PHYSIOLOGICAL PROBLEMS OF THE SOLDIER IN TROPICAL WARFARE
AN OPERATIONAL APPROACH

BY

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The desert and jungle are too well known to warrant description, but their operational aspects have certain physiological implications. Land desert warfare has been, in the main, characterised by fighting vehicles and by mobile infantry in "hard" or "soft" vehicles who rarely march long distances with a pack. Dust and haze impair visibility but glare when a problem is related more to airstrips, roads and vehicles rather than to the desert itself. During the day, cooling the vehicle may be more urgent than cooling the man. Nights are seldom completely dark and hence allow manoeuvres. Jungle war, on the other hand, has, in general, been characterised by hidden activities of small isolated groups of men who may have to forgo vehicles and rely on air-drops. Plantations are easy to pass through unless neglected, and the rate of movement by foot may be as rapid as on a fair road. Virgin forest, that is primary jungle, is thick but not always impenetrable and being sheltered is cooler and more pleasant than open country. Visibility may be a matter of ten to fifty yards, and the rate of travel is cut down by half. When primary jungle is cleared and left to itself, a dense overgrowth (secondary jungle) develops at man height through which he must cut a way. The rate of movement is cut down by another half. In swamp areas, progress of a hundred yards or less an hour may be quite an achievement. Added to all this is a hot, damp atmosphere with rain of variable amount. Hills of considerable height may occur in the tropics and are common in jungle areas.

PSYCHO-PHYSIOLOGY OF THE SOLDIER

In times of war the soldier comes in contact with a variety of individuals, not all of whom have to be considered in civilian life: a vicious and implacable enemy, comrades of other nations, his own group of men and officers, and finally, himself, in an unusual role. To know them, and to understand them, is vital.

Evidence to hand suggests that, from the military viewpoint, there are but few important physiological differences between men of different races; however, the men have very different habits, reason differently and, as soldiers, may not always "play the game" by other men's standards. When physiological differences are found (e.g. in blood cells or chemistry), they may be related to variation in nutrition or to subclinical infection rather than to race itself (1).

Fear of the sun and of a damp air has for centuries bedevilled the European soldier campaigning in the tropics. "In 1853," said Ranald Martin, physician to
the Bengal Army, “soldiers became terrified of the sun, and the hospitals were overcrowded with men anxious to escape solar exposure.” Another physician said later: “Intense fear of disease should disqualify for the tropics . . . they see danger everywhere and imagine every headache a sunstroke.” It was, indeed, fear of the sun and the “miasms” arising from damp air which brought in the topee, the spine pad (2) and the cholera belt (3), clothing items characteristic of the British Army for so long. Competent physicians were convinced that they had “proof” of the dangers of being without them, for did not symptoms (headache, weakness, diarrhea, etc.) disappear when they were used? Similar argument is nowadays put forward for the value of salt in the prophylaxis or treatment of heat disorders, but fear or a fetish may have great power over the physiology of the body. Emotional stress may produce, temporarily, some of the physiological effects of a hot climate—for instance, a rise in body temperature and urinary changes; and functional and organic disease of the frontal cortex, hypothalamus and pituitary gland are sometimes associated with changes in body temperature, blood pressure, blood and urine volume or chemistry, skin changes (dry or sweating skin, rash resembling prickly heat) and mental disturbances which, to the experienced clinician, are reminiscent of heat disorders. Those with experience of the latter will remember the peculiar overlay of mental symptoms in many cases. How much mental disturbance is a cause and how much a result is not clear; but it is, however, fairly certain that undue fear of the climate in the soldier (or even the medical officer) is not a factor to be lightly dismissed. It is essential not to underestimate the enemy but it is, perhaps, unwise to use the unqualified expression “hostile” environment in front of the uninformed soldier who may tacitly assume that continuous sweating for weeks or months is bad for his health. Problems of family ties and comforts, of boredom, restrictions and dangers have always been the common lot of the soldier; but, with the present trend of war, he may be much more concerned with the safety of his family than of himself. In this context, the fear, sometimes present, that prophylaxis of tropical disease (e.g. the use of anti-malaria tablets) is followed by impotence, is not to be forgotten.

