The Commonwealth of Massachusetts
Executive Office of Human Services
Department of Public Health
150 Tremont Street
Boston 02111

Bailus Walker, Jr., Ph.D., M.P.H.
COMMISSIONER

March 11, 1985

Kathryn F. Calhoon, Esquire
Legal Services of Middle Tennessee
404 James Robertson Parkway
Nashville, Tennessee 37219

Dear Ms. Calhoon:

Attached to this letter is a statement of heat stress and its control.

Two other items are attached: 1) my vita and 2) a publication on Health and High Density Confinement in Jails and Prisons published in Federal Probation March, 1980. As you know, I have participated as an expert witness in more than 200 cases involving conditions of confinement in jails and prisons across the country - evaluating environmental factors which may impinge on the health of confined populations.

It is from that and other environmental health experiences and my academic background in environmental health that I developed the attached statement which I trust will meet your needs.

Sincerely,

Bailus Walker, Jr., Ph.D., M.P.H.
Commissioner

BW:sb

Attachment

HEAT STRESS: ITS EFFECTS AND CONTROL

Heat represents one of the classical physical stresses in residential environments. Although exposure to heat has been a problem for centuries, only in modern times have the environmental and physiological characteristics of heat exposure been related so as to develop a good understanding of the limits of exposure and of suitable control menthods for reducing the risk of heat-related illness and mental dysfunction.

As our technology advances, new information in environmental medicine is influencing the requirements for safe and healthful housing. New data now affirm that the interaction of heat and various chemicals, combined with physical and biological stresses in the home, impose a body burden that would not be anticipated for heat exposure alone.

From the point of view of health, a dwelling's most important function is the provision of an environment conducive to rest, relaxation, and sleep. This function cannot be fully satisfied unless the persons concerned are able to spend their time at home in an environment that does not increase the risk of disease and disability. To that end a favorable microclimate in the home is essential.

However, a question unsettled is whether there is an epidemiologic basis for requiring air-conditioning systems as standard fixtures in dwellings in certain geographical areas.

The fundamental premise of this statement, supported by empirical data, is that home air-conditioning is as essential for the prevention of heat-related illness as toilet fixtures are for their well-established role in the prevention of fecal-borne and urine-related disease.

Housing Standards

At the outset it is well to review the present fundamental requirements for safe and healthful housing.

As a society advances, the rise in its cultural levels and standards is accompanied by an increase in demands made upon the home, especially by persons in low socioeconomic groups who cannot afford extensive away-from-home recreational activities.

The modern home should not only provide protection from unfavorable atmospheric conditions but also prevent the spread of disease and ensure physical and mental comfort, rest and creative activity, and maintenance of human health in the wider sense.

In summary, modern housing for human occupancy must meet four basic human needs:(1) 1) fundamental physiologic needs; 2) fundamental psychologic needs; 3) protection against agents that cause acute and chronic disease; and 4) protection against physical injuries such as electric shock, burns, and other accidents.

Housing not meeting all four of these needs is unsafe and significantly increases the risk of acute and chronic disease and mental dysfunction. Among the most essential physiologic needs is the maintenance of a thermal environment which on the one hand will avoid undue heat loss from the human body but will on the other hand permit adequate heat loss from the human body.

(1) American Public Health Association Committee on Hygiene, Report of the Committee, 1967.

These requirements can be met by use of an appropriate residential heating system in the winter and an adequate cooling system - air-conditioning - in the summer months.

Heat stress in the home and the inability to remove metabolic heat (generated by bodily functions) lead to well-known reactions including increased heart rate, strain on the blood circulatory system, sweating, and increased core temperature of the body.

Heat Disorders

Viewed from a wider perspective, three overlapping responses to heat stress occur in human populations: psychological, psychophysiological, and physiological.

1. Psychological Disorders

It is commonly observed that social behavior in very hot and humid residential environments is quite different in tone from behavior in "comfortable" or even cold environments. Interpersonal responses are detectably more negative when one is hot and uncomfortable than when one is situated in a more comfortable environment.[2][3][4]

Rohles [5] has observed continual arguing, needling, agitation, jibing, fist-fighting, threatening, and even attempted knifing in residential settings with high temperature of 80°- 90°F. Further, an analysis of urban riots revealed that in most instances the temperature was quite high during the day on which violence first erupted. In 9 of 18 disorders that occurred in the 1960's,

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(2) Bell, P.A. and Baron, R.A. "Agression and Heat: The Mediating Role of Negative Effect." J. of Applied Social Psychology 6: 18-30, 1976.

