

Observations upon the construction and use of the respirator : an instrument for facilitating respiration, to be worn on the face by persons suffering from coughs, consumption, asthma, and other affections of the chest / [Julius Jeffreys].

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OBSERVATIONS

UPON

THE CONSTRUCTION AND USE

OF THE

RESPIRATOR;

AN INSTRUMENT FOR FACILITATING RESPIRATION,
TO BE WORN ON THE FACE BY PERSONS SUFFERING FROM COUGHS,
CONSUMPTION, ASTHMA, AND OTHER AFFECTIONS
OF THE CHEST.

BIRMINGHAM:

PRINTED BY T. B. WRIGHT, UNION PASSAGE.

1836.

OBSERVATIONS, &c.

THE prevalence and fatality of diseases of the lungs in this climate, render every method of relieving them worthy of the attention of the physician. For success in our efforts towards this great object, it is necessary that their causes should be ever kept in view. Among the most influential, are those which act through the atmosphere we dwell in; such are its impurities,—its state as to drought and moisture, and as to heat and cold. It is well known that ordinary miasms, however injurious to the lungs indirectly, have less direct effect upon them, excepting in asthmatic cases, than might have been expected from their immediate contact with the lungs in respiration. Impure air, if warm, is often less injurious than the purest cold air.

The thermometric state of the air is, doubtless, that which has most influence over the action of the lungs. Experience shows that sudden changes,* and a low temperature, are the most frequent of all causes of pulmonic disorder, and will often keep it up in spite of the best remedial measures. In England, during the greater part of the year, the body is exposed to sudden, if not extreme cold; for people are at all times passing from warm apartments into the cold air, either in passages or out of doors.

* The far greater frequency of pulmonary consumption in England, than either in tropical climates, or, it is said, in the arctic regions, would tend to show that it is the sudden change, so frequent in our climate, from warm to cold weather, and the sudden change from warm apartments to cold air out of doors, rather than any thermometric *extremes*, which are most injurious. It is still, however, the cold which is the cause of the mischief; though, as in the case of many other irritants, a little of it applied suddenly, and at intervals, may have much more effect than a greater degree, acting gradually and steadily. Because, on this account, some climates, colder than England, may not excite disease so frequently in the lungs, it would be absurd to conclude against the experience of every day,—against the feelings of every sufferer,—that cold air in England is not mainly contributable to pulmonary disease; yet there are persons to be met with who draw this conclusion, and that, too, in the medical profession!

It is plain, that cold air can act upon the body through two channels only,—namely, by the surface of the body, and the lungs. The surface may be, and is by all prudent persons who have the means, well guarded against cold; but hitherto the lungs and throat have been unprotected, or screened in some way injurious to respiration.

The action of cold air upon the lungs is twofold. First, it proves directly irritating to the windpipe and air vessels, exciting the lungs of the invalid to that one of the numerous diseases of the lungs to which he is predisposed.—Secondly, cold air acts indirectly in a manner scarcely less injurious. Owing to the uneasiness which it occasions, the chest refuses to receive any more cold air than will barely suffice to support life, or than can be deprived of its chill in the mouth or nostrils. How many persons are there whose respiration is sufficiently free in the summer, but who are compelled to live upon a short, panting kind of breathing throughout the winter, during which time the lungs are never properly inflated! However gradual in some cases, the certain consequence of this imperfect respiration must in time be a change in the structure of the lungs, independently of alterations of structure from other causes. They will lose much of their spongy texture. Some of their finer passages and cells will become obliterated by condensation and adhesions,—the natural consequence of want of use in irritated parts. The chief benefit of inhaling warm vapour arises, as the physician knows, more from the mechanical expansion the lungs are thereby subjected to, than from any medicinal action of the substances inhaled. All sufferers are familiar with the direct irritation of cold air; but this indirect effect is little observed except by the physician. It is a fact daily to be lamented, that transcendent as is the medical skill at command in England, it is often unavailing, owing to the constant opposition of so powerful a cause of disease as cold air applied at each inspiration to the passages and to the lungs. Could this cause be removed but for a time, many a patient would be enabled to appreciate aright the skill which had discovered the peculiar disease supervening, and which was now afforded an opportunity for the undisturbed operation of its remedies.

