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MICROCLIMATIC STUDY, II A NEW TYPE THERMOJUNCTION FOR MICROCLIMATIC USE

BY

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1. Introduction

Upon microclimatic temperature measurement a radiation shield is of general use to be free from radiation error, the use of such, however, may affect the microclimatic state under observation to deviate from the natural state. It would not be without any effect upon temperature of a few millimetres air layer, even if an extremely small type shield should be employed to restrict the shade as small as possible. As it is well known, the controlling factors of the microclimatic state are the thermal economy at the earth's surface and the degree of turbulence in the adjacent air layer, these two factors must not be affected by measurement itself. Accordingly, only the smallest number of apparatus should be set up near the measuring portion. Thus a method of removal of radiation error without using shield in the measuring portion is considered in the following discussion.

2. A compensated thermojunction

In addition to the measuring element J_1 and cold element J_2 , as indicated in the diagram, another compensating elements named J_3 and J_4 are employed. All the elements except J_1 are set at a distance from the measuring portion so that the general microclimatic state should remain undisturbed. All the elements are constructed in the same form and the compensating elements should be placed very close to each other, J_4 , one of them, having small shine cover. Then J_3 and J_4 are in the same temperature and only J_3 receives the solar radiation, and the E. M. F. between J_3 and J_4 is due to the rise of temperature by solar radiation. This compensates the E. M. F. introduced by similar solar radiation between J_1 and J_2 , showing now only the air temperature of the measuring portion, that is $J_2 - J_1 - J_3 - J_4$.

3. A testing example

A testing example on the short cropped lawn is shown on Plate I, which is the measurement of air temperature at the layer almost touching the ground. In the Plate, (a) is the record by the new type compensated junction and (b) the record by usual thermojunction without radiation shield, (c) the record of E. M. F. on a pair of same shaped thermocouples, placed closely to each other and only one of them screened, that is $J_3 - J_4$.

These are simultaneous records and the wind velocity by hot-wire anemometer and solar energy by Gorczyński's solarimeter are added as references.

On this record, it is clearly shown that the uncompensated and exposed junction (b) received direct effect of solar radiation. This fact becomes more evident when

mean state is considered and the compensated junction shows true temperature even the measuring element exposed to sunshine.

TABLE 1.

	14 ^h 25 ^m —36 ^m	52 ^m —55 ^m
(a) $J_2 - J_1 - J_3 - J_4$	22.98°	22.51°
(b) $J_2 - J_1$	27.81	26.68
(b) - (a) (calculated)	4.83	4.17
(c) $J_3 - J_4$ (measured)	4.96	4.02

(showing mean values of every 10 readings respectively)

In these tests the writer used the relatively thick wires (0.25mm) to get the larger radiation effect. Usually thin wires less than 0.2mm in diameter are used and the error should be smaller than these values.

