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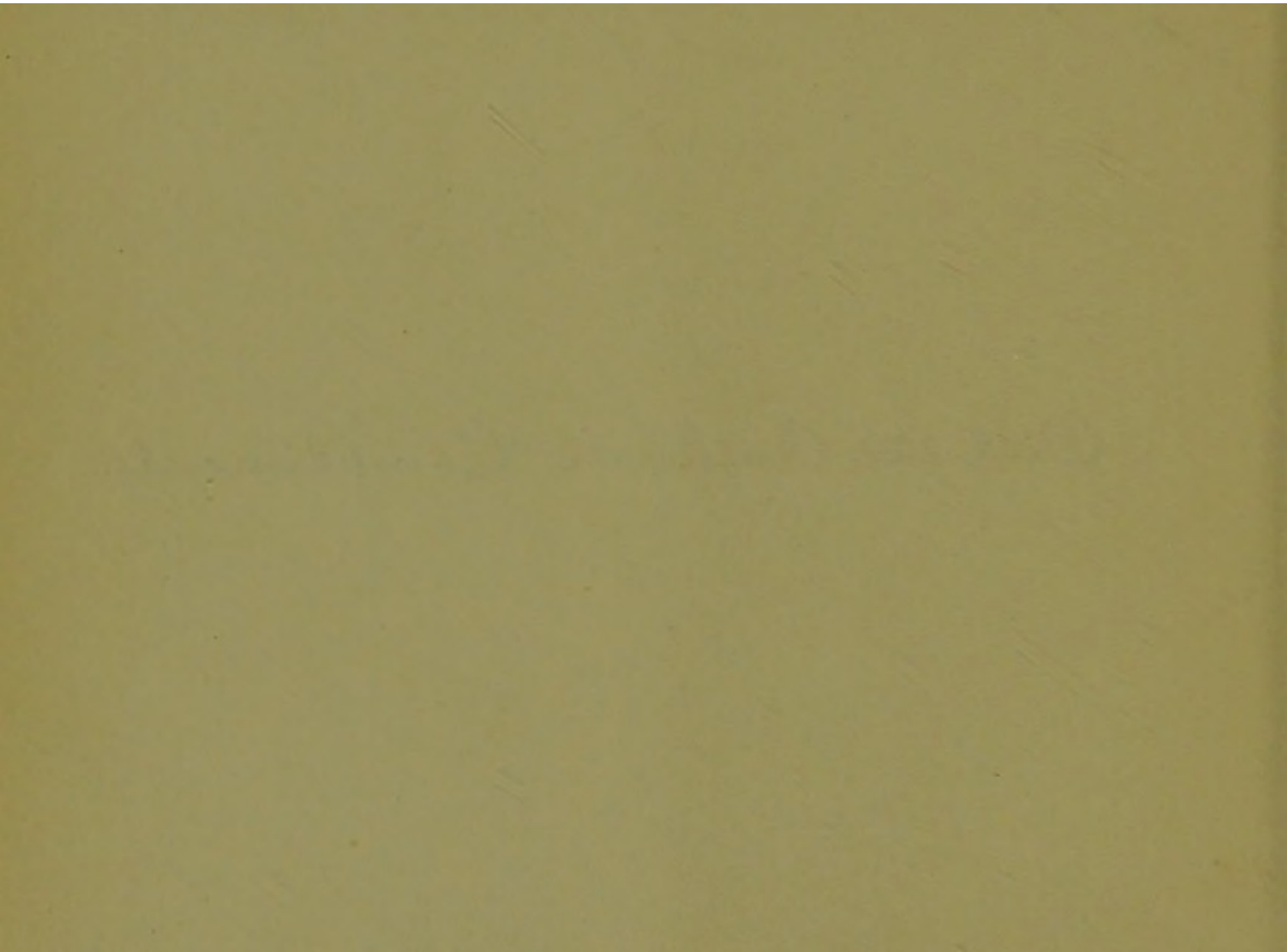
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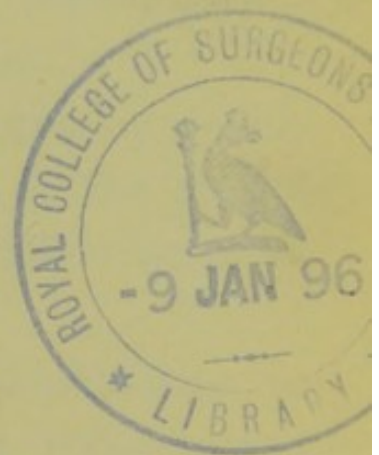
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THE
PROPHYLACTIC CLOTHING OF
THE BODY

