of the trachea, that of the trachea, or tracheal tube itself, and consequently, that also of every division of the bronchial tubes; these being no other than branches of the trachea, within the lungs.

The names of these parts, therefore, thus distinguish the seat of disease; laryngeal complaints affecting that

part of the bronchial membrane which lines the larynx; tracheal affections being chiefly confined to that portion of it which lines the tracheal tube, whilst "bronchial diseases" are usually referred by medical writers, to the last or lower portion only of this membrane, which, having here reached the lungs, acquires so remarkable a degree of extension, throughout those organs, as to line all the divisions and even the smallest ramifications of the air tubes.

Notwithstanding these distinctions, however, in the membrane, which thus lines all the organs of breathing, in speaking of it, I shall often have occasion to employ the term "bronchial," in its true or general sense.

Some doubt has been entertained, if this membrane, which is thus frequently the seat of irritation, be actually continued into the air-cells of the lungs, in which so extensive a capillary union of the extremities of the arteries with those of the veins, takes place; since it cannot be there detected, although its search be aided by a high magnifying power. It indeed, appears to terminate with the ramifications of the air-tubes or passages, on their entering, at the end of their course, the minute cells of the lungs; the air-tubes themselves, lined by the bronchial membrane, becoming less cartilaginous and more and more membranous, as they diminish in size.*

On the contrary, the pulmonary blood-vessels, which ramify on the bronchial membrane, being continued onwards, form a complicated net-work, within the air-

* It is remarkable, that quadrupeds, in which the cartilaginous character of the air-passages extends much farther than in ourselves, enjoy a far greater exemption from bronchial diseases, though with less power of sustaining vocal sounds; whilst their more limited power of varying the intonations of voice, depends on other interesting differences in structure.

cells; and supported by the peculiar tissue of the lungs, they chiefly compose the sides or walls of those microscopic cavities. Hence it is probable that the delicate coats of these blood vessels, constitute the only intervening substance, between the external atmosphere and the blood itself.

Now as inhalations, combined with the air inspired, expand or dilate this infinitude of ultimate air-cells, and consequently pervade every portion of this membranous surface, we have reason to believe that their influence extends to the more internal parenchymatous structure of the lungs also; through the absorbing property of the bronchial membrane. For this membranous lining of the air-passages, like the skin, is beset with inhaling or absorbing pores; and these bronchial absorbents, like those of the skin, are endowed with a power of selecting what they imbibe; as is shown in their absorption or non-absorption of noxious matters, from the various effluvia presented to them by the air in breathing; and the same, of different medicinal or curative agents, offered to them by inhalation.

The operation of inhalation, therefore, thus consisting in the exposure of the whole of the internal surfaces of the lungs, to the effects of the agents inhaled, this process is employed in two capacities. It either communicates to the lungs, the soothing action of warm vapour only, (which is indeed the internal medium of protection to those organs, afforded by nature herself, and the presence of which becomes apparent in the surcharged vapour of the air we expire,) or it conveys the active or curative principles of medicinal substances, by means of this vapour, to the immediate seat of irritation or disease; the useful or remedial principles of

many medicines being of a volatile nature, and therefore readily so conveyed. In other words, this kind of inhalation, carries such remedies at once into immediate contact with affected organs, which organs, it is very necessary to remember, as incontrovertible, are quite inaccessible to the action of medicines by any other means, except either through remote sympathies, subsisting between certain parts of the nervous system, or by changes such medicines may produce in the blood itself, after their passage through the stomach.*

Independently however, of the specific influence which particular remedies exert, when thus conveyed to the seat of disease, by inhalation, this process appears to be scarcely less valuable, from its soothing and alleviating influence, on the nervous system. And it is to precisely the same operation alone, that we can ascribe the benefit of fomentations and cataplasms; which, by their mitigation of irritation and suffering, on the surface of the body, often prove more efficacious likewise, in restoring healthy action, than any other attainable means.

But the membranous lining of the air-passages, besides possessing absorbents, as before observed, is well-known to be endowed with exhalant vessels also; and this throughout its whole extent; including the larynx, the trachea, and the bronchial tubes; and in some situations, probably as extensively as the skin itself. The important operation, therefore, of inhalations of warm vapour, on the vast exhalant surface of this membrane, (for the extent of the bronchial membrane, traced through its various ramifications, has been

* All medicines, therefore, which are unsuited for inhalation, because their active principles are not of a volatile nature, can only affect the lungs, thus indirectly.

supposed to greatly exceed that of the outward surface of the entire body,) affords too close a parallel, to the action of that invaluable agent the warm bath, on the exhalant vessels of the skin, to escape our notice.

It is from an early perception of these advantages, with others, that inhalations now rank amongst the older curative means with which we are acquainted; dating their origin as far back as the days of some of the most distinguished physicians of antiquity; at least those of Galen, in the second century: and, in the present day, it is their power of conferring the same benefits, that has induced many, in this country, on the continent of Europe, and in America, to bestow a careful attention to their operation: and on this just ground, to seek their useful aid in the removal of disease.

As the phenomena, presented by the disorders of the organs to which inhalations are applied, are various, such is likewise the mode of operation, of these remedies. Amongst the former, it may be observed, that many chronic affections of the larynx, the trachea, and the bronchial tubes, or rather of the bronchial membrane, lining these several parts of the air-passages, are attended with deficient secretion, and consequently, a dry, harsh, or sonorous cough; and in these cases, it appears that a certain condition called "spasmodic constriction," often as really affects the mouths of the exhalant vessels of this membrane, as it affects those of the skin when perspiration is suppressed. In these complaints, therefore, it is well known that medicines which possess nauseating properties, are amongst the most valuable remedies; because, partly by a relaxing, and in part by exercising a peculiar or specific operation, they remove constriction from, or excite increased

action, in the affected vessels. In other words, it is probable that they produce these effects on the tracheal or pulmonary exhalant vessels, in a similar manner, as medicines which induce perspiration, excite the action of the exhalant vessels of the skin, or are supposed to remove constriction, from their pores or orifices.

But, as in these frequent complaints of the bronchial mucous membrane, attended with urgent and continued coughs, an irritability of the stomach is very liable to exist already, which unsuits it even for the reception of adequate nourishment, and often at a time when this is much required, I have satisfied myself from experience, that, by the more immediate application of the former nauseating medicines to the actual seat of deranged action only, the patient may be equally relieved, whilst spared the tedious and painfully depressing influence of that degree of nausea, which is usually excited by the same medicines, when received into the stomach.

And this advantage is partly derived, from greater accuracy being afforded, by inhalation, in determining the effects of nauseating remedies on the system; by the gradual addition of the medicine which is used, and by the portion of time occupied in its inhalation; whilst the stomach may be often employed to far greater advantage, than in the reception of any medicine of this class. By the aid of inhalation also, in cases of severe coughs, the stomach is spared the cloying effects of mucilaginous or saccharine medicines; or the proportion of those administered, may be thus very much lessened.

It is obvious therefore, that from interference with the function of the stomach, being by this means diminished, that organ is left in a better condition for the reception of other medicines; which may fulfil similar indications,

or aid the same objects, by a modified mode of action. Or, during the use of inhaled remedies, the stomach may be permitted to receive such medicines only, as may augment the effects desired, by acting on a principle entirely different.

Of the latter kind, for instance, are those which by tending to remove debility from the exhalant vessels of the lungs, may control or diminish the inordinate secretion of phlegm, or may improve and invigorate the general health; objects of great importance to attain, in the frequent and lingering chronic bronchial diseases of elderly persons; which, like most other affections of this membrane, are the most prevalent and severe during the winter months.

With the last mentioned view, the mineral acids, for example, taken by deglutition, are often exceedingly beneficial; and in these cases, as undue secretion would appear to be induced, most frequently, by a certain relaxed or weakened condition of the pulmonary secreting organs, often combined with spasmodic difficulty of breathing, the utility of these medicines, is explained by their tonic influence, and by their power of allaying irritability, and of controlling irregular muscular action. To means of this kind, may then likewise be added, the aid of a supporting diet, in more adequate proportion to the requirements of the system, than could otherwise be received by the stomach; besides the employment of more general curative or palliative measures.

It is quite apparent, on equally reasonable grounds, that the aid of inhalations may be advantageously sought, in many of the minor and more frequent complaints to which we are subject; or, indeed, extended, from the common hoarsenesses and sore throats, the inflamed or

enlarged tonsils, which attend a slight cold, to the most serious diseases of the organs of breathing. And in all these affections, but especially in influenzas, and inflammations of the air passages, accompanied with pain and difficulty in expectoration, we find that they prove exceedingly soothing and beneficial to the inflamed surface, when applied at a moderate temperature.

On the other hand, if inhalations be caused to exceed the temperature of the body, their useful anodyne influence is liable to become converted into that of an injurious stimulant; and this circumstance probably affords one of the reasons, why the advantage of inhalations, in the treatment of diseases of the organs of breathing, has been too much neglected. The same result may also partly have arisen, from confining inhalation to the use of a single remedial agent only; and from undue confidence having been often reposed in the curative powers of the agent employed.

Disadvantage, in the use of inhalation, also sometimes may be attributed, not unjustly, to the absence of that experience in its practice and its effects, by which alone, as in other departments of medicine, the most appropriate choices of agents, or modification of means, can be adapted to the requirements of the particular case; it being obviously, only by a careful selection of the most suitable remedies to be applied by this process, and by a clear discrimination of the circumstances, under which advantage may be reasonably expected from them, that the most satisfactory results can attend their use; whatever may be their inherent efficacy.

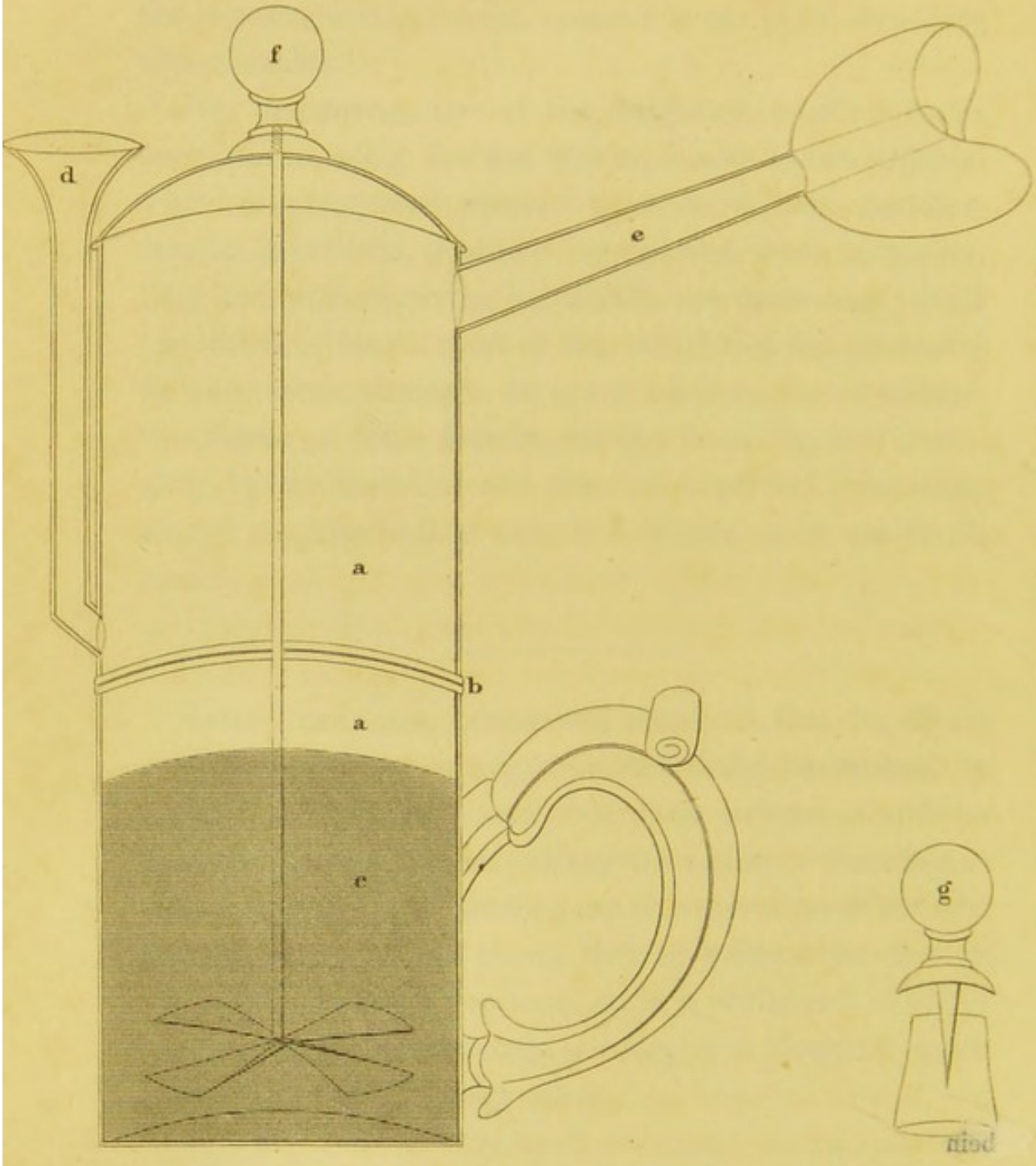
But I think the most common cause of the too frequent neglect of this aid, is the very imperfect and inefficient manner, in which the act of inhaling is often conducted;

a defect, often greatly depending on the glass apparatus, that has been of late usually employed for this purpose, the construction of which appears to me to be decidedly objectionable.