APPLIED PHYSIOLOGY OF THE TROPICS

The last war gave ample opportunity of checking the findings of the previous twenty years in the field of tropical physiology. Many of the data were obtained from research carried out in the controlled air (and radiation) conditions of a climatic chamber, and some from the less controlled but realistic environment of the soldier in the tropics or the patient suffering from a heat disorder. Experiments were not always designed to minimise either the large difference between individuals or the naturally occurring time variations (diurnal, day to day, seasonal, etc.) within them. In general, experiments in a climatic chamber are of short duration, being limited by the elemental requirements of food or other demands of nature. The well-fed and fresh subject, exposed to a few hours of muscular work in simulated tropical heat, is also subjected, but for a longer period, to the weather and other uncontrollable variables outside the laboratory.
The term "heat acclimatisation" is used, in general, to designate those changes taking place with heat exposure. There is no doubt that such exposure in a climatic chamber produces many of the changes associated with living in the tropics. However, life in the tropics is more than a question of thermal balance; for, just as climate modifies the man, so can he modify the terrain and the "climate" of his home or office. He takes with him (or leaves behind) his family ties, habits and social customs. The motorised infantryman of the desert leads quite a different life from a soldier shackled to his pack, Bren gun or wireless set in the jungle.

Artificial conditions in a hot chamber, without desert sunlight, diurnal temperature change, dust and glare, jungle rain, damp clothes, the ration pack, disease-bearing pests, poor sleep and loneliness, can hardly simulate fully the biological, physiological, psychological and clinical problems of either the contented civilian or the harassed soldier in the field. Yet "jungle" and "desert" conditions in the climatic chamber have been assumed to be equivalent because they can, apparently, be equated by the Corrected Effective Temperature and similar indices. Nevertheless the climatic chamber has thrown important light on many facets of heat exposure, particularly the indoor climate of hot industries, hot mines, and aboard ship or plane in the tropics. It is a screening agent for physiological clothing studies, and may help to eliminate the man without sweat glands or the soldier who is psychologically or otherwise unsuited for service in the tropics. The final and appropriate "laboratory" for hot climate physiology is, undoubtedly, not the hot chamber but the tropics themselves.

Insufficient is yet known of the difference in response to heat between the "browned off" man, the anxiety case and the soldier of good morale. Results from the climatic chamber suggest the development of a worth-while level of acclimatisation in a matter of a few days, yet many experienced tropical practitioners have for long insisted that the white man never becomes completely adjusted to living a full life in the tropics. How much more may this apply to the soldier under continuous operational conditions? With a few days of exercise in a hot chamber, there is a decreased rise in pulse rate and body temperature, a quicker response to profuse sweating and an increased sense of well-being to a given work level. The volume of urine decreases (oliguria), as does the excretion of sodium chloride. Such changes, which also occur in healthy soldiers in the tropics or even during a hot season in Europe, are undoubtedly part of a normal compensatory and hormonically induced reabsorption and redistribution of water and crystalloids rather than a simple salt-deficiency dehydration from excess loss in the sweat. Artificial acclimatisation does not appear to affect the resting body temperature on return to the normal environment. However, the resting oral and rectal temperature of fit British soldiers, after several months' service in India, was found to be appreciably higher than in England, reaching commonly between 99.4° and 100° F. in the mouth. No relation was found between body temperature level, the general appearance of the man, pulse rate, "physical fitness" test (Harvard Pack test), level of sweating, blood sedimenta-
tion rate or intensity of prickly heat (4). The "fever," at first glance, suggested heat storage and poor acclimatisation. However, when the same phenomenon was found in equally healthy Indian troops it was obvious that this could hardly be the explanation. Perhaps nature has a "purpose" in slightly raising the "thermostat" level, for the same phenomenon is seen in the camel—an animal certainly adapted to the extremes of hot climates. In Paiforce and India during the last war insufficient knowledge of the normally raised body temperature was a cause of minor but unnecessary manpower wastage brought about by the incarceration of otherwise fit men in hospital or by prolongation of convalescence (4). Whether the hot chamber is of value, or indeed practical, for air-transported replacements who go out without the advantage of a sea journey is not known. To forgo indoctrination and natural acclimatisation after arrival may be hazardous. There is some belief that, during the last war, the Africa Korps were acclimatised in hot chambers in Germany, hardened in Italy, and then flown to Libya. This, however, appears to be a myth. The effect of anxiety, sea sickness or an uncomfortable two- to three-day plane journey on what the body has "learned" in a climatic chamber has also not yet been ascertained.

