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BY

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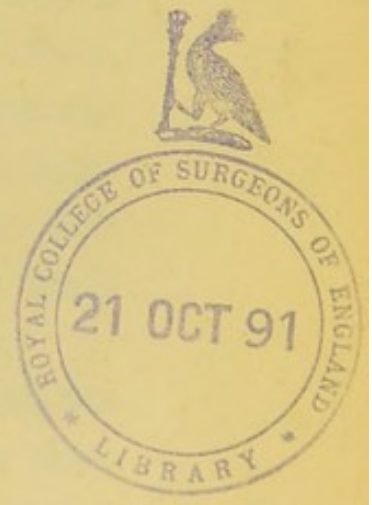

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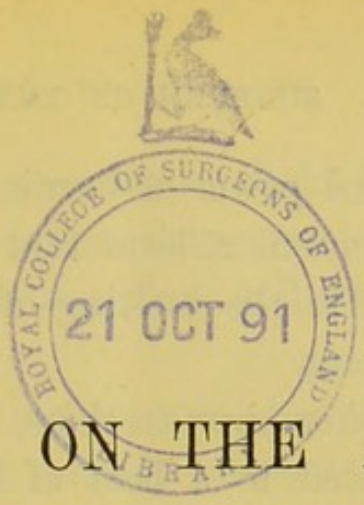

SUNBURN ON THE ALPS.

In conversation with an Alpine friend it was suggested to me that some observations I had made during my many holidays among the Alps would be interesting to the readers of the "Alpine Journal," and he expressed a hope that I would string them together in the form of a paper.

These observations are more or less of a scientific character, but have no pretension to scientific accuracy. As my wanderings among the Alps have always (except on one occasion when I paid a visit to Davos in winter) taken place in June and July, I have been necessarily much more amongst the snow than those who visit Switzerland at a later period, and, as the days are long and the sun powerful, the subject of sunburn soon forced itself in a very practical manner upon my attention.

It will, I think, be readily conceded by Alpine climbers that sun on snow burns more quickly than on rocks or in the heated valleys at a lower elevation, although one may feel the heat more in the two latter situations; it is when one reaches the snow that one adopts veils, masks, and snow-glasses.

This increased power of burning appears somewhat singular when one reflects that the heat rays must be occupied in the melting of the snow and thus rendered latent.

Glass-workers, iron-workers, and others are constantly exposed to a heat of four or five hundred degrees Fahrenheit, and yet do not become burnt; and there can be little doubt that the enormous radiation from heated rocks and valleys, in addition to the direct rays of the sun, make up an amount of heat far greater than is ever experienced on even a very sunny snow-slope, and yet one does not become sunburnt. How grateful is the change from the hot and oppressive rocky moraine to the refreshing coolness of the glacier! No doubt the surface of the snow reflects and disperses much heat, but certainly far less than it receives; for, as above stated, heat rays are absorbed and rendered latent by the snow melting and evaporation. Experience fully corroborates this, for one may often lie on one's back and freely expose the face for long periods to the sun and yet remain unburnt. There must, therefore, be some other factor in sunburn than heat alone.

In discussing the subject with Dr. Tyndall, he agreed that many artisans are exposed to far greater heat than travellers on a snow-slope, and that the former do not become burnt, and he added the very interesting and significant fact that he was never more burnt on the Alpine snows than he was whilst

experimenting with the electric light at the North Foreland lighthouse, where there was no heat sufficient to produce such an effect, and where no snow was present.

