of the fingers and that this low temperature of the fingers persisted for one hour after the ice pack was removed.

ADAPTATION TO ENVIRONMENTAL CONDITIONS

As stated previously, the optimum environmental conditions for comfort are those under which the body can maintain complete thermal equilibrium with only minor adjustments in blood distribution. As conditions depart from the optimum, more drastic adjustments are made by the body in its attempt to maintain equilibrium, and the sensation of comfort gives way to one of increasing discomfort. If conditions are too severe, adequate adjustments may be impossible, and prolonged exposure may result in serious injury or death.

In a cold environment the blood vessels leading to the surface are constricted, thus decreasing the flow of blood and heat to the skin, and reducing the radiation and convection losses from it. If this adjustment is insufficient, an involuntary muscular activity (shivering) takes place which increases the metabolism. The range over which these physiological controls are effective is rather narrow, and man's existence in cold climates is dependent upon his ability to provide himself with heated living quarters and warm clothes.

During the last few years extensive research has been carried on by and for the armed services of the United Nations to determine the proper types and amounts of clothing for a wide range of conditions. The results of these studies are now being released and should add greatly to our knowledge on the subject.

As man's environment changes from cool or comfortable to warm, the body first attempts to adjust to the new conditions by a redistribution of the blood circulation. Blood capillaries near the surface become dilated, allowing more blood to flow to the skin, thus raising the skin temperature and increasing the radiation and convection losses from the body. If this correction proves inadequate, the stimulus is extended to the sweat glands which cause progressively greater portions of the body area to become moist or wet as conditions become more severe. The evaporation of this moisture from the body surface provides the body with its most effective method of cooling, but even this fails when the dew-point temperature of the air becomes so high that rapid evaporation is no longer possible. Although the body is able, by evaporative cooling, to maintain complete thermal balance under conditions of moderate excess, it does so only at the cost of considerable discomfort.

Studies at the *John B. Pierce Laboratory of Hygiene* [13] have indicated the relation between discomfort and the degree of wetting of the body surface by perspiration for lightly clothed subjects in a semi-reclining position, and the investigators there have designated this as the *zone of evaporative regulation*. The relation between sensible perspiration and the atmospheric environment for normal persons at rest and at work has been determined at the A.S.H.V.E. Research Laboratory [10].

HIGH TEMPERATURE HAZARDS

Studies at the A.S.H.V.E. Research Laboratory [14] and elsewhere [15] during the past two decades have made available a mass of information dealing with the physiological effects of hot atmospheres on workers and means of alleviating the distress and hazards associated therewith. This

interest has been termed *air conditioning in industry*, or *the effects of hot atmospheres in industrial hygiene*, and is a growing factor in air conditioning applications. Table 2 gives some of the physiological responses of men at rest and at work, to hot environments. Physiological studies [16] indicate that frequent and continued exposure of workers to hot environments results in physiological derangement affecting the leucocyte count of the blood, and other factors dealing with man's mechanism of defense against infection.

In hot environments the blood is diverted from the internal organs to the surface capillaries, in order to serve in the process of cooling. This affects the stomach, heart, lungs and other vital organs, and it is suggested that the feeling of lassitude and discomfort experienced is due in part to the anaemic condition of the brain. The stomach loses some of its power

TABLE 2. PHYSIOLOGICAL RESPONSES TO HEAT OF MEN AT REST AND AT WORK [a]

Effective Temp	Actual Cheek Temp (Fahr Deg)	Men at Rest			Men at Work 90,000 ft-lb of Work per Hour			
		Rise in Rectal Temp (Fahr Deg per Hr)	Increase in Pulse Rate (Beats per Min per Hr)	Approximate Loss in Body Weight by Perspiration (Lb per Hr)	Total Work Accomplished (Ft-Lb)	Rise in Body Temp (Fahr Deg per Hr)	Increase in Pulse Rate (Beats per Min per Hr)	Approximate Loss in Body Wt by Perspiration (Lb per Hr)
60	.....	.....	.....	.....	225,000	0.0	6	0.5
70	.....	0.0	0	0.2	225,000	0.1	7	0.6
80	96.1	0.0	0	0.3	209,000	0.3	11	0.8
85	96.6	0.1	1	0.4	190,000	0.6	17	1.1
90	97.0	0.3	4	0.5	153,000	1.2	31	1.5
95	97.6	0.9	15	0.9	102,000	2.3	61	2.0
100	99.6	2.2	40	1.7	67,000	4.0[b]	103[b]	2.7[b]
105	104.7	4.0	83	2.7	49,000	6.0[b]	158[b]	3.5[b]
110	.....	5.9[b]	137[b]	4.0[b]	37,000	8.5[b]	237[b]	4.4[b]

[a] Data by A.S.H.V.E. Research Laboratory.
[b] Computed value from exposures lasting less than one hour.

to act upon the food, owing to a diminished secretion of gastric juice, and there is a corresponding loss in the antiseptic and antifermentive action which favors the growth of bacteria in the intestinal tract [17]. These are considered to be the potent factors in the increased susceptibility to gastro-intestinal disorders in hot summer weather.

In warm atmospheres, particularly during physical work, a considerable amount of chloride is lost from the system through sweating. The loss of this substance may cause excessive fatigue, or may lead to attacks of cramps, unless the salts are replaced. In order to relieve both cramps and fatigue, it is recommended that salt tablets be taken, or that sufficient salt be added to the drinking water to provide a $^1/_{10}$ of 1 per cent saline solution [18].

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. The incidence of industrial accidents reaches a minimum at about 68 F, increasing above and below that temperature. Sickness and mortality rates increase progressively as the temperature rises.

Diseases due to heat are now classified as heat exhaustion, heat cramps,