CHIEFLY IN RELATION TO COLD

*Read before the North London District of the
Metropolitan Counties Branch of the British Medical Association,
October 31st, 1895.*

BY
W. F. CLEVELAND, M.D.



LONDON
H. K. LEWIS, 136 GOWER STREET, W.C.
1896

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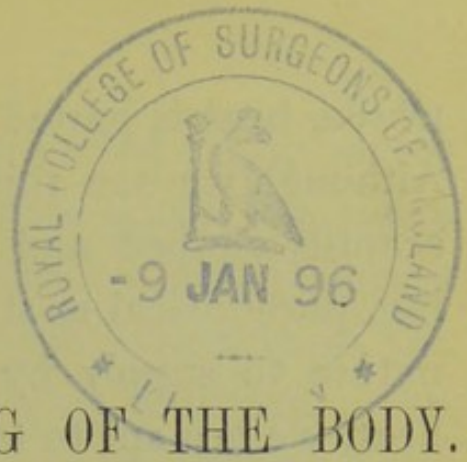
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1902



THE
PROPHYLACTIC CLOTHING OF THE BODY.

WHEN we reflect on the provision made by Nature for conserving the bodily heat of animals inhabiting climates subject to great variations of temperature, the question is suggested whether man, as a reasonable and intelligent being, is sufficiently mindful of the duty that devolves on himself of guarding against the undue escape of heat from his body, which escape occurs chiefly by radiation from the skin.

Under ordinary circumstances "a constant bodily temperature," as it is called, whether in the tropics or arctic regions, is maintained in the following manner:—

The blood is heated by the continual oxidation or metabolism of the tissues, notably the muscles and the liver, and carried to those organs or tissues which are losing heat by radiation and evaporation, as the skin and lungs. Now when prolonged exposure to excessive cold, such as was experienced in this country during the last winter, takes place, unless the body is adequately protected by warm clothing, this natural equilibrium is disturbed, or in other

words, heat is parted with faster than it is generated. Although we see this actually occurring among the scantily clothed and ill-fed poor, whose very shivering, paradoxical as it may seem, is really an effort of nature to supply by muscular metabolism deficient heat, we are apt to take but little heed of the circumstance, in a physiological point of view, or pass it over with the comment that possibly they may have constitutions more allied to those of cold than warm-blooded animals.

But let us glance at the general effect of cold in higher latitudes than our own, where it is more intense, and note the deadly influence it exercises on the Eskimo for example, whose snow hut will not admit of more artificial heat than is afforded by an oil lamp, lest its walls should melt. We find that, in order to maintain his bodily temperature at all, he must be almost continually consuming large quantities of carbo-hydrates in the form of oil and blubber, and studying by the use of non-conducting fur clothing, such as sleeping in a bag made of seal skin, with the fur outside, and lined with reindeer skin with the hair inside, to prevent the escape of what heat he is able to generate. No wonder the race is weak, stunted, and almost extinct, and, as Mr. Herbert Spencer, in his "Principles of Sociology," has remarked, "Inevitably survival of the fittest must ever have tended to produce and maintain a constitution capable of enduring the miseries, hardships, and

injuries necessarily accompanying a life at the mercy of surrounding actions, since there must ever have been a destruction of constitutions not enduring enough." Again, referring to the islanders of the Southern Ocean, he says, "The Fuegian, who quietly lets the falling sleet melt on his naked body must be the product of a discipline which has killed off all who were not extremely tenacious of life." And to conclude, "when we read that the Yakuts, who from their ability to bear cold are called 'iron men,' sometimes sleep in that rigorous region completely exposed to the heavens with scarcely any clothing on, and their bodies covered with a thick coat of rime, we cannot but infer that their adaptation to the severities of their climate has resulted from the continual destruction of all but the most resisting."

