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XXII. *Experiments made to determine the poſitive and relative Quantities of Moiſture abſorbed from the Atmoſphere by various Subſtances, under ſimilar Circumſtances. By Sir* Benjamin Thompſon, *Knt. F. R. S.; communicated by* Charles Blagden, *M. D. Sec. R. S.*

Read March 22, 1787.

BEING engaged in a courſe of experiments, upon the conducting powers of various bodies with reſpect to heat, and particularly of ſuch ſubſtances as are commonly made uſe of for cloathing, in order to ſee if I could diſcover any relation between the conducting powers of thoſe ſubſtances, and their power of abſorbing moiſture from the atmoſphere, I made the following experiments.

Having provided a quantity of each of the under mentioned ſubſtances, in a ſtate of the moſt perfect cleanneſs and purity, I expoſed them, ſpread out upon clean China-plates, twenty-four hours in the dry air of a very warm room (which had been heated every day for ſeveral months by a German ſtove), the laſt ſix hours the heat being kept up to 85° of FAHRENHEIT's thermometer; after which I entered the room with a very accurate balance, and weighed equal quantities of theſe various ſubſtances, as expreſſed in the following table.

This being done, and each ſubſtance being equally ſpread out upon a very clean China plate, they were removed into a very large uninhabited room upon the ſecond floor, where they were

were expoſed 48 hours, upon a table placed in the middle of the room, the air of the room being at the temperature of 45° F.; after which they were carefully weighed (in the room) and were found to weigh as under mentioned.

They were then removed into a very damp cellar, and placed upon a table, in the middle of a vault, where the air, which appeared by the hygrometer to be completely ſaturated with moiſture, was at the temperature of 45° F.; and in this ſituation they were ſuffered to remain three days and three nights, the vault being hung round, during all this time, with wet linen cloths, to render the air as damp as poſſible, and the door of the vault being ſhut.

At the end of the three days I entered the vault, with the balance, and weighed the various ſubſtances upon the ſpot, when they were found to weigh as is expreſſed in the third column of the following table.

The various ſubſtances.	Weight after being dried 24 hours in a hot room.	Weight after being expoſed 48 hours in a cold, uninhabited room.	Weight after being expoſed 72 hours in a damp cellar.
	Pts.	Pts.	Pts.
Sheep's wool	1000	1084	1163
Beaver's fur	1000	1072	1125
The fur of a Ruſſian hare	1000	1065	1115
Eider down	1000	1067	1112
Silk, Raw, ſingle thread	1000	1057	1107
Silk, Ravelings of white taffety	1000	1054	1103
Linen, Fine lint	1000	1046	1102
Linen, Ravelings of fine linen	1000	1044	1082
Cotton wool	1000	1043	1089
Silver wire, very fine, gilt, and flatted, being the ravelings of gold lace	1000	1000	1000

N. B. The weight made uſe of in theſe experiments was that of Cologne, the *parts* or leaſt diviſions being $= \frac{1}{6\,5\,5\,3\,6}$ part of a mark, conſequently 1000 of theſe *parts* make about $52\frac{1}{4}$ *grains Troy.*

I did not add the ſilver wire to the bodies above mentioned from any idea that that ſubſtance could poſſibly imbibe moiſture from the atmoſphere; but I was willing to ſee whether a metal, placed in air ſaturated with water, is not capable of receiving a ſmall addition of weight from the moiſture attracted by it, and attached to its ſurface; from the reſult of the experiment, however, it ſhould ſeem that no ſuch attraction ſubſiſts between the metal I made uſe of, and the watery vapour diſſolved in air.

