The Urban Heat Island in Akron, Ohio

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ABSTRACT.—Data gathered by automobile traverse were used to describe the urban heat of Akron, Ohio. Observations were made at 2100 or 2200 EST on four nights—17 April, 11 July, 10 October, and 2 January. Weather conditions not conducive to heat-island development were avoided. Temperatures in the center of the heat island were 6 to 14°F warmer than rural areas outside the city. The heat-island center was always over a mixed residential/commercial area. Topographic influences were apparent in the heat-island pattern.

MUCH HAS BEEN WRITTEN about the micro-climatic variations that have been found in some urbanized areas and hence have been assumed to exist in other urban centers as well. The most commonly documented urban impact on climate has become widely known as the "heat island."

Factors contributing to a heat island's existence are integral parts of urban areas — pavement, brick, concrete, asphalt, and other stone-like building materials; high volume of motorized traffic; large concentrations of heated and otherwise energy-serviced buildings; and industrial complexes. Despite the near certainty that a heat island can be identified in almost any urban center, the precise location and the magnitude of its development are anything but certain. The factors bearing on the way in which heat islands develop are reviewed as the heat island in Akron, Ohio, is examined here.

METHOD OF DATA COLLECTION

Data for this study were collected on the nights of 17 April, 11 July, and 10 October 1972 and 2 January 1973, using the automobile traverse method similar to that used by Hutcheon *et al. (1967)*. Weather on the days chosen for the investigation varied significantly enough throughout the days (and during the time of the traverse runs) to assure a fair representation of meteorological conditions. However, days with strong winds, cloud cover, and precipitation were avoided for data collection because these conditions weaken or eliminate heat islands. Week nights were chosen for investigation because Mitchell *(1953)* showed that increased human activity through the week days cause warmer urban temperatures than those that occur on weekends.

RESULTS

As may readily be seen (figs. 1 to 4), the center of the heat island in Akron formed over the same area on all four occasions — approximately 1.5 miles northwest of the central business district (CBD). The intensity of the heat island is indicated by the temperature differential between the edge of the city and the heat island center. The intensity varied with the season: 9°F in spring, 6°F in summer, 14°F in autumn, and 7°F in winter.

The center of Akron's heat island is located over a mixed residential-commercial land-use area. The commercial activity is located in relatively low-profile buildings with large paved parking areas. These low-profile buildings have very little shadowing effect on each other; hence considerable solar radiation

Figure 1.—Akron's heat island location 2200 EST, 17 April 1972.

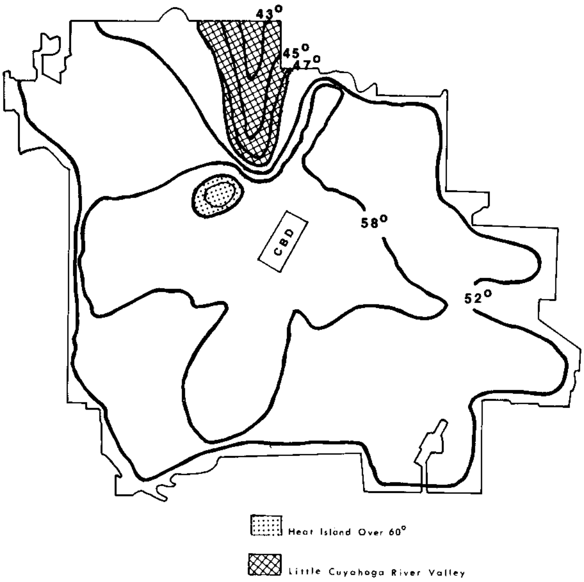


Figure 2.—Akron's heat island location 2100 EST, 11 July 1972.

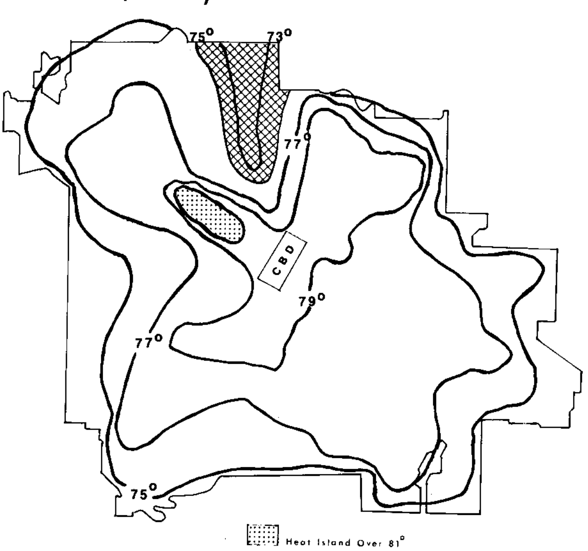


Figure 3.—Akron's heat island location 2100 EST, 10 October 1972.

