HEAT EXHAUSTION AND DEHYDRATION IN THE ARABIAN DESERT.¹

By LIEUTENANT-COLONEL H. STOTT, O.B.E., M.D., F.R.C.P., D.P.H.

Indian Medical Service.
Professor of Pathology and Physician, King George's Medical College, Lucknow.

The forced landing of the aeroplane "Horsa" in the Arabian Desert at 4 a.m. on Saturday, August 29, 1936, presented an occasion—unwelcome though it was—to observe the effects of the heat exhaustion followed by great body desiccation after a few hours' exposure to dry desert heat. A few notes may be of some general professional interest.

ON THE ATMOSPHERIC CONDITIONS.

One officer was interested in this point and watched the available thermometers. In the shade of the wings where the passengers lay he estimated that the air temperature was about 125° or 130° F. from soon after sunrise to sunset. This, of course, was a temperature much above that of the human body. The air humidity was extremely low, since the air was scorched-dry in its passage over the burning desert sands, which surrounded the airship on all sides and continued without water, trees, shade or vegetation for some fifty miles.

Air Movement.—A continuous fair breeze—though hot and dry—made conditions seem less unpleasant.

ON THE RESULTING HEAT EXHAUSTION.

The first experience of great body heat stimulated endeavours to anticipate and to minimize the condition which was likely to follow; the symptoms were slight restlessness, considerable giddiness and faintness, inability to walk beyond a few steps or even to stand, and rapid shallow breathing. Such symptoms were followed by signs of severe cardiac collapse, evidenced by a cold skin, a feeble pulse and cyanosis. The clammy sweat one would have expected with cardiac collapse was not apparent since it at once evaporated and increased the skin coldness. The available brandy, spiritus aetheris nitrosi, digitalis, and eau de Cologne, for such cases proved invaluable. The early appearance of such cardiac collapse symptoms amongst a group of fit officers returning from leave was remarkable. The ship's captain and navigation officer were the first two cases. They developed symptoms about noon after some six hours' exposure which included the early morning hours when the heat was less trying.

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ON THE INFLUENCE OF MENTAL STRAIN.

In them, however, the considerable mental strain, to which they had been exposed for two hours before landing, provided a special predisposing factor. During this period the Bahrein aerodrome could not be located on account of defective lighting and the enveloping haze, whilst wrong air bearings directed the aeroplane further into the desert instead of into its airport. Petrol was almost exhausted but a forced landing in unknown country before the first light of the breaking dawn was full of the gravest danger. In such circumstances the responsibility for passengers, mail, and plane was no light one.

ON THE INFLUENCE OF PHYSICAL EXERTION.

The least movement added to the body heat which the vital processes themselves produced. We soon found that exertion of any degree was followed by increasing weakness and that a few yards of staggering walk was of necessity followed by a period of breathless immobility. All, therefore, soon diminished physical exertion to an absolute minimum. And yet it was remarkable how eleven out of the thirteen managed to cross one mile of desert at 2 in the afternoon to the rescuing R.A.F. bomber—though it was true that this was accomplished after copious fluid and concentrated foods.

It appeared indeed doubtful whether all could cross that mile but the attainment of safety at the end was the prize that won through. Some marched with eyes fixed on the ground a few yards ahead. To look at the plane itself seemed a distance impossible of attainment. I personally made for a selected mark about twenty yards ahead and, encouraged by the successful accomplishment of that, chose such successive landmarks till the plane was reached. Perhaps I was lucky in being the possessor of an umbrella, which was especially fortunate, as two of us had no topees. Some of us at bad periods were helped by gallant men of the Royal Air Force. Three-quarters of an hour was spent on that mile in absolute silence, every energy being concentrated on the goal to be attained.

RESULTING BODY DEHYDRATION.

The dry scorching breeze like a blast from a furnace sucked fluid through the skin sweat glands which immediately evaporated so that no visible sweat was produced. This evaporation, no doubt, caused some slight cooling of the skin surface, which made us choose to lie where the breeze was. But such temporary cooling was produced only at the vital expense of the invisible constant drain of body fluids through the skin to the atmosphere. I recall considering whether it would be of greater advantage to lie where there was no breeze and conserve one's body fluids, or to hazard the future for the slight relief the breeze gave. And the present won! The available fluids, in the ration of three-quarters of a small tea-cup thrice daily, were a drop in the ocean in an attempt to replace any material part of the fluid lost through the skin. The clinical
result was not unlike that of a cholera attack though the fluid was not lost through the same channel. The skin became “bone” dry and lost elasticity. The eyes sank into their sockets and became encased with heavy dark rims. The cheeks hollowed, the pulse became feeble—and its tension fell due to diminished volume from dehydration. The urinary secretion failed, so that a few ounces only were voided in the twenty-four hours and that of the deepest colour, most concentrated and highly acid—so that its passage was accompanied with a slight sting. Blood changes, resulting from the rapid loss of blood fluid, must have corresponded to those in cholera. The total red and white cells must have relatively risen—and blood become thick and “tarry.” Cyanosis certainly developed. The highly acid urine pointed to a reduced blood alkalinity, as in cholera. The blood urea must have considerably risen. The urea retention was not due to failure of the excretory kidney function from organic disease, as in the uræmia of advanced Bright’s disease, but to retention due to desiccation of the body—by an acute drain of the body fluids from it—with insufficient fluids by the mouth to provide for a urinary secretion—as in cholera and at times in diabetic coma. It will be recalled that an easy method of bedside differentiation of these two types of retention is by estimating the concentration of urinary urea, which is high in dehydration when the kidney is healthy and could concentrate well, and low in Bright’s uræmia when the kidney is almost entirely destroyed. No doubt toxic metabolic products and acids retained by the failure of the urinary excitation were in great part responsible for the muscular weakness producing physical inactivity, for the mental drowsiness which all felt, for the dyspnœa from which many suffered, and for minor bouts of Cheyne-Stokes' respiration which also occurred.