(3) Provén, K.A. and Bell, C.R. "Effects of Heat Stress on the Performance of Two Tasks Running Concurrently." J. of Experimental Psychology 85: 40-44, 1970.

(4) Wilkinson, R.T., Goldsmith, R.H., et al. "Psychological and Physical Response to Raised Body Temperature." J. of Applied Physiology 29: 287-292, 1966

(5) Rohles, F.H. "Psychological Aspects of Thermal Comfort." Psychology Today 1: 55-63, 1967.

the ambient temperature had reached 80°F or more and was also high inside dwellings of those who actively participated in the civil disturbances. [5][6][7] Greenberg [8] also has examined the incidence of aggressive assaults and found that they increased as temperatures rose.

Other studies report that high residential temperatures, especially when combined with other sources of irritation or discomfort, may become so debilitating that aggression is no longer facilitated. [9][10]

2. Psychophysiological Disorders

In addition to the psychological effects of heat, subpathological effects may modify performance or behavior in the home or initiate possible responses to other stresses imposed simultaneously.

There is no demonstrable effect on health at low levels of thermal stress, but as the residential heat load increases, there appears to be a higher order of psychophysiological disturbance, an increase in the frequency of errors, a higher frequency of accidental injuries, and a reduction in efficiency in the performance of household tasks.

3. Physiological Disorders

At high levels of heat exposure in the home there is an increasingly well-defined disturbance of physiological well-being, with strain on the heart and the circulatory system, and overloading of the water and salt balance mechanisms in the body.

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(6) Proven, K.A. "Environmental Heat, Body Temperature and Behavior." Australian J. of Psychology 18: 118-129, 1966.
(7) Bell, Fisher, and Loomis. Environmental Psychology. W.B. Saunders, Philadelphia, 1978.
(8) Greenberg, G. "The Effects of Ambient Temperature on Aggression." Unpublished doctoral dissertation. Kansas State University, 1969.
(9) Glass, D., Singer, C. et al. "Psychic Cost of Adaptation to An Environmental Stressor." J. of Personality and Social Psychology 21: 200-210, 1969.
(10) Griffitt, W. "Environmental Effects of Interpersonal Affective Behavior: Ambient Effective Temeprature." J. of Personality and Social Psychology 15: 240-244, 1970.

Under conditions of heat stress, increased demands for blood flow are made to the periphery of the body, diverting some of the heart output and rendering it unavailable to active muscles. Accordingly, as upper limits of tolerance are reached, performance (output) is reduced.

Wyndham (11) has demonstrated that real limits of endurance exist, and Pepler (12) has reviewed the effects of heat on skilled tasks and mental tasks. Qualititatively there is no doubt that heat interferes with these types of activity.

Furthermore, it is common experience that heat exposure accelerates the onset of fatigue. Increased body temperatures and discomfort also increase other emotional states that may induce dwelling occupants to commit rash acts or otherwise exhibit emotional reactions.

Interactive Effects of Heat and Other Environmental Conditions

The combination of heat and carbon monoxide, an odorless gas common in living quarters, has been found to have a deleterious effect greater than that due to either stress element by itself. Dwelling occupants report persistent headaches, anorexia, irritability, depression, and general malaise, with effects more pronounced in women than in men.

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(11) Wyndham, D.H. Ergonomics 5: 115, 1962.
(12) Pepler, R. "Performance and Well-Being in Heat." In Herzfeld, C.M. (Ed.) Temperature, Its Measurement and Control in Science and Industry (Vol. III., Part 3). New York, Reinhold, 1963.

Experimental studies have also demonstrated that exposure to high environmental temperatures markedly increased susceptibility to toxic chemicals such as lead, benzol, and pesticides such as parathion. [13]

Interaction between heat and toxic chemicals has taken on added public health significance in recent years as new synthetic materials have been increasingly used in construction and in equipment for living quarters. Plastics that have been employed in homes and in the construction of household furniture and equipment include polyethylene, polystyrene, polyvinyl alcohol, and phenol-formaldehyde resin.