Clinical dehydration (due to impaired water intake, vomiting or diarrhoea), particularly in the surgical patient, unquestionably predisposes to heat exhaustion and heat stroke; but it is doubtful whether, in spite of theoretical considerations, it is a prime cause. In a hot climate, blood may be exposed for some time to an ambient temperature of 105°F. or more before reaching the laboratory. The resulting swelling of the red corpuscles produces a raised haematocrit which may be interpreted as "dehydration" (5). Unpublished work by Major J. H. Bowie, I.M.S., and the author in Paiforce failed to show at autopsy or as a result of histological or haematological investigation any definite evidence of dehydration in men or animals in uncomplicated cases of heat stroke. On the other hand, cerebral oedema and gastro-duodenal haemorrhages are common (with pulmonary oedema in some cases treated by intravenous saline). In fact, the early clinical features suggest acute increased intracranial tension. Typical changes may be present where rectal temperatures during life do not exceed 105°F. There are authenticated cases of men, lost for several days in a hot desert without food or water (and luckily, without salt) who, when found, showed extraordinary shrivelling up of the body (with loss of up to a quarter of their body weight) without the characteristic features of either heat stroke or heat exhaustion, and who recovered fairly rapidly on gradual reintroduction of water and food. Before setting out, such men were filled with highly concentrated morale, but not always with water or salt. It is strange that salt hunger (halophagia) occurs in conditions where there is little evidence of its deficiency; and, except in those who are "salt indoctrinated," is not characteristic of the tropics—either in the indigenous inhabitants, healthy soldiers or patients with heat disorders. A number of infections (lobar pneumonia, typhus and sand-fly fever, etc.), even in the cool season, show many of the clinical and biochemical changes believed to be characteristic of heat exhaustion, again without evidence of salt deficiency. In the absence of such disorders, marked diminution of urinary chlorides (with
or without a low plasma chloride level) is, during the hot season, strongly suggestive of heat exhaustion. Such findings alone are, nevertheless, not proof of salt deficiency, even if symptoms disappear on administration of salt by the mouth. Cases may rapidly improve in a darkened, quiet and cool ward, with mild sedatives but no extra salt. A crucial experiment would be the clinical effect of "salt" which was, in fact, not sodium chloride. It may be added that in the heat stroke centre a low humidity may be more important than a decreased dry bulb temperature.

There is a long history of the dire consequences of heavy work carried out in the heat of the tropical day, particularly by unacclimatised men. The following appeared in a wartime booklet on jungle warfare: "You should be able to: (a) march 20 miles a day for two consecutive days carrying a jungle pack and rifle, without having sore feet, shoulders, legs or back; (b) run one mile on a hot tropical day in your field clothes and boots in less than 7½ minutes, without feeling sick or exhausted afterwards."