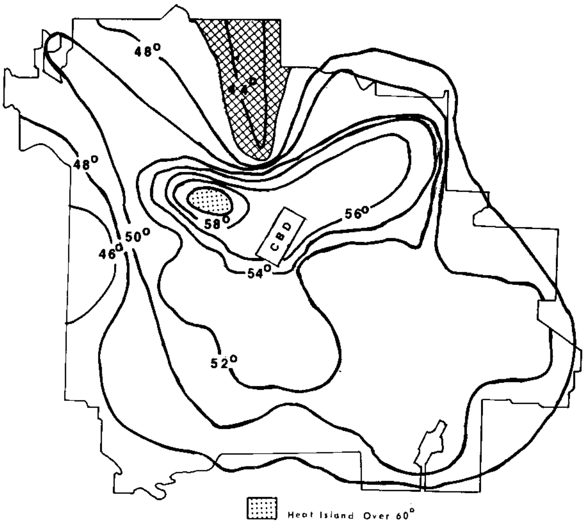
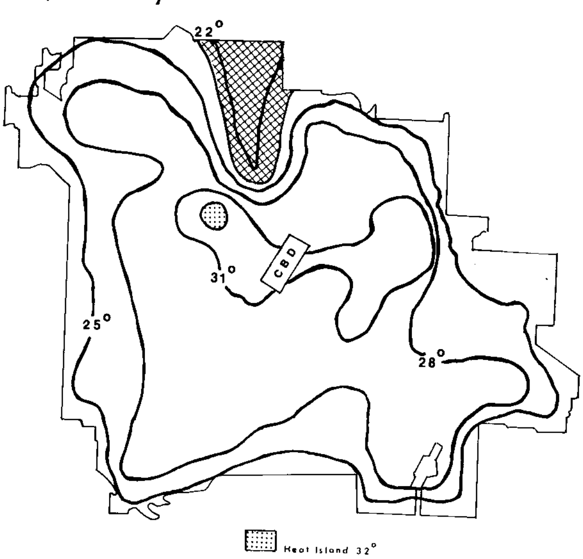


Figure 4.—Akron's heat island location 2200 EST, 2 January 1973.



is absorbed by them during the day. After sunset, the stone-like surfaces conduct heat to the urban air-causing excess heating.

The housing at the center of the heat-island area varies from modern multistoried apartment houses to large frame (and a few brick) houses that are about 60 years old and have been converted into apartments. The average number of residents per apartment is three.

This concentration of apartments has resulted in the area having the second highest housing and population density in the city of Akron. The areas of the city that have the highest housing and population density are located on low-lying ground, and cold air drainage prevents the formation of a heat island over these high housing/population density areas.

The University of Akron Laboratory for Spatial and Cartographic Analysis has produced maps of Akron, using 1970 Census Data, which show the sections of the city with population density of 20 to 25 persons per acre and 6 to 10 houses per acre (figs. 5 and 6).

These population and housing variables are important, since human and animal metabolic heat, and waste heat from space heating (and cooling), all contribute heat to the urban atmosphere.

In addition, the heat-island center is located over relatively high ground that causes cold air to drain away from that area. The heat-island center is approximately 100 feet higher than the surrounding ground.

DISCUSSION

Since heat-island formation is due to the impact of man, it follows that heat islands can be reduced, intensified, or possibly eliminated by man's effort. Investigation into how to eliminate a heat island should become an area of research after its location and intensity is known. Bach *(1972)* showed that wise land use can decrease the effect of heat islands.

Some may question why this type of investigation should become important and a source of intensive investigation. The answer is simple — heat islands are killers. Clarke *(1972)* and Buechley *et al. (1972)* have shown that the combination of increased heat and humidity of urban areas produces thermal stres-

Figure 5.—Housing density in the heat island in Akron, Ohio (1970 Census data).

