MEETING REPORT

Arid Lands: Environmental Physiology and Psychology

The effect of environmental factors in arid zones on the functioning of man's body and mind was the main theme of a symposium sponsored by UNESCO and the Central Drug Research Institute of India, at Lucknow, 7–13 December 1962. Over 50 scientists from 13 countries participated.

A session on the influence of environmental factors specifically considered only solar radiation, methods of measuring its incidence upon a man, and some ways for assessing the physiological significance of radiative heat exchange. The methods, however, are related to specific on-the-spot measurements, and do not indicate how meteorological data may be used to assess the radiative load and its significance for areas and periods of time in which special measurements are not possible. If we are to make valid generalizations, and that is at least one objective of science, we need methods for predicting the probable reaction of men to meteorological conditions as well as point data on the radiative environment. Whereas systematic observations of the incidence of solar radiation are still sparse, approximations can be made from astronomical data and records of cloud cover or hours of sunshine.

In spite of nearly 60 years of work since Haldane published his paper on Cornish tin miners, the subject of performance and comfort standards is in a very unsatisfactory state. In the range of conditions where "comfort" and "discomfort" still have meaning, there is very little in the way of physiological response to measure. French workers have found changes in the electroencephalogram, but unless these changes turn out to be more widespread, few quantitative measures other than correlations of subjects' responses to questions on sensations are available. Unfortunately, the technique of questioning and the conditions of questioning are far from standardized. Under great stress measurable responses do appear, but they constitute no more than partial glimpses of the fundamental strains developing in the subjects' tissues. Correlations of responses with environmental conditions have been largely limited to simple, stable laboratory conditions, and there is no

satisfactory way of applying these correlations to the fluctuating and unstable environments of the field, or, for that matter, of using them with meteorological data. The equations of heat transfer used are extremely crude and take no account of even first-order variations, such as differences in curvature of different parts of the body, transient conditions, or change in physical parameters over a range of temperatures. There is little more than empiricism to guide us in selecting the duration and environmental conditions desirable for breaks in work under hot conditions.

It is now well established that the chloride loss in sweat is low in acclimatized persons and that chloride is replaced by a normally constituted diet, even though the rapidity of adjustment may be delayed by a high chloride diet. The role of aldosterone in the maintenance of the ratio of sodium to potassium and the water balance is becoming clearer, although some details remain unresolved. The role of the catechol amines in human sweat production is still somewhat uncertain. Although alkalosis can be produced readily in chamber experiments, its incidence and magnitude in free living are not certainly known. We do not know what factors govern the level of blood chloride concentration at which symptoms of hypochloremia appear; nor are we certain what the consequences to a normal individual will be of a continued unnecessary addition of salt to a normal diet.

Dehydration and starvation both invoke some compensatory reactions which mitigate, to some extent, the severity of effects upon bodily function. Dehydration increases nitrogen excretion in the urine and thus tends to increase the effects of any accompanying starvation. Starvation, on the other hand, by decreasing the water requirements for urinary excretion, may help to decrease the effects of dehydration. Much work remains to be done before satisfactory practical guides for the management of restricted food and water supplies can be given.

In neurophysiology, attention is now focused on the limbic and reticular systems, which participate in heat regulation. The introduction of cybernetic concepts has sharpened discussion on modes of control and the interplay of nervous loops, although the jargon at times obscures matters for the nonspecialist. It would seem that some of the energy spent in discussing whether

central or peripheral thermoreceptors predominate would be better employed in determining the details of their interaction. It would be surprising indeed if the excellently placed peripheral receptors did not act as an early warning on external situations and if the internal receptors did not act as a warning system for changes in metabolic heat or in presenting after-the-fact information on regulatory inadequacies.

The exciting pioneer fringe of adaptation studies is in psychology. Available methods may still be inadequate, but it may be better to use less precise methods to study an obvious deficiency in knowledge than to refine a well known concept with precise tools. It is clear, even from preliminary results, that acculturation is a dominant factor in determining the psychological and psycho-motor responses of indigenous groups. Methods are being developed for the study of attitude and motivation in their relation to performance, and they should be applied to the problems of adaptation to stressful environments. It is time to set such studies up on a systematic basis, particularly with regard to the adaptation of primitive and isolated groups to desert environments. There is room for considerable improvement in measures of performance and in the standardization of conditions for their application. On the subject of neurasthenia, the adjective "tropical" may be added to the noun "neurasthena" if the intent is to indicate that a tropical environment provided the trigger factors; but it should not be taken to suggest that the resultant mental disturbance is of an essentially different kind.