Extraordinary feats of escape and endurance were carried out during the Burmese campaign by trained men of extremely high morale. Modern athletic events have shown that the peak of human physical performance has not yet been reached. To obtain this ideal, training and motivation are equally important. For a century or more it has been accepted that under temperate conditions the carriage of loads of more than one-third body weight rapidly leads to deterioration of efficiency (as measured by oxygen utilisation, pulse, body temperature, etc.). Recent work has shown that this is not necessarily true for a fit young man walking for an hour on a treadmill in a cool laboratory. When marching on sand the energy expenditure is appreciably greater than when on a good road, and the energy spent in getting through the jungle even without a loaded pack may be extremely high. Remembering that jungle fighting is the toughest of all schools, it is wiser to assume that requiring the soldier to carry loads over a third of his weight, particularly if he is hungry, thirsty, exhausted by lack of sleep and pestered by unpleasant parasites, can in a short time impair his fighting efficiency and predispose to serious heat disorders. The infantryman on jungle patrol carries a mere 20 pounds, but the usual "marching" load in Malaya today is about 60 pounds, with, for good measure, another 4-5 pounds, as rain, sweat or other source of water. The wireless operator carries yet another 7 pounds, and the No. 1 Bren Gunner a total of about 80 pounds—half his own weight or more (6). Under such heavy strains on the muscles and heat regulating mechanism, the above quoted demands on his marching or running capacity (based, no doubt, on the teaching of Wingate and the exploits of the Chindits) may be too great. Men vary a great deal in height and weight, in physique and response to work and heat; yet the same claims may be made from any of them. The well-known principles of load carriage were put forward by Edmund Parkes almost a century ago, but they have always conflicted with operational requirements. The soldier and the physiologist must somehow work out a solution to this important problem of the soldier's load.

The "Pulheems" system takes into account fitness for service outside
temperate climates, but it is based on broad criteria. During the last war many indices of "physical fitness" of the service man were devised which were derived from physiological measurements (blood pressure, pulse rate decrement, etc.), taken after a fixed period of stepping—or for as long as the man could continue. One of these, the Harvard Pack test, used on British troops in India over a period of several consecutive days, showed a learning factor with a superadded random variation, during which time "fitness" itself was not likely to have changed appreciably. Use of the test during a ration trial on Gurkha troops showed amazing scores (all well over 100 per cent) compared to those of their own British officers (70-85 per cent), who "lost face" as a consequence. However, during the realism of forced marches in the jungle, the officers always came in ahead of their men, whereas stragglers (of very high Pack score) were brought back by truck because of "fatigue" or blisters on the feet. The high score of the small Gurkhas appeared related to their fine calves, for the test is one of rapid step climbing. Since a man cannot be forced to finish the test (five minutes), there is clearly a loophole for the morale factor, and the simple matter of sore feet or backache can produce a temporary low score. Critical work on several of such "fitness" tests did not show a good correlation between them, or between any and a realistic situation (7). There is experimental evidence to show that an experienced officer may be a better assessor of a group of men to take out on a prolonged jungle patrol than any known "fitness" test.

ARMY HEALTH: APPLICATION OF ACCEPTED PRINCIPLES

Equal to or perhaps of greater importance than acclimatising the soldier to sweat easily in the heat is attuning his mind to living and fighting (particularly in small isolated groups) in the desert or jungle. This can be done by indoctrination courses before leaving for abroad. Here he would be taught to respect, but not to fear, a hot climate, and to understand the purpose of his sweat and the changes in the urine. The medical officer should accept that slight "fever," "oliguria," so called "dehydration" and "chloride deficiency," occurring in healthy men in the tropics, are but normal physiological variations. Under present conditions, troops are indoctrinated (and acclimatised) after arrival in excellent jungle schools, and are not sent out on active manoeuvres for four to six weeks. The term fatigue is used to cover such a multitude of conditions that one might well ask at the outset—fatigue for what? Tropical fatigue (formerly tropical neurasthenia or "Burma head," etc.) covers a number of overlapping entities related to prickly heat (viz., thermogenic anidrosis) or to heat exhaustion, but some are of a primary anxiety nature. Because of the greater, more varied and unrelenting demands on the individual soldier and junior commander in jungle warfare, tropical fatigue occurs much more frequently than in the desert. The "browned off" man probably acclimatises badly and may be liable to any heat disorder. Because his personal hygiene is poor, he is also a candidate for any type of environmental "trauma," including tropical infection.