Polymers are used for, among other things, floor covering, internal lining of walls and the protection of surfaces against moisture. New adhesives based on various resins, and paints based on polyvinyl acetates have been recently introduced into homes.

In Renshaw's [14] investigation of the effects of noise and heat, the effects of heat were found to be statistically significant. Performance was poorer at a 90°F effective temperature than at a 72°F effective temperature, when the noise level was held constant.

This is not an insignificant health concern. With increasing urbanization, and growth in the means and power of transportation, street noise continues to penetrate dwellings and cause great disturbance, interferes with rest and sleep, and adversely affects mental health.

Although noise originating within the building, as it affects the noise

(13) Betjer, A.M. "Temperature." In Sartwell, P.E. (Ed.) Preventive Medicine and Public Health. Appleton Century Crofts, New York, 1973.
(14) Renshaw, F. In American Industrial Hygiene Association J. Abstract Supplement 38, 1971.

level within a room, has been investigated much less than street noise, data that give a clear picture of this environmental hazard also are available.

Plumbing installations and domestic appliances can be significant sources of noise within dwellings if acoustic insulation and other protective measures are inadequate. Within an individual apartment, sources of domestic noise include loud speech, radios, television sets, the slamming of doors, the movement of furniture, and children playing and crying.

Heat-Induced Illness

Two major clinical disorders that can result from excessive residential heat stress to occupants are heat stroke and heat exhaustion. Some existing disorders also respond unfavorably to heat.

1. Heat stroke results from failure of the thermoregulatory center in the brain. This can be brought about by high environmental temperatures, high humidity, and the lack of air circulation.

2. Heat exhaustion results from depletion of body water and/or salt. Heat exhaustion is a state of collapse brought about by an insufficient blood supply to the brain. The failure is not so much that of heat regulation of the body but an inability to meet the price of heat regulation. Among the chief factors leading to heat exhaustion are reduced heart efficiency because of emotional stress, malnutrition, and/or infection, all problems common in low socioeconomic groups that often are without adequate medical care.

3. Other Conditions. Studies by Hollander [15] confirm that changes in weather affect musculoskeletal disease. A rise in humidity (similar to that which occurred in Nashville in June 1984) made symptoms of rheumatoid arthritis and osteoarthritis worse in patients, whereas stable climatic conditions were advantageous.

(15) Hollander, J.L. "Environment and Musculoskeletal Disease." Archives of Environmental Health 6: 527, 1963.

Susceptability to and Tolerance for Heat

Dwelling occupants without demonstrable health impairment vary in their biological capacities to withstand high residential temperatures. Because of a variety of selective processes - e.g. genetic, physiological, social, educational, economic and environmental - different population groups and different ethnic groups may also vary in their level of resistance.

There is, for example, a progressive lowering of health status as population groups shift from the professional/managerial group through various skilled and semiskilled occupations to the category of unskilled laborer - the grouping of many who occupy public-assisted housing. Differences in health status are seen in both husbands and wives in this group, which suggests that the differences are characteristics of socioeconomic rather than occupational groups.

Another source of variation in ability to withstand residential heat stress, however, which does not come within the "normal" category, is the loss of resistance on account of previous or present illness or state of chronic disability.

An individual with cardiovascular disease, diagnosed or undiagnosed, is especially vulnerable to heat stress on the body's circulatory system. Dwelling occupants with respiratory (heart-lung) problems also may fall victim to added stress in the form of residential heat.

Blacks are especially vulnerable to heat-induced illness because of their general health status. The average life expectancy for blacks is about seven years less than for whites, and between the ages of 25 and 44 hypertension-associated mortality is approximately 16 times higher among blacks than among whites.[16]

(16) Davis, M.E. and Rowland, A.S. "Problems Faced by Minority Workers." In Levy and Wegman (Ed.s) Occupational Health. Boston, Little Brown, 1983.

For infectious diseases such as pneumonia, influenza, and tuberculosis, age-adjusted death rates for blacks are twice those for whites. In the working-age population, the prevalence rate of heart disease, a condition which increases susceptability to heat-induced illness, is higher among nonwhites.