I was totally miſtaken in my conjectures relative to the reſults of the experiments with the other ſubſtances. As linen is known to attract water with ſo much avidity; and as, on the contrary, wool, hair, feathers, and other like animal ſubſtances, are made wet with ſo much difficulty, I had little doubt but that linen would be found to attract moiſture from the atmoſphere with much greater force than any of thoſe ſubſtances; and that, under ſimilar circumſtances, it would be found to contain much more water: and I was much confirmed in this opinion upon recollecting the great difference in the apparent dampneſs of linen and of woollen clothes, when they are both expoſed to the ſame atmoſphere. But theſe experiments have convinced me, that all my ſpeculations were founded upon erroneous principles.

It ſhould ſeem, that thoſe bodies which are the moſt eaſily wet, or which receive water, in its unelaſtic form, with the greateſt eaſe, are not thoſe which in all caſes attract the watery vapour diſſolved in the air with the greateſt force.

Perhaps

Perhaps the apparent dampneſs of linen, to the touch, ariſes more from the eaſe with which that ſubſtance parts with the water it contains, than from the quantity of water it actually holds: in the ſame manner as a body appears hot to the touch, in conſequence of its parting freely with its heat, while another body, which is actually at the ſame temperature, but which witholds its heat with greater obſtinacy, affects the ſenſe of feeling much leſs violently.

It is well known, that woollen clothes, ſuch as flannels, &c. worn next the ſkin, greatly promote inſenſible perſpiration. May not this ariſe principally from the ſtrong attraction which ſubſiſts between wool and the watery vapour which is continually iſſuing from the human body?

That it does not depend entirely upon the warmth of that covering, is clear; for the ſame degree of warmth, produced by wearing more cloathing of a different kind, does not produce the ſame effect.

The perſpiration of the human body being abſorbed by a covering of flannel, it is immediately diſtributed through the whole thickneſs of that ſubſtance, and by that means expoſed by a very large ſurface to be carried off by the atmoſphere; and the loſs of this watery vapour, which the flannel ſuſtains on the one ſide, by evaporation, being immediately reſtored from the other, in conſequence of the ſtrong attraction between the flannel and this vapour, the pores of the ſkin are diſencumbered, and they are continually ſurrounded by a dry, warm, and ſalubrious atmoſphere.

I am aſtoniſhed, that the cuſtom of wearing flannel next the ſkin ſhould not have prevailed more univerſally. I am confident it would prevent a multitude of diſeaſes; and I know of

no greater luxury than the comfortable ſenſation which ariſes from wearing it, eſpecially after one is a little accuſtomed to it.

It is a miſtaken notion, that it is too warm a cloathing for ſummer. I have worn it in the hotteſt climates, and in all ſeaſons of the year, and never found the leaſt inconvenience from it. It is the warm bath of a perſpiration confined by a linen ſhirt, wet with ſweat, which renders the ſummer heats of ſouthern climates ſo inſupportable; but flannel promotes perſpiration, and favours its evaporation; and evaporation, as is well known, produces poſitive cold.

I firſt began to wear flannel, not from any knowledge which I had of its properties, but merely upon the recommendation of a very able phyſician (Sir RICHARD JEBB); and when I began the experiments of which I have here given an account, I little thought of diſcovering the phyſical cauſe of the good effects which I had experienced from it; nor had I the moſt diſtant idea of mentioning the circumſtance. I ſhall be happy, however, if what I have ſaid, or done, upon the ſubject, ſhould induce others to make a trial of what I have ſo long experienced with the greateſt advantage, and which, I am confident, they will find to contribute greatly to health, and conſequently to all the other comforts and enjoyments of life.

I ſhall then think theſe experiments, trifling as they may appear, by far the moſt fortunate, and the moſt important ones I have ever made.

With regard to the original object of theſe experiments, the diſcovery of the relation which I thought might poſſibly ſubſiſt between the warmth of the ſubſtances in queſtion, when made uſe of as cloathing, and their powers of attracting

moiſture from the atmoſphere; or, in other words, between the quantities of water they contain, and their conducting powers with regard to heat; I could not find that theſe properties depended in any manner upon, or were in any way connected with, each other.

The reſult of my experiments upon the conducting powers of theſe ſubſtances, I reſerve for a future communication.