It is, perhaps, inevitable that the skin—the part of the body in closest contact with a tropical environment—should be the sensory organ from which heat...
acclimatisation and, perhaps, its failure take place. For this reason much attention should be paid to its hygiene. A good tan is a rational start to continuous tropical exposure; it may prevent over-sweating but is, apparently, no guarantee against prickly heat. Two cold showers a day whilst in base camp, and one or two wash-downs a day in the jungle, act as a sedative to the continually stimulated skin and are prophylaxis against prickly heat and heat disorders. Prickly heat (to which no race is immune) is an annoyance under any conditions, but in the jungle are to be added flies and the nauseating blood-filled leech during the day and the mosquito, mite and tick at night. The use of chemical insecticides is now widespread, but the long-term effect on the man and the possibility of producing "acclimatised" pests is not to be lost sight of. It is probably the "jungle" microclimate at skin level which encourages not only the fungi causing "foot rot" and "dhobie itch" of the groin, but also the bacteria associated with boils, infected bites and abrasions. In some individuals under ordinary conditions, such organisms appear to live as harmless saprophytes. The boiling of unshrinkable socks and underwear—a no mean task for the soldier at any time—has been suggested as a preventative, but this treatment can hardly be applied to the feet, or even to the boots. Friction due to any cause—clothing, web equipment—may initiate skin infection or prickly heat. Skin disorders, which form a high percentage of casualties in hot damp climates, are hardly to be diminished by the use of towels which are rarely clean or dry. Water is, usually, abundant in the jungle, but it may be infected. It is, furthermore, not clear whether frequent washing in cold or hot water, with or without soap, will decrease skin disorders. Exposure to chemical warfare agents may necessitate the use of sweat-inhibiting drugs with the consequent impairment of heat loss.

Exposure to a hot climate is believed to modify the normal microscopic flora of the bowel. This, together with unusual food (including extra salt), unsuitable drinks (including large quantities of cold water) and varied psychological factors, may explain a number of cases of minor abdominal pain and diarrhoea. Heat stroke and exhaustion on occasion present themselves as diarrhoea or vomiting; but infection is the most important cause of prolonged bowel disturbance. Although it is supposed that in a hot climate men have a smaller appetite, especially for protein, the British soldier appears to carry his normal dietary habits with him everywhere. Fit soldiers on manoeuvres can remain efficient for a few days on a low calorie diet if this is followed by a week of first-class rations to "fill up" again. Palatability and variability of a ration are important factors, but in the jungle, where a man may have to carry on his back food for five days, weight becomes a serious consideration. Dehydrated foods may be the answer. Living off the land is only a practical proposition for specialised troops.

A "drill" for drinking water is laid down in medical and training pamphlets and cannot be improved upon. It must be accepted that the man acclimatised to the heat cannot be adapted to drink less than that required by thirst. However, one can hardly do more than encourage him to drink as much as he wishes—if, of course, plenty of palatable water is available. For the battle casualty and for
chemical warfare decontamination, speed in getting to the water-bottle may be vital. In any case the water-bottle may be the final arbiter of what he can actually get to slake his thirst. It is still widely believed that an increased intake of salt is necessary for the health of the soldier in the tropics, but the evidence is not always convincing. Salt in the form of the uncrushable tablets of the last war, or even dilute tepid saline, may induce nausea or vomiting and diarrhoea in some men and aggravate prickly heat in others. In any case, salt is thirst-producing and thus a drain on the water supply. The last word on this controversial matter has not yet been said.

Rest for the soldier may be considered under (a) that associated with continuous activity—marching or digging—and requiring, in the tropics, five or ten minutes’ rest every half-hour or less, (b) diurnal rest—or sleep—and (c) periodic rest and leave. Night, in both desert and jungle, is an important time for action and patrol. In the hills and many desert areas the night is appreciably cooler than the day. The change soothes the sweating skin and is conducive to sleep. Sand makes a good bed. For the infantryman in the jungle, the extreme fatigue of the day’s activities, coupled with the long nights and with the discomfort arising from skin disorders, may make sleep difficult. In the damp atmosphere, the action of the usual mosquito repellent wears off in three hours, and the man awakes to repeat the treatment and then get off to sleep again. Head and hand nets are too uncomfortable to wear for sleep, but may be necessary for night patrols. Because of the damp soil and the affinity of the typhus-bearing mite for human skin, the soldier should not sleep on the jungle floor. Some acclimatisation is required to sleep comfortably in a hammock or a platform of saplings. For many reasons it may be necessary to “dig-in.” Prolonged activity of small groups of men produce particular strain on the junior officer, and more data are required on the maximum periods that soldiers should spend in a fighting zone and elsewhere. It is, furthermore, not sufficient to have leave centres. Steps should be taken to ensure they are fully used.

