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AN INDEX OF COMFORT FOR LONDON

by

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Introduction

Previous papers by Stephenson[1], McLeod[2] and Watt[3] examined the climates of Singapore, Gan and Bahrain respectively from the point of view of human comfort, using effective temperatures (a combination of dry bulb and wet bulb temperatures and wind speed) from the scale devised by the American Society of Heating and Ventilating Engineers (S.H.V.E.)[4] and also published by the Air Ministry[5]. These papers should prove of great interest to staff likely to serve in tropical areas but it was felt that a better idea of the relative comfort of the various climates would be obtained if a similar investigation was made for London.

The three tropical climates were analysed by using mean monthly values of dry-bulb temperature, wet-bulb temperature and wind speed but since the mean monthly dry-bulb temperature in London does not exceed 64°F a different approach had to be made using daily rather than monthly values. The comfort zone of effective temperature in temperate regions is between 60 - 66°F in summer and 57 - 63°F in winter[5]. Excursions above the upper limit of the comfort zone (66°F effective temperature) occur for periods of a few hours rather than in prolonged spells of weeks or months and are extremely rare outside daylight hours.

Summary of data used

The observations made at the London Weather Centre (L.W.C. Victory House until 1959, Princes House until 1965, then Penderel House, High Holborn) were examined for the twenty years 1947 to 1966 inclusive. During most of this period temperatures were read in °F and throughout the period the corresponding figures in °F were available. The scale of effective temperature devised by S.H.V.E.[4] and published by the Air Ministry[5] is also in °F and public enquiries about the comfort index almost invariably refer to the Fahrenheit scale. Hence the Fahrenheit scale has been used in this investigation. Days when the simultaneous combination of dry-bulb

temperature, wet-bulb temperature and wind speed gave an effective temperature greater than 66°F were extracted. Any observation which gave the above result was used, i.e. one or more observations which qualified on one day gave one occasion. Observations at L.W.C. were made at 0001, 0300, 0600, 0900, 1200, 1500, 1800 and 2100 hours GMT throughout the period but from 1960 onwards during periods of B.S.T. extra observations were taken at 0500, 0800, 1100, 1400 and 2000 hours GMT. In practice the observations at 1200, 1400, 1500 or 1800 hours GMT were normally the only ones to qualify.

Mean values of wet-bulb temperatures are not available for L.W.C. so in Table 3 thirty-year mean values of monthly effective temperatures for Kew have been calculated for comparison with similar values for Singapore, Gan and Bahrain. The mean effective temperature at Kew for the months November to April inclusive proved to be too low to be read off the diagram published by S.H.V.E.[4]

Discussion of Data

From Table 1 it can be calculated that the average number of days per year when the upper limit of comfort is exceeded is 9.5 days and only one day during the twenty-year period had an effective temperature above the comfort zone of a TROPICAL area (66 - 76 °F effective temperature). The number of days of discomfort (from high temperature) vary from nil in 1962 to 29 in 1949 and only three years had more than 20 days above the comfort zone.

The final column in Table 1 shows the maximum effective temperature from the available observations for each year. The average of these maxima is 72.9°F and the annual maximum ranged from 66°F in 1962 to 77°F in 1948. In fact 30th July, 1948 was the day of greatest discomfort during the period under review and may well be remembered as being the second day of the 1948 Olympiad held at Wembley. During this period the effective temperature reached 73°F on the 29th July and was still 71°F at 0001 hours on the 30th; fell to 56°F by 0600 GMT then rose to 67°F at 0900 and reached 77°F at 1500 hours GMT on the 30th.

The earliest date in the year when the upper limit of comfort was exceeded was 29th April, in 1958. The latest date was 3rd October, in 1949. Indeed these were the only days in both April and October to exceed the upper limit during the twenty years.

The highest effective temperature in March was 64°F. As already stated high effective temperatures were normally confined to daylight hours and throughout the period the effective temperature at 0300 and 0600 GMT never exceeded 64°F, although as mentioned above the maximum value at 0001 GMT was 71°F, on 30th July, 1948.

Eighty four per cent of the discomfort occurs during the three summer months of June, July and August - July having a rather greater average than the other months. However, high values of effective temperature can occur from May to September inclusive and it is notable that 76°F effective temperature (the upper limit of TROPICAL comfort) was recorded as early as the 4th June, in 1950 and as late as the 5th September, in 1958.

Table 2 gives the frequency distribution in four-day stages of the annual totals of days exceeding the comfort zone. This shows that 5 to 8 days of discomfort are more usual than the range 9 to 12 days, despite the arithmetic mean being 9.5 days per annum. 25% of the years reviewed had 13 or more days above the comfort zone; 75% had 12 days or less.

Comparison with Singapore, Gan and Bahrain

Table 3 shows the monthly mean values of effective temperature for the various places, using Kew for London, and reveals the low mean values in the United Kingdom. The three warmer climes have long, continuous periods of discomfort whilst London experiences much shorter spells, the longest being of seven consecutive days in July 1955. Table 4 gives the frequency distribution of the length of spells of high effective temperature. It must be borne in mind that this does not mean a period of continuously high effective temperatures but merely that at least one observation on each day gave an effective temperature above the upper limit of the comfort zone. There were 95 such spells, during the 20-year period, ranging from 1 to 7 days in duration; 52% were one-day spells and 27% were of two days duration.

London experiences far longer periods during the year when discomfort is due to low effective temperatures - below the lower limit of comfort for winter in temperate regions (57°F). Indeed the months of November, December, January and February were constantly below this lower limit during the review period and an effective temperature below 57°F occurs frequently in any month of the year at London.

However the annual maxima in Table 1 show that effective temperatures similar to those experienced in the three warmer climates (i.e. 72°F or above, effective temperature) occur in three years out of four, although for a few hours rather than months at a time.

Conclusions

1. A comfort index is applicable to London but may not be exceeded in some years. Cold discomfort is far more frequent than warm.
2. During the brief intervals when effective temperatures rise to maximum values they are comparable with the figures obtaining at Singapore, Gan and Bahrain but any mitigating factor such as air-conditioning or forced ventilation would easily return the situation to a comfortable one.
3. Critical effective temperatures causing dangerous rises in body temperature are extremely unlikely in London and excessive exercise should rarely prove dangerous from this source. By coincidence some of the 1948 Olympiad took place in the worst conditions experienced in the period under review, without any adverse effect on health that the writer can remember.

References

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4. New York, American Society of Heating and Ventilating Engineers. Effective temperature chart showing normal scale of effective temperature. New York, Am. Soc. Heat. Vent. Engrs. Guide, 1944, p.61.
5. London, Air Ministry. Handbook of preventative medicine, A.P.1296B. London, HMSO, 1959.