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J. N. ...
From the Author
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On the Functions of the Colouring Matter of the Skin in the Dark Races of Mankind. By ROBERT MORTIMER GLOVER, M.D., Lecturer on Chemistry in the Newcastle-on-Tyne School of Medicine. (Read to the British Association at the Newcastle Meeting.)

(From the *Edinburgh New Philosophical Journal* for October 1840.)

Various hints and hypotheses have been put forth as to the functions performed by the peculiar organization of the skin in the dark races of mankind. The opinions of Sir Everard Home, published in the *Philosophical Transactions* for 1821, have been generally adopted by physiologists as apparently founded on a methodical attempt to investigate the subject by direct experiment, and to elucidate it by analogical reasoning. The experiments of Sir Everard give results certainly quite opposed to what has been determined by physical observers respecting the laws which affect the radiation from, and absorption of, heat by, coloured surfaces. This circumstance drew my attention to the subject, and led me to repeat some of the experiments related by Sir Everard.

It may be mentioned, before entering on the subject, that this inquiry was proposed by Lord Bacon.

The structure of the skin and of its layers is yet involved in some doubt as to many particulars; but so far as our inquiry is concerned there is no doubt whatever. It is clear that there is a spongy or vascular layer between the cuticle and true skin; or on the surface of the latter, constituting a portion of it. It is also certain that the colouring matter of the skin resides in this region. And that the intensity of shade is the greater or less abundance of the colouring matter. Hence the European and the Negro furnish extreme instances in this inquiry; since in the one the colouring matter is in small quantity or of light shade, whereas the other has it so abundantly that in him we speak of the *pigmentum nigrum*. Between these extremes exist many curious varieties, in whom the functions of the colouring matter are well worthy of consideration, but we have data to reason only with regard to the European or White, and the Negro. Indeed, in many of the

coloured races, the existence of something analogous to the dark pigment is only inferred, although the occurrence of Albinos in all races should induce us to believe the presence of a pigment universal. So that what is said of the colouring matter in the Negro may be extended to all varieties of colour, reasoning by analogy.

It is scarcely possible to regard the dark colouring matter otherwise than as a provision for, in some way, enabling those who possess it in abundance to withstand the heat of the climate they inhabit. Accordingly, there are facts which prove such individuals to be more capable of withstanding the heat of torrid regions than acclimatized Europeans, or other whites born there. There are also facts to connect this power of withstanding excessive heat with the development of the dark colouring matter. Thus, Albinos of Guinea, differing from both Europeans and their countrymen in this, that they totally want the colouring matter, according to many authors, are even less capable of resisting the heat of their native country than European strangers; indeed their skins are said to crack and blister on exposure to the sun's rays. And I am informed by Mr Granidge of Barbadoes, that he has observed the same fact in that island.

Now, when we reflect that the European cannot be without some colouring matter between the true skin and cuticle, since he must differ in this respect from the Albino, it seems as if a relation were established between the development of the pigment, and probably of the rete mucosum along with it, and the power of resisting the sun's heat in torrid regions.

It is clear that in this inquiry we should regard, not merely the physical properties of the organization we consider, nor its vital properties only, but the action and reaction of the whole, and their effect on the system of the individual. For want of a consideration of all circumstances, before the publication of Sir Everard Home's views, it was not conceived how the tint, which, on analogy, should absorb more heat than any other, could, in the hottest regions of the earth, confer any exemption on its possessor. And perhaps before this paper is concluded, it may be apparent that, since Sir Everard published, the matter has been misunderstood.

The notions entertained at present by physiologists, with regard to the operation of this pigment, are implicitly those of Sir Everard. And what they are, will appear from the following brief quotation from an elementary work:—"The secretion on the cutis vera, which gives the black colour to the skin, appears to assist in fitting men for residence in hot climates, because although such skin, by absorbing more caloric, rises to a higher temperature under the sun's rays than white skin does, yet it does not inflame so readily from a rise of temperature." Dr Alison's meaning is, that although the skin of a negro may rise to a higher temperature under the sun's rays than a white skin in the same circumstances, yet the dark skin is less likely to inflame at *that higher temperature* than the white skin at *that lower one*. This, then, is the conclusion of Sir Everard Home, whose paper I now proceed to examine.