Long exposure to desert heat and to abrasion by sand dries the skin and the membranes of the eyes (emery-cloth eyes), mouth (peeling of mouth and tongue), ears and nose, but, ordinarily, this is not a great problem. The ultra-violet light reflected from sand and stone, and the intensity of “glare,” are not such as to necessitate sun-glasses for the ordinary infantryman, but these may be necessary after administration of atropine. The headgear should have a good peak. For night vision to be at its optimum, a man should wear tinted lenses (particularly red) during daylight hours. With long periods of driving it may be sufficient to give a coat of green paint to the top of the windscreen, but with exposure to wind or sand, especially in convoy, efficient all-purpose goggles are required (with untinted lenses for night). A piece of cloth or handkerchief is sufficient protection for the nose. Ordinary tinted glass (or perspex) lenses are no safeguard against the direct sun exposure (retinal burn) of sky-scanning, and will give no protection against the much greater atomic flash at distances where the man is otherwise unhurt. There is no way out of the mirage phenomenon. Jungle fighting by day is reminiscent of night operations, for light intensity is low and
visibility limited. The soldier must rapidly develop the jungle eye—look through and ahead—and easily recognise hand signals. Smell sensation may be important. It is the ear, however, which becomes the important sense organ for the man must learn to listen, to discriminate natural and code sounds, and to use the whispered voice effectively. The ear should be protected from loud noises of gun fire but otherwise uncovered by headgear.° In a climatic chamber, a high Corrected Effective Temperature (80°F. or more) is said to impair the efficiency of psycho-motor tasks, and the same may be true of field conditions. In a fighting vehicle (with its “wild” armament fumes and heat) or in the radar or other control truck, the man may be much worse off inside than he is in the open. It may sometimes be necessary to introduce means of ventilating either the vehicle or the man.

CLOTHING AND EQUIPMENT

For physiological evaluation, the soldier’s clothing (normal and protective) and all his personal equipment are to be regarded as one. Clothing for the tropics should be streamlined, light, loose, absorptive and freely permeable to sweat and water vapour. Sweat retained at skin level will predispose to prickly heat. It is doubtful if there is any particular virtue in linen for a hot climate and, colour apart, there is little physiological difference of practical importance between garments required for jungle or desert. The problem of damp clothes in the jungle is not easy to answer, and dry spare garments must be carried by the man for wear at night. Heavy rain is best kept off by a separate light and very loose impermeable cape. A white cloth will be efficient in reflecting solar heat (or atomic flash), but like a metallic surface has camouflage and near infra-red detection disadvantages. The most suitable colour is some variant of well-tried khaki. Many surface treatments of fabrics (anti-flame, water- and insect-repellent etc. treatments) add little to heat load of garments. Starching, however, tends to close air interstices, makes the material harsh, and, in the hands of the local “dhobie,” may be a possible source of fungus infection.

The question of one- versus a two-piece garment for the tropics is frequently raised, but the better ventilation of the latter may be neutralised by a belt round the waist and the equipment on the back. Nevertheless, the soldiers’ belt has, in the past, supported the load, suspended the trousers and, perhaps, subconsciously raised his morale. The advantages of removing clothing from the chest, and the demands of nature, make the one-piece garment impracticable for the soldier. For similar reasons a bush-jacket may lose its advantages under operational conditions. The flame-proofing of cotton has, up to the present, a number of practical disadvantages, and for many reasons (including A.W. requirements) it may be wise at present to stick to the well-tried long-sleeved “woollen” shirt (but of pure wool) for tropical warfare. Men of the British Army are issued in the tropics with vest and drawers, but the former does not appear to be popular. Although objective physiological proof of the value of the Brynje or string vest (for hot or cold conditions) has never been forthcoming, recent trials have shown that a soft garment of this sort might add to comfort in
the tropics and, as a “spacer,” protect against atomic radiant heat. There is no agreement as to the value of drawers, but in the presence of prickly heat or skin infection (and with the possibility of diarrhoea), they help to keep the dirty or infected trousers off the skin. Underclothes are also more likely to be frequently washed. Friction in the buttocks, may, perhaps, be minimised by elimination of the back seam of drawers. It is considered that continuous filament non-absorptive nylon or terylene is not suited for tropical underclothing. Shorts are traditional in the British Army, but if used should be wider as formerly worn by officers of the Indian Army. They are not worn on jungle manoeuvres, for the skin must be protected against mechanical injuries, thorns, leeches and insects. In future warfare their use may be prohibited. The soldier requires a “cool head” but for this a topee is no longer necessary.

