ONE HUNDRED AND SIXTEENTH SCIENTIFIC MEETING
FIFTY-SECOND SCOTTISH MEETING
HANNAH DAIRY RESEARCH INSTITUTE, KIRKHILL, AYR

26 APRIL 1958

NUTRITION AND CLIMATIC STRESS

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Chairman's introductory remarks: the assessment of climate

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In any consideration of the effects of climate upon nutritional requirements one clearly needs some index of climate with which to correlate the food requirements.

The type of index required may depend on the kind of investigation in which it is to be used. I am not conversant with nutritional surveys, and I therefore write with diffidence. But it seems possible that for some purposes a simple classification such as the one that has been advocated for use in deciding upon military-clothing requirements might be adequate (Lee & Lemons, 1949). Seven zones are disguished: (1) tropical zone, defined roughly by the parallels of 20°N and 20°S; (2) semi-tropical zone, in which the mean temperature during the coldest month is between 50°F. and 68°F.; (3) temperate zone I, with mean monthly temperatures ranging from 32°F. to more than 68°F.; (4) temperate zone II, with a range from 32°F. to 68°F.; (5) temperate zone III, with a range from below 32°F. to more than 68°F.; (6) temperate zone IV, with a range of 14°F. to 68°F.; (7) Arctic zone (including the Antarctic as well as the commonly recognized Arctic and Subarctic regions), where the temperatures of the coldest months average below 14°F.

If the needs of large populations spread over large areas are being considered, such a scale may suffice. Indeed, I can imagine that the precision with which the average energy expenditure, and even the food consumption, can be expressed might not warrant the use of a more precise measure of climate.

I think it is when an intensive survey of a relatively small population is being made that more precise measurements of climate may be desired.

Let me remind you that if any thermal environment is to be completely specified, account must be taken not only of the dry-bulb temperature of the air, but also of the atmospheric humidity, the wind speed, and the radiation from the surroundings. Indoors, these surroundings are the walls, fires or other surfaces which radiate towards the point of observation. Out of doors, radiation is received from the sun, the sky and the terrain.

The measurement of the atmospheric conditions—temperature, humidity, and air speed—presents no great difficulty. Suitable instruments for measurements

out of doors have long been in use at meteorological stations, and for measurements indoors a variety of instruments is available.

Measurement of radiant heat

The major difficulty arises in connexion with the assessment of thermal radiation, especially out of doors.

Indoors, where conditions are commonly fairly stable, one can generally measure the radiation with suitable accuracy by using a globe thermometer (Vernon, 1930, 1932; Bedford & Warner, 1934). This is a hollow copper sphere, 6 in. in diameter, coated with matt black paint, and containing a mercury-in-glass thermometer with its bulb at the centre of the sphere. A thermocouple can be used instead of the thermometer if desired. The reading of this instrument is affected by the temperature and speed of movement of the air, as well as by the incident radiation, so that measurements of temperature and air speed should be made at the same time that the reading of the globe thermometer is observed. Details of the use of this instrument are given elsewhere (Bedford, 1946).

In connexion with the measurement of radiant heat out of doors, it is interesting to recall that Aitken (1884, 1887) used a globe thermometer for meteorological purposes over 70 years ago, but he used it to obtain an indication of the combined effects of solar radiation and wind.

The great difficulty in using the globe thermometer for the separate assessment of radiation out of doors is the variability of conditions. Even if the sun does not become obscured by cloud during an observation, the wind speed is likely to vary substantially, and it may therefore be hazardous to place much reliance on the computed radiation figure. Furthermore, though with radiation of long wavelength such as occurs indoors the colour of the receiver is immaterial, with solar radiation colour has a notable effect. If one wished to use a globe thermometer to assess the radiation exposure of people wearing white or light-coloured clothing, an instrument of suitable colour would be desirable.

Hardy and his colleagues in America have reported encouraging results. Using the pan-radiometer they have been able to measure the total radiation out of doors, and to subdivide it into (a) solar radiation, and (b) radiation from the sky and terrain (Richards, Stoll & Hardy, 1951). It seems very probable that these new instruments will be of wide use in the assessment of radiation out of doors.

Indices of warmth

If nutritional needs are to be correlated with climate so as to take count of the four factors I have mentioned, calculations are likely to be laborious and complicated. It would clearly be of great advantage if some scale of warmth were available by means of which the overall warmth of the environment could be expressed in a single figure, due weight being given to each of the four component factors.

From time to time various attempts have been made to devise such scales. Latterly, indices of heat stress, which also make allowance for the rate of heat production of

the individual, have been proposed and used, but I imagine that for the purposes of the nutritionist an index of warmth only will be preferable.

For the assessment of the indoor climate the so-called corrected effective temperature (Bedford, 1946) is probably the index of choice. There are two scales, the 'basic' scale, which applies to persons stripped to the waist, and the 'normal' scale, which is applicable to persons wearing light indoor clothing. For most purposes the normal scale will probably be preferred, if one is concerned primarily with indoor conditions.

With reference to outside conditions I have already mentioned the difficulty of assessing the radiation exposure. Over the range of conditions to which it applies (saturated air at 30–110°F., or unsaturated air up to 120°F., with wind speeds up to 700 ft./min) the original scale of effective temperature (i.e. with no specific allowance for radiant heat) can probably be used as an index of the atmospheric conditions, and it will then be necessary to take radiation into account as a separate variable. It should be noted, however, that the maximum wind speed covered by the scale is only 8 m.p.h., and for higher speeds it would be necessary to extrapolate beyond the speeds covered in the original experiments on which the scale was based.

I do not think there is available another scale for outdoor conditions in hot or temperate climates that has been soundly based on physiological experiments. For use in cold climates Siple's wind-chill index (Siple, 1949; Siple & Passel, 1945) appears to have much to commend it, but it does not allow for radiation.

Throughout these remarks I have referred to the indoor as well as the outdoor climate. In any populated area, hot, cold or temperate, many people spend much time indoors. If a climatic survey is to give results which will indicate the overall thermal exposure of a section of the population, it would seem necessary to have information about the conditions encountered indoors as well as out of doors. The diurnal as well as the seasonal variations of climate should also be known.

The full appraisal of climate is obviously difficult, and the correlation of such appraisals with nutritional requirements will not be easy. Though I am in favour of such precision of measurement as is obtainable, I am left wondering whether for some time to come it will be practicable to go much further than the use of a classification of climates such as the one I mentioned at the outset.

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