Undernutrition is also more common in blacks than in whites. In fact the mortality rate from many infectious diseases in malnourished children has led to many studies of the interaction of nutrition and infection. The very high infant mortality rates in developing countries and in the United States are due in part to a combination of infection and undernutrition.

Thus undernutrition results in increased mortality from infection, while infection puts an increased strain on the individual's nutritional reserve. All of these conditions intensify the effects of heat on blacks of low socioeconomic status. Undernourished blacks with acute and chronic disease account for much of the excess mortality reported in urban and rural communities during sustained periods of high residential heat.

Heat Strain

Heat strain is a reactive physiological manifestation of environment heat stress. The burden of balancing bodily heat gain and heat loss - a balance needed to prevent elevation in body temperature - falls on the sweating mechanism and the circulatroy system. Sweating increases sharply in warm environments. However, in order to have a cooling effect the humidity must be low and/or the air velocity must be high since the cooling effect is due to the evaporation of the liquid content of sweat.

The evaporation of sweat is severely restricted in Nashville because of the high relative humidity. For example, on June 19, 1984 the relative humidity reached 100 percent by early afternoon and did not fall below 90 percent for the rest of the day.

Similarly, on June 24 the average hourly relative humidity was 85-90 percent. Under these conditions the skin temperature rises, putting even more stress on that portion of the brain (the hypothalmus) which regulates body temperature.

These conditions also increase the heart and pulse rates to augment blood flow through the skin's blood vessels. It is well known that physiological strain increases exponentially in the upper ranges of heat stress. Thus a small incremental increase at high levels (80-90°F) of heat stress can result in a large increase in strain.

The Effect of Weather

Even in well-ventilated homes constructed of materials that maximize interior cooling, the severity of heat stress is determined largely by weather conditions. The prevailing meteorological conditions, the onset of hot weather, and heat wave episodes can have a very siginificant effect in terms of heat stress experienced by dwelling occupants.

In Nashville a combination of factors exacerbates heat exposures of residents of publicly-assisted housing. First, these units are two-story brick-exterior structures and second, Nashville summers are characterized by high relative humidity, low rates of air movement, and high temperatures in the ambient environment.[17] These ambient conditions are superimposed on dwelling heat levels caused by normal body functions, and heat-generating household appliances - i.e. cooking stoves, water heating equipment, television sets - on odors and, in some cases, smoke.

(17) National Oceanic and Atmospheric Administration. Local Climatological Data Monthly Summary, 1984.

Thus on any given day, depending on Nashville weather, the heat stress in the dwellings could reach the maximum "dose" tolerable to humans.

For all of the foregoing reasons housing must meet fundamental human physiologic and psychologic needs for a thermal environment that will both avoid undue heat loss and permit adequate heat loss from the human body.

Controlling Heat Stress

I now comment on options for controlling heat stress in living quarters.

The control of residential heat stress to ensure that occupants' exposure falls below acceptable limits requires the application of feasible engineering procedures. Engineering control of heat stress - i.e. air-conditioning in this statement's context - calls for an understanding of the physiological response of humans in a hot environment.

The undelying human-thermal balance suggests that when dwelling occupants are exposed to elevated temperatures their rate of heat loss will decrease. The role of engineering controls is to help sustain a rate of bodily heat loss equal to the imposition of heat from the environment.

In a general sense this requirement can be satisfied by increasing the velocity of air across the body, a technique that is useful within certain limits of temperature and humidity; above such limits it is necessary to reduce surrounding temperature. In practice it is often necessary to combine these two approaches to achieve an acceptable thermal living environment.

Among the alternatives is general or natural ventilation, making use of wall openings for entrance of outside air, commonly of the gravity type.

Unfortunately, general ventilation cannot offset Nashville-type heat exposure. Even in its secondary role, general ventilation often fails to function as needed mainly because of an inadequate supply of make-up air. Insufficient areas of openings and poor location of inlets often results in improper distribution or too little air within the building. (18)

As stated earlier, control of heat stress must take into consideration the physiological response of humans to hot environments. For example, in recent years there has been increasing recognition that during sleep there is an important inhibition of thermoregulation of the body, causing a reduction in the temperature difference between the deep and superficial tissues that is characteristic of the waking state. This inhibition can be deepened only when external heat stress is weak (less than 75°F).