For, in consequence of the resistance, required to be overcome in using this instrument, I have known invalids, who have supposed themselves to have been pursuing regular inhalation, during a long period, when in reality, they had been receiving habitually, not more than about one third or fourth part of the volume of air necessary to inspiration, through the glass inhaler; the remaining two thirds or three fourths, having been received insensibly, by the nostrils; and cases of imperfect inhalation, almost or quite to this extent, I believe to be not at all rare.*

Some years since, I conceived therefore, that the efforts of enfeebled patients might be materially diminished, in the act of inhaling; and that their powers would be better employed, in gently aiding the action of the muscles of breathing, or in producing the due elevation of the ribs and expansion of the chest, than in being expended, in the production of a vacuum, or in a prolonged effort of suction; and this through a tube, of a diameter quite inadequate for free respiration.

* The best test, for ascertaining this point, merely consists in observing the current of air on a downy feather, when held beneath the nostrils, or above the ingress or funnel-tube of the inhaler; and such a test of proper inhalation, though apparently insignificant, should be had recourse to by all who commence the process; it being on such lesser matters, that the most important results, in medical treatment, often depend.



a *Interior*
b *Union of the two portions*
c *Contained fluid*
d *Ingress-tube*
e *Egress-tube & Mouth-piece*
f *Mixing rod*
g *Additional plug & cork*

Section of an Instrument of simplified construction for conducting inhalation without causing fatigue.

See page 11.

And, to this end, it seemed obvious, that the inhalers in use, might be advantageously substituted by one of greater simplicity in its construction; and which might entirely remove the exhausting labour of overcoming atmospherical pressure, augmented by the inadequacy of the supply of air; whereby, it is certain, that the action of the chest is constrained and rendered imperfect, or confined much within its natural limits.

This impression therefore, led me to the formation of an instrument, in which no protracted effort is necessary, nor any impediment whatever, is offered, to the speedy, full, and free expansion of the chest in the act of inhaling. Experience has now proved the great advantage of this instrument, and since it claims no other merit, than simplicity of construction, and very easy and convenient employment, for the sake of the invalid, I am glad to know that these qualities have recommended it to the use of some of the most eminent members of the profession; and also to that of some important public institutions.*

* This inhaler may be obtained from Messrs. G. Waugh and Co., Chemists to the Queen, No. 177, Regent Street; and from Messrs. Maynard and Burkitt, Borough, opposite St. Thomas's Hospital.

On the Hastings coast, it may be had at the principal Chemists'.

To better maintain warmth, if required, it may be obtained, formed of pewter, or of double plates of tin; the interval between them g filled with any substance, which by retaining the particles of the air, is rendered a non-conductor of heat. But the advantage thus obtained is not very great, and this remark equally applies to surrounding the instrument with flannel, or hot water; for it is well known that polished metallic surfaces always part with their heat, by radiation, very slowly; and hence the surface at least, of all inhalers, obviously should be formed of metal.

When very volatile remedies are added to the warm water employed,

Regarding the act, and operation of inhaling, (some more general remarks concerning which, will be found at page 26,) it should be observed, that, whatever advantage may be obtained, subsequently, by employing deep inspirations, delicate invalids should always endeavour, at first, to conduct this process as much like their ordinary breathing as possible; or in other words as free from all effort or fatigue.

But as some difficulty occasionally opposes the proper attainment of this act, I have found that it is speedily acquired, in the following very easy manner.

The inhaler should be either wholly supported in the hands, or what is better, it should be raised to a convenient height, upon the table or the couch, the handle being held by the right hand; a little to the left of which the mouth-piece may be placed.

During inhalation, the teeth should remain a very little apart;—the mouth-piece gently pressed around the lips, and there retained steadily;—the vapour should next be drawn through the mouth;—the tip of the tongue should then be raised to the back of the upper front teeth;—whilst, lastly, the air is expired through the

they require frequent and gradual renewal, through the ingress-tube; and to be combined with the water, by one elevation and depression of the mixing rod.

When medicinal substances of little solubility, are only suspended in the water, the fluid may also be occasionally and gently agitated, during inhalation, by the same means.

In the absence of these, and when less volatile matters only, are required to be added to the water, the rod may be unscrewed at the top, and withdrawn, the short plug introduced as its substitute, and a cork fixed upon its extremity, to retain its position.

The inhaler should be properly dried after using.

nostrils; the tongue being then again depressed, for a renewed inspiration.

Now, if it please us to trace the connexion between these simple movements, and the internal parts immediately concerned in inhalation, we become better enabled to understand this process.

In ordinary breathing through the nostrils, the membranous velum of the palate, with the uvula, hangs vertically behind the tongue, like a curtain, as its name implies; and thus it cuts off the communication of the air inspired, with the mouth. But, in inspiring the air or vapour through the mouth only, this curtain of the palate is involuntarily and insensibly raised from its vertical position, more horizontally, or towards the plane of the palate itself; thus extending backwards, it however, again closes all communication between the mouth and the nostrils, and directs the air or vapour, received by the mouth, uninterruptedly, through the trachea into the lungs. To view the throat distinctly therefore, the air should be inspired by the mouth, for the purpose of raising this useful curtain.

In expelling, consequently, the air or vapour received by the mouth, through the nostrils only, the trifling movement of the extremity of the tongue, before noticed, not only forms a valve, to oppose the exit of the air through the teeth, although they still remain apart, but the velum of the palate with the uvula, then forms another valve, by resuming its vertical position, and again applying itself to the base of the tongue; whereby the nostrils, again pervious, can now alone transmit the air or vapour outwards. The perfect action of this valve, formed by

the velum of the palate and the uvula, is immediately exposed to our view, when the teeth are widely separated, and we inspire successively through the mouth, and expire through the nostrils.

I may here remark, that the act of smoking totally differs from that of inhalation; as the smoke does not pass into the trachea, in consequence of the then closed state of the valves of the throat; and so admirable is the protection, afforded to the lungs by these means, that although the smoke taken into the mouth, be permitted to traverse the pharynx, and even to return through the nostrils, by the elevation and depression of the velum, yet the perfect valve, formed by the epiglottis, still prevents its entering the trachea.*

In consequence of increased attention to the aid of inhalation, in the treatment of pulmonary diseases, in London, some very ingenious instruments have been lately invented for conducting that process; specimens of which were recently shown to me by Sir James Clark, and by Dr. Davies, Physician to the Infirmary for Diseases of the Lungs. Some of these, however, by containing two artificial valves, like another I had formerly seen, act independently of the important assistance of the nostrils, in inhalation, and thereby set aside the great

* The speedy removal of spasm, from the air passages, in difficult respiration, which I have often seen produced by the smoking of stramonium, is therefore doubtless the effect of sympathy, communicated by the numerous connecting branches of the several nerves which are distributed to the parts concerned in breathing; this sympathy of action, thus extending remedial impressions from the throat and fauces, to the inferior and ultimate ramifications of the air tubes.

advantage, of the instantaneous action of the admirable valved structure, of twofold application, just described; which mechanism, being provided by nature, is therefore exercised without effort; eluding even our sensations, and determining the course of every breath we expire.

Nevertheless, as instruments thus formed, may be supposed by some invalids, unacquainted with the practice of inhalation, to supersede the more simple kind of inhaler I myself employ, the action of which, is, intentionally, rendered as dependent as possible on natural mechanism, and as little so, on that of art, and as this instrument has been found to offer thereby, very decided advantages in its practical use, it may be no more than proper or due to the reader, to mention, briefly, further considerations, in favour of its simplicity of construction; that important, though sometimes unappreciated recommendation in mechanics, on which my own expectation of its usefulness was at first founded.

The action of artificial valves, howsoever ingeniously contrived, appears to me to involve, necessarily, an increased effort in inspiration, on the part of the patient; nor can I approve of the use of any inhaler, the inner extremity of the ingress tube of which, like that of the glass apparatus, is placed below the surface of the water, instead of above it; because an additional, and altogether unnecessary effort, is thereby further imposed on free inhalation.

When spiral tubes, or other receivers of air, are conveyed below the surface of the hot water, for the purpose of augmenting the heat of the air to be inspired, this arrangement appears to my mind, only to secure the advantage proposed, at the sacrifice of a greater. For the warmth of the air to be inspired, seems to be not

only more conveniently, but better supplied, at the expense of that of the vapour already exhaled, and contained within the inhaler, than of that of the water; because the continued heat of the water is necessary to the further exhalation of vapour; and, more especially, because the quantity of caloric thus abstracted by the air, in its passage through the improved inhaler, is so easily and amply afforded by the heated ingress-tube, and by the vapour of water at a proper temperature, that we are more careful to avoid an excess of heat, acquired by the air to be breathed, than anxious to supply its deficiency.

I also conceive, that a fixed canal, for the egress of the vapour from the instrument, is more steady in its application to the lips than a flexible one; and likewise, more convenient, in never requiring the exclusive support or assistance of the hand, nor occasioning the necessity for the introduction of a tube of adequate caliber, into the mouth; the presence of which tube, if of a proper size, I find to be an insuperable obstacle, to that freedom of inhaling, and to that perfect mode of conducting this process, by the motion of the tongue, before noticed, which it is so easy, and necessary to attain. Lastly, such a fixed egress-canal as that of the inhaler, by its shortness and straightness, is much less liable to occasion the speedy cooling, and condensation of the vapour, than one of greater length and flexibility; and therefore conducts it more perfectly, to the membranous lining of the lungs.

We sometimes find, that the quantity of a medicine required for inhalation, is as small, as would form a

requisite dose if otherwise administered; but if we remember that the volatile constituents only, of medicines, can be conveyed to the lungs by inhalation, the less volatile parts, which constitute their bulk, still remaining diffused in the water of the inhaler, we perceive that the influence or energy of medicines generally, is augmented in this process, beyond what they exhibit when received by the stomach.

This increased activity of medicines, when inhaled, doubtless in part depends on their more perfect solution; but it arises, more especially, from their immediate and very extended action. And this result does not excite our surprise, when we obtain a more distinct view of the structure and functions of the organs, to which these observations relate; as for example, when, in reconsidering the vast extent of surface, of delicate mucous membrane, which is directly exposed to the influence of inhaled vapour, we regard the great vascularity of the lungs, as likewise affording a not less important cause; for the ramifications of the blood-vessels upon the bronchial membrane, and throughout the other pulmonary structure, are so extensive, that within a given time, the lungs have been computed to transmit a volume of blood, five times greater than that which flows through any other organ of the body.