It may be here mentioned that the opposite extreme of temperature, viz., that which prevails in tropical regions has not altogether such an injurious effect on the constitution as excessive cold, and it may also be remarked "that the process of hardening parts of the body may be carried to such an extent that the Zulus become like salamanders, and will arrange with impunity burning faggots with their feet, or dip their hands into the boiling contents of cooking vessels."

"It must be borne in mind that life in its general sense is possible only between certain limits of temperature; and in the higher forms of life it is possible only within a comparatively narrow range."

The mode in which death is brought about from exposure to too great external cold is, according to Dr. Michael Foster, through the lowering of the metabolism of the tissues. He says, "not only are the katabolic changes which lead to the setting free of energy thus affected, but the anabolic changes also share in the depression. The 'living substance' falls to pieces less readily, but is also made up less readily. The diminished metabolism tells first and chiefly on the central nervous system, especially on the brain, and more particularly on those parts of that organ which are concerned in consciousness. The intrinsic lowering of the cerebral metabolism is further assisted by a slowing of the heart-beat and of the breath, drowsiness is succeeded by a condition very like to, if not identical with that known as sleep, but by a sleep which insensibly passes into the sleep of death."

In estimating the effect of cold upon the body, it should not be overlooked that different individuals possess different powers of generating animal heat. The late Sir Henry Holland, in his suggestive work, "Medical Notes and Reflections" has a chapter on the Influence of Weather in Relation to Disease, in which he intimates that this thermogenic function is probably less dependent primarily on changes in the blood and manner of circulation than it is on the nervous system, and this view seems to a great extent to be confirmed by modern physiological research.

Dr. M. Foster tells us that "when a warm-blooded animal is poisoned by urari, or, as it has been observed, when the medulla oblongata is divided, the temperature falls, and the metabolism falls also, and further, that the former is caused by the latter, and that the animal under these circumstances behaves, as regards exposure to higher or lower temperatures, like a cold-blooded animal."

The explanation of the phenomena is founded on the supposition that there is a heat centre placed somewhere in the nervous system above the spinal cord, perhaps in the corpus striatum or optic thalamus, and that in the normal state, heat production, which as we have seen, is so intimately connected with muscular metabolism, is influenced and regulated by this centre, being stimulated to more or less activity through cold acting on the afferent nerves of the skin, and thence through the heat centre on the motor nerves of the muscles, thus increasing muscular metabolism and the production of heat. So it would appear that this thermotaxic mechanism is of a distinctly reflex character.

Now the effect of urari (a powerful paralyser of motor nerves) is to break the chain at its muscular end, but when the spinal cord is divided the break is nearer the centre.

The explanation of some persons being able to resist unusual cold better than others (a power that is said to have been possessed in a high degree by Sir

John Franklin, of Arctic celebrity) may be traceable to their having exceptionally active heat centres, and conversely, the susceptibility to cold which some persons manifest even by sitting near an open window in the summer, may be owing to their having feeble heat centres.

From the foregoing remarks it is obvious that, although cold to the skin in a moderate degree may lead to the increase of muscular combustion and the generation of heat, yet when the cold is excessive it may overbear this heat regulating function or *put out the fire altogether*, and so lead to death.

But we must pass on to consider what Nature does for the protection of warm-blooded animals which are exposed to these low temperatures. Among the Mammalia (including the Cetacea or Whale tribe) the skin becomes enormously thickened and penetrated with oil, so as to form the substance known as blubber, by which the cold of the Arctic Sea is prevented from robbing them in an injurious manner of their heat. Then, birds, whose normal temperature varies from 100° to 111° F., which inhabit the waters are clothed with a thick and soft down, which is rendered impervious to fluid by the oily secretion applied with the bill. Lastly, it may suffice to notice how the coats of animals, inhabiting variable climates, are thickened as the winter comes on. Take the horse, sheep, fox, and many others as examples that are familiar to most of us. Dr.

