conference summary¹

Conference on metropolitan physical environment: vegetation, space, and structure for human amenities, 25–29 August 1975, Syracuse, N.Y.

Lee P. Herrington
College of Environmental Science and Forestry
State University of New York
Syracuse, N.Y. 13210

Gordon M. Heisler
Northeastern Forest Experiment Station
Forest Service
U.S. Department of Agriculture
Pennington, N.J. 08534

1. Introduction

A five-day conference on several related aspects of the metropolitan physical environment was held in Syracuse, N.Y., between 25 and 29 August 1975 (see BULLETIN, 56, 644–648). Papers were presented during three- to four-hour sessions, with two sessions for each of four subject areas: 1) urban micro- and mesoclimates, 2) outdoor acoustics, 3) air quality, and 4) “qualitative” aspects of the metropolitan environment. The conference was multidisciplinary with participation by scientists, planners, designers, and managers with interest in the physical environment of cities. Main sponsors were the American Meteorological Society; the State University of New York, College of Environmental Science and Forestry; and the U.S. Forest Service, Pinchot Institute of Environmental Forestry Research. The origin of this conference can be traced to the founding of the Pinchot Institute by the U.S. Forest Service in 1970. The Institute fostered the organization of a working group of scientists interested in characterizing and evaluating the effects of forest vegetation on man’s physical environment and well-being. The initial work of these scientists indicated a need for exchange of information and cooperation with people in other disciplines and with managers, planners, and designers. With this need as inspiration, planning was begun by the working-group scientists for a multidisciplinary conference intended for a wide range of professionals interested in metropolitan physical environments and the effects of those environments on people.

Because of the large number of papers and amount of information presented at the conference, this summary is meant merely to illustrate the type of information dealing with topics of meteorological interest. Of the 53 papers presented at the conference, at least 20 dealt with urban meteorology and climatology. Proceedings of the conference will be published by the U.S. Forest Service as a USDA technical report.²

¹ This summary was presented as part of the Fifth Symposium on Scientific Reviews at the 56th Annual Meeting of the American Meteorological Society, 19 January 1976, Philadelphia, Pa.

² Write: Director, Northeastern Forest Experiment Station, 6816 Market Street, Upper Darby, Pa. 19082.

2. General conference summary

The conference, as indicated above, dealt with a wide range of topics: meteorology, acoustics, air quality, and “qualitative” environments. In each area the papers ranged from a description of the environment to a discussion of basic physical processes and a consideration of the human reaction (physiological, psychological, and behavioral) to the environment. A synopsis of the sessions is given below:

Meteorology 1—Mesoscale
Meteorology 2—Microscale and Human Reaction
Acoustics 1—Acoustic Environment
Acoustics 2—Control of the Acoustic Environment
Air Quality 1—Environment and Physics
Air Quality 2—Biological Impact
Qualitative 1—Perception, Social Factors, Aesthetics
Qualitative 2—Planning and Design

3. Acoustics

Although acoustic energy is propagated through the atmosphere, none of the formal presentations dealt with the effects of atmospheric structure on the propagation of noise. Papers dealt with the description of the noise environment and the role of vegetation as a noise control element. However, because many acousticians were present during the meteorology sessions, they were exposed to aspects of urban meteorology important to acoustics. As a result, significant informal exchange of information between acousticians and meteorologists took place.

4. Qualitative environment

The term “qualitative” was used to group papers emphasizing the aesthetics and function of metropolitan spaces, human behavior, planning, and design. With two exceptions the papers presented in these sessions did not deal with meteorological problems. Rowntree and Robertson in their paper “Perception and Behavior in Urban Amenity Spaces” reported on the relationship between the summer use of urban plazas and parks and climatic variables. Secretaries tended to use certain spaces only on days when the sun was out, whereas men tended to use increasingly a well-shaded and ventilated space as

air temperature increased. Joelee Normand presented an interesting "poster" session dealing in part with a method of presentation of complex air quality data to planners and designers. Movies of computer-plotted predictions of air pollutant concentrations were found to be effective in planning for the location of new industry.

In addition to the papers in the "qualitative" sessions, a number of the papers in the meteorology sessions dealt in part with urban planning and design.

