

THE SOLDIER'S HEAD-DRESS.

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THE actinic theory of sunstroke advanced many years ago by Colonel Maude, R.E., and Colonel Duncan, I.M.S., has of late years found an advocate in Dr. Sambon.

The natives of warm countries have dark skins and exposure to the sun tans the European; it is therefore suggested that the latter should, in conformity with this hint from Nature, cover the most exposed parts of his body by some material, such as red, yellow or black, which intercepts the actinic or heat rays of the sun.

The question has recently come up for special consideration, and it is thought that the following account of experiments which were carried out by me when I was D.A.D.M.S. (sanitary) of the First (Peshawar) Division may be helpful to officers now working at the subject. My experiments were directed to ascertain the value of a lining of red calico in the soldier's ordinary helmet, which it was thought might fulfil the desideratum of intercepting the heat rays.

The helmets tested weighed $13\frac{1}{2}$ oz., and were used without pugarees. None of the helmets available fitted me, so I was unable to wear one myself and thus ascertain if the red-lined helmet was cooler than the ordinary helmet. One helmet was issued to the Senior Medical Officer at Peshawar, and one to the Senior Medical Officer at Nowshera, for report as to comfort in wear; reports were submitted as follows:—

PRACTICAL EXPERIENCE.

The Senior Medical Officer at Peshawar forwarded a report from a junior officer of the Corps, who stated he had worn the helmet at Peshawar and Nowshera during the summer months, i.e., from June to August. He complained that after wearing the experimental helmet he invariably got a headache, which he attributed to the weight of the helmet, being greater than that of the Cawnpore topee which he usually wears during the hot weather months. He regarded the lining of the helmet with red material as a great improvement, as it certainly made the wearer feel the sun's rays less. Except this subjective impression, however, he furnished no evidence as to the value of the red lining.

The Senior Medical Officer, Nowshera, reported at some length on the helmet. He considered that the red lining was an improvement, but pointed out the following defects in the soldier's ordinary

helmet, from which, as has been pointed out, the experimental head-dress only differed in the matter of lining.

(1) The helmet is too heavy.

(2) The thin layers of cork comprising the helmet are not sufficient protection against the fierce sunlight of the Punjab and Frontier Province.

(3) The shape of the helmet does not provide sufficient protection against the slanting rays of the rising and setting sun.

He advocated the adoption of a red-lined Cawnpore tent club helmet in lieu of the present regulation pattern.

LABORATORY EXPERIMENTS.

In carrying out my laboratory experiments the only methods available were:—

(1) The exposure of a helmet in the sun with a thermometer placed inside it; the direct rays of sunlight being carefully excluded from the thermometer by black material.

(2) The exposure of sensitized material inside a helmet for measured periods, direct rays being excluded as in the first series of experiments.

(3) Observation of the temperature recorded by a clinical thermometer inside a helmet.

For purposes of comparison the experiments were conducted simultaneously with the following varieties of head-gear:—

(a) The experimental helmet.

(b) A soldier's regulation khaki helmet.

(c) A soldier's regulation white helmet.

(d) An officer's khaki helmet, lined with black silk.

(e) A Cawnpore tent club helmet.

(1) *Experiments with Ordinary Thermometers.*—With reference to the first series of observations I would point out that they cannot be regarded as of much value, as even solar radiation thermometers are known to give large errors in actual use.

Six of these thermometers, even when they are of the same make and give identical readings in the shade, will when exposed together to the sun give results differing by some degrees.

If this is the case with carefully made instruments of identical construction, too much reliance cannot be placed on observations on the protective value of different kinds of material when placed over thermometers which have of necessity been subjected to rough treatment during transit in a tropical country.

As pointed out by Colonel R. J. S. Simpson, the differences in temperatures found beneath different materials are not greater

TABLE I.—SHOWING TEMPERATURE AND TINT OF P.O.P. FOUND INSIDE HELMETS AFTER EXPOSURE IN THE SUN FOR ONE HOUR, WITH DETAILS OF METEOROLOGICAL CONDITIONS DURING THE OBSERVATIONS. THE EXPERIMENTS WERE CARRIED OUT ON SUITABLE DAYS DURING THE HOTTEST MONTHS OF THE YEAR.