These circumstances therefore may in part lead us to conceive, how the whole of the blood itself may be affected, by the influence of subtile and active agents communicated to it by breathing; but they exhibit this operation the more clearly, when we witness the remarkable effects of oxygen on that fluid; and ascertain that it can readily produce these effects, through the delicate coats of the vessels that contain it. For it is

well known, that oxygen can not only penetrate the coats of the pulmonary blood-vessels, but that it can instantly pervade even thick membranes, as bladders; and, rushing through them, as it does through the coats of the pulmonary vessels, that it can in like manner deprive blood contained therein of its carbon, and change its colour.

But if we contemplate the pulmonary structure further, and view by means of a high magnifying power, its ultimate and capillary system of blood-vessels, we then perceive how directly the latter are exposed to the action of inhaled vapour. For these capillary vessels, (which are of a somewhat cellular structure, and do not exhibit the cylindrical form, although, by their interposition, they unite the extreme terminations of the arteries with the extreme origins of the veins,) are distributed throughout every cavity, and over every internal surface of the lungs, howsoever minute, to which the air and vapour has access.

When therefore we consider, that within these capillary vessels, thus exposed to the influence of external causes, the blood certainly becomes changed in its colour and properties, and that, consequently, a certain portion at least of our animal heat, is probably there evolved, by every breath we draw, we may better conceive the influence of suitable remedial emanations: not only on the part itself, but on the system generally; when carefully brought into proximity with this admirable organization.

I cannot avoid, in this place, endeavouring to encourage the due estimation of every means, calculated to preserve, or to restore the healthful action of the organs of breathing, by further conveying an idea, how-

ever indequate, of the vast importance of their office, in the animal economy.

The necessity for great extent of pulmonary membranous surface, is abundantly manifested to us, when we investigate more closely, the remarkable phenomena afforded by respiration, as an animal function. For breathing, or the inhalation of the atmosphere, was determined with great accuracy by Sir Humphrey Davy, to consist in nothing less than the abstraction of 45,504 cubic inches of oxygen, from the air, daily; and its appropriation within the lungs, to the formation of exactly the same quantity of carbonic acid; whilst heat and electricity are evolved in the process: this function therefore, depends on the great avidity with which oxygen seizes and combines with carbon, and on its thus conveying it away from our bodies, in a gaseous form. In other words, breathing has been thus found to consist, in the abstraction or removal, by means of the oxygen of the air, of about twelve ounces, or three quarters of a pound, of carbon or charcoal, from the blood, during every twenty-four hours of our existence.*

* This principle, carbon, being deleterious to animal life, therefore renders the function of breathing, under various modifications, indispensable to all created beings, to enable them to reject it from their bodies; whilst, in conformity with that beneficent law of exact adjustment, which characterises all the works of Providence, this deleterious product, of animal bodies, of combustion, and of putrefaction, is exchanged for the great supporter of animal life, by the vegetable kingdom; for whilst vegetables of every kind, except the fungi, absorb carbon from the air, for their nourishment, they furnish to the atmosphere an immense supply of oxygen. According to the recent experiments of Dr. Daubeny, the quantity of oxygen they afford, is somewhat proportioned to the quantity of carbonic acid with which they are supplied, and to the influence of

And here we are presented with an illustration, well worthy of our notice, of that beautiful and appropriate adaptation of means to particular ends, which it is the constant and delightful province and privilege, of every department of physical science to unveil to us. For this exact equality, between the quantity of oxygen received, or abstracted from the air by the lungs, and the quantity of carbonic acid gas given out, or expired by them, is only produced, when the oxygen exists in the atmosphere breathed, in the precise proportion in which it is naturally found combined with the other elements of the air, or when it forms one-fifth part of the whole; for if these ordained proportions of the elements of the atmosphere be in any way altered, a very different result follows its inhalation.

For example, if even more oxygen be breathed, than the atmosphere has been destined to contain, instead of more carbon, as we might have expected, nearly one half less carbon is abstracted from the blood, than when the common air, of more appropriate composition, is breathed. In this case also, a certain proportion of oxygen is absorbed by the blood, and an exactly equal quantity of nitrogen is evolved by it. And again, if hydrogen, in the same large proportion as the nitrogen of the air, be substituted for the latter, and added to its oxygen, then, there is no loss of oxygen whatever, by breathing, but the whole consumption falls on the hydrogen; and here the hydrogen is absorbed by the blood, and is replaced by the same quantity of nitrogen, which in this case is given out by that fluid.

the sun-beams, and the fineness of the weather; a very small proportion only of the emitted oxygen, being reabsorbed by them during the night, and this only, if it be retained in contact with their leaves.

But besides these, and numerous other results of respiration, scarcely less remarkable, the function of breathing likewise brings under our notice, circumstances peculiarly worthy of our attention, from their great practical utility; as for example, those which demonstrate the necessity for ventilation, and explain its salubrious influence; whether produced by the varied motions of the external atmosphere, constituting the winds, or by the frequent change of the air contained within our dwellings.

Thus in order to effect by respiration, the wonderful abstraction of carbon from our blood, before noticed, it is found that we each destroy, daily, or render totally useless for the further purpose of breathing, not less than about 216,000 cubic inches, or 125 cubic feet of atmospheric air; for at the rate of about 31½ cubic inches per minute, we each deprive the atmosphere of rather more than 25 cubic feet of its oxygen, daily.

But the entire volume of air actually breathed, within the same twenty-four hours, very greatly exceeds this amount. For, as we inspire about twenty times per minute, these inspirations amount to 1,200 per hour, or to 28,000 every twenty-four hours; and this number, multiplied by 40, which is the average number of cubic inches of air computed to be received at each inspiration, determines the marvellous fact, if this latter number be not somewhat overrated, that not less than 1,152,000 cubic inches, or 666½ cubic feet, or 24½ cubic yards of the atmosphere, have been actually caused to pass through the lungs of each individual, to carry off the carbon from the blood, during every twenty-four hours of our lives.

It appears also, that 40 cubic inches, forms only the

small proportion of about one seventh part of the air which is usually contained within the lungs, as this is thought to amount to about 280 cubic inches; and hence, it is further supposed, that the air expired, does not consist of the altered elements of the air of the preceding inspiration.

In returning, from the inhalation of the atmosphere only, to that of remedial influences, communicated with the air breathed, to the lungs,—it will have been rendered sufficiently apparent, that no alteration whatever is produced by this latter process, in the natural proportions of the elements of the air, so breathed or inhaled.

The medicinal agents, which I have been in the habit of employing in inhalation, with few exceptions, have been selected from remedies that have long proved the most useful in similar cases, when received into the stomach; rather than from medicines whose supposed virtues have not yet been firmly established by time and experience. They therefore chiefly consist of vegetable substances, possessing different medicinal principles, and these adapted to inhalation, by being of a more or less volatile nature.

In regard to their general operation, in the fulfilment of the three great objects with which inhalation has been pursued;—several of them exert a soothing or an anodyne influence, under different modifications; and these, when applied by inhalation to the immediate seat of deranged action, often prove highly efficacious, in removing excitement or irritation, as it exists in the varied bronchial affections; when productive of periodical or

permanent coughs, or when combined with asthmatic paroxysms.

The same soothing action is often not less beneficial in tracheal and larygeal complaints; and I have also known cases, that have afforded much reason for believing, that these inhalations have greatly assisted in retarding or arresting the earlier progress of tubercular consumption; when, as occasionally happens, even in this early stage, it has been attended with bronchial irritation, and been influenced by its presence.

But as consumption, in its earlier forms, is generally accompanied with little or no bronchial irritation, or inflammation, (the cough being also generally slight, and often entirely absent,) and as the same absence of inflammation, and of much irritation, is likewise often observed at a much later period, in this disease, other kinds of inhalation are then employed with greater advantage.*

* My own observations regarding consumption, have justified an entire acquiescence in the opinion, that this disease has not usually an inflammatory origin; which opinion has been entertained by many of the most eminent investigators of the subject, as Doctors Bayle, Laennec, Louis, Sir James Clark, and others, who have not regarded inflammation of the chest as a primary cause of consumption: the fact being, on the contrary, that consumption itself very often produces such inflammation, the existence of which, when induced, hastens its own progress.

For it is proper to observe, that although neither pneumonia, pleurisy, nor bronchitis, may in themselves be adequate to the production of the tubercles of consumption, yet, where a tubercular tendency already prevails, whether hereditary, or induced in a healthy constitution, by any of those causes which are believed to be capable of its production, we have far too abundant evidence, that the supervention of inflammation, from whatever cause it may

The next kind of medicines, employed in this process, communicate a more stimulating operation, and these are well known to often prove highly useful, in many

originate, like the various causes which induce debility, may become the prolific source of serious transformation, into tubercles, of the semi-transparent secretion first deposited; which might otherwise have remained in a state of inert quiescence throughout a long life.

The absence of inflammation, may sometimes be justly assigned as a cause of the frequent entire absence of pain, in consumption, even although this disease may have proceeded to its latest stage; but so far from this explanation being correct in all cases, it is very remarkable, that chronic inflammation often exists, in connexion with consumption, without inducing any pain; and this absence of pain may be likewise observed in other forms of disease.

For example, even extensive ulcerations may take place in various parts of our structure without producing any pain; and yet we find, that acute inflammation of the very same parts, occasions severe suffering. It has indeed, been clearly demonstrated, by the investigations of Dr. Louis, that the former not only happens to the lungs, but to the trachea, and even to the epiglottis; although I may add, that this latter part, is supplied by branches of one of the most irritable nerves in the body; as is further indicated by its possessing a sensitive ganglion, a fact, which, in its interesting relations, has been particularly noticed by Sir Astley Cooper.

Independently of any connexion with consumption, or with any other form of disease, I myself also, in practice, have met with two instances of ulceration, which was scarcely productive of any sensation of pain, although of fatal extent, and having its seat even in the sensitive stomach itself.

With a knowledge then, that chronic inflammation may be present, without occasioning pain, in situations where acute inflammation is productive of severe pain, we may often detect its existence in the chest, when frequency of pulse is its chief external characteristic; or, when, in other cases, even this external symptom is absent: in which latent form it often proceeds to the production of extensive adhesions, of the pleural or external pulmonary

chronic diseases of the air-passages; and, in the absence of bronchial irritation, some of them have also long been thought to lessen the susceptibility of the lungs to the incursion of tubercular disease; which effects, it has been supposed that they produce, chiefly, by sustaining and promoting the due action of the exhalant vessels of those organs; although their influence may possibly augment the action of the absorbent vessels also. This preventive operation, which is sometimes very ambiguously expressed, by that of "imparting tone to the lungs," has often appeared to have attended the inhalation of the more volatile principles of resinous substances; as the vapour of tar, &c.

But in the frequent cases of consumption, last referred to, our attention is more especially directed to the auxiliary use of whatever remedy may best fulfil the third great object of inhalation; which is, that of augmenting the energies of the pulmonary absorbent vessels, without disadvantage to the system; and of thereby promoting the removal of tuberculous matter already deposited within the lungs, or of preventing its further deposition.

This power of absorbing tuberculous matter has nevertheless, been directly denied by some; but the impossibility, is at least as incapable of proof, as the

membrane, without such inflammation ever having been suspected to exist.

With this frequent want of outward evidence, even of inflammation, how little should the parents or friends of delicate young persons, expect the existence of pain, in order to certify the presence of consumption; and precisely the same may be said of cough and expectoration; and consequently, how necessary is a careful and minute investigation of the much earlier, and more internal indications of this disease, by every available means!

process of its absorption, of actual demonstration. And when we witness the quiescent state, which is sometimes induced in the tubercular disease of the lungs, constituting consumption, under the combined aid of this kind of inhalation, well knowing, with feelings of deep and melancholy interest, the too frequent inefficacy of all other methods of treatment, employed separately in this disease, we are furnished with, at least, sufficient reason and encouragement, to urge our perseverance in the measure; and with sufficient evidence of the removal of disease, to justify the impression that some absorption of the tubercular accretion has been produced.