The paper of Sir Everard Home contains alleged facts and experiments, tending to prove the Negro more capable of withstanding excessive heat of the sun's rays than the white man, and attributing this to a supposed property in dark surfaces of destroying the scorching and blistering effect of the sun's rays. The former conclusion has already been admitted. The facts by which Sir Everard supports his second position are to be considered.

Sir Everard having fallen asleep on the deck of a vessel exposed to a tropical sun, found, on awaking, his thigh scorched through a pair of *thin* white linen trousers. From this simple observation, the extravagant conclusion is drawn of black being a better protection against the sun's rays than white.

An experiment is next related, in which Sir Everard found, on exposing his hand to the sun's rays for 45 minutes, while a thermometer attached to it stood at 90°, that blisters rose and coagulated lymph was exuded. I have attempted to produce the same effect by the concentrated rays of the sun at the same temperature indicated in a similar way, and kept up to within one or two minutes of the time, when my patience was exhausted, without any result except slight reddening. Six years ago, while off the coast of Algiers, I sat for half an hour immoveable in the sun, having the greater part of my face exposed, the thermometer in the sun's rays being considerably

above 100° , and though my face was scorched, nothing like the effect described by Sir Everard took place.

Sir Everard next attempted to compare the inflaming and blistering power of the sun's rays with that of hot water. He says, that water at the temperature of 120° was painful to the body, and became unbearable when still further heated. From this experiment and the preceding, he wishes us to infer a power of vesicating in the sun's rays not in proportion to their temperature.

In a third experiment, he exposed the backs of his hands to the sun with a thermometer on each, the one hand being uncovered, while the other had a covering of black cloth under which the thermometer was placed. After ten minutes, the degree of heat on each was marked, and the state of the surface examined, and this was repeated three times. During the last trial, the thermometer which had its ball covered by the cloth stood at 106° , while the other was at 98° . The exposed hand was scorched, that covered was unaffected in all the trials. I have not repeated this experiment because it is subject to an obvious fallacy, for the ball of the thermometer being between the cloth and the part, a space intervened, and across this space the heat from the cloth could only pass by radiation or by transmission through the thermometer, but not directly from the cloth to the hand, so that the heat might not accumulate on the skin.

In a fourth experiment, a Negro bore the sun's rays on his hand when a thermometer on the part indicated 100° without any scorching being the result. As the scorching of which Sir Everard speaks could be only a slight blush, it might not be observed on a sable skin. However, I do not question the result of this experiment.

Sir Everard observed in his next experiment, during the course of an eclipse, as the darkness on the sun's disk diminished, the scorching power of the rays, concentrated by a lens, increased in a ratio which is assumed to be greater than could be accounted for by the mere rise of temperature during the time of the experiment. Whence it is to be inferred that the excess of effect is due to the increased quantity of light present with the heating rays at each advance of time. A refe-

rence to the original paper will convince the reader that this assumption is established without sufficient data.

Most stress has been laid by Sir Everard, and those who have adopted his views, on the seventh experiment. We are told that, on the 9th of September, at 11 A. M., thermometer 90° in the sun, the concentrated rays applied to a piece of black kerseymer wrapped round the arm, gave no real pain, as it is expressed, during 15 minutes; and at the end of that time left no appearance on the arm; whereas, when white kerseymer was substituted, during the same time, and the concentration we are led to suppose being the same, the heat of a thermometer in the sun only 86° , yet blisters were formed. From this experiment, taken along with those preceding, it is supposed to be fully proved that although black surfaces rise to a higher temperature than white under the sun's rays, yet they scorch the surface of the body less; the scorching effect depending on a union of the rays of heat with those of light, the latter being supposed, by way of explanation, to be excluded by the black surface. First, I shall state my repetition of the experiment, and then attend to Sir Everard's explanation of his supposed fact.

I have attempted to ascertain the rise which the absorption of heat by black and white cloths respectively gives to the thermometer; to compare this observation with the effects of the same cloths under the sun's rays upon the body, and with the effect of the sun's rays on the naked skin. When the thermometer stands at about 80° in the sun, the solar rays concentrated on white cloth over the ball of a thermometer, to a space of an inch and a half in diameter by a burning-glass, caused a rise of the thermometer to 125° in a quarter of an hour. When black cloth was substituted the rise during the same period was to 172° . In five minutes, with the white, the rise was to 108° , with the black to 140° ; and in some experiments in a proportion nearer that given by the longer period.