Carpenter, in his Comparative Physiology, further points out that the change in the colour of the fur from dark to white, which many animals exhibit at the approach of winter, has evidently for one of its purposes the diminishing of radiation of heat from the surface.

Seeing then that our bodies are so constituted that a certain amount of animal heat in them is essential for the performance of the various functions of life; and seeing further that the deprivation of heat may retard or arrest those chemical changes by which that necessary amount is maintained, we have to consider the question of guarding by artificial means against a loss which, if not always of a fatal character, may in a lesser degree be highly injurious to those of delicate constitution, or to the very young, or aged.

It is obvious that the wearing of non-conducting or badly conducting clothing *next the skin* must help materially towards the attainment of this end.

Flannel, varying in thickness according to circumstances, or merino vests should be worn all the year round during the day, and changed for those of thinner material for sleeping. Such a precautionary measure there is reason to believe is still disregarded by many young persons, including especially the large class of domestic servants. Jaeger clothing, which appears to be increasing in fashion, has been found in my experience very serviceable, and fur lined overcoats, to those who can afford them, are a useful

luxury in exceptionally cold weather. To those who are advancing in life or happen to be very chilly mortals, I would recommend the wearing of woollen socks at night, or sleeping between blankets instead of sheets, or having a heated brick or hot bottle wrapped in flannel in their beds, rather than lie cold and sleepless, as many do with whom it is not convenient to have a fire in their bedroom. I cannot quit this part of my subject without adverting to what seems an objectionable custom viz., that of ordinarily making such an indispensable garment as a waistcoat, if intended for winter wear, of thinner material at the back than in front. Surely the back part of the lungs needs protection from cold as well as the front.

That it is not always in the depth of winter that severe chills are taken, or that unpleasant consequences may follow exposure to sudden cold during the holiday season, is shewn by the following case:—

A clergyman during the last summer, when the weather was warm, visited an artificial ice factory at Milford Haven. In one of the rooms he felt the cold to be intense, and reasoned within himself that it was not right to remain there. However he completed his visit and came to London on the following day.

On the third day after exposure he felt sick and feverish and thought he had a severe bilious attack. I saw him the next evening, when he was in bed and complained of headache and pain in his limbs, tem-

perature 102° , rest in bed was strictly enjoined. On the following day his temperature was 100° and on the next day rather below 100° . The day following it was normal, and with the exception of weakness he was improved in all respects. It should be mentioned that he was accompanied to the ice-house by three ladies, all of whom put on extra clothing as they entered, but he did not. All the ladies escaped.

That those of robust constitution and with a vigorous circulation may not infrequently be exposed to great vicissitudes of climate with apparent impunity is an experience with which most of us are familiar, but it is not difficult to conceive how a chill may induce a congestion, or inflammation, where the subject of it has an internal organ impaired by previous disease, or where there is vascular degeneration. When the capillaries and smaller arteries of the skin are contracted by cold, the blood flow is diverted and carried in greater abundance, through the dilation of the splanchnic vascular area, to the internal organs.

According to the integrity or soundness of those organs and the duration of time in which the engorgement to which they are thus subjected may have lasted, will be the amount of injury they will probably sustain. In one case an ordinary catarrh, affecting the mucous membrane of the upper portion of the respiratory tract, may result, while in others, an attack of pneumonia, peritonitis, or other grave disease may supervene. Again apoplexy with extrava-

sation sometimes induced by extreme cold, may be explained in a similar manner.

In addition to the above theory of how a chill is taken, which may be termed more or less mechanical, it should not be forgotten that in all probability an important factor may exist in the interrupted or suppressed secretion of the sweat glands themselves, whereby a toxic effect on the blood is induced. We know that if the shaved skin of a rabbit is covered with an impermeable coating of gelatine so as to effectually stop exhalation, the temperature of the animal falls, and it soon dies. It is believed that, under the circumstances, death occurs through a poisoned condition of the blood supervening in a way analogous to what takes place when non-elimination of urea is brought about through kidney failure.