	Observation I		Observation II		Observation III		Observation IV		Observation V		Observation VI		Observation VII		Observation VIII	
Time	9.45—10.45		11.15—12.15		10—11		10—11		9.40—10.40		9.30—10.30		9.30—10.30		9.30—10.30	
Temp. wet bulb ..	64.5—75° F.		62—63° F.		73—71° F.		73—75° F.		68—69° F.		71—73° F.		73—73° F.		70—73° F.	
„ dry bulb ..	67—76° F.		85—89° F.		78—78° F.		68—85° F.		78—81° F.		78—84° F.		77—78° F.		71—75° F.	
Meteor. conditions	Cool, bright and windy		Windy, cool day		Warm, bright day		Slightly windy, but bright		Cool, windy day		Bright, warm day		Cool day		Cool day	

Helmets	Temp. of interior of helmet	Tint of P.O.P.	Temp. of interior of helmet	Tint of P.O.P.	Temp. of interior of helmet	Tint of P.O.P.	Temp. of interior of helmet	Tint of P.O.P.	Temp. of interior of helmet	Tint of P.O.P.	Temp. of interior of helmet	Tint of P.O.P.	Temp. of interior of helmet	Tint of P.O.P.	Temp. of interior of helmet	Tint of P.O.P.
	Deg. C.		Deg. C.		Deg. C.		Deg. C.		Deg. C.		Deg. C.		Deg. C.		Deg. C.	
Experimental ..	30	Deepest	41	Faintest	37.5	Deepest	42	All the same	39	All the same	35	Deepest	35	..	33	Deepest
Soldier's khaki ..	28.5	..	40	..	36.5	..	42	..	38	..	34	..	34	..	31.5	..
„ white ..	28.5	..	40	Deepest	36	..	40	..	36	..	33	Deepest	34	..	31	..
Officer's khaki ..	28	..	39	..	37	..	41	..	37	..	34	..	34	..	32	..
Cawnpore topee ..	29	Faintest	40	..	36	Faintest	38	All the same	36	All the same	33	Faintest	33	Faintest	31	Faintest

	Observation IX		Observation X		Observation XI		Observation XII		Observation XIII		Observation XIV		Observation XV		Observation XVI	
Time	9.40—10.40		10—11		9.45—10.45		10.5—11.5		9—10		10.20—11.25		10.25—11.25		11.5—12.5	
Temp. wet bulb ..	74—76° F.		74—75° F.		72—74° F.		73—74° F.		70—71° F.		72—71° F.		72—73° F.		74—72° F.	
„ dry bulb ..	78—84° F.		82—86° F.		76—80° F.		76—79° F.		72—75° F.		78—76° F.		77—79° F.		82—80° F.	
Meteor. conditions	Cool, still day		Warm, bright day		Cool day		Cool, bright day		Cool, sunny day		Cool, sunny day		Warm, bright, sunny day		Cool day	

Helmets	Temp. of interior of helmet	Tint of P.O.P.	Temp. of interior of helmet	Tint of P.O.P.	Temp. of interior of helmet	Tint of P.O.P.	Temp. of interior of helmet	Tint of P.O.P.	Temp. of interior of helmet	Tint of P.O.P.	Temp. of interior of helmet	Tint of P.O.P.	Temp. of interior of helmet	Tint of P.O.P.	Temp. of interior of helmet	Tint of P.O.P.
	Deg. C.		Deg. C.		Deg. C.		Deg. C.		Deg. C.		Deg. C.		Deg. C.		Deg. C.	
Experimental ..	41.2	Deepest	42	..	36	Deepest	36	Faintest	32	Deepest	32	Deepest	32	Deepest	35	..
Soldier's khaki ..	40	..	41	Deepest	36	..	35.5	..	32	..	32	..	32	..	35	..
„ white ..	38	..	39	..	35	..	34	Deepest	29	..	30.5	Faintest	30	Faintest	34	Lightest
Officer's khaki ..	39	..	39	..	36	..	35.5	..	30.5	..	30.5	..	33	..	36	..
Cawnpore topee ..	38	Faintest	38	Faintest	35	Faintest	34	..	30	Faintest	30	..	35	..	35	Deepest