The concussion of the chest, occasioned by repeated emetics, has been regarded, from early periods, as favourable to the removal of tuberculous matter, in incipient consumption; but it seems to me by no means certain, that some, of whatever advantage has been derived from these medicines, may not be better assigned to the well-known promotion of absorption, by the influence of nausea.

In addition to what has been already said in page 12, concerning the most convenient mode of inhaling, I would now add the following more general remarks regarding this process.

I have generally employed inhalation, two, three, or four times during the day; the first being had recourse to early in the morning, before rising, or before the accession of cough, by which this is usually lessened, or is rendered much less severe and distressing to the patient; expectoration being greatly facilitated, by the moisture with which the mucous membrane of the air-passages, is imbued, by the inhaled vapour. Bed-time

also, is usually a regular and proper time for inhalation.

The most suitable portion of time, occupied in the act of inhaling, is necessarily governed by the state of the individual, and the nature of the remedies used; exposure to a cold atmosphere soon after inhaling, being avoided; and subsequent increased susceptibility to its influence prevented, by employing vapour at a moderate temperature only.

As the interior of the lungs, and of the stomach, alike consist of absorbing surfaces, it is hence, that the system is similarly affected, by medicinal agents, to whichsoever surface they may be applied; nauseants, for example, though inhaled, producing sickness, and anodynes, their usual effects on the nervous system. We must also remember the facts, that some medicines exert a very powerful action by inhalation; and that the operation of most, is more speedy, when thus applied to the pulmonary mucous membrane, than if presented to that of the stomach; or in other words, when administered by inhalation, than if swallowed, or taken by deglutition; since these circumstances are practically advantageous in many instances.

And this is particularly the case, in the treatment of affections of the organs of breathing; in which diseases, when most required, we have the advantage of this choice in the manner of employing medicines; since many of those which are the most efficacious, are equally well suited to either mode of administration. Here, also, inhalation, when properly performed, not only insures activity and rapidity in the operation of remedies, which are objects very desirable to attain, in severe coughs, and in difficulty of breathing, but, as before noticed, the

influence of medicines when thus employed, may be augmented so cautiously, by their gradual addition, or controlled so effectually, by the quantity employed, and by the time occupied in inhaling, that their required effects on the system, may be often obtained with greater accuracy, than when the same medicines are at once swallowed, in any fixed or definite proportion.

These advantages are obviously great, in the administration of most narcotic remedies, to persons unaccustomed to their use, and more especially, that of opium; which medicine is well known to vary so materially in its action, on different individuals, as to render the greatest caution requisite in its employment. And as relates, further, to the action of morphia, Battley's sedative, or to other forms of opium, I have long found that these may be inhaled safely and beneficially, in cases of bronchial irritation and coughs, without inducing that torpid or inactive state of the bowels, their necessary dose is so liable to occasion, when otherwise administered; a fact, which opens to us an interesting view of the advantage of this local application only, of narcotic medicines.

In commencing the inhalation of these anodyne medicines generally, with the intent to soothe and allay pulmonary irritation, their effects on the nervous system require to be carefully observed, that the most suitable quantity only, may be employed; whereby subsequent headache and other inconveniences produced by too large a dose, (as happens also when they are received by the stomach,) may be avoided.

It appears likewise, that the same good effects are produced, by a less quantity or dose, when employed in the morning, than in the evening; and that the power of these medicines on the nervous system, is diminished

inversely with the supply of nourishment; they being the most active, immediately before meals, and the least so, after them.

In inhalation, the mere sensible impression of heat, to the tongue, fauces, or throat, from the vapour inhaled, may generally be regarded as a proof of too elevated a temperature; because it then exceeds that of the body; but we must not suppose, that the heat of the vapour inhaled, is identical with that of the water in the inhaler; for it is almost too obvious to mention, that the heat of the vapour, is greatly reduced, by the ingress of the cooler atmospheric air, in its passage through the inhaler. Hence the temperature, of a mixture of an equal volume of atmospheric air, and of the heated vapour within the inhaler, might be expected to exhibit an approximation to the mean of both temperatures; or, for example, the atmospheric temperature being 40°, and the vapour of the inhaler 140°, we might suppose, that an inhalation consisting of equal volumes of each, would afford half of the whole amount, or about 90 degrees of temperature.

But, in order to ascertain this matter with greater accuracy, I made it a subject of experiment; by retaining the bulb of a delicate thermometer in the vapour, within the inhaler, and successively passing a volume of twenty cubic inches of atmospheric air, of a given temperature, through the instrument; this volume of air, being similar to that which is received by the lungs, during diminished or impeded respiration, and its passage through the inhaler, being conducted in the succession of the inspirations of breathing.

By these experiments, the above supposition was well supported; the mean of the temperatures, of the air, and of the water, in this case, having proved to be nearly that of the inhalation; as was shown by the following results; which therefore constitute facts of importance in the employment of inhalations.

It was thus ascertained, in these instances, that atmospheric air at 57 degrees of temperature, when combined, in its passage through the inhaler, with the vapour, arising from

Water, at	100	degrees,	afforded an inhalation of	79	degrees.
do.	110	„	do.	84	„
do.	120	„	do.	88	„
do.	130	„	do.	93	„
do.	140	„	do.	99	„
do.	150	„	do.	104	„

We may also perceive, that by having used water at 140 degrees, the heat of the inhalation just exceeded the natural temperature of the body, which, as before observed, it is of importance to avoid; because the action of inhalation, becomes more stimulating and disadvantageous, with the excess of heat. An inhalation, however, of 99 or even 100 degrees, does not actually exceed the heat of the lungs themselves, or of the organs in their immediate proximity, since these possess a somewhat higher temperature than that of the body generally.

Beyond 140 degrees, I believe that inhalations ought never to extend; and the temperatures ranging from 110° to 135°, probably afford the best scale for ordinary purposes; 130° being frequently the most suitable temperature.

The only objections, which I have ever heard offered, to the employment of inhalations, are, "that their action is palliative only; that they produce relaxation; and that they increase the susceptibility to cold."

The first of these objections, would appear to be based on illogical reasoning; since whatever is itself capable of palliating disease, derives thereby a just and sufficient recommendation to our notice; as it may, in conjunction with other remedies, become an agent in producing its entire removal, or may perform, at least, a part, in promoting the curative process; to render no greater aid, being, exclusively, the office, of many of the most valuable of the remedies which are employed in medical practice. But this limitation, as applied to inhalation, often appears in reality, to be untenable, when its agency is submitted to the test of experience; as these pages may tend to illustrate.

It is likewise, obviously, from the neglect of the before-mentioned important considerations in regard to temperature, that a relaxing influence has been sometimes indefinitely attributed to inhalations generally; and with precisely the same sweeping injustice, that a relaxing effect has also been imputed to the warm bath, howsoever it may be employed.

For, that relaxation can be induced by inhaled vapour, of a lower temperature than that of the vapour afforded by the lungs themselves, and consequently, than that of the surface to which it is applied, is clearly impossible; and hence, whenever such an effect has been produced, it affords a decided proof, that an injurious temperature, exceeding that of the body, has been used. As therefore, relaxation is only liable to occur, when inhalation is inconsiderately employed, its existence merely proves, in

reality, that, with the warm bath, and every other remedy, this useful agent is alike subject to abuse.

It will likewise be seen, that the other objection to inhalations, namely, that they increase the susceptibility to cold, is, on the same grounds, equally, and, as obviously, founded on misconception, regarding the heat they communicate to the body, when properly used.

We cannot however feel surprised, that some inconvenience has been often incurred in the use of inhalation, when we know, that very little attention has been frequently given to this process; and that the vapour of water, so nearly approaching the boiling point, as 170 or even 180 degrees, (for it is very possible to inhale the vapour of water, even at this high temperature,) has been often supposed necessary for its employment. In these cases a highly exciting inhalation is afforded, at 110 or 115 degrees of heat; instead of a soft, mild, and often invisible vapour, arising from water at a temperature ranging from that of the atmosphere only, to about 135 degrees; being therefore, seldom too warm to be borne by the hand, and at its highest point, never communicating more than 99 degrees of heat to the body.*

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* When a thermometer is wanting, to regulate the heat of the water for the inhaler, a temperature of a little more than 120 degrees, may be obtained, (after allowing the absorption of a few degrees by the vessels employed,) by mixing in the inhaler, equal parts of boiling, and of cold spring water; the medicinal ingredients being lastly added.

From the advantage that attends the methodical arrangement of medicinal substances, according to their supposed mode of action, and in conformity with the plan adopted by Dr. Paris, in his useful division of expectorant medicines, I would propose, as an approximation only, to accuracy, the following method of arrangement, for medicines which are suited to inhalation.

Class 1. Simple warm aqueous inhalations.

Class 2. Inhalations containing medicines, which allay pulmonary irritation, mitigate spasmodic difficulty of breathing, and usually lessen the secretions of the lungs;

a. By diminishing the power or excitability of the nerves of sensation; or by diminishing the sensibility, irritability, and mobility of the system; as the hydrocyanic acid, preparations of opium, lactuca, conium, and some other narcotics.

b. By likewise affecting the nerves of vitality; and thereby reducing the action of the heart and the arterial system; as digitalis, and probably others.

c. By a peculiar anti-spasmodic action, on the bronchial passages, added to that of diminishing nervous power; as stramonium and lobelia.

Class 3. Inhalations which remove spasmodic difficulty of breathing, without occasioning any increase in the pulmonary secretions; and without diminishing nervous power;

a. By a certain specific stimulus, to the nerves of sensation; as coffee, and probably several others.

Class 4. Inhalations which increase pulmonary exhalation, and thereby facilitate expectoration;

a. By inducing nausea; and thus removing constric-

tion of the pulmonary exhalant vessels; as ipecacuanha, squill, &c.

b. By exciting the action of these vessels, by the actual contact of a stimulus; as some volatile principles contained in particular gums, resins, and balsams, certain vegetable acids, as the acetic and benzoic, &c.

Class 5. Inhalations which tend to diminish the secretions of the bronchial membrane, when preternaturally augmented;

a. Apparently, by imparting tone to the exhalant vessels; some medicines of the preceding class, as myrrh, tar, and kreosote, appear to act on this principle, in certain cases; and perhaps to this division, may also be added, chlorine.

Class 6. Inhalations which relieve very difficult expectoration;

a. By their powerful stimulus to the nerves of the lungs, tending, like galvanism, to renew the excitability of those also, which supply the muscles of respiration, when nervous power is diminished; as ammonia, camphor, and æther.

Class 7. Inhalations which are supposed to remove tuberculous matter, deposited in the lungs;

a. By augmenting the action of the absorbent vessels of those organs; as iodine, and perhaps some of those contained in class 4. *a* and *b*.

The remaining observations I shall now offer, will chiefly relate to the action or operation of these inhalations, and to the methods I have found to be the most convenient for their employment.

The emollient effects, and the removal of constriction, from the exhalant vessels of the surface of the body, produced by the warm and vapour baths, are familiar illustrations of the influence of simple warm aqueous inhalation, on the exhalant vessels of the bronchial membrane; and some of the advantage of those baths also, doubtless depends, on the influence of their exhalation, on this membrane.

In consequence of the volatility of the various narcotic and anodyne vegetable principles, they require to be conveyed to the lungs by the vapour, of water at a temperature seldom exceeding 110 or 120 degrees; but as the greater is the volatility of medicines, the less is the heat required for their inhalation, a still lower temperature is sufficient for this purpose, when some of them are employed; and especially, the hydrocyanic acid. These medicines often prove the most advantageous in their action, when accompanied, in inhalation, with one of an expectorant nature, as ipecacuanha. It has also been well established, that, in many cases, the action of the exhalant vessels of the skin, is augmented, by thus exciting those of the bronchial surface; and similar advantages are also derived, by the combined action of diaphoretic medicines taken by deglutition; as the acetate of ammonia, or preparations of antimony; circumstances of importance, in practice.