There is, however, another view of the subject to which I would briefly refer, viz., the possibility of suitable clothing being indirectly prophylactic against the contraction of zymotic diseases.

In vol. xxxv., of the "Obstetrical Society's Transactions," there is a paper by Dr. Boxall on "Fever in Childbed."

In the discussion that followed, relative to the increase in mortality from that disease during the winter months, I ventured to suggest that "a chill might predispose the system to imbibe the puerperal poison when it was, so to say, *a float*, in the same way that diarrhœa, if neglected, predisposed the sys-

tem to take the cholera bacillus, when it was lurking in the neighbourhood." I was not aware at the time that Sir H. Holland had referred to this point in the following remark:—"But it is a further question here," he says, "whether variations of atmospheric temperature may not induce a state of body rendering it more liable to receive specific infections, however generated, by agents without."

Now, if there is any foundation in this hypothesis, may it not suggest the desirability of specially protecting the body by warm clothing, exercise short of fatigue, and a diet perhaps more generous than usual (as best calculated to promote the heat producing function) during an epidemic of influenza. We know that this unwelcome visitor is prone to enter an appearance during the cold and inclement season of the year, and bring with him an artillery that will penetrate the bodies of those whose *vis resistens* from whatever cause has fallen below the normal standard.

According to my observation the following are among the not infrequent factors in the production of a chill. I do not pretend to name all of them.

1. Sudden atmospheric changes.

2. In the winter months especially, exposure to a strong east wind after sitting, say, in a heated church or other place of assembly without adopting additional clothing. Also the changing of warm day garments for those of much thinner material for evening dress, and in females exposure of the bare neck and chest to draughts of cold night air.

3. The traditional aversion to what is termed "coddling" and as a consequence going to bed with cold feet and remaining awake perhaps half the night, also wearing too thin boots or shoes in wet weather.

4. The attendance at funerals, &c., in the open air with insufficient clothing and bare headed. The incautious driving in a hansom with the window up, or riding outside an omnibus.

It is unnecessary to point out how the susceptibility to cold may under these or other circumstances be increased, if, at the time of exposure the body is exhausted by fatigue, or any other depressing influence.

The various local effects of cold on exposed or unprotected parts of the body, such as the eyes, face, mouth, and hands can scarcely be said to fall within the scope of these remarks, but chilblains and frost-bite of the feet should be guarded against on the principle of conserving the natural heat by clothing as much as possible.

The sudden and injudicious application of heat to the extremities, when benumbed, should be avoided, and, as a note of warning, I may say that I have known death occur from gangrene of the toes in an elderly lady who, after returning from a walk through melting snow, fell asleep before the fire with her feet on the fender.

On this occasion it is not my intention to consider in detail "Prophylactic Clothing" in regard to ex-

cessive atmospheric heat, but it will be readily recognized that the object here is to cool the body by facilitating evaporation from the skin, and this is best carried out by wearing garments which are porous, and of light texture and colour. Provided the body perspires freely, and is not covered with impermeable clothing, and, further that the air is dry, evaporation would seem equal to maintaining for a time a "constant bodily temperature" although a degree of heat above that of the boiling point of water is involved in the exposure.

It has been proved by experiment that when the blood in the carotid artery of an animal is warmed above the normal, dyspnœa is produced through the increased activity of the respiratory centre; and a sudden rise of temperature of the blood, such as takes place in heat-stroke or sun-stroke, would appear to hurry on the metabolism of all the tissues, and soon exhaust the nervous capital of the respiratory centre, or of the heart, or perhaps that of both.

The first part of the paper will be devoted to a
 description of the apparatus used in the
 present investigation. The second part will
 describe the method of measuring the
 rate of reaction between the
 various components of the
 system. The third part will
 discuss the results of the
 experiments and compare them
 with the theoretical
 predictions. The fourth
 part will conclude the
 paper with a summary of
 the findings and a
 few suggestions for
 further work.