Even with only slight overheating, sleep is uneasy. It is particularly important that these conditions be satisfied for normal healthful sleep of residents of publicly-assisted housing, to enhance their alertness on the job. This alertness is essential to prevent occupational injuries among individuals in low socioeconomic groups who, being semiskilled or unskilled, are usually concentrated in the most dangerous sectons of the economy.

Consequently, if measures such as air-conditioning, designed to prevent disturbance of the human body's heat-control mechanism and to protect dwellings from overheating, are to be effective, they must apply to particular periods of the day. The actual time will of course vary.

Even though the body's thermoregulatroy mechanism is highly efficient, it is unable to cope with the demands made upon it by high temperatures accompanied by an increased rate of heart beat and blood circulation.

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(18) Hatch, T.F. "Heat Control in the Hot Industries." In Industrial Hygiene and Toxicology, Patty, F.A. (Ed.) New York, Wiley Interscience.

The Societal Context

The adverse health effect of heat stress is clearly unacceptable in the context of today's standards of comfort, health promotion, and disease prevention, and in the context of burgeoning legislative prohibition against both health impairment and increasing health care costs. Society has recognized that with today's fast-changing technology, there are minimal services essential to healthful daily living.

These so-called "lifeline" services, including at least telephone, home heating in winter and home cooling in summer, are so essential that human services advocates are lobbying the United States Congress to pass laws that will guarantee low income persons these essentials for mere survival in today's technological society.

In response, one "lifeline" bill has been proposed in the United States House of Representatives, by Representatives Leland of Texas and Markey of Massachusetts, and a similar bill is expected to be proposed in the United States Senate by Senator John Heinz of Pennsylvania.

At the state level, California was the first state to implement legislation requiring "lifeline" services. Other states are moving rapidly in this direction. Thus the precedent has been established and provides clear direction for states and cities across the nation.

Bailus Walker, Jr., Ph.D., M.P.H.
Environmental Health Science Consultant

CURRICULUM VITAE

Bailus Walker, Jr., Ph.D., M.P.H.

DATE OF BIRTH: June 23, 1932

PLACE OF BIRTH: Springfield (Robertson County), Tennessee

EDUCATION:

Public School System
Springfield, Tennessee

Bachelor's Degree
(Biology and Chemistry)
1954
Kentucky State University
Frankfort, Kentucky

Master's Degree
(Occupational and Environmental Health)
1959
University of Michigan
Ann Arbor, Michigan

Post Master's Studies
(Environmental and Occupational Hygiene)
1964-1965
Johns Hopkins University
School of Hygiene and Public Health
Baltimore, Maryland

Post Master's Studies
(Environmental Health Science)
1965-1966
University of Kansas
Lawrence, Kansas

Doctor of Philosophy Degree (with highest honors)
(Occupational and Environmental Health)
1975
University of Minnesota
Minneapolis, Minnesota

Employment History

1954-1958	U.S. Air Force (Medical Service Corps) Sanitary and Industrial Hygiene Engineering (fulfilled military obligation)
1958 (April - August) Special Project	Research Associate Bureau of Environmental Health Department of Public Health, District of Columbia Washington, D.C.
1959-1961	Environmental Health Specialist Department of Public Health Philadelphia, Pennsylvania
1961-1963	Environmental Health Specialist Wayne County, Michigan Department of Public Health Eloise, Michigan
1963-1965	Instructor and Director of Short-Term Training Department of Community Health Practice College of Medicine Howard University Washington, D.C.
1965-1966	Research Associate Environmental Health Research Laboratory Department of Civil Engineering University of Kansas Lawrence, Kansas
1966-1968	Research Fellow and Director of Environmental Health Research Laboratories School of Public Health College of Medical Sciences University of Minnesota Minneapolis, Minnesota
1968 (September - January) Temporary Assignment	Chief, Environmental Health Services Dayton Division of Health Dayton, Ohio