Thus, then, does the inhalation of narcotic medicines, often exercise a very soothing and satisfactory influence, on the tender, or even slightly inflamed vessels of the air-passages; whilst cough, in its frequent and varied forms, when produced by irritation only, of any part of the bronchial membrane, is necessarily lessened, in proportion as this, its cause, is diminished.

The hydrocyanic acid, by its influence on chronic morbid sensibility, and irritation, when carefully thus employed, often exerts great and speedy control over long continued and severe coughs, dependent thereon; and doing this in consequence of its very powerful action on the nerves of sensation, it does not affect the motions of the heart, or the circulation, unfavourably.*

The plants, which best communicate similar advantages, by inhalation, are those which have been long found the most efficacious, in medical practice, in removing coughs; when the consequence of irritation.

But these narcotic vegetables present to us modifications in their action on the nervous system; and we find consequently, that coughs, depending on irritation only, are best removed by those that we should not make choice of, for the removal of spasmodic difficulty of breathing, and *vice versa;* whence it is an observation verified by experience, that the use of opiates, for example, in asthmatic attacks, has often proved both inefficient and injurious.

The juice of the lettuce, or lactuca, when used in inhalation, in quantities of from four to eight or more grains, exerts a very soothing influence; preparations

* The most suitable quantity of this medicine, is one, two, or more minims for each inhalation. From its very volatile nature, the best mode of employing it, is to mix the quantity required, with a little water, in a phial, previously, and thus to introduce it gradually into the inhaler, through the ingress-tube, during inhalation; combining it with the warm water, by once raising and depressing the mixing rod. The same method is also very convenient, in the use of any other very volatile fluid; or of substances containing very volatile principles, including the narcotic extracts.

From the great uncertainty of the quantity afforded, by drops, a minim-glass is indispensable to the proper conducting of inhalation.

of opium, as the tincture, and Battley's liquor opii sedativus, similarly employed, in doses of from five to twelve or more minims, morphia,* the conium or hemlock, &c., are therefore preferable in the former cases; whilst the stramonium, the lobelia, and others, generally best exhibit their useful operation, in the latter.

The use of tinctures, for inhalation, appears to me to be somewhat disadvantageous, in consequence of the stimulus they afford; when therefore more than a few minims only are required for this purpose, I prefer the use of the extracts, or rather, the inspissated juices; since these do not impart such stimulus, whilst they concentrate more of the active properties of the plant.

For the very convenient employment of these extracts, or juices, they may be mixed, in proper quantity, with a little cold water, at the time of inhaling, or be previously thus reduced to the consistence of a syrup; but only in sufficient quantity at a time, for one or two days' consumption, especially during warm weather, from the increased liability of the extractive principle to undergo speedy decomposition when diluted. In cases in which it may be desirable to preserve them longer in a diluted state, they may be thus combined with distilled water, with a small proportion of alcohol; the disadvantage of the spirit being in part counterbalanced, by more of the medicinal principles of the plant being thus retained, than in the tincture.

In this way, several of the narcotic volatile principles

* Considering, what I thought, the non-volatile qualities of the salts of morphia, it was not without surprise that I found a quarter of a grain or more, of the acetate, added to the water of the inhaler, to form a useful means of at once allaying bronchial irritation, and promoting refreshing sleep.

of plants, may be usefully conveyed to the bronchial membrane, when irritable; and the peculiar sedative qualities of the lactuca and the conium, and the powerful control which they exercise over pulmonary irritation, often render their operation highly beneficial.

It is supposed that much of the medicinal activity of the conium, resides in a resinous element quite insoluble in water. This plant however, doubtless also yields active principles of a very volatile nature; and it appears, that the extract or juice, (in quantity from two to five or more grains,) is rendered more appropriate for inhalation than the tincture, by containing more of these volatile properties:—for if the tincture be thus used, a quantity of not less than a drachm and a half, or more, is frequently requisite; and hence I have often observed, that cough has been temporarily augmented, by the early escape of the spirit, before the soothing action of the medicine had commenced.

The nature and effects of the elementary constituents of this plant, should induce us not to reject too hastily, the inhalation of other useful vegetable medicines, of somewhat insoluble principles; and to prefer their extracts, when they can be conveniently used. The medicinal efficacy of some other plants of this class, resides in principles possessing greater solubility in water.

Of this kind is the hyoscyamus or henbane, the extract of which, is nevertheless so nauseous, as to prevent my often using it in inhalation; fifteen minims or more, of the tincture, however, may be sometimes advantageously added to other inhaled medicines, as a substitute for preparations of opium.

The belladonna, another medicine of this kind, does

not appear to be very eligible in pulmonary disorders; although, from its powerful sedative qualities, the careful use of some minims of a saturated tincture, containing little alcohol, has proved advantageous in relieving spasmodic oppression of the chest, and in mitigating thoracic pains.

In the remarkable effects of the hydrocyanic acid, on the nerves of sensation and voluntary motion, or on the sensorial nervous power, its action seems to be essentially distinct from that of digitalis; the sedative and depressing effects of which latter medicine, seems to result from its influence being chiefly exercised on the ganglionic, and the eight pair of nerves, or in other words, on the vital nervous power.*

This view of the operation of digitalis, I think, renders the propriety of its employment in inhalation, very doubtful, in some of the diseases of the organs of breathing; especially those occurring in the decline of life, and in some others, in which the force of vitality is often already deficient. On the other hand, it tends to explain why its effects are often highly beneficial, when carefully administered, in perturbed actions of the heart and the vascular or arterial system, which are more dependent

* It is probably owing to tobacco exercising a similar influence on these nerves, that Sir Benjamin Brodie found the infusion of that plant to suspend the motions of the heart, before respiration had ceased; this latter function partly depending on the influence of the sensorial nerves, as illustrated by Dr. Philip. It is nevertheless well known, that the essential oil of the same plant contains an entirely different active principle, which like the hydrocyanic acid, instantly affects or even destroys the sensorial functions, and therefore the act of breathing, before the motions of the heart cease; on which organ it only acts indirectly.

on the vital nervous power; as in some female disorders, attended with palpitations, and general excitability of the system; in which it has been justly admitted that opium generally proves disadvantageous.

The operation of digitalis, indeed, in its very useful capacity of promoting absorption, is still that of depression to the vital functions; since its apparent promotion of the action of the absorbent vessels, (which action is supposed to be in part mechanical,) is only effected, at the expense of, or by diminishing, the counteracting vital action of the heart and arteries; as the pulse indicates; and not, as some authors have supposed, by really increasing the activity of the absorbent vessels. And this operation, is exactly in accordance with the fact distinctly shown by Drs. Magendie and Marshall Hall, that the loss of blood is likewise favourable to the action of the absorbent vessels.

Acute inflammation of the lungs or air-passages, does not furnish a suitable occasion for the employment of digitalis, in inhalation. And, as the proximate cause of such inflammation, is evidently prior to the attendant increased action of the heart and arteries, the frequent inefficiency of digitalis, as it has been so often administered, cannot excite our surprise: moreover, the experience of ages has shown, that evacuant remedies, of sudden or general operation, are usually indispensable to the removal of acute inflammation. But although digitalis is a very unsafe substitute for these remedies, its valuable aid, in combination with them, or, subsequently, in furtherance of their action, is well known; and sometimes, its sedative effects may be speedily and conveniently communicated and controlled by inhalation.

As the valuable anti-spasmodic and anodyne effects of

stramonium, are alike obtained by water and by alcohol, besides having used the extract, of the pharmacopæia, I have employed an infusion, and a saturated tincture of this plant. The extract, being prepared by heat, it seems to have lost that part of its original power, which resided in volatile principles; whence I have employed twelve grains and even more, at a time, with little effect. On the contrary, the quantity required of the tincture, being small, as from ten to twenty or more minims, this tincture appears to me to be preferable for inhalation.

A powerful saturated tincture, having been obtained from the seeds of stramonium, recently grown on a dry soil, in my garden, I have found ten or more minims of this preparation, to impart speedy relief, in spasmodic cough and difficulty of breathing; and to afford equal benefit, and greater convenience, by inhalation, than the smoking of the dried plant; when this latter had previously proved advantageous.

A sense of tightness across the chest, and difficulty in breathing, probably depends on a spasmodic or constricted state of the air-passages of the lungs, or of the bronchial ramifications; which spasm is communicated to the respiratory muscles; and it appears that this oppression, either may, or may not, be attended with that kind of constriction, which peculiarly affects the exhalant vessels of the lungs.

It has been supposed, that this spasm of the air-passages, is insufficient in itself to produce the wheezing sound which often accompanies it; and that wheezing, requires the presence of a superabundant secretion within the air-tubes, in addition to a diminished diameter of the tubes themselves, produced by spasmodic constriction; whereby a further obstruction is offered to the free passage of the air.

But whilst these causes appear to apply with great accuracy, to the mucous wheezing, of chronic and humid asthmatic complaints, a very different kind of wheezing often exists in other forms of difficult breathing; in the production of which sound, the presence of secretion is by no means necessary; as it indeed ceases with the spasm, and with the augmentation of secretion. This kind of wheezing is less audible than the former, and is often very sudden in its attack; it is also a frequent attendant on diseases of the organs of breathing, and generally more oppressive to the patient than the former. It appears to depend on spasmodic constriction alone, and, in its treatment, it is important to distinguish it from the preceding, although both may often yield to the same remedies.*

* Some of the most capricious forms of idiopathic disease, also, to which we are liable, are well-known to be characterized by these symptoms, in what are called dry or nervous asthmas; and so peculiarly marked are they in a lady of rank, whom I first attended only yesterday, July 8th, that I cannot help mentioning the case: which is not unknown to several eminent physicians.

The attacks of difficulty of breathing, are hereditary, and extremely distressing; the spasm having almost prevented deglutition for days together, by extending to the muscles of the throat. These attacks have been of many years' recurrence; and each year, they never commence until about the 20th of May, nor do they ever extend beyond the 12th of July. Sometimes they continue more or less urgent, during almost the whole of the intervening period, and thus prevent the enjoyment of the recumbent posture; when otherwise, they are excited by the slightest and most opposite causes, during this interval; a thunder-storm, as often happens in these complaints, being one of the most powerful, and its approach accurately predicted by the feelings. Symptoms of the complaint, misnamed "hay fever," affecting the eyes, nose, and palate, likewise sometimes attend this case; in the treatment of which, laudanum has been often carried to the extent of from 100 to 150 drops, for a dose.

Spasmodic difficulty of breathing, therefore, may occur either with, or without increased secretion; and in its relief, I believe the useful anti-spasmodic effects of stramonium, to chiefly result, from the influence of that medicine on the nervous system; thereby producing relaxation, without any necessary augmentation of the secretions of the lungs.*

In most cases of severe oppression of the chest, and spasmodic difficulty of breathing, the inhalation of from six, to twenty or more minims, of the æthereal tincture of the lobelia inflata, likewise operates on the nervous system with very great advantage; the efficacy of this preparation depending on the great solvent power of æther, on some of the active medicinal principles of vegetables. The action of the lobelia, in moderate doses, appears to me to be very similar to that of the stramonium, but if its dose be increased, in inhalation, to the point of producing nausea, it then often occasions free expectoration, more speedily, and with greater relief to the respiration, than ipecacuanha, but with some tendency to excite headache, which, however, may be easily avoided.

Finding that there are certain agents, whose anti-spasmodic action is exerted, without necessarily occasioning any increase of the pulmonary secretions, and which differ from the former, in not producing any diminution of nervous power, I have been obliged to

* I have observed, that when increased secretion has followed the smoking of stramonium, it has appeared to arise from a sudden stimulus, sympathetically communicated along the bronchial membrane; which stimulus, has been occasioned by the accidental inhalation of a portion of smoke into the glottis; whilst relief often immediately succeeds this process, though neither cough nor increased expectoration be induced by it. In smoking, respiration is entirely conducted through the nostrils.

institute a separate class for their reception. Amongst these, coffee, and perhaps æther when in small proportion, may be placed.