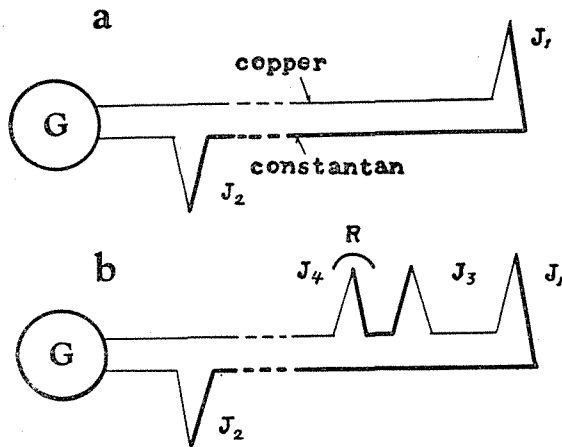


FIG. 1. Diagram of the thermojunction

a) Usual type

b) New type

J_1Measuring element

J_2Cold (constant) element

J_3 }.....Compensating element

J_4 }

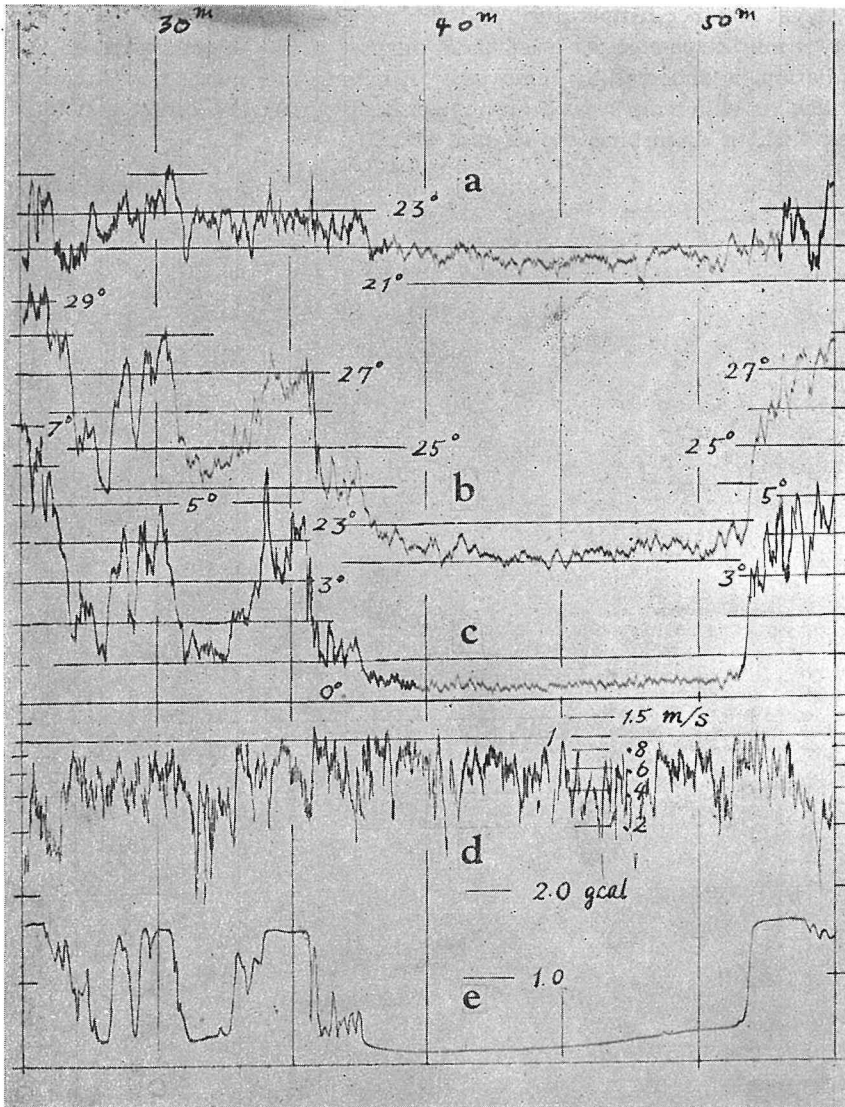
RRadiation shield

GGalvanometer

4. Remarks

It is evident that all the possible radiation including direct sunshine must be avoided to get the true temperature, and this may be accomplished in similar manner. However, it may be enough for the present purpose if the largest radiation, i. e., direct solar radiation, is successfully removed. Applying this method, the temperature of leaf surface or skin-temperature of human body under the direct sunshine can be measured without disturbing the natural state.

PLATE I



A testing example of the thermojunctions on the lawn of Met. Res. Inst., Kyoto Univ.
at 14^h25-55^m, 13 April, 1950. (Weather: calm, 3/10 Cu)

- a) Air temperature measured by the compensated thermojunction.
- b) Air temperature measured by the usual type thermojunction without radiation shield.
- c) The record of E. M. F. on the pair of same shaped thermocouples, one of them having been screened.
- d) Wind velocity measured by hot-wire anemometer.
- e) Solar radiation measured by Gorchynsky's solarimeter.