THE USE OF KATA-THERMOMETERS FOR THE MEASUREMENT OF EQUIVALENT TEMPERATURE.

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(With 1 Figure in the Text.)

(1) In the last few years considerable interest has been aroused in the use of radiant heating for warming schools, offices, factories and other buildings, and it has come to be felt that the traditional methods of determining the warmth of a room are not entirely satisfactory. The deficiencies became evident in the course of the investigations carried out by the Building Research Station and by the Industrial Health Research Board. A joint Committee of the Medical Research Council and the Department of Scientific and Industrial Research was therefore set up to review the physical criteria, physiological considerations and nomenclature involved, and to examine the possibility of adopting standard terminologies and methods of measurement.

This Committee has issued an interim report, a summary of which is published in the *Report of the Building Research Board* for the year 1931, and expressed the view that it is possible that some instrument might be used to give a correction-factor, for radiation effects, of readings taken with the kata-thermometer of the cooling power of an environment and that, in spite of the complication, this aspect merits further development. The Committee recommended that eupatheoscope readings should be taken as a basis for comparison of readings taken with such combinations of instruments.

It may be remarked here that the eupatheoscope is a physical instrument designed to measure and record a quantity analogous to the physiological sensation induced by a cool environment[1]. The instrument is essentially a black-painted cylinder at 75° F., the loss of heat from which is recorded and scaled in degrees of equivalent temperature, the equivalent temperature of an environment being defined as that temperature of a uniform enclosure in which, in still air, a sizable black body at 75° F. would lose heat at the same rate as in the environment.

(2) It appears that a correction for the excessive convection-loss of a kata-thermometer can be achieved by the use of a second kata-thermometer with a surface of different emissivity, and a pair of special kata-thermometers

[1] Dufton, A. F. The Equivalent Temperature of a room and its Measurement. Building Research Technical Paper No. 13. London, 1932, H.M. Stationery Office, price 6*d.* net.

constructed some years ago for this purpose have now been tested[1]. To ensure that the surface is at the same temperature as the thermometric liquid, the bulbs are made of copper with a very thin lining of glass (0·4 mm.) and the thermometers are filled with mercury. The surface of the bulb of one is blackened and that of the other is silvered. The thermometers are allowed to cool from 75½ to 74½° F. and the times are measured with a stop-watch.

A series of determinations in twelve widely different environmental conditions has been compared with the corresponding determinations of equivalent temperature made with a eupatheoscope and the observations have been correlated by means of the simple alignment-chart shown in Fig. 1. From the cooling times of the two thermometers this chart enables the equivalent temperature of the environment to be read at a glance.

Table I shows the cooling times for the twelve environments and the corresponding equivalent temperatures as read from the chart and as measured with a eupatheoscope.

Table I.

Environmental conditions			Cooling time		Equivalent temperature	
Air temperature °F.	Air velocity *ft./min.*	Radiant heating	Black *sec.*	Silver *sec.*	From chart °F.	By eupatheoscope °F.
56	250	On	12·9	11·8	46·6	45·7
44	0	Off	19·8	31·6	46·9	44·5
61	130	Off	19·6	24·6	49·5	50·6
56	160	On	15·6	14·6	50·0	50·8
59	130	Off	19·0	21·8	50·2	50·6
51	0	Off	27·0	43·5	53·0	51·7
57	130	On	22·2	19·8	56·8	57·5
67	130	Off	32·0	43·0	57·0	57·0
64	0	Off	64·5	99·0	63·0	64·3
64	200	On	34·8	24·2	64·6	65·0
51	0	On	46·5	34·0	65·5	64·8
72	250	Off	76·0	71·6	65·9	64·9

Although the environments were chosen with a view to the inclusion of extreme conditions, the probable error of a determination is less than 1° F. This must be regarded as highly satisfactory since the equivalent temperature is essentially determined as a cooling power extrapolated from those of the two kata-thermometers.

There is no doubt that alcohol-in-glass thermometers are more portable than the thermometers described above and the possibility of using them is now being considered.

(3) The comparative observations described above were made at the Home Office Museum, Horseferry Road, Westminster, where a specially designed building is equipped to reproduce unfavourable atmospheric conditons such as are experienced in various industries. The arrangements provide for ventilating the building by regulated air-movements and for heating by convection or radiation: widely differing conditions can be obtained.

[1] These kata-thermometers were described in *Phil. Mag.* 1930, **9**, 860; in the early attempt to use them, sufficiently extreme conditions, particularly of air-movement, were not examined.