In consequence of the well known benefit, which has often been obtained from the use of coffee, in asthmatic paroxysms, and from some inconvenience attending its being frequently received by the stomach, I was induced, some years since, to make trial of the effects of the vapour of a strong infusion, by this convenient method of aiding the treatment of diseases of the organs of breathing; when it so far answered my expectations, in relieving the less severe attacks of wheezing, and oppression of the chest, that some asthmatic patients have derived much advantage from its employment. It appears that its usefulness depends on a volatile principle, which is perhaps developed with its odour, by previous roasting. Its powers may be readily increased, by the introduction into the inhaler, of some minims of either of the anti-spasmodic tinctures just noticed; and this is a very effective method of employing those medicines.

As an anti-spasmodic medicine, in difficulty of breathing, sulphuric æther may be also used, in the small quantity of six or more minims at a time, with water not exceeding 90°, or of lower temperature; or it may be usefully combined with the extract of conium, or the hydrocyanic acid; these ingredients being previously diluted with water, in a phial, and introduced into the inhaler, gradually. But although, when swallowed, the operation of æther is usually regarded as narcotic or anodyne, yet in inhalation, its sedative or anti-spasmodic influence appears liable to be overwhelmed by its stimulant properties.

Of medicines which have not a narcotic or anodyne operation, some of the most useful, in inhalation, are those, which from their nauseant effects, exert an anti-spasmodic influence on the pulmonary exhalant vessels, more especially; whereby they tend to restore their action, when suppressed, and thus promote the healthful functions of the affected surfaces, in bronchial, catarrhal, and other complaints.

A diminished secretion, is well-known to characterize several affections of the bronchial membrane; whence the term dry (or nervous) asthma, is applied to some of them; and this diminished secretion, as I have before noticed, often attends that spasmodic constriction of the air-tubes, which is distinguished by the cough being slight, and the wheezing less audible, and of a different character, from that which is attended with increased secretion.

In these complaints, therefore, the usefulness of inhalation, may be well conceived, from the then, often, favourable influence of humidity in the atmosphere; and the advantage of medicines of this kind, may be equally understood, from their power of exciting increased moisture within the lungs; by that relaxation of vessels, which is induced by a slight degree of nausea.

Of these medicines, as contained in class 4. *a*, the action of the squill, and of ipecacuanha, when employed in inhalation, may be regarded as amongst the most important; as their operation has long proved to be, when they have been otherwise administered.

The efficacy of each of these medicines is increased by their union; which is readily accomplished, as the active properties of both, are sufficiently volatile to be communicated together, to the lungs, by means of warm vapour.

And when thus employed, for the removal of dry and difficult coughs, the increased pulmonary exhalation they occasion, may be often further promoted, by exciting the action of the exhalant vessels of the skin also, by means of a diaphoretic medicine.

Thus, I may repeat, the protracted and distressing nausea these medicines often occasion, when received into the stomach in determinate doses, may be moderated and controlled; and relaxation of the constricted exhalant vessels of the lungs, effected by their modified operation, when applied more immediately, and to the lungs only.

Besides an infusion of three or more grains of the powder of squill, in the water of the inhaler, the ordinary tincture, in the proportion of from fifteen to sixty or more minims, and the vinegar of squill, of the pharmacopæia, are each well suited for conveying the influence of this vegetable, by inhalation; the quantity employed, of the latter, being proportioned to the difference in its nauseating power; and active inflammation of the lungs, being absent, as in the application of all stimulating inhalations.

The vapour of ipecacuanha, is conveniently obtained, by mixing with the water of the inhaler, from fifteen to sixty minims, or, in some cases, much more, either of a saturated tincture, or of the ipecacuanha wine, of the pharmacopæia; or by infusing from ten to thirty or more grains of its powder, like that of the squill, in the water of the inhaler. And this inhalation, is also capable of greatly aiding other more general means of removing bronchial affections; by increasing the pulmonary secretions when deficient, and thus softening and ameliorating the harsh and trying character of the attendant coughs;

and when irritation prevails, with the same results, in laryngeal and tracheal complaints, its effects are often not less beneficial.

For these or similar purposes, the union of ipecacuanha with vinegar and water, forms a very useful inhalation; and if much spasmodic constriction likewise exists, the addition of tincture of stramonium increases its efficacy.

It will be observed, that class 4. *b*, contains many medicines, which occasion a similar increase in the pulmonary secretions, by a different mode of action from the preceding; and as this latter consists in communicating a stimulus to the affected surfaces, it is very necessary that acute inflammation, or a tendency to hæmoptysis, should be absent when they are employed.

From my own experience of the inhalation of medicines of this class, very satisfactory proof has been afforded, of the benefit which several of them are capable of imparting; and the advantage thus derived, from certain gum and balsamic-resins, appears to depend on their containing particular volatile principles, which have not been impaired or dissipated, by having been submitted previously to any process effected by heat; as that of purification, by softening, &c.

Amongst the more useful of the medicines of this kind, are the ammoniacum, galbanum, assafœtida, and the balsam of tolu. In some forms of chronic bronchial complaints, which are attended with severe and tedious dry coughs of varied character, and in which debility is greatly increased, by the efforts of coughing, the inhalation of the vapour of these substances, separately or combined, has often been attended with great relief.

The ammoniacum, galbanum, and assafœtida, are moreover well known to exert more or less of a specific control over constriction of the exhalant vessels, and that kind of spasm which induces difficulty of breathing; whereby they alleviate the latter, without affecting the nerves of sensation. Of these anti-spasmodic expectorant medicines, the assafœtida is, I think, the most active, although its odour, in inhalation, often forbids its use.

The efficacy of ammoniacum being often great, and water being the proper solvent for its medicinal principles, as it is also of those of assafœtida, I have occasionally used the "ammoniacum mixture," of the pharmacopœia, for the purpose of inhalation; but having observed, that by triturating the best gum, or "guttæ ammoniaci," with arrowroot, it may be thus conveniently retained in a powdered state, in a closed phial, I prefer the use of a drachm or more of this powder; which on being previously mixed with a little cold water, is added to the warm water of the inhaler.*

The same simple and convenient method of preparation, is equally applicable to the other gum-resins, and

* In bronchial complaints, amongst many useful combinations of remedies, one consists of a drachm and a half of this compound power of ammoniacum, and twenty minims of tincture of stramonium, with infusion of coffee. Another consists of five grains of extract of conium, or of lactuca, fifteen minims of tincture of stramonium, and forty minims of wine of ipecacuanha; or these medicines in reduced, or augmented proportions. In the former case, the ammoniacum tends to increase expectoration, whilst the stramonium and coffee diminish spasm of the bronchial tubes. In the latter, the conium, or lactuca, and stramonium allay irritation, and spasm of those tubes, whilst the ipecacuanha obviates any tendency to diminish expectoration, by relaxing the mouths of the exhalant vessels.

Galbanum with camphor, is likewise useful in dyspnœa.

solid balsams; for even the tenacious tolu, and galbanum, when dried, or rendered somewhat concrete by keeping, may be thus retained in a powdered state. These substances may be likewise all employed in a similar manner; their active medicinal principles alone being thus obtained, whilst their indigestible and other qualities, which ill adapt them for the reception of the stomach, are rejected; and they are kept suspended in, or diffused through the water of the inhaler, by the occasional elevation of the rod, during inhalation. By thus using the balsam of tolu, I have known that kind of aphonia or loss of voice, which depends on the imperfect closure of the aperture of the glottis, from relaxation of the muscles of the organ of voice, to be immediately removed.

From the frequently favourable action of the inhalation of the gum-resins, on the bronchial membrane, which medicines do not contain benzoic acid, and from the usefulness of the balsams bearing no relation to the quantity of this acid they do contain, I believe that the efficacy of these remedies depends on their volatile oil and other principles, rather than on the presence of benzoic acid, as has been supposed.

It is probable that the well-known vapour of vinegar and water, employed at a moderate temperature, in the frequent slighter affections of the fauces, the throat, and the air passages, derives its value as a domestic inhaling remedy, by increasing their secretions, or by thus assisting difficult expectoration.

As medicines are well known to be relative agents only, often varying in their action, according to the disease to which they are applied, it is a remarkable fact that when the secretions of the bronchial membrane are on the contrary, already augmented, from relaxation of

its vessels, several of the remedies of this class, equally diminish the effusion.*

Thus the medicines arranged in class 5, although of the nature of the preceding, often restrain inordinate secretion, by exerting a certain tonic influence; a want of power in the exhalant vessels, in chronic bronchial complaints, and in the later periods of life, being often connected with general debility. In some instances also, this altered effect is produced, by employing the same medicines in different proportions.

The specific nature of the stimulus, which remedies of this kind afford to the pulmonary exhalant vessels, even when they are received by the stomach, has been so long known, that their use in medicine is of very ancient date. Hence in the treatment of diseases of the chest, tar, for example, was recommended by Dioscorides, in the days of Nero; and of late years, its employment by inhalation, in consumption, has also been strongly advocated by Sir Alexander Crichton and others; whilst still more recently, the inhalation of the kreosote, which is a volatile fluid obtained from the same substance, has likewise acquired reputation: much confidence having been reposed in its operation, by some physicians, when thus applied to the bronchial surface. Dr. Elliotson employs it in doses of about five or six drops, for each inhalation; the drops being combined in the inhaler, with a mucilaginous fluid, of the ordinary temperature of the atmosphere.

* From some very recent trials of the effects of the vapour of copaiba, in restraining the undue secretion of the bronchial mucous membrane, when directly applied to it, by inhalation, some promise of advantage is offered; which I hope to be able to substantiate by further observations.

My own experience of the effects of chlorine, has not been hitherto sufficiently extensive, to enable me to offer any useful testimony regarding its curative powers, in consumption. During its inhalation, about six minims of a saturated solution, in distilled water, should be introduced into the inhaler every three or four minutes, till the entire quantity amount to twenty, thirty, or more minims for each inhalation; the water not exceeding 110 degrees of heat; a small quantity of a soothing medicine being added at the time of commencing the process, as recommended by Sir Charles Scudamore.

The more stimulating inhalations, as those of ammonia and camphor, employed with a temperature of about 100 degrees, and likewise of æther, when used in the larger proportions of twenty or more minims, with a temperature not exceeding 90 degrees, are frequently very useful in relieving distressing symptoms, and in promoting the cure of some affections of the fauces, the larynx, or the trachea; amongst which, the most common are hoarseness, and loss of voice; their benefit arising, either from acting directly on the part affected, or from communicating their influence along a limited extent of certain nerves of the throat, by a sympathetic action.

On other occasions, by suitably diminishing the stimulus of these inhalations, their influence may be safely extended to more remote parts of the pulmonary nervous system; and hence, in some of the chronic complaints of the chest, in elderly persons, much benefit has attended the addition of a little ammonia to ammoniacum or other expectorants; with a view to arouse and augment nervous power in the lungs; in consequence of this being so far diminished, as to render the removal of phlegm from the air-passages very difficult.

The last class, is intended to contain the medicines which especially promote the action of the pulmonary absorbent vessels; it therefore chiefly comprehends the inhalation of iodine;—for the removal of tubercular deposits within the lungs.

Very favourable opinions and reports of the effects of iodine, when administered internally, in consumption, and likewise when employed by inhalation, in that disease, have been published by Drs. Baron, Gairdner, Morton, Thompson, Murray, and many other medical authors. This medicine has been also very usefully employed in inhalation, by Sir Charles Scudamore;* the success of whose treatment of diseases of the organs of breathing, by the aid of inhalations, has particularly recommended them to our attention, and to whom we are indebted, for the communication of his experience in their use.