So far then all evidence goes to prove that some other active principle must be at work, besides heat, to irritate the delicate capillary vessels of the skin, and to cause them to fill with blood and exude those products which doctors know to be connected with inflammation, giving rise to redness, swelling, blistering and subsequent peeling of the skin. I am aware that sometimes, in peculiar conditions of the atmosphere, the direct sun's rays will burn. I have met with some singular instances where several persons have been burnt on the same day, even in England, who had never previously suffered in that way. I am further aware that sometimes (not always) on a ship's deck in a dead calm one may be severely burnt, and that in boating on a river the same may occasionally happen. These experiences do not, however, detract from the induction that there is in snow-burning some cause in addition to heat which is constantly in operation; indeed, they raise the suggestion that the sun's rays are in some way, hitherto unexplained, at times acted upon by atmospheric, electric, or other causes, and brought into a condition similar to those rays which are reflected from snow. It appears that sunlight reflected from freshly fallen snow acts

much more energetically on the skin than that reflected from older snow.

If my premisses are in the main correct, there are other matters of interest connected with snow-burning, such as its modifications by colour and complexion, or susceptibility of the nerves of the skin, its effects on the eye in producing snow-blindness, the dark colour acquired in the Upper Alps by the châlets where they are exposed to the combined influences of sun and snow, and the curiously brown colour of the complexions of those who spend their winters in the Engadine.

In illustration of some of the points raised, I would relate the following observations. A gentleman (Mr. W.) tells me that on July 9, 1886, he crossed the Findelen glacier to ascend the Findelen Rothhorn, and that he had felt no discomfort whatever from the sun until they had arrived nearly at the top of the mountain, when they crossed a patch of fresh snow, and in five minutes he began to feel the stinging, burning sensation of sunburn, and in the evening the usual symptoms were fully developed. On no place besides the snow did he feel the sun, and he was only on the snow for ten minutes. A gentleman and lady (Mr. and Mrs. L.) tell me that they were never more burnt in their lives than when ascending the Pigne d'Arolla, and they had not a ray of sun from the moment they started until their return. They were enveloped in clouds so thick near the snow that the guides had

the greatest difficulty in finding their way. They were, moreover, quite cold—so cold, indeed, when standing, that the lady's hands were blue and senseless : both she and her husband had considerable experience in high Alpine regions. The Pigne d'Arolla is a mountain of 12,472 feet high, with very much snow on its surface. Probably the cloud overhead was not very thick, and acted in some way on the sun's rays so as to develop their irritating properties.

In June, 1879, a gentleman of very fair complexion and light eyes, almost an albino, became extremely ill from the effects of sun-burning. He had been up the Titlis on the preceding day ; his face was immensely swollen, red and painful, and his arms up to the elbow in the same condition, hard and extremely painful. They felt benumbed, stiff, and useless ; he had scarcely slept the preceding night in consequence of the pain and discomfort. The next day the parts were all covered with yellow blisters, and he felt very ill in himself ; the only parts not inflamed were those that had been protected by spectacles.

It appeared that he had turned up his shirt sleeves on ascending the snow-slopes. He was seriously ill and in his bed for a week.

On a subsequent occasion, a few years later, I encountered the same gentleman at Bel Alp on the morning after he had made an ascent in the snow ; again he was suffering severely from sunburn. The

face was much swollen, but I observed that it was pitted in various parts, and that each pit corresponded to a freckle. The following daythe face was more swollen and inflamed, and the third day the pitting had all disappeared. It would seem as if the brown pigment of the freckle had prevented the immediate influence of the light rays, but that subsequently the freckles had become involved in the general inflammation.

Every one knows the beneficial influence of a brown veil and brown glasses to protect the eyes, and I presume that freckles must have a similar protecting influence. I determined to try the effect of colour on my own person. I painted my face brown, and on a brilliant day ascended the Gorner Grat at a time when there was much snow. As it was the first fine day of the season, four different parties had started for the ascent of Monte Rosa; out of one hundred people staying at the Riffel Alp Hotel, about eighty ascended the Gorner Grat to watch the climbers, I myself amongst the number, with my face, as I have already said, painted brown. In the evening every individual who had been up the Gorner Grat (myself excepted) was smarting under the effects of sunburn. The twenty people who had kept near the hotel and had wandered about the woods during the day, although they had been fully exposed to the sun, were quite unaffected. On the following day I made another excursion on the snow with half my face painted

blue, and the other half coloured with burnt cork. Unfortunately I was overtaken by cloud which lasted the whole day, and my skin, perhaps naturally, showed no result. As I had to leave for England the day after, I had no opportunity of prosecuting my experiments further.