In considering cold as the grand atmospheric irritant, we must not overlook the injurious effects of dryness of the atmosphere, when combined with cold, in many affections of the lungs. A portion of the benefit of inhaling vapour

is due to its humidity, as well as its warmth; and consumptive persons in general derive benefit from a moderately humid as well as a temperate atmosphere.

The above is an outline of the reflections which led to the construction of the RESPIRATOR, an instrument which, it is hoped, will prove of much use in affections of the lungs, by effectually guarding them against the action of cold. In searching after all means at command for effecting this object,—although the lungs cannot be clothed like the surface of the body, nor a stock of warm air carried about by a person,—a source of warmth presents itself, abundant in amount if the heat can but be caught, and the rightful property of the lungs, inasmuch as it is generated by the lungs themselves. The lungs are continually giving out the warmth which might save them from destruction, but to no purpose, for it is carried out in the breath, and lost in the air around. The air which issues forth at each expiration, contains more heat than enough to warm the following inspired air. To transfer the warmth from the former to the latter becomes the grand desideratum, for which object some instrument must be employed. To do it successfully, this instrument must be worn on the face: it must catch with rapidity all or nearly all the heat of the breath as it issues forth: it must store this heat up, and deliver it to the fresh air next drawn in, in order that it may enter the mouth or nostrils comfortably warm.

While these positive properties are necessary in the instrument, it must possess, also, certain negative ones, without which it could not be employed. In the first place, while drawing from the air its heat, the instrument must not, in any appreciable degree, impede the exit of the air; and in giving heat to the returning current, it must not obstruct its entrance: respiration, in short, must not be rendered at all more laborious. In the next place,—if possible, the vibrations of the air, which constitute sound, must not be checked, for the instrument ought not to obstruct the voice in speech. Again, it must not be of any larger size than can be made to answer the purpose, since it has to be worn on the face. Lastly, it must be very simple, durable, easily employed, and moderate in price. Some nicety of construction is requisite for combining successfully so opposite properties in a small and simple instrument.

The following deductions from the known properties of

matter afforded data upon which it was easy to proceed with confidence of a successful result.

In the first place, the lightness of air is such, that sixteen grains may be taken as the full weight of the air of each respiration. Secondly—The capacity of air for heat is small, so that any substance which is to take up the heat of temperature of sixteen or twenty grains of warm air, need not itself weigh much. Thirdly—Though air is a bad conductor of heat, its ready divisibility affords a way of exposing simultaneously all its parts to the action of the substance which is to conduct off its heat. Fourthly—Its mobility and elasticity, together with this divisibility, are so complete, that they enable it to pass readily through very small apertures, if these apertures are not long or tubular; and as these apertures (for the purpose of the third indication, *i.e.*, for rapid conduction,) must be very numerous, the motion need not be perceptibly obstructed. There may even be many layers of the conducting substance, provided the layers be very thin. Fifthly—Not only may the ready passage of the air be thus secured, but even those minute vibrations in it, which constitute the voice, may be preserved, if the conducting substance it traverses be metallic. Air will not have its most delicate vibrations disturbed by passing through many metallic plates, well perforated, however small the apertures. Whereas, by plates of fibrous substances, as paper or parchment, which themselves vibrate with vocal sounds, the voice is deadened. Sixthly—As for the vocal effect the conducting substance ought to be metallic, so does the main principle of its action require that the depository of the heat should be formed of matter of the best conducting power. Hence, on this account, also, it must be of metal. The two indications are thus in happy accordance; and silver, as the substance whose conducting property is nearly the greatest, may be employed. Seventhly—Since the temperature of any one substance must be lower than that of any other before it can receive heat from the latter by conduction, it is plain that a single sheet of perforated metal could only take a part of the heat from the breath; even if the contact were longer than it is, the breath would lose no heat after it had raised the metal up to its own temperature. In order to extract more heat from the breath, it must be carried through another layer of metal, which being much colder than itself, can abstract heat from it. As the breath and this second layer approach towards the same temperature, this second layer will not be able to abstract more heat from the