5. Air quality

Two of the several papers in the session on biological impact of air pollution dealt with the removal of air pollutants by trees. At the Connecticut Agricultural Experiment Station, G. H. Heichel and L. Hankin found that windbreaks of white pine were effective in the removal of particulate lead from vehicular traffic on a nearby road.

Another paper, by C. E. Murphy, Jr., T. R. Sinclair, and K. R. Knoerr, discussed a computer model for estimating the uptake of gaseous air pollutants by forests. The model describes atmospheric diffusion immediately above and within the canopy, and into sink areas of the trees. One of the author's conclusions was that in the southeastern United States it is possible to grow areas of coniferous tree species that have good SO_2 absorption characteristics throughout the year. However, even with less than optimum climatic conditions and with less than ideal species, forests play an important role in pollution abatement.

Kuldip Chopra reported on a study with W. M. Pritchard of air pollution and urban climatology of Norfolk, Va. They found generally decreasing visibility between 1960 and 1972 and a possible trend reversal in recent years. Analysis of precipitation data for 1960–74 shows a slight increase in the annual number of days with precipitation exceeding 0.01 inch. Correlation between annual frequencies of low visibility and days with precipitation greater than 0.01 inch was small and negative.

In a "poster" paper, Peter W. Summers described his urban mixing depth model. He used the model to show that the mean annual levels of suspended particulate levels in downtown areas of Canadian cities are proportional to the fifth root of city population. The model also indicates that energy conservation could possibly increase pollution concentration. This would occur if the release of waste heat to the atmosphere were reduced at a rate greater than the reduction in the square of pollution input.

6. Meteorology

The sessions dealing with meteorology were divided into two sections—micro- and mesoscale. Both sessions were chaired by Peter W. Summers of Environment Canada. The papers presented in the mesoscale session fell into four groups: urban heat island, thermal structure of the urban atmosphere, precipitation in urban areas, and urban moisture climate. The microscale papers dealt

mainly with the description of urban microclimate and the comfort of people in outdoor urban areas.

The mesoscale session was keynoted by an invited paper by Roscoe Braham. He reviewed the state of knowledge concerning 1) the urban heat island, 2) the vertical structure of the urban boundary layer, 3) effects upon clouds and haze, and 4) urban effects upon precipitation. Many of the recent results from METROMEX were used in the discussion of these topics. Braham concluded that the urban heat island is well understood, that urban effects upon cloud nuclei and cloud microstructure are observed and partially understood, and that the causes of urban effects on rainfall remain speculative.

a. Volunteer observations

Thomas Blackburn reported on the microscale network of weather stations that are operated by volunteer agencies or individuals in the Washington, D.C., area. He described the techniques used in recruiting volunteers and sustaining their interest and reliability. Volunteer networks can provide observations for studies of temperature and rainfall patterns, the small-scale distribution of some types of air pollution, and microscale variations in the length of the growing season. Real-time volunteer observations could be used to a much greater extent to supplement radar and paid observers in reporting severe storms, heavy precipitation, and flash floods.

b. Surface-level temperatures

Two presentations described microscale, surface-level temperature variations in cities. Frank Martin and Grace Powell showed how the heat-island effect of Akron, Ohio, varied with season of the year, topography, land use, population density, number of households per unit area, and general weather conditions. The center of the heat island was completely surrounded by lower elevations, and cold-air drainage seemed to account for the fact that the heat-island center was located near the center of the city rather than in the business district, the area of highest population, or in the area of greatest housing density.

In a "poster" session, J. D. McTaggart-Cowan and J. W. S. Young demonstrated their system for measuring air temperatures by car traverse. A dual thermistor is mounted between two circular plates about 7 cm in diameter that serve as a radiation shield. The thermistors are combined with a simple resistive network and the output read with a digital voltmeter. The system has an absolute accuracy of $\pm 0.2^\circ\text{C}$ between -5° and $+45^\circ\text{C}$. Two of these systems were used simultaneously in studies in the St. John, N.B., area. In examples of results from these studies, the strong land-sea breeze effect had a greater impact than urban influences on air temperature.

c. Thermal structure of urban atmospheres

Two of the following papers placed emphasis on the vertical thermal structure of the urban atmosphere.