The Hon. Ralph Abercromby, in a letter to "Nature," April 15, 1886, relates, as one of those strange anomalies in which physiological experience contradicts the teachings of pure physics, first, that in Morocco and all along the north of Africa the inhabitants blacken themselves round the eyes to avert ophthalmia from the glare of the hot sand; that in Fiji the natives, who are in the habit of painting their faces with red and white stripes as an ornament, invariably blacken them when they go out fishing on the reef in the full glare of the sun; and, lastly, in the Sikhim Hills the natives blacken themselves round the eyes with charcoal to palliate the glare of a tropical sun on newly fallen snow, and he further tells me that during his experience of a winter in Canada he was never inconvenienced by the glare, for the simple reason that the air is usually so hazy that the sun is more or less dim.

In relation to snow-blindness, which is certainly associated with sun-burning, I saw some years ago in the "Lancet" that a German savant had discovered that sunlight rapidly destroyed the visual purple of the retina, and that this effect was much modified when the light was passed through coloured

glasses, and that brown glass, more than any other, prevented those changes taking place in the retina.

In my experience sunstroke is not heard of in mountainous regions, and Mr. Ralph Abercromby, who has travelled much, tells me that equatorial regions are not the worst for sunstroke, but sub-tropical and semitropical dry countries, such as Scinde, S.W. Bengal, United States, Italy, &c., &c.

It seems that rays reflected from snow have special influence in promoting pigmentary changes in the skin.

I was much struck in my winter visit to Davos by the extreme brownness of the skin of those who remained there; it was as though the skin had been coloured by walnut juice. I have several times visited those parts in summer also, but although the sun is much stronger, it by no means produces the same colouring of the skin, excepting on those who make excursions above the snow-line. Residing as I do at Folkestone, I have many opportunities of seeing travellers on their way to and from Davos and St. Moritz for winter residence, and the result is invariably the same. Connected with this subject is the brown colour of the châlets in the Higher Alps. My attention was first drawn to this by Dr. C. J. B. Williams, with whom I was discussing the cause of the brown colour of the skin.

The châlets in the less elevated regions, and

which are less exposed to the snow, do not become brown, or only very little so ; but as far as I have seen, and my experience is now considerable, they invariably do so amongst the snows. I have investigated this point with some care, and found that the parts of the châlets which are covered by the snow four or five feet from the ground, and the north sides, and those parts so shaded that no rays reflected from the snow could reach them, were of a dirty white colour, as were also the insides and the parts between the timbers.

In a few I found even the north sides brown, but then there was, near by, a bank sloping at such an angle that the sun's rays must necessarily be reflected from the snow on the north side of the châlet. At Zermatt, Mürren, and Bel Alp are many illustrations of this interesting observation. There is yet another point of interest; invariably over the doorways of the cow châlets the timber is white, even where most exposed to the sun and snow. At first I wondered whether this was due to some chemical change produced by the carbonic acid of the expired air of the animals, but I am disposed to explain the white colour by the presence of a very large amount of water vapour always emanating from the upper part of the doorway, more than to the carbonic acid.