breath. It must, therefore, pass through a third still cooler layer, and, for the same reason, through several. In practice, six or eight will not prove too many for the fullest effect in cold weather. In this series of laminæ, each is warmer than the one in front of it, from the exterior one, which is nearly of the temperature of the atmosphere, to the innermost one, which is perhaps within ten or fifteen degrees of the temperature of the breath. These laminæ would not remain one instant of time at so different states as to heat, if they were placed in contact with each other. In order to preserve the progressive difference in their stocks of heat, they must be kept apart; and it will be found, that during the short period of one respiration, a very small separation will suffice for the purpose. An interval for each of one-sixteenth of an inch, including the metal, is more than enough; the whole six or eight layers may therefore lie in less than half an inch. These plates having been warmed during an act of expiration, and being each warmer and warmer as they lie nearer the mouth, are enabled to give heat in the most advantageous manner to the fresh air entering from without, which takes up a parcel of heat in traversing each; since, although it grows more and more warm, it is sure to find every plate it comes to warmer than itself, which is, of course, a relative condition necessary for the communication of heat to the air. While these laminæ of metal warm the inhaled air, they lessen also the dryness of it, which proves irritating to many consumptive persons. This is effected with the minute deposit of moisture from the breath, which takes place during expiration. The instrument is so contrived, that most of this is spontaneously drawn off by a small sponge contained in a receptacle below, but a sufficient quantity of moisture remains to render the air bland.

In completing such an instrument, all that remains to be done is to enclose it in a frame suited to its operation and adapted to the part of the face it is to be applied to. It may be kept in its place by elastic bands united at the back of the head.

Such an instrument is the RESPIRATOR, which the inventor has now the honor to introduce to the notice of the profession and the public. So far as he is aware, it has but one defect, which rather concerns the directors of fashion than the physician; namely, the unusual appearance it will at first present on the face. This may operate, for a time, to check the use of it abroad during the day, but not after custom has rendered

its appearance familiar to the eye. The indifference with which spectacles are viewed, placed, as they are, on features of far more importance in physiognomy, is a sufficient proof of this. Nothing could have appeared more disfiguring to the face than they must upon their first introduction, yet now they are passed unnoticed, even upon the female countenance.

It is a curious fact in physics, the application of which promises to be of much importance, that heat may be instantaneously separated from a body of air, by means which need not in the smallest degree disturb its mechanical condition. Thus, in the present case, the Respirator draws off the warmth of the breath without any mechanical effect perceptible by the individual who may put it on, or by those whom he may be addressing in the lowest tone of voice. Both his respiration and speech will be unaffected by it, while it will afford a grateful warmth to the inspired air. *Now this is the chief object for which invalids suffering from pulmonic affections are sent to milder climates.* It is of great importance that the warmth it communicates should be distinguished from that of a close apartment or of any woollen covering muffling the face. In the latter case, the warmth arises from the repeated admixture of warm, stale air, vitiated by being frequently respired, with a proportion of fresh air. To avoid a respiration rendered painful and imperfect by chilling air, the sufferer has to bear one rendered laborious and unhealthy by impure though warm air. But when the Respirator is employed, the impure air from the lungs is entirely voided at each expiration. There is no bulky substance or fibrous matter to detain it, the compass of the whole being trifling; it may almost be said, that nothing is retained but the heat; and this heat, by tempering the air drawn in, permits the sufferer to breathe freely out of doors. Hence, when in bed in a cold room, or when abroad in the open air, he is enabled to expand his lungs without uneasiness, and to obtain more and purer air than he could by any means inhale without the instrument.

The instrument has two forms to suit the convenience and habits of different persons, or the same person at different times. One is made to fit the mouth; the other, to communicate with the nostrils as well as the mouth. Since in this climate it is necessary to sit in apartments artificially warmed, there does not appear any other means by which the invalid can guard against sudden vicissitudes in passing

through the colder parts of a house, (not to mention the outer air,) than by having a Respirator at hand, which may lie under the chin while he is in the warm apartment, but be always raised over the mouth when he moves out of it.

The instrument has been found by all who have tried it to answer the expectations held out by the inventor in every respect. It is hoped, therefore, that it will prove of much value to the public, by affording ease to all needing its use,—giving rest at night to many who are now disturbed by inhaling cold air, enabling others to follow without injury their vocations abroad, and many others to enjoy fresh air and exercise, at present denied to them. To the physician, it promises to be equally useful, by removing a disturbing power, which has hitherto too often rendered unavailing his remedial measures, how judicious soever they may have been.

JULIUS JEFFREYS.