One presentation was a discussion of the two-dimensional transport model used by R. Viskanta, R. O. Johnson, and R. W. Bergstrom, Jr. This model is used to study the short-term effects of urbanization and air pollution on the thermal structure in the urban atmosphere. Simulations for summer conditions representing the city of St. Louis were used as illustrations. Although possible causes of heat islands are well recognized, the relative importance of the individual causes has not been determined by past studies. Viskanta *et al.* conclude that, in general, radiatively participating pollutants are relatively unimportant in forming the urban heat island in comparison with other factors. There is a feedback mechanism between pollution, thermal structure, atmospheric stability, and pollutant dispersion. The feedback has the potential of being significant in modifying pollutant concentrations under highly stable conditions and heavy pollutant loadings.

D. Yap reported on an empirical study of the nocturnal temperature structure over Edmonton, Alberta, in November and December 1974. Detailed observations were obtained during a three-week period from minisonde ascents, instrumented helicopter, and platinum resistance thermometers mounted on towers. Temperature inversions typically extended to 100 m above ground level in the urban area. The very stable upwind air became less stable as it flowed toward the city center.

d. Precipitation in urban areas

F. A. Huff presented some results from the first four summers (1971–74) of a five-year METROMEX study of urban rainfall enhancement. Data from a dense network of recording rain gages and a 10 cm PPI radar were analyzed. Summer events were emphasized because earlier studies showed the urban effect to be most pronounced during that season in the Midwest. Substantial enhancement of rainfall was found downwind of the St. Louis urban-industrial complex. This anomaly appears to be caused primarily by the intensification of naturally occurring storm systems through addition of heat and raindrop nuclei from the urban area. The enhancement is most pronounced during and following the period of maximum diurnal heating.

Richard Semonin reported results from METROMEX research on rainfall pH. A sampling network was established with 81 collectors distributed over 1800 km² within the METROMEX research circle around St. Louis. Data were collected during 25 consecutive storm days in the summers of 1972 and 1974. The area average pH for all storms was 4.9, with a range from 4.3 to 6.8. A single storm event was studied to determine the change of pH as a function of time. The rain was pH 7.1 at the start of the storm but decreased to 4.1 by the end.

e. Urban moisture

METROMEX data were used by Douglas Sisterson and Richard Dirks of the University of Wyoming in a study

of urban moisture climate. Observations by aircraft, mobile weather units, hygrothermograph and telemetry, and radiosondes were used in a case study for 26 July 1974. Overall, the urban-influenced atmosphere of St. Louis is drier than the atmosphere over the surrounding rural area. Because there is less moisture available at the surface level in the city, less energy is used for evapotranspiration. Regions of low specific humidity have impervious surfaces, which are found in the densely populated residential areas and light-industry areas. The authors concluded that, during daylight hours, anthropogenic sources do not appear to be of consequence except in a few areas.

In a paper with Yam-Tong Tam as coauthor, Robert Bornstein presented some of his latest findings concerning anthropogenic moisture production and its effect on boundary-layer circulations over New York City. In seeming contradiction to the findings for St. Louis by Sisterson and Dirks, helicopter soundings over New York City showed a moisture excess. Bornstein and Tam postulated a “dome” of heat and moisture excess over New York City. The URBMET urban boundary-layer model indicated that buoyancy produced by the moisture excess was about 10% of that produced by the urban heat-island effect.

f. Urban microclimate

The majority of the papers in the microscale session dealt with human comfort in one fashion or another. An interesting discussion of human discomfort due to the mechanical effects of wind on the body was presented by Edward Arens. Arens and his coauthor, Donald Ballani, presented a useful model for determining discomfort frequency in a spatial context based on both wind and thermal comfort. The procedure will be useful in planning for outdoor human comfort in urban areas.