As the direct rays of the sun pass through, and have but little heating power on the air itself, the air near the surface of the earth and rocks must be

warmed by contact with the same, and then diffused around. On the glacier, on the other hand, the air in contact with the snow or ice can only be at or near thirty-two degrees Fahrenheit, as it gets no warmth from contact. The sloping sides of the glacier depend not only upon the greater amount of dust and dirt on that part of its surface, but also upon the air warmed by contact with the contiguous rocks, which moreover continue to radiate heat for some time after the sun has disappeared from the glacier. Dirt and dust on a glacier, when not too thick, by constantly absorbing and giving off heat to the ice around, cause rapid diminution of the ice, and little wells and basins are thus formed. This principle is utilised by the natives for hardening the snow-track or path from the Théodule hut to Breuil; dark earth is strewn upon the snow-path, and this by absorbing heat causes rapid melting of the snow beneath, which the nightly frosts render more dense, and thus travellers are saved during the warmth of the day from plunging deeply into the snow. In conclusion, then, I may state generally:—

First. That heat *quâ* heat is not the cause of sunburn.

Secondly. That there is strong evidence for believing that it is caused by the violet or ultra violet rays of light reflected from the snow, which reflected light is not necessarily of the same quality as that which is incident.

Thirdly. Captain Abney finds that the violet or ultra violet rays are very strong at high altitudes, and believes that altitude has much to do with sunburn.

Fourthly. That altitude alone does not explain sunburn, for one may be unburnt on rocks, say, at 10,000 feet, and yet be immediately affected on descending to a glacier 3,000 or 4,000 feet lower down.

Fifthly. That sunburn and snow-blindness arise from similar causes, but that sunstroke is not apparently associated with either.

Sixthly. That rays from the electric light produce much the same results as sun-rays reflected from snow.

Seventhly. That the bronzing of the skin and the browning of the wooden châlets are probably produced by rays reflected from snow.

The varied experiences just related would probably all be readily explained by a few simple physical laws—*e.g.*, glass is athermanous to the dark or long heat-rays which arrange themselves at the red end of the spectrum ; but glass, on the other hand, transmits the light-rays which are readily decomposed by objects on the farther side of it, and there degraded into long heat-rays, which are now radiated as sentient heat. This is well illustrated in a greenhouse. The light-rays are alone admitted through the glass, and practically *all* the energy in the house is degraded, and then

radiated as long heat-rays from the earth and other objects within, which have been agents for the degradation of the "light energy" into the heat form. After a similar fashion the transparent epithelial layer of the fair skin will transmit the light-rays to the nerves, vessels, and other tissues immediately beneath; the light-rays would there be decomposed, and probably develop dark or long heat-rays, which would be sentient and excite in the very vessels themselves those primary actions which lead to inflammation and its consequences. Black skins, on the other hand, and various pigments, would absorb these light-rays and stop their transmission to those vital parts which may be excited to inflammatory action.

In reference to the singular but well-authenticated fact that, although feeling very cold, one may be more severely burnt on snow *in a mist* than in direct sunlight, we may take it that mist is nearly like glass, athermanous to dark heat-rays, and the explanation of the effects of the admission of light into a greenhouse may be here again applied to sunburn in a mist.

APPENDIX.

I have just (December, 1889) had the great pleasure and advantage of reading a lecture delivered at the Royal Institution in April, 1885, by PROFESFOR S. F. LANGLEY. This lecture was on "Sunlight and the Earth's Atmosphere," and it gives the results of a series of experiments undertaken to show the selective and absorptive influences of our atmosphere on the solar spectrum, and to get some clearer idea of the nature and energy of sunlight before it has been influenced by our atmosphere. The general result may be broadly stated thus: that sun-light, as it emanates from the sun, is of a blue colour, and is infinitely more energetic in various ways before it has been modified by our atmosphere. To make correct observations it was necessary not only to be on as great an elevation as possible, but to be also in a bright and clear region free from cloud and fog, and beyond the interference of surrounding influences. The most suitable spot was found to be Mount Whitney, in the Sierra Nevada, Southern California, about 300 miles south of San Francisco. It is about 15,000 feet high, and stands out in lonely peaks above the surrounding