The inhaling mixture noticed below, is a very convenient combination; the alcohol having been added, to better retain the iodine in a state of solution, and the tincture of conium, to render the action of the iodine more soothing. This combination however, may I think, often be modified with advantage, by the substitution of

* This physician's iodine mixture for inhalation, consists of a solution of an iodurettted hydriodate of potass; as

"Iodine——————5 grains.
Hydriodate of Potass—3 grains.
Distilled Water————5 ounces.
Alcohol——————2 drachms.
Tincture of Hemlock—6 drachms."

of which mixture, a drachm and a half only, is at first used at a time, the water of the inhaler not exceeding 120 degrees of heat.

the extract of conium, for the tincture, and the omission of the alcohol; which may be sufficiently compensated, by a trifling increase in the proportion of the hydriodate of potass.

Thus, the inhaling mixture I have usually employed, consists of one grain of iodine, and one of hydriodate of potass, to each ounce of distilled water; the extract being previously diluted for inhalation, as noticed at page 37, and added at the time of inhaling; and the required quantity of ingredients for each inhalation, being generally introduced in divided portions, through the ingress-tube of the inhaler, during inhalation.

Not being aware of any advantage attending the use of much larger proportions of iodine, I should fear that its constant and more extensive inhalation, in the manner lately again instituted, by means of an iodine atmosphere, is not likely to increase its benefits; from the usual disadvantage to the general health, of an atmosphere by any cause materially altered; and consequently, for the purposes of life, deteriorated. It is however now admitted, that the unfavourable effects of iodine have been greatly overrated; and that they are not exhibited, except when its employment is injudiciously conducted; a condition, which equally applies to nearly all the most efficacious of medicines; because it is these that exert the most power over the system.

In the treatment of consumption, with the aid of iodine inhalation, the use of such internal medicines has been regularly pursued, as have appeared to administer best to the general requirements of the entire system, or, more occasionally, to the urgency of existing symptoms; whilst as attentive a regard to regimen, as circumstances have seemed to require, has been adopted.

Although therefore I am unable to speak from my own observation, of the curative effects of iodine, in consumption, when employed independently of other methods of treatment, I am happy to be able to state, that its careful use, in combination with them, has occasionally been attended with very satisfactory results.

Thus, amongst other less decided cases, in instances in which the symptoms, and sounds of the chest, as manifested by the use of the stethoscope and by percussion, have appeared to other physicians, with myself, to prove the existence of tubercles in the lungs, the patients have lost all indication of existing disease. At least, I may observe, that during a long, and, at present, uncertain period, a quiescent state in the diseased structure of the lungs, has followed the use of these combined means; and, with the general evidences of restored health, great improvement has also taken place in the sounds of the chest; a state which I presume may be regarded as that of recovery. And I have additional satisfaction in being able to add, that the same favourable results have succeeded the continued employment of these measures, even where suppuration and other symptoms, as distinctly the result of pulmonary excavations, co-existent with tubercles, have been present.

Whether this happy change has been produced by the process of perfect cicatrization, which, though rarely, has occasionally effected the cure of consumption, as proved by Drs. Laennec, Andral, and others, (amongst the many instances, in which its cure has been clearly established by subsequent investigation,) or whether produced by any other, or less permanent curative means, I cannot state with certainty. In other advanced cases of consumption, as might be expected, iodine has

appeared to exert little power, in promoting either the process of healing or that of absorption.

From the advantages, which I have frequently found to attend the use of iodine inhalations in bronchial diseases, it appears to me very doubtful if the useful operation of this medicine, in consumption, consists exclusively, in augmenting the energies of the absorbent vessels of the lungs, and in thus removing tubercular deposits from them, (and this, by exercising a peculiar influence on these vessels, similar to that it produces on those of the conglomerate glands,) as some authors suppose. On the contrary, some of its benefits appear to be conferred, by exciting the healthy functions of the bronchial membrane more generally; by its contact affording a salutary stimulus to the mucous surface. It may also be remembered, that in the hands of other medical practitioners, results the most satisfactory, in consumption, have likewise followed the inhalation of several of the remedies of class 4. *b*, as the vapour of tar, kreosote, &c., whose most obvious and usual effect, is that of sustaining the action of the pulmonary exhalant vessels only, by presenting a specific stimulus to those vessels; although this stimulus, may, possibly, in reality, augment the action of the absorbent vessels also.

From the whole of the results of the inhalation of iodine, in tubercular disease, I have myself received a very favourable impression regarding its remedial influence; but I must at the same time observe, that as its action is less readily demonstrable, from symptoms, than that of most other inhaled medicines, much caution is indispensable in determining the extent of its real efficacy. We should also remember, that by the combination of iodine with other means, and by the union of different

medicines in the inhaler, some liability is incurred, of estimating the value of each measure unduly, and even of mistaking the action of the base of the inhaling remedy, for that of its adjunct.

I would also repeat, that, combined with more general measures of treatment, I have had much reason to believe, that even soothing medicines only, employed in inhalation, have occasionally been the chief means of arresting the earlier progress of particular cases of consumption; by the removal of bronchial irritation: and the observation is rendered the more probably correct, by the concurring testimony of others, of the beneficial effects of several anodyne medicines, when alone had recourse to, in certain cases of that disease.

From, however, all the opportunities I have had of observing the effects of remedies, in consumption, my own impression coincides with the opinions of Laennec, and other authors, who think that we must chiefly expect a diminished prevalency in this disease, to result from a more vigilant and early attention to that particular condition of the entire system, which is favourable to its incursion and development:—by leading to a more regular and careful employment of general measures, adapted to the prevention or removal of this condition. But I would now repeat from experience, my own conviction, that general preventive or curative measures may often derive the most important aid, from the application of remedial influences to the immediate vicinity of disordered action: which latter, though internal, may yet be often as accessible to these agents as that of more superficial disease.

It is worthy of our notice, that the air, after being inspired by the nostrils, presents itself to the minute blood-vessels and to the air-cells of the lungs, with very different qualities from those of the external air; for, in the first place, it has acquired a much higher temperature, in its course thither, through warm and narrow channels; in which it has probably absorbed much sensible heat from the decomposition of air previously inspired. On arriving at the air-cells, therefore, if the atmosphere be warm, the temperature of the inspired air perhaps nearly equals the ordinary animal heat. Hence it protects the pulmonary vessels against the constricting effects of outward cold, by its own acquired warmth; and, consequently, it does this more or less perfectly, according to the temperature of the external atmosphere, and to the heat it has absorbed from within.

Secondly, the natural exhalation, or the vapour, formed within the air-passages of the lungs, has been in part provided, as a further defence, to their exceedingly delicate internal surfaces, against the operation of unfavourable states of the atmosphere. And it is very apparent that it affords as suitable a protection to the exhalant vessels within the body, as clothing does to those of its exterior; for the inspired air, warmed, as we have seen, in its course, by being also surcharged with moisture, from the exhalations of so vast an extent of mucous membrane, is further adapted to resist the parching effects of too great dryness, in the atmosphere, on this delicate structure, in the most appropriate and admirable manner we can conceive.

What agency, or medium then can be proposed, I think we may very candidly and impartially inquire, so well calculated to substitute, and to restore the secreting

functions of the lungs, when suppressed, or to convey remedial emanations to these important organs, as a soft vapour? For, in conformity with that beneficent law of exact adaptation, which characterizes all the works of Providence, we perceive, that this very form and quality of fluid, has been caused to exhale from the lungs themselves, for their own protection. And we well know that this same vapour, is the natural medium through which they are affected, by the various powerful and subtile influences constantly communicated by the atmosphere.

In breathing through the mouth, the warming process just noticed, is necessarily less perfect than through the nostrils; whence I have observed, that some coughs, depending on irritation only, of the throat or larynx, in persons who inspire partially through the mouth, may be almost entirely suppressed for the time, by attention to the mode of breathing; or by respiring entirely through the nostrils. And this fact leads me to add, that for those persons, in whom the membrane of the air-passages is very susceptible to impression, and who are accustomed to breathe through the mouth, or to hold conversation in the cold air, the great advantage afforded by the ingenious instrument called the "oral respirator" is thus rendered very obvious. Too much reliance on its preventive powers, however, very often leads delicate invalids abroad, under circumstances when they incur great risk, and not unfrequently, serious consequences.

For whilst with this instrument an endeavour is made to defend the lungs from injury, equal precaution is not always adopted, to protect the surface of the body from cold and damp, the effects of which, when combined, are peculiarly trying to a feeble frame. For, by the addition

of much moisture, to cold, the power in the atmosphere of conducting the warmth away from our bodies, like that of transmitting electricity, is greatly augmented, above the chilling, or conducting power, of a drier air, of the same temperature. And hence, when a thaw occurs, although the atmosphere has then acquired several additional degrees of heat, yet by the addition of moisture, we experience a sensation of greater chilliness and cold, instead of an impression of increased warmth.

In affections of the organs of breathing, we likewise frequently observe alterations in symptoms, to succeed changes in the moisture or dryness of the air; the character of the cough often varying with the hygrometer; and we can scarcely fail to remark, that catarrhal and bronchial complaints generally prevail, even in the most healthy persons, on the sudden increase of humidity attending the breaking up of a frost.

This latter case, is an instructive illustration of the manner, also, in which similar complaints of the organs of breathing very often arise. For, as the effects of a much colder external air, during frosts, are usually resisted by the lungs, without inconvenience, and as moisture, in itself, is a quality of the atmosphere which is calculated to affect those organs rather advantageously than otherwise, when directly applied to them, as we often see in the action of the moister winds, the air-passages of the lungs being also naturally imbued with moisture, its unfavourable action, when united with a low temperature, is I think obviously exercised almost wholly on the surface of the body.

It should therefore be remembered by invalids, that the operation of cold and moisture, on the skin, is not very much less injurious to the lungs, than the operation

of cold and dry northerly and easterly winds, when more directly applied to the lungs themselves; the peculiar and unfavourable action of which winds, on the organs of breathing, I have endeavoured to explain in another place: a consequence, depending on the immediate sympathy subsisting between the exhalant function of the skin, which is affected in the former case, and that of the membrane lining the air-passages, which is chiefly influenced in the latter; or, between the external and internal exhalant systems.

As the inhalation of a sea atmosphere, is in some measure incidental to the subject of this publication, it might be desirable to add a few observations on its effects, in the various states of pulmonic disease; deduced from the experience of eight years' residence on the Hastings coast, and of a much longer general acquaintance with the climate of Hastings.* The object, however, and the assigned limits of these pages, are equally incompatible with any satisfactory view of a subject of such interest and importance; as relating to a part of our coast so much frequented by invalids, who labour under these disorders.

I can therefore here merely observe, that, in the great majority of cases, the advantages of a sea atmosphere have been very evident, when combined, as in this situation, with much mildness and elevation of winter temperature, and when, consistently with the law, that planes inclined to the horizon receive a greater share of the sun's rays,

* The more particular qualities of the climate, of this part of the coast, whereon its effects in these diseases greatly depend, formed a subject of inquiry, to which, for my own information, and in connexion with a regular series of daily observations, I continued to bestow much attention, in the years 1832, 33, and 34; and I have verified the deductions by subsequent experience.

this warmth is augmented, by the southern inclination of the surface, and by the position and protection of the cliffs: whilst the same marine influence has been not less demonstrable, in preventing the incursion of consumption.

Amongst other illustrations of the favourable influence of a marine climate, in consumption, one of the most impressive, usually afforded, is the comparative rareness of this complaint amongst seamen; who are more exempt from it than any other class of persons. But as the justice of this inference has been questioned, in consequence of seamen being chosen from amongst the most healthy persons, and as the same objection by no means applies to fishermen, I was induced to institute some inquiries on the subject; feeling assured, from my own observation on this coast, that they enjoyed considerable immunity from this disease.

As one result of these inquiries, may afford interest to the reader, by tending more firmly to establish the preventive influence of a sea atmosphere, in consumptive disorders, it may be here mentioned.