Footgear should protect against hot ground of the desert and the entry of leeches in the jungle. Because a pound on the sole is equivalent to two to three pounds on the back, the weight of a boot must be a consideration (8). A considerable body of data shows that the virtue of leather lies in its ability to take up sweat rather than its so-called ability to “breathe,” that is to allow skin water vapour to pass out. On the other hand, leather absorbs water from without and rapidly deteriorates in the jungle. Preliminary trials have shown that the “improved G.S. boots” (pre-moulded composition soles and leak-proof) are both warmer in the cold and cooler in the desert than the conventional G.S. item. This is due, apparently, to the removable “ventilating” insole. It appears that neither an impermeable sole nor unshrinkable, sterilisable socks of 100 per cent nylon or terylene (of the same colour and weave as the G.S. socks) decreased foot comfort or increased “foot-rot” in men marching in the desert during a several weeks’ trial. The present canvas jungle boot would be improved by being modified to take a removable insole. Whenever possible men should get their feet washed, dried and powdered and put into a good sandal or “chapli.” This may be a useful prophylaxis against fungus infection. Men are no longer punished for not wearing a topee, but it is disquieting that the British soldier has sometimes preferred the beret, cap comforter, or jungle hat to the ballistic protection of a steel helmet. There are three factors to be considered; the morale value of the beret, the likelihood of being hit, and the discomfort and other disadvantages of an unstable steel helmet—particularly in the jungle. The combination of regional lightweight armour with the load carriage equipment has its possibilities. Completely impermeable garments will be necessary for chemical warfare protection or for men working with toxic propellants, etc., under tropical conditions. The necessary cooling may be obtained by an added wetted porous exterior or by artificial ventilation using cooled or dried ambient air.

CONCLUSION

Physiology and personal hygiene of hot climates are to be considered in relationship to the ecological and operational environments in which the soldier finds himself. There is a blurred zone between the physiology and psychology of...
tropical exposure, and between these and heat disorders. The relative value of artificial acclimatisation and indoctrination is worthy of study. The present attitude to drinking water cannot be improved, and no longer are salt tablets administered as a drill. Extra salt is probably no guarantee against heat disorders and may in some men aggravate prickly heat. More important than extra salt are good personal hygiene and high morale. Research on tropical clothing is continuing, but serious thought should be given to the weight of the infantry jungle load. If past lessons are not to be forgotten, a still closer link must be maintained between the disciplines of Army Health, Applied Physiology, Service Psychology and Military Medicine.

REFERENCES

INCIDENCE OF ABNORMALITIES OF THE TOE CLEFTS AMONG BRITISH TROOPS IN MALAYA

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During the period October, 1956 to July, 1957, a random sample of 1,000 men were inspected for abnormalities of the toe clefts. These included scaling, maceration, fissuring and vesicle formation, either singly or in association. The term tinea pedis cannot correctly be used, as microscopic confirmation of the presence of fungus could not be made under the circumstances. The lesions were, however, situated in what could be regarded as likely sites of fungus infection, and this would no doubt have been confirmed in many cases had the examination of scrapings been practicable.

The sample was composed as follows:

R.A.C. ... ... ... ... ... ... 204
Infantry and airborne troops ... ... ... ... 478
Others (R. Sigs., R.A.S.C., R.A.M.C., R.A.O.C., etc.) ... 318