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	Observation XVII	Observation XVIII	Observation XIX	Observation XX	Observation XXI	Observation XXII	Observation XXIII
Time	11.5—12.5	10.45—11.45	11.45—12.45	10.15—11.15	10.15—11.15	11—12	10.45—11.45
Temp. wet bulb ..	75—73° F.	72—73° F.	74—75° F.	75—77° F.	73—74° F.	74—75° F.	73—74° F.
„ dry bulb ..	83—82° F.	79—80° F.	78—81° F.	80—81° F.	79—81° F.	79—81° F.	77—78° F.
Meteor. conditions	Dry, sunny day	Bright, sunny day	Bright, cool day	Bright, sunny day	Cool, cloudy day	Bright, sunny day	Cool, bright day

Helmets	Temp. of interior of helmet	Tint of P.O.P.	Temp. of interior of helmet	Tint of P.O.P.	Temp. of interior of helmet	Tint of P.O.P.	Temp. of interior of helmet	Tint of P.O.P.	Temp. of interior of helmet	Tint of P.O.P.	Temp. of interior of helmet	Tint of P.O.P.	Temp. of interior of helmet	Tint of P.O.P.
Experimental ..	Deg. C. 24	Deepest	Deg. C. 40	Deepest	Deg. C. 37	Dark	Deg. C. 39	Faint	Deg. C. 34	Deep	Deg. C. 36	Faintly dark	Deg. C. 38	Dark
Soldier's khaki ..	32.5	Dark	36	Slightly dark	37	Faintest	37	Slightly dark	33	Faint	37	Dark	36	Deepest
„ white ..	34	Light	39	Faintest	36	Faint	38	Deep	32	Slightly dark	36	Deepest	38	Faint
Officer's khaki ..	33	Slightly dark	39	Dark	37	Slightly dark	39	Deepest	31	Deepest	35	Faintest	37	Faintly dark
Cawnpore topee ..	33	Lightest	37	Faint	36	Deepest	37	Faintest	32	Faintest	..	Faint	36	Faintest

	Observation XXIV	Observation XXV	Observation XXVI	Observation XXVII	Observation XXVIII	Observation XXIX	Observation XXX
Time	11.30—12.30	12.15—1.15	11.45—12.45	11.15—12.15	11.15—12.15	11.15—12.15	11.45—12.45
Temp. wet bulb ..	73—73° F.	77—76° F.	67—73° F.	73—75° F.	68—69° F.	77—74° F.	73—69° F.
„ dry bulb ..	77—77° F.	77—80° F.	73—76° F.	76—75° F.	75—76° F.	80—77° F.	73—73° F.
Meteor. conditions	Cool, cloudy day.	Bright, cool day, rained 7.10 a.m.	Bright, warm day	Cloudy, cool day	Cool, bright day.	Warm, sunny day	Cool, cloudy day

Helmets	Temp. of interior of helmet	Tint of P.O.P.	Temp. of interior of helmet	Tint of P.O.P.	Temp. of interior of helmet	Tint of P.O.P.	Temp. of interior of helmet	Tint of P.O.P.	Temp. of interior of helmet	Tint of P.O.P.	Temp. of interior of helmet	Tint of P.O.P.	Temp. of interior of helmet	Tint of P.O.P.
Experimental ..	Deg. C. 36	Dark	Deg. C. 39	Dark	Deg. C. 38	Dark	Deg. C. 37	Faint	Deg. C. 35	Faint	Deg. C. 36	Faintly dark	Deg. C. 32	Faint
Soldier's khaki ..	37	Deepest	42	Deepest	35	Deepest	36	Dark	36	Deepest	38	Dark	31	Dark
„ white ..	35	Faint	38	Faint	38	Faintly dark	36	Faintly dark	33	Dark	40	Deepest	30	Faintly dark
Officer's khaki ..	32	Faintest	40	Faintly dark	36	Faintest	34	Faint	36	Faintest	37	Faint	30	Deepest
Cawnpore topee ..	33	Faintly dark	37	Faintest	33	Faint	35	Deep	31	Faintly dark	38	Faintest	32	Faintest

Note 1.—The shade temperatures of wet and dry bulb thermometers were recorded at the commencement and at the end of each observation. The first figure in each case refers to the temperature when the helmets were first exposed, and the second to the temperature in the verandah at the end of the hour's exposure. All temperatures in helmets are in Centigrade.

