

MODIFICATION OF VERNON'S GLOBE THERMOMETER **AND** ITS CALIBRATION IN TERMS  
OF PHYSIOLOGICAL STRAIN

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Ten young healthy men served as volunteers in more than 400 climatic chamber experiments carried out to investigate the suitability of VERNON's globe thermometer for evaluating a physiologically equivalent combination of unequal air and radiant temperatures and for developing a modification of this measuring instrument.

In about 200 experiments some of the nearly nude test subjects performed 3 h treadmill work (oxygen uptake about 0.8 l/min) exposed to either equal air and radiant temperatures (= reference temperatures, range 25-50°C) or to air temperatures stepwise lowered up to 5°C combined with all round radiant temperatures stepwise increased up to 81°C. All combinations were chosen in such a way that VERNON's globe temperature remained equal to the respective reference temperature. The experiments revealed significant decreases in body temperature, heart rate and sweat loss when air temperature was lowered and radiant temperature increased correspondingly. This means that VERNON's globe thermometer overestimated heat radiation and underestimated heat loss by convection as compared with the human body.

In a following series the subjects performed similar experiments in lowered air temperatures, but at globe temperatures stepwise superelevated until the physiological responses became equal to those measured at reference temperatures. These results enabled the derivation of physiologically equivalent combinations of air temperatures and globe temperatures. Subsequent technical measurements showed that among 20 other modifications, particularly a black globe with 65 mm diameter instead of 150 mm of the original instrument of VERNON reached fairly equal temperatures under equivalent combinations mentioned above, at air speed of 0.5 m/s as well as at 2 m/s.

These findings were examined in about 100 further physiological experiments. Some subjects worked at lowered air temperatures and increased radiant temperatures resulting in equal temperatures of the modified globe thermometer. The remaining error of this instrument due to the variation of air speed between 0.5 and 2 m/s which had to be expected according to the technical measurements was 25 % of the error of VERNON's instrument.

A limited number of about 80 additional experiments indicated that the modified instrument was superior also when unidirectional instead of all round heat radiation was used. This seems to apply also to subjects performing heavier physical work or wearing usual working clothes.