1968-1972	First Deputy Health Commissioner for Environmental Health Services Department of Public Health Cleveland, Ohio
1972 (March - November) Temporary Appointment	Director of Public Health and Welfare Newark, New Jersey
1972-1979	Administrator and Senior Health Scientist Environmental Health Administration Government of the District of Columbia Washington, D.C.
1979-1981	Director Directorate of Occupational Health Standards Occupational Safety and Health Administration United States Department of Labor Washington, D.C.
1981-1983	State Director of Public Health * Michigan Department of Public Health Lansing, Michigan (on appointment by the Governor of the State of Michigan)
June 1983 - present	Commissioner of Public Health ** Massachusetts Department of Public Health Boston, Massachusetts
June 1983 - present	Chairman Massachusetts Public Health Council (on appointment by the Governor of the Commonwealth of Massachusetts)

* First non-physician to be appointed to this position

** First non-physician to be appointed Commissioner of the oldest state health department in the United States.

ADJUNCT ASSIGNMENTS AND SERVICES TO ORGANIZATIONS AND AGENCIES
(Study Commissions, Task Forces, Consultancies)

Chairman (1973-1980)
Occupational Health Task Force
American Public Health Association

Member (1974-1978)
Task Force on Jails and Prisons
American Public Health Association

Member (1975-1979)
Environmental Health Advisory Committee
Science Advisory Board
U.S. Environmental Protection Agency

Member (1976-present)
National Accreditation Council for
Environmental Health Curricula

Member (1978-1980)
Council on Education for Public Health
(Joint Accreditation Council for Schools
of Public Health)

Member (1978-1981)
U.S. Council on Radiation Policy

Member (1978-1980)
Committee on Urban Pest and Pesticide Management
National Research Council
National Academy of Sciences

Member (1981-1983)
Michigan Hospital Finance Authority

Chairman (1981-1983)
Michigan Air Pollution Control Commission

Member (1970-1979)
Committee on Training and Demonstration Grants
(Environmental Health)
U.S. Department of Health, Education and Welfare

Member (1980-1981)
U.S. Toxic Substances Strategy Committee
Executive Office of the President
Council on Environmental Quality

Chairman (September, 1980)
U.S. Exchange Mission to Japan on Collaborative Efforts (research, teaching, regulatory programs) in Occupational Health established by the U.S. Secretary of Labor and the Minister of Labor-Japan.

Member (1982-present)
American Public Health Association
Executive Board

Member (1982-present)
Board of Directors
Professional Examination Service
New York, New York

Chairman (1982-present)
Council on Environment
National Association of Public Health Policy

Consultant (Spring, 1982)
Royal Commission on Matters of Health and Safety
Arising from the Use of Asbestos in Ontario (Toronto, Ontario)

Member (1983-present)
National Academy of Sciences
Study Commission on the
Health Effects of Air Pollution

Member (1983-present)
Study Group on Cancer Prevention/Control
National Cancer Institute
National Institutes of Health

Consultant (1984)
Miami University - Florida
International University on the
development of a graduate degree
granting program in the public
health sciences

Director-at-large (1984-present)
Board of Directors
American Lung Association

Member (1984-present)
Advisory Board
Educational Testing Service
Princeton, New Jersey

Chairman (1985-present)
Executive Board
American Public Health Association

PUBLICATIONS

1. Goals and Policies for Our Physical Environment. AMA-Archives of Environmental Health, Vol. 16:447, 1968.
2. Environmental Health Needs and the Role of the Medical Profession. Journal of the National Medical Association, Vol. 57:41, 1965.
3. Environmental Health: An Old Problem with a New Look. Journal of the National Medical Association, 1964.
4. Methodology for the Microbial Examination of Spacecraft Hardware. Final Report to the National Aeronautics and Space Administration (Mimeographed), 1967.
5. Research and Current Developments in Environmental Microbiology. AMA-Archives of Environmental Health, Vol. 17-979, 1968.
6. Issues in Environmental Health Planning. Journal of the Ohio Public Health Association, Vol. 3 #4, 1970.
7. Manpower Problems of Environmental Health. Journal of Environmental Health Association, Vol. 32 #6, 1970.
8. Environmental Health in Medical Care Facilities. Ohio's Health, Vol. 22 #4, 1970.
9. Effects of Environmental Conditions on Viruses. Journal of Environmental Health, Vol. 32 #5, 1970.
10. Health Hazards Associated with Urbanization and Overpopulation. Journal of the National Medical Association, Vol. 62 #4, 1970.
11. An Evaluation of Progress in Air, Water and Waste Management. Journal of Environmental Health, Vol. 33 #1, page 97, 1970.
12. Manpower Predicament of Environmental Health. Journal of Milk and Food Technology, Vol. 33 #9, 1970.
13. Occupational Health - Concerns and Issues. The Ohio State Medical Journal, Vol. 66 #11, 1970.
14. Infections, Disease and Community Hygiene. Journal of the National Medical Association, Vol. 63 #5, 1971.
15. The University, the Community, and Environmental Health. Journal of the American College Health Association, Vol. 20 #3, 1972.
16. Water Resource Management - A Critique. American Journal of Public Health, Vol. 61 #12, 1971.