**On Mental Reactions.**

During the first few hours the faculties of perception and understanding were stimulated. The situation seemed appreciated in its correct perspective with the utmost clarity and right decisions seemed easily and rapidly reached. Later such periods of clarity were recalled whenever decision of thought was required, but periods of drowsy sleepiness started to intervene. Amongst the problems to be decided were: the immediate necessity of rationing our slender drink and food resources, of working the plane’s ground wireless, of not leaving the plane in any attempt to reach the sea or to search for help, of conserving our strength, of diminishing heat production by body inactivity, of the best time to fire the available twelve Very lights and two magnesium flares which were carried, of other means of possibly attracting attention, of the best manner of aiding our comrades when attacks of exhaustion seized them, of the best employment of the available sedative, sleeping, stimulant and other drugs, of the collection of night dew from the aeroplane wing and of its possible poisoning qualities.
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from aeroplane wing dope if drunk, of sanitary arrangements, and of the manner of dealing with possibly unfriendly Arabs if such appeared.

My present estimate was 5 per cent of chances we should be found on the first day, 95 per cent on the second, and 100 per cent on the third day, but I also estimated (though did not mention) that probably two or three would be dead by the second evening and only two or three would survive by the third evening. Deaths would, I think, have been easy by increasing drowsiness, breathlessness, and cardiac failure.

A few delusions of mild degree arose, e.g. that it was raining beyond the plane, and the individual (who was too weak to move) was being restrained from reaching the cooling water. Some dozed and dreamed. One dream was of turtles waddling in their dozens from a river, fattened by feeding on corpses, and advancing over the desert hungry for their latest victims. Their huge red eyes gleaming in anticipation formed a target for the thrust of the point of the dreamer's umbrella—when thus blinded they attacked each other. Rather too realistic a dream in such circumstances!

The first sounds and sight of the R.A.F. relief planes were too good to be accepted. One heard and refused to believe. One saw and looked again and yet again lest our senses deceived us. The realization of being saved produced deep emotion even to tears. This was followed in some cases by a fear that we had not been seen, or could not be reached or would again be lost. And again, when we were saved and drinking freely in an R.A.F. bomber, flying back to Bahrein, advice was offered that we should drink no more but save our water, in case the bomber became stranded and we again became waterless. I myself in my host’s house at Bahrein was about to pour water from a large jug into a basin to wash my hands—when suddenly my raised hand stopped. I could not pour out this fluid, each drop of which was so precious, in such quantity and for so wanton a purpose! And it took a real effort to pour out that water. We owed our thirteen lives to the R.A.F. flight that found us, and to all those of the R.A.F. or of the Imperial Airways, or of the Royal Navy, who stimulated and helped in so rapid a search. To them our gratitude is in proportion to our debt. Had it not been so rapid, it would have been too late.

ON HYPERPYREXIAL HEATSTROKE.

Though no cases of heat fever fortunately arose amongst the passengers or crew of the “Horsa” yet etiological factors link this condition so closely to heat exhaustion, and the recognition of the factors contributory to hyperpyrexial heatstroke in Indians is so important and their distinctive treatment, if life is to be saved, is so vital that brief reference to hyperpyrexial heatstroke in this contribution seems justified.

My original work on this subject was founded on cases from Mesopotamia—and was published in 1915, under the title of "Malarial
and other Infections as Ætiological Factors in Hyperpyrexial Heatstroke."

The main conclusions were:

(i) In 1915, though the Indian Forces in Mesopotamia outnumbered the British Forces by some 4 to 1, yet 96 per cent of the cases for heatstroke (including effects of heat) came from British troops.

(ii) Amongst Indians, hyperpyrexial heatstroke is rare, and pure, that is, uncomplicated hyperpyrexial heatstroke, due solely to heat, is excessively rare. Indeed, it should be assumed that if an Indian even under atmospheric conditions predisposing to heatstroke develops hyperpyrexia then there is some underlying unrecognized infection which demands diagnosis and treatment.

(iii) In considerably over 50 per cent of cases amongst Indians the causative infection is malaria. It is, therefore, wise to treat all hyperpyrexial heatstroke in Indians as cerebral malaria—until the contrary is proved; especially is this so when such cases develop in a malarious region, or show an enlarged hard spleen, or give a history of recent attacks of malarial infection.

(iv) Amongst Europeans, the possibility of two other common causes should be considered: (a) Exposure to the sun from inexperience and from non-acclimatization, and (b) intemperance.

Acute conditions due to great heat give rise to medical emergencies which demand clear thinking and immediate adequate attention if life is to be saved.