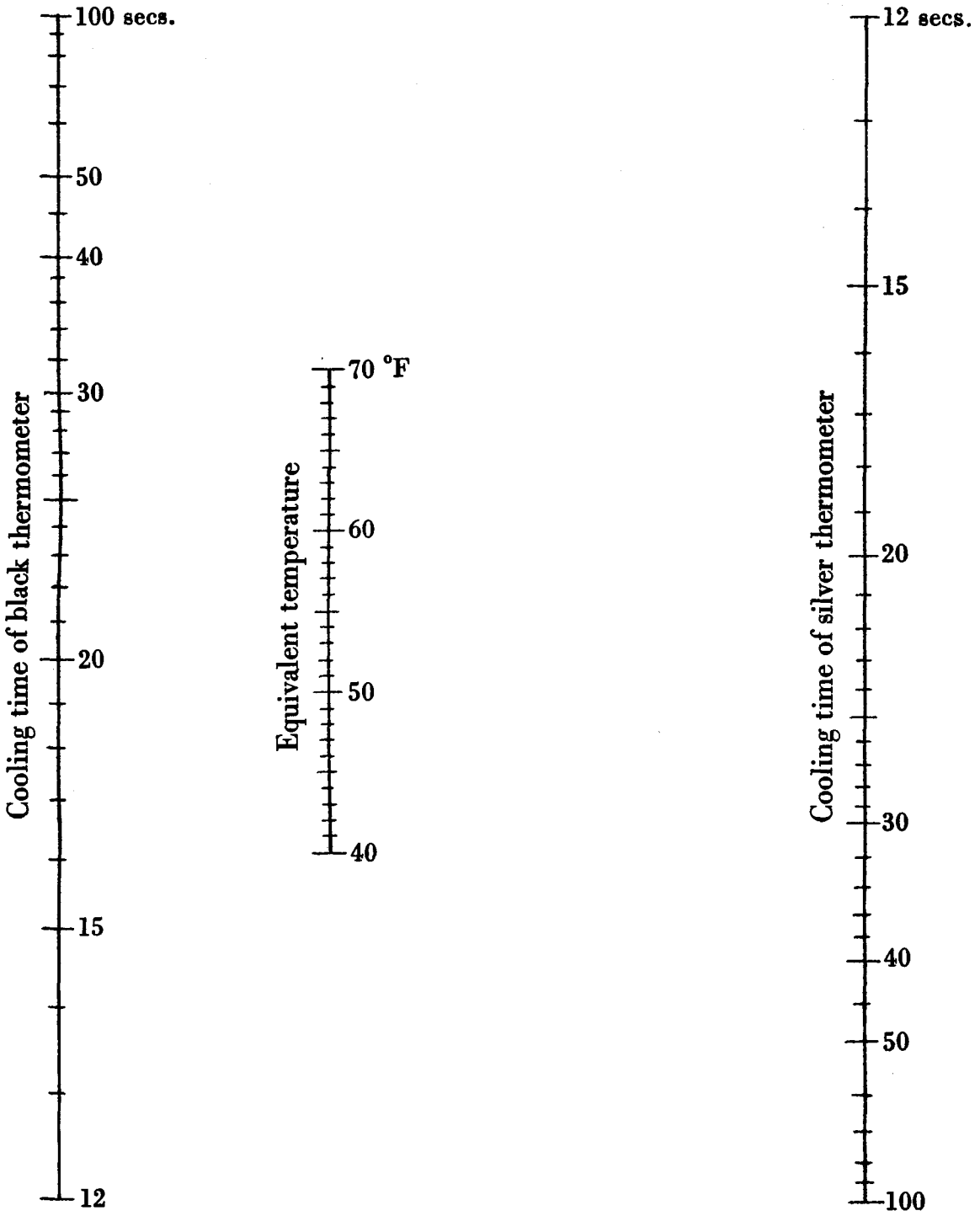

Fig. 1. Alignment chart for kata-thermometers.

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The building comprises a room 40 ft. long, 20 ft. wide and 8 ft. high, which is subdivided into three sections by two walls reaching from floor to ceiling but not extending the whole length of the room. At one end of the central corridor, which is designed to serve as an observation airway, is a large electrically driven fan. For heating the air, heaters taking a total input of 32 kilowatts are installed in the return airways and, for radiant heating, panel heaters taking a total input of 7 kilowatts are installed in the observation airway.

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