17. The Residential Environment: A Century of Failures. Journal of Environmental Health, Vol. 35 #4, 1972.

18. The Priority of Health in Environmental Health. Journal of Environmental Health, Vol. 35 #1, 1972.

19. Health Consequences of Population Density and Crowding (Reactor Paper), in Proceedings of the Congress on Environmental Health, DHEW Publications No. 73-10015, April, 1972.

20. Environmental Quality and the Local Health Agency - A Re-examination. American Journal of Public Health, Vol. 63 #4, 1973.

21. Environmental Health Factors in Penal and Correctional Institutions. Journal of Environmental Health, Vol. 36 #3, 1973.

22. Community Health Aspects of Water Pollution Control Problems. Journal of Milk and Food Technology, Vol. 37 #1, 1974.

23. Environmental Health: Program Planning and Implementation. Journal of Milk and Food Technology, Vol. 37 #2, 1974.

24. Public Behavior During an Air Pollution Episode: Implications for Health Planning (with Melba Varner). Medical Annals of the District of Columbia, December, 1974.

25. Professional Accountability in Environmental Management. Journal of Environmental Health, Vol. 37 #8, 1974

26. Occupational Health Problems in a Non-Industrial Community. Journal of Environmental Health, Vol. 38 #2, 1975.

27. Health, the Environment, and the Urban Community. Journal of Environmental Health, Vol. 39 #6, 1976.

28. Food Protection in Jails and Prisons. Journal of Food Protection, Vol. 40 #6, 1976.

29. Administrative Aspects of Environmental Health in Correctional Institutions. Journal of Environmental Health, Vol. 39 #3, 1976.

30. Environmental Health Needs in Correctional Institutions. Federal Probation, Vol. 41 #4, 1978.

31. Health and High Density Confinement in Jails and Prisons. Federal Probation, Vol. 43 #5, 1980.

32. Lead Content of Milk and Infant Formula. Journal of Food Protection, Vol 43 #3, 1980.

33. Occupational Cancer. Journal of Environmental Health, Vol 44(4) 176-179, 1982.

34. Occupational Exposure to Aromatic Amines: Benzidine and Benzidine-Based Dyes. National Cancer Institute Monograph No. 58, 11-13, 1981.

35. The Relevance of Occupational Medicine. Journal of the National Medical Association, Vol. 74, No. 4, 1982.

36. Occupational Health Standards for Laboratories. American Journal of Industrial Medicine, Vol. 2:404-410, 1981.

37. Issues in the Regulation of Environmental Carcinogens. Journal of Public Health Policy, Vol. 3, No. 4, 1982.

38. Occupational Exposure to Benzene. American Journal of Industrial Medicine, Vol. 1:233-243, 1980, Coauthored with White and Infante.

39. Data Sources for Estimating Environment-Related Disease. Journal of the National Medical Association, Vol. 76, No. 3, 1984

40. The Occupational Safety and Health Act of 1970: A National Policy for Prevention of Work-related Illness. Journal of Environmental Health, August 1984

ACADEMIC APPOINTMENTS

Fellow (Environmental Health)
School of Public Health
University of Minnesota
Minneapolis, Minnesota (1967-1969)

Visiting Professor
Environmental and Occupational Medicine
Meharry Medical College
Nashville, Tennessee (1972-present)

Adjunct Professor
Occupational and Environmental Health
Department of Community Medicine