It is becoming increasingly apparent that cultural and personal experience factors have an over-riding effect on adaptation of the individual, and that in the morphological realm the phenotypic is often more important than the genotypic character. The significance of surface area, as a determinant of heat loss, seems to have lost some of its appeal. Such differences in heat exchange possibilities as may be brought about by differences in surface area seem to be lost in the other and greater variables of heat balance. In the anthropological as in the psychological realm, and certainly to be coordinated with them, studies are urgently required on primitive and isolated groups exposed to stressful desert environments. In particular, those measurable characteristics which throw light on metabolic

processes, such as blood protein fractions, blood enzymes, and cytological functions, should be carefully studied. Changes in the thermal efficiency of energy transfer may be just as important to adaptation as differences in the opportunities for heat loss.

The now common plea was reiterated that the distribution of disease in a particular type of environment, such as that of the arid zone, should be studied in full ecological detail, and not merely as an exercise in simple correlation with a few easily recognized climatic factors. Evidence was produced to support the contention, often ignored, that cessation of sweating may be a sufficient but is not a necessary prologue to heat stroke. Severe physical work may, under appropriate motivational conditions, push the body beyond its physiological limits. In such cases cessation of sweating may occur later as part of a runaway breakdown. A plea was made for distinguishing between true heat cramps following on a marked reduction of blood chloride concentration, and muscle cramps appearing as part of a circulatory failure in heat exhaustion.

While the gross physiological reactions of various species of animals are fairly well established, the variation within species and breeds has seldom been investigated. Any attempt to characterize the reactions of a group tends to be vitiated by nonstandardization of very influential factors, such as the nutrition of the animals examined. The full potentialities of an individual are unlikely to be revealed unless the animal is in full, including nutritional, health. Over-nutrition, on the other hand, may detract from heat tolerance. Argument from one species to another is fraught with danger. Not only in such directly influential factors as the presence and functional capacity of sweat glands, but also in such pervasive regulators as endocrine reactions, species vary extremely from one another. One study revealed that at least one species may lay down fat at the time that it is experiencing dehydration. This seems to present an interesting converse to the demonstration that, in response to dietary restriction, water may be stored as fat is removed. It is high time that studies of "heat tolerance" were carried out under strictly standardized conditions, with collateral studies investigating in each group the effect, within that group, of deviations from the standard conditions. Until this is done, knowledge will re-

main fragmentary and uncoordinated.

The proceedings will appear as a volume of the Arid Zone Research Series. Background papers on modification of drug action by heat, physiological anthropology, role of the kidney in arid and semiarid zones, circulatory adjustments, endocrine functions, work, sleep, and comfort, tropical neurasthenia, and field test methods were precirculated and will appear as a separate volume already in press.

DOUGLAS H. K. LEE
Occupational Health Research and Training Facility, U.S. Department of Health, Education, and Welfare, Cincinnati 2, Ohio

Forthcoming Events

June

26–29. National Soc. of **Professional Engineers**, Cleveland, Ohio. (P. H. Robbins, 2029 K St., NW, Washington 6, D.C.)

28–1. **Psychosomatic Approach to Chronic Illness**, congr., Chamonix, France. (French Soc. of Psychosomatic Medicine, 15, rue Santerre, Paris 12)

July

1–2. Occupational **Safety and Health** Information Center, Lucerne, Switzerland. (L. Wildman, Intern. Social Security Assoc., 154 rue de Lausanne, Geneva, Switzerland)

1–5. New **Nuclear Materials Technology**, conf., Vienna, Austria. (Intern. Atomic Energy Agency, 11 Kärntner Ring, Vienna)

1–5. **Nobel Prize** Winners, 13th meeting, Lindau im Bodensee, Germany. (H. Kiderlen, Uferstr. 65a, Nonnehorn, Lindau im Bodensee)

1–5. **Operations Research,** intern. conf., Oslo, Norway. (F.O. Falch, P.O. Box 90, Lysaker, Norway)

1–5. **Macromolecular Chemistry**, intern. symp. Paris, France. (Secretariat, Laboratoire de Chimie Physique, 11 rue Pierre Curie, Paris 5)

1–6. Conference on the Control of **Cell Division** and Induction of Cancer, Cali, Colombia. (A. Hollaender, Oak Ridge Natl. Laboratory, P.O. Box Y, Oak Ridge, Tenn.)

1–7. International **Dental Federation**, 51st intern. meeting, Stockholm, Sweden. (T. Telander, Sveavägen 52, Stockholm)

1–13. **Brain Gland** System, intern. conf. on structure and function, Amsterdam, Netherlands. (Director, Netherlands Central Inst. for Brain Research, Mauritskade 59B, Amsterdam 0)

2–4. **Cellular Injury**, Ciba Foundation symp. (invitation only), London, (Ciba Foundation, 4 Portland Pl., London, W.1)

2–5. **Free Radicals**, 6th intern. symp., Cambridge, England. (A. B. Callear, Dept. of Physical Chemistry, Univ. of Cambridge, Lensfield, Cambridge)

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