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and may be less than those between solar radiation thermometers in which the disturbing effects of connection currents do not reach the bulb.

I carried out thirty observations of this nature at Cherat during the months of June, July, August and September, i.e., the hottest season on the North-west Frontier of India.

TABLE II.—RESULTS OF EXPERIMENTS WITH ORDINARY THERMOMETERS PLACED IN INTERIOR OF HELMETS WHICH WERE THEN EXPOSED TO THE SUN.

Helmets	Highest temperature. Number of times recorded	Lowest temperature. Number of times recorded	Same temperature as highest of other helmets. Number of times recorded	Same temperature as lowest of other helmets. Number of times recorded
Experimental helmet	12	1	10	<i>nil</i>
Soldier's khaki	4	2	6	1
Soldier's white	1	4	3	9
Officer's khaki	1	5	5	1
Cawnpore topee	1	9	1	9

Out of 30 observations the experimental helmet recorded highest on 12 occasions, lowest on one occasion, and the same temperature as the highest of the other helmets on 10 occasions.

All temperatures are Centigrade.

TABLE III.—RESULT OF EXPOSURE OF SENSITIZED PAPER IN THE INTERIOR OF THE HELMET.

Helmets	Darkest tint with P.O.P. Number of times recorded	Lightest tint with P.O.P. Number of times recorded	Same tint in all helmets. Number of times recorded
Experimental helmet	11	2	} 2
Soldier's khaki	6	1	
Soldier's white	5	4	
Officer's khaki	3	5	
Cawnpore topee	3	16	

The darkest tint was produced in the experimental helmet on 11 occasions, and lightest on 2 occasions.

TABLE IV.—OBSERVATIONS WITH CLINICAL THERMOMETERS IN THE INTERIOR OF HELMETS IN ACTUAL WEAR.

Helmets	Above 95° F.	Below 95° F.
Experimental	2	28
Other helmets	<i>nil</i>	20

The results of my observations are shown in Tables I and II. The former table gives particulars of each observation and the latter summarizes the results.

(2) *Exposure of Sensitized Material, inside Helmets.*—The plan adopted was suggested by the method used in the Watkins and Wynne Exposure meter, and consisted in simply recording the tint produced on sensitized photographic paper after exposure for a measured time in the interior of the various helmets.

Direct rays of light were of course carefully excluded by black material.

The results of each experiment are shown in Table I, and the thirty observations summarized in Table III.

(3) *Observations with Thermometers placed inside Helmets in Actual Wear.*—Colonel Firth points out "Theory and Practice of Hygiene," p. 833), that sufficient experiments have not been made either: (1) with regard to the temperature to which the skin of the head and neck is raised by the sun's rays in the Tropics; or (2) with regard to the heat in the interior of the caps and hats in warm climates.

The only instruments available for these experiments were clinical thermometers. These instruments are not constructed to record temperatures below 95° F., so that most experiments merely showed that the temperature was below this figure.

It is by no means easy to fix a clinical thermometer in a helmet, so that thermometers were somewhat frequently broken in carrying out these observations. I would have endeavoured to obtain a special thermometer, but was unable to find a suitable type quoted in any of the price lists consulted. I suggest that a number of special instruments might be obtained and experiments conducted on this interesting subject in various parts of India.

The results of this group of observations are given in Table IV.

CONCLUSIONS.

The results of my four series of observations may be summed up as follows:—

(1) From practical experience in actual wear, helmets lined with red material are stated to be cooler than the ordinary khaki head-gear.

(2) From observations with thermometers the temperature in the interior of the experimental helmet was higher than that recorded in four other varieties of head-gear exposed to the sun at the same time on twelve occasions, and lower on only one occasion out of thirty observations.

(3) Exposure of sensitized material showed that the tint obtained in the interior of the experimental helmet has, on eleven out of thirty occasions, been darker than that produced in four other kinds of head-dress.

(4) The temperature recorded by a clinical thermometer inside a helmet has on two occasions out of thirty experiments risen to about 95° F. In a similar number of experiments the temperature in the interior of Cawnpore tent club helmets and Curzon topees has always been below this figure.