When the black and white cloths were applied to the skin at the same temperature, and with the same degree of concentration, as already mentioned, the black cloth generally caused intense pain in the course of a few minutes, and on being allowed to remain for five or at most seven minutes, produced

blisters. During the same period very little apparent effect followed the application of the white cloth, though considerable pain was sometimes produced. The experiment was at different times performed on several individuals, all of whom found the black cloth give the sensation of pain sooner than the white. On the whole, I found nothing like the difference described by Sir Everard, though certainly the vesicating effect of the black surface appeared to be much greater than that of the white. From many experiments I conclude, that the rays of the sun will scorch when they are applied to the surface so as to cause a heat of about 130° and upwards. And from the experiment related by Sir Everard, it appears that hot water is capable of producing a similar effect at that temperature. From all this, I am inclined to deny the existence of a scorching power in the sun's rays, independent of the heat they contain, or at least of the effect they produce on the thermometer. Moreover, if such a power do exist, black cloth should yet scorch more than white, since it will absorb all the rays of light, whereas the other surface will reflect them.

In those experiments which I performed, care was taken to have the white and black cloth nearly of the same density. Sir Everard does not appear satisfied with his explanation of the extraordinary *fact* he relates, for he gives another furnished by Davy, who, indeed, is made to ascribe the alleged difference in vesicating power between black and white surfaces, to the former rendering the heat *sensible*. Were I not quoting from the Philosophical Transactions, a misprint might be suspected. I conclude that a black skin will absorb more heat than a white skin, and were it not for other accompanying circumstances, would produce inconvenience precisely in the ratio of the amount of heat absorbed. It must not be overlooked, however, that in the Negro the pigment is not superficial, but covered by a layer of translucent cuticle. The experiments of Dr Stark prove that colours absorb heat in proportion to their depth of shade through transparent media. It only remains to shew the cuticle to be a medium in the condition of those. For this purpose, I covered the balls of a differential thermometer, one with cuticle, the other with cuticle of the same thickness, having ivory black rubbed on its inner surface; on bringing

the thermometer into the sun's rays, the column of liquid descended rapidly in the stem, the ball of which was covered with the blackened cuticle.

It is evident, from the result of experiments which I have related, that a much less degree of heat can be borne when the heat is applied locally, or so that the perspiratory process is not excited over the whole system, than Sir Joseph Banks and others were able to bear in heated apartments where perspiration was fully excited.

This circumstance leads me to offer an explanation of the functions, or, not to speak mincingly, of the *uses* served by the peculiar colouring matter in the dark races. Blumenbach and Dr Winterbottom concur in stating the Negro to perspire more readily than the European or White, and Dr John Davy, in the 3d vol. of the Medico-Chirurgical Transactions, gives its due influence to this property. After noticing that the excessive perspiration in dark people must keep down the temperature, he proceeds, "In the inhabitants of the tropics, the exhalant arteries of the skin seem unusually expanded, and the whole apparatus peculiar to this secretion unusually developed; and I believe that the blood itself is less viscid, more fluid, and flows more readily through the vessels, so as to promote perspiration, and by that means contributing to the cooling of the surface, and being cooled itself, it contributes again when it flows back upon the heart, to the reduction of the temperature of the internal parts."

Were the inhabitant of the tropic not possessed of this organization, his system could not respond to the stimulus of heat, by a determination of fluid to the surface of the body. And the heat absorbed by the skin being prevented from entering the system by the perspiratory process, the greater radiating power of a dark skin must be beneficial in cooling.

Again, the dark skin places the Negro in the conditions of his climate by causing him to radiate heat at night, and become at that time cooler than a White in the same circumstances. This is a fact which has been observed of the Negroes. Their propensity for exercise in the open air at night has been remarked. Thus we read that when the fleet of Hanno approached the shores of Negroland, the country which,

during the day, presented only silent woods without the least trace of man, at night was lighted up with immense fires, while the woods resounded with the sounds of festivity. In a climate where, during the day, vegetation appears burnt up, the earth is cracked by the heat, and all living creatures languish ; but where at night breezes refresh the air, and cheer exhausted nature, plants run with dew, and animals leave their haunts, man also, fitted by the structure of his skin to throw off heat, issues forth animated by the irresistible propensity to exercise which is always given by the bracing air of colder climates.