desert. These peaks are described as of *grey* granite, the desert being of a *red* sand. In the desert at the bottom of the mountain the heat was found almost unbearable—237° in the sun, and not much less in the tent. And now come the points of interest in relation to my own observations on Sunburn. The desert sun had tanned the faces of the travellers to "a leather-like brown." As they ascended they found the cooler air delightful, "but "soon," says PROFESSOR LANGLEY, "the cooler it "grew the more the sun burnt the skin—quite "literally burnt, I may say, so that by the end "of the third day my face and hands, case-hardened "as I thought in the desert, began to look as if "they had been seared with red-hot irons, here in "the cold where the thermometer had fallen to "freezing at night; and still as we ascended the "paradoxical effect increased; the colder it grew "about us, the hotter the sun blazed above. We "have all heard probably of this curious effect of "burning in the midst of cold, and some of us may "have experienced it in the Alps, where it may be "aided by reflection from the snow, which we did "not have about us at any time except in scattered "patches; but here by the end of the fourth day "my face was scarcely recognizable, and it almost "seemed as though sunbeams up here were different "things, and contained something which the air "filters out before they reach us in our customary "abodes. Radiation here is increased by the

"absence of water vapour too, and on the whole
"this intimate personal experience fell in almost too
"well with our anticipations that the air is even a
"more elaborate trap to catch sunbeams than had
"been surmised, and that this effect of selective
"absorption and radiation was intimately connected
"with that change of the primal energies and
"primal colour of the sun which we had climbed
"towards to study."

PROFESSOR LANGLEY clearly infers that his sunburn sufferings were due simply to his being in a clearer atmosphere, nearer to the sun, and in consequence that the sunlight energy was less affected than lower down. To an extent no doubt this was so, but a careful perusal of the foregoing pages of my paper will show very conclusively that it is not that alone, for I have pointed out that at low elevations—on the earth's surface, on the sea, on rivers, and on certain sands and rocks—one may be severely sunburnt, and that at higher elevations one will not be burnt on grass and on rocks of a different nature and colour, whereas one is at once burnt on snow at such a height. This experience is so common amongst Alpine climbers, that in my opinion there can be no doubt that, under certain conditions, there is a peculiarity in the nature of light reflected from snow and certain other white and bright surfaces. PROFESSOR LANGLEY says the rocks which he ascended were of *grey granite*, and

from what I have already indicated it is clear that crystalline grey would be certain to modify and possibly intensify light rays reflected from their surfaces.

Mr. STANLEY in his book, "In Darkest Africa," at p. 156, says, "that the complexion of the natives "of Mupe is more ochreous than black. When a "body of them is seen on the opposite bank, there is "little difference of colour between their bodies and "the reddish clayey soil of the landing place. Much "of this is due to the Camwood powder, and with "this mixed with oil they perform their toilet. But "protection from sunshine considerably contributes "to this light colour. The native boy, Bartartu, for "instance, was deprived of this universal cosmetic "made of Camwood, and he was much lighter than "the average of our Zanzibaris."

That some intimate relation exists between the colour of the skin and the sun's influence, is not a modern view, we may gather from the following verses :—

THE SONG OF SOLOMON,

CHAPTER 1, VERSES 5, 6.

"5. I am black, but comely, O ye daughters of Jerusalem, as the tents of Kedar, as the curtains of Solomon.

"6. Look not upon me, because I am black, because the sun hath looked upon me : my mother's children were angry with me ; they made me the keeper of the vineyards ; but mine own vineyard have I not kept."

REVISED VERSION, CHAPTER 1, VERSES 5, 6.

"5. I am black, but comely,
O ye daughters of Jerusalem,
As the tents of Kedar,
As the curtains of Solomon.

"6. Look not upon me, because I am swarthy,
Because the sun hath scorched me
My mother's sons were incensed against me,
They made me keeper of the vineyards;
But mine own vineyard have I not kept."

In the summer of 1889 I was able to continue my experiments on the influence of colour protection against sunburn. I obtained many interesting results corroborative of views expressed in the preceding pages, but they are not at present sufficiently definite for publication.

R. L. B.