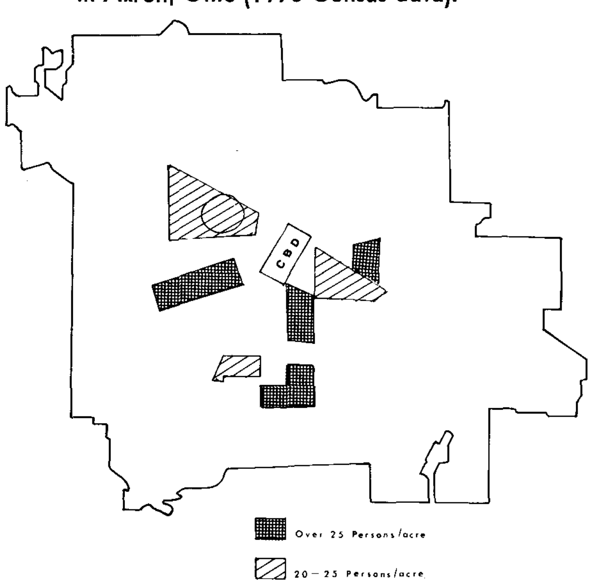
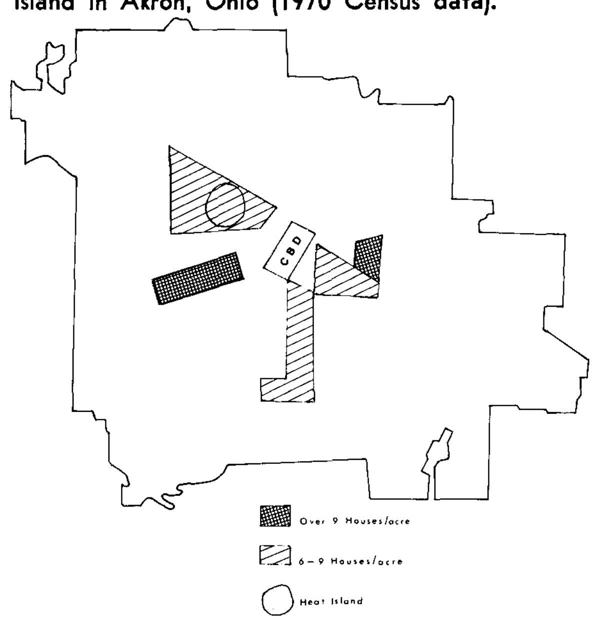


Figure 6.—Population density in the heat island in Akron, Ohio (1970 Census data).



ses, particularly at night among the poor and elderly, who are the predominate economic and age groups that live in the central cities.

These thermal stresses are a significant factor in causing urban mortality rates to be much higher than rural or suburban mortality rates during heat-wave conditions. The thermal stresses are produced because there is virtually no relief from heat and humidity in the urban areas at night due to the heat-island effect and the lack of air conditioning among the poor and elderly. However, in the rural and suburban areas, relief from thermal stress occurs once nocturnal cooling begins.

Just how significant this death rate can be was indicated by Bridger and Hefland *(1968)*. They studied the St. Louis, Missouri, area for July 1966 and found that, although the corporate limits of the city (at that time) contained only 32 percent of the metropolitan population, 85 percent of the heat-related deaths took place within the corporate limits. The urban death rate was 5.5 times as great as the rural death rate for the same time period. Other studies have indicated similar results.

CONCLUSION

Despite the prevalence of heat islands as urban climatological phenomena, their location, nature, and magnitude cannot be inferred on the basis of city size, industry mix, and housing density alone. Local climatological and physiographic conditions must also be considered. The net result is that, at least until much more work is done, each urban situation must be treated as a unique case. As this study has shown, careful and precise measurements need to be taken within an urban area to determine the nature, extent, and magnitude of heat islands.

The heat island in Akron is the result of the interaction of four variables: elevation, land use, housing density, and population density. A significant change in any of the four could cause the heat island to be weakened.

City planners should take such matters as those discussed in this study into consideration when making plans for urban expansion or building within the city, because whatever they do affects the microclimate. However, it seems that most planners have little knowledge of microclimatology. Unpleasant urban climates reflect both the lack of planning and the lack of knowledge of microclimatology.

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