

when for unknown reasons free sweating suddenly stops. At such high temperatures coma appears and death may be imminent. Emergency measures are required to reduce the excessive body temperature by cooling quickly to avoid irreparable damage to the brain¹⁶.

The deleterious physiologic effects of high temperatures exert a powerful influence upon physical activity, accidents, sickness and mortality. Both laboratory and field data show that physical work in warm atmospheres is a great effort, and that production falls progressively as the temperature rises.

ACCLIMATIZATION

When men move to deserts or to jungles some adaptation to the climate takes place. If work is gradually increased day by day and if the men can get plenty of water and salt, and can sleep each night, acclimatization may be complete in 7 to 10 days. The acclimatized man works with a lower heart rate, lower skin and rectal temperature, and more stable blood pressure than when unacclimatized. The process of acclimatization requires work in the heat¹⁷. During the recent war white troops lived and did hard physical work for long periods in tropical conditions when disease hazards were controlled.

In recent tests made at the A.S.H.V.E. Research Laboratory¹⁸, subjects were required to perform light work under very hot conditions for a 4-hr period each day. It was found that the ability of a new subject to endure these conditions showed daily improvement for a period of at least 2 weeks. However, after acclimatization was completed, a recess of several days had no effect on the endurance of the subject. Individuals differ widely in their capacity to acclimatize. Acclimatized men lose these capacities in a few weeks of temperate climate, even though they are vigorously active. Acclimatization to dry heat increases the capacity to sweat and to conserve salt by secreting a dilute sweat¹⁹.

Deterioration of performance and other ill effects of heat may arise during prolonged exposure to heat when men cannot get sufficient rest and sleep each day. Acclimatization to extreme conditions involves a strain upon the heat regulating system and interferes with the normal physiologic functions of the human body. Thousands of years in the heat of Africa do not seem to have acclimatized the Negro to a temperature exceeding 80 F. The same holds true of northern races with respect to cold, although the effects are mitigated by artificial control. Some persons regard the unnecessary endurance of cold as a virtue. They believe that the human organism can adapt itself to a wide range of air conditions with no apparent discomfort or injury to health. In the light of present knowledge of air conditioning these views are not justified.

The adaptive level changes somewhat with the season. There are also marked differences between the sexes. In the cold zone the thickness of thermal insulating tissues of women is almost double that of men, although the sensory responses to cold are similar. In the hot zone, the threshold of sweating is higher for women. The thickness and insulating value of the clothing worn are also important factors in the determination of the comfort level.

UPPER LIMITS OF HEAT FOR MEN AT WORK

In very hot conditions humidity is the limiting factor and the wet-bulb temperature assumes great importance. In 1905 Haldane recognized that

TABLE 3. UPPER LIMITS OF ENVIRONMENTAL CONDITIONS FOR ACCLIMATIZED, HEALTHY, YOUNG MEN IN MILITARY SERVICE

ENVIRONMENT	REACTIONS AT THE END OF 4 HR	
	Rectal Temp F	Pulse rate
Relatively Easy.....	Below 101	Below 130
Difficult.....	101 to 102	130 to 145
Impossible.....	Above 102	Over 145

88 F wet-bulb was the limit of endurance for coal miners and later observers have concurred.

A study was made at the Armored Medical Research Laboratory²⁰ to determine the upper limits of environmental conditions under which a man can perform certain work. Thirteen enlisted men, thoroughly acclimatized to the hot conditions, served as subjects. During each test, the subjects were required to march for 4 hr at the rate of 3 mph, carrying 20 lb packs under a wide range of environmental conditions which were rated as relatively easy, difficult, and impossible, on the basis of the physiological reactions of the subjects at the end of the 4-hr period as shown in Table 3 and Fig. 3.

Recognition of the need of air conditioning for workers in hot industries is growing rapidly. The choice of the type of system to be used in any given instance must be determined by the air conditioning engineer after a study of conditions. In some hot industries where few workers are engaged in large spaces the worker himself, rather than the atmosphere, can be cooled by placing him in a small booth, and blowing cooled air over him, or by circulating cooled air through a loose-fitting suit²¹.

The A.S.H.V.E. Laboratory has studied the effects of walls of higher temperature than the air¹⁸. The findings are in part shown in Fig. 4. Mean radiant temperatures up to 40 deg above the dry-bulb did not influence physiologic processes much. For example, at 84 deg ET and 40 deg elevation in MRT, 1 deg ET change was equivalent to a 4 deg rise in MRT. Similarly, at a constant ET of 90 deg and with MRT elevations of 0 and 40 deg, 1 deg increase in ET was equivalent to 7.5 deg and 11 deg rise in MRT respectively. Under ordinary *still air* conditions the effects of air temperature and MRT appear to be interdependent. Various au-

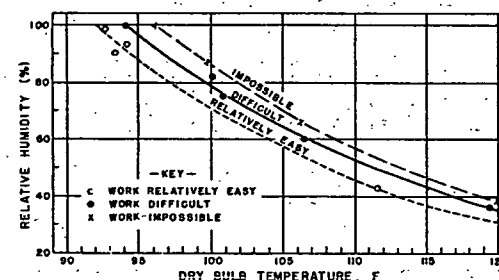


FIG. 3. HEAT ENDURANCE OF ACCLIMATIZED SUBJECTS WORKING AT A SPECIFIC RATE²⁰