The fishery of Hastings, is the most extensive on the south coast of England, employing, as I learn from Mr. Bevill, Comptroller of the Customs, from eighty-seven to ninety boats, and consisting of 500 men; who with their families, amount to about 2,000 persons. Although, then, the diet of this interesting people chiefly consists of fish, bread, and tea, and although, as their earnings are usually very small, they constantly seek the useful aid of the Hastings Dispensary, in case of illness, nevertheless, since its establishment in the year 1830, to June the 27th, 1839, out of the 7,789 patients which have been received, I have ascertained from Mr. Pam, the resident Dispenser, that not a single instance, of a

fisherman labouring under consumption, has occurred in this Institution.

During the last eight years, the same preventive influence of a sea atmosphere, has been also very clearly indicated by the results of my own medical practice, on this part of the coast; (which includes the whole of the medical cases of the St. Leonard's Dispensary, since its establishment in 1832;) from which it appears, that, although consumption so greatly prevails amongst visitants, the proportion of consumptive cases, to other diseases, amongst the resident part of the population, has been remarkably small, when compared with that of many other parts of England.

When formerly physician to the Brighton Dispensary, I likewise observed the proportion of consumptive cases in that institution, to be below the usual averages afforded in those of inland situations.

Notwithstanding more rain falls on land than at sea, it is well known, that on all the coasts of England, as of other countries, a sea atmosphere is necessarily more humid, than that of the interior; whilst, on many parts of our coasts, combined causes, amongst which is a deep and rich vegetable soil, are productive of what constitutes to the invalid, an excess of moisture in the air. Now, although as little humidity prevails on the Hastings' coast, as on any part of the shores of England with which I am acquainted, it being visited by about one half only, of the quantity of rain that falls on the western side of our island, and although the surface of its soil, is of so dry and absorbent a nature, as to secure a comparative exemption from land exhalations, yet inconvenience from exposure to moisture is often experienced, in

consequence of certain erroneous ideas which some invalids entertain, regarding the nature and salubrity of sea exhalations; and also, concerning the most suitable time of the day, for pursuing exercises in the open air.

Sea air, is often combined with indefinite proportions of the salts contained in sea water, and it is well known that these saline particles, are raised with the spray from the surface of the water, by the influence of sea winds; and are often wafted to very great distances inland; and that by rendering the moisture of the air more stimulating, when thus suspended in the atmosphere, these particles of salt diminish that liability to cold which damp would otherwise occasion.* But it is not always considered, that this stimulating, or protecting influence, by no means appertains to the exhalations that arise from the sea, under a more calm state of the atmosphere; and that, consequently, the qualities of such exhaled moisture, are merely those of fresh water.

Notwithstanding therefore, that in health, an undiminished vital force of circulation, very effectually prevents constriction of the exhalant vessels of the skin, and torpor in their action, yet, the chilling operation of damp clothes, should be cautiously avoided by invalids who already labour under pulmonary complaints, or who possess a susceptibility to their approach. For from this cause, the insensible perspiration of the skin, is liable to become impeded or arrested, and this unfavourable influence, being communicated by sympathy

* During the great hurricane, in the north of England in January last, 1839, this saline matter was thus conveyed from the Irish Channel, even over many parts of Yorkshire; or to the distance of seventy or more miles: and was collected from the surface of window glass.

to the exhalant vessels of the lungs, these organs are compelled to perform their functions, whatsoever may be their condition, under the great disadvantage of partially suppressed exhalation also; thus tending to augment their disorder, or to accelerate the progress of disease, by the addition of inflammatory action.*

It is a circumstance also, worthy of much more attention than it receives, that the liability to inconvenience, from an unfavourable state of the atmosphere, is by far the greatest, when delicate invalids are exposed to its action, under circumstances in which no increased power whatever, of resistance to its effects, is aroused by bodily exercise. And this is precisely the case during an airing in an open carriage, in a cold, or a cold and moist wind; for then the circulation continues almost as quiescent as in the chamber, and the animal heat, if not preternaturally augmented by the effects of actual pulmonary disease, remains at its natural minimum; and is therefore the more readily and rapidly abstracted from the system, by these causes.

It should therefore be regarded as a matter of some importance, that during the months of spring, autumn, and winter, the earlier part of the day, is generally the

* So important are the exhalant functions, that on an average, about a pound and a half of fluid, charged with carbon, lime, phosphoric acid, &c., are thus thrown off from the lungs alone, during every twenty-four hours; besides an approximation to a similar quantity, insensibly and sensibly afforded by the exhalant vessels of the skin. But in warmer climates, the activity of these functions is so greatly increased, that I am informed by J. B. Estlin, Esq., that during his stay in the West Indies, more than three pounds, formed about the average amount of exhalation from the human body, during the night only; he having ascertained the fact, by accurate experiment on several persons, all being in perfect health.

only time, for those who are affected with pulmonary complaints, to enjoy the influence of a sea atmosphere with great advantage; or in its purest and most salubrious state. For then, with genial warmth, it usually combines a comparative freedom from those visible exhalations, which soon begin to affect the air, more or less, on all the English coasts, and which become more dense, and disadvantageous to the invalid, with the sun's declining power.

The higher and more uniform temperature of the air, during the winter months, on the coasts, than in the interior of our island, depends chiefly on the contact of the atmosphere with the then higher and more steady temperature of the vast surface of the sea; whose warmth, the air acquires, by means of those constant changes in the position of its own particles, which alterations in their specific gravity occasion; and by means of which equalizing motions, all changes in temperature are produced in fluids. Hence, over the sea, during the winter, the lowest stratum of the atmosphere usually ascends; having sustained a diminution in its specific gravity, by an increase of its temperature: and thus it conveys upwards, the warmth it derives from the sea. Terrestrial causes, as on this coast, may obviously aid this important influence of the sea, of augmenting the temperature of the air during the winter, as they may also, that of promoting its salubrity.

It will be observed, on the other hand, that the temperature of the sea, as necessarily diminishes that of the air, during the summer months; from the then much lower temperature of the water, than of the air. Hence, coast situations, with a higher winter, possess a lower summer temperature than the interior of the country; the heat of the Hastings coast, for example, during summer, I find very seldom to exceed 72 degrees; whence the difference between its temperature, and the great summer heats experienced in London, sometimes amounts to even more than ten degrees: 85°, 86½°, and 87°, having been occasionally experienced there, during late years.

Thus then, does the far more steady annual temperature of the sea, than of the air, limit the range of heat and cold: or impart that equability to the temperature of a sea atmosphere, that distinguishes

it in every situation; a quality, which, with its constant motion, has been considered, from the days of Hippocrates to the present, as the chief source of its peculiar healthfulness; its restorative influence being alike observed in disease, in recovery from severe injuries, and in the constitutional powers of those who are most exposed to its agency.

I may therefore here remark, that the great extent of sea coast, in proportion to that of the whole surface of the county of Sussex, together with the absorbent nature of its soil, and its favourable geographical position, (this county being alike remote from the exposure of the eastern, and the humidity of the western shores of England,) may be regarded as just causes of salubrity; which, by the result of Mr. Rickman's investigations, as exhibited in his government tables of mortality, this county seems to possess in a remarkable degree. For, from an average, of the ten years from 1811 to 1821, Sussex proved to be the most healthy county in England; having a less rate of mortality, or fewer deaths, in proportion to the number of its inhabitants, than any other.

This circumstance, has likewise been noticed by Dr. Hawkins, in his medical statistics; by means of which inquiries, facts of high interest and importance have recently been brought to light, in consequence of the greatly increased attention to this most exact source of medical knowledge; statistical, including numerical investigations, being almost the only source, whence we can ascertain, with a precision approaching to mathematical certainty, the physical causes of diseases, and consequently, the indications of their cure.

A similar deduction regarding Sussex, however, was not supported by the subsequent census, from 1821 to 1831; nor indeed should this perhaps reasonably be a subject of surprise; when, without being able to assign any cause for diminished salubrity, we consider how greatly this county has of late become the resort of invalids, from all other parts of Great Britain.

In January, 1838, the degree of cold, which visited the southern counties of England, was so rare and remarkable, as well to deserve our notice; being probably without parallel in the existing records of preceding observations, in the same parts of England: and this severe cold will be the longer remembered, in having occurred, when this coast was honoured by the presence, and was benefited by the kind acts of benevolence, of her Majesty the Queen Dowager.

The greatest depression of the thermometer took place to the south of London; and, as has been often remarked, the cold was more intense in the valleys, than on the more elevated parts of the country. At Sundridge, near Sevenoaks, and also near Reigate, it was marked by nine degrees below zero; and eleven degrees, is said to have been observed, at the bottom of the hill, behind the church at Bromley.

But the most remarkable depression noticed, fortunately fell under the accurate observation of Launcelot Holland, Esq., at a few yards from his house, near Beckenham; in which situation, the mercury actually descended, in two of Cary's thermometers, to even thirteen and a half degrees below zero; a fact, obligingly communicated to me by the Rev. L. Vernon Harcourt. During, therefore, the memorable night of the 19th of January, the temperature of this southern part of England, thus fell to within half a degree, of the greatest cold probably still recorded in Great Britain; this being, I believe, fourteen degrees below zero; and observed at Glasgow, in 1780.

During the whole continuance of this cold, the combined causes before noticed, so effectually sustained the temperature of this part of the coast, that the thermometers never sunk below thirteen degrees above zero, even on the most exposed parts of its lower level; or below fourteen degrees, where that surface is protected by cliffs, as at Hastings and at St. Leonards; and where highest, at Hastings, nearly one degree more, was added, by their increased radiation. In comparison therefore, with the depression observed near Sevenoaks, there was a difference of temperature of nearly twenty-four degrees, within about forty miles of distance, from this coast. And even on the Sussex coast itself, the difference was so unusual, that on January 20th, when the thermometer, in a north aspect, on the lower level of this part of it, indicated seventeen and a half degrees, at No. 12, St. George's-place, Brighton, the thermometer stood at five degrees only.

As the presence of natural enemies, will not explain the following phenomena, I cannot avoid adding, that one of the most remarkable and unexpected illustrations, of the powerful influence of outward causes, on animal life, which has ever fallen under my notice, is the effect of certain peculiar states of the air, or of the water, connected with a low temperature, on creatures, apparently the least exposed to the first and last of these causes; as on various sea-fishes; some of which inhabit the depths. Thus, during the great cold of February,

1830, red-mullets, wrasse, and conger-eels, continued to swim on shore, on this coast, in great numbers, and became an easy capture; even many cart-loads of conger-eels, having been, I am assured, thus picked up on the beach. And in January, 1837, on the yielding of the frost, and during the visitation of perhaps the most generally prevailing, and severe influenza, that has been recorded to have ever afflicted this kingdom, great numbers of fishes, chiefly living gurnets, of large size, continued to strew and strand themselves, along this line of coast, during many days together; thus furnishing an ample supply of food to the suffering poor, as, by a kind provision in their favour.

The greater cold, often experienced in valleys and low situations, is peculiar to the winter months; and has been thought to arise, from the upper strata of the atmosphere, then consisting of warmer air, which flows from equatorial regions towards the poles. It has likewise been explained, more satisfactorily, by differences in the power of the earth of radiating heat; and this, under different states of the atmosphere. As evaporation proceeds even from the surface of ice, and is generally more constant and uniform, in low situations, though retarded by increased atmospherical pressure, and as friction is there diminished, by the less circulation of the air, these circumstances cannot fail to affect the electrical state of the atmosphere; and may also prove more favourable to the general development of cold:—whence it is probably in connexion with a particular electro-chemical condition of the atmosphere, when at rest, that severe cold is usually attended with stillness of the air.

But whatever be the combined physical causes of these phenomena, it is certain that the latter circumstance constitutes one of those innumerable, wise, and beneficent laws, in favour of animal and vegetable life, whose protecting operation we cannot contemplate, without awakening feelings of the deepest interest. For although man, besides enjoying the pre-eminent gift of reason, has been endowed with bodily powers, above the rest of creation, capable of surviving the vicissitudes of every clime, yet we well know that even his enduring being, could not be sustained, under the conducting and congealing influence of powerful winds, and intense cold.

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