A series of papers dealing with the analysis of human thermal comfort in urban outdoor spaces were presented together as “poster” presentations. The Pinchot Consortium was the source of partial funding for all of these studies. Stark and Miller reported on a study of the effects of vegetation on thermal comfort of people in areas typical of college campuses. They found that, on the average, thermal comfort could be expected in summer when 28–55% of the radiational view (percent of total spherical view) of a person was composed of synthetic materials. Herrington and Vittum reported on a study of the microclimate and potential for human thermal comfort within a number of parks and plazas in downtown Syracuse, N.Y. They concluded that thermal comfort for people in such spaces could be influenced by design only through the control of solar radiation, infrared radiation, and wind. Air temperature and humidity were found not to be determined by the characteristics of the space. Harriet Plumley presented a set of design guidelines that would allow a site designer to 1) determine the amount of radiational heating or cooling needed for comfort in a given site and 2) then determine how best to achieve the required com-

fort conditions by use of vegetation and structures. Her work was an extension of that by Vittum. These papers were of considerable interest to city planners and designers, and since they were presented in the "poster" format, there was a great deal of discussion between the authors and the audience.

Since one of the goals of the conference was to establish two-way communication between planners or designers of urban areas and scientists working on urban problems, the paper by Spencer Joyner from the University of Massachusetts, Department of Landscape Architecture and Regional Planning, was especially interesting. Joyner and his colleagues have developed a procedure that allows the thermal climate—as determined by integration of topographic, soil, solar radiation, and vegetation information—to be presented in map form in such a way that planners can use the data. The use of the computer to develop and summarize this information parallels that reported earlier in the section on "qualitative" environment for the paper by Normand and to some extent that reported on by Arens above. There is a lesson here for the scientist.

David Miller described the microclimate at the interface between a parking lot and a wooded area. He found that the microclimates were about as one would expect and that there was considerable advection of energy between the woodland and the parking lot.

7. Conference evaluation

The conference concluded with an open round-table discussion of the conference itself. Each session chairman summarized his session in terms of both subject material and success in meeting conference objectives. The general conclusions reached during the discussions that followed were:

- 1) The general idea of a conference focusing on many aspects of urban physical environment rather than on an area of scientific study, such as meteorology or acoustics, was applauded.

- 2) From the scientific point of view, the conference was successful, particularly in that those who attended all of the sessions were exposed to a broad range of subject matter. There was also ample time for discussion with managers, designers, and planners of urban spaces.
- 3) The conference was less successful from the point of view of the designers and planners. First, most of the organizers of the conference were scientists, and they were not successful in reaching the potential audience of designers and planners. Second, those designers and planners who were present felt that many of the papers were much too technical for ready absorption. The conclusion was that scientists must spend more time making their results more easily understood if they are interested in having the results of their work put to use.
- 4) Those attending the summary conference felt that there should be further conferences of this type. The suggestion was made that the organizers of the conference should prepare a mailing list of people who are interested in the physical environment of the city so that planners of future conferences will have an easier time reaching the appropriate audience. (The conference organizers have agreed to prepare this list.)
- 5) About one-third of the papers presented at the conference were "poster" presentations. Rather than losing time in coffee breaks, part of each half-day session was devoted to this type of presentation. Authors prepared posters (3 ft × 5 ft) outlining the major points of their work. The "audience" moved from poster to poster as individuals, entering into discussions with the poster authors as interest dictated. Both participants and audience found this to be an effective way to exchange information. In our opinion, all AMS conferences should consider this highly efficient means of encouraging scientific interchange.

(Continued from **announcements**, page 695)

Project Skywater draft environmental statement

The Draft Environmental Statement for the Bureau of Reclamation's "Project Skywater: A Program of Research in Precipitation Management" (INT DES 76-10) was forwarded to the President's Council on Environmental Quality on 5 March 1976. Gilbert Stamm, Commissioner of Reclamation (Department of the Interior) noted that "The scope of the draft statement is broad because in addition to cloud physics,

the project also is researching the environmental, social, and economic implications of cloud seeding."

Although a first printing of 750 copies of the two-volume statement has already been depleted, a second printing should be available in the near future. For information contact: Chief, Division of Atmospheric Water Resources Management, Bureau of Reclamation, Engineering and Research Center, P.O. Box 25007, Denver Federal Center, Denver, Colo. 80225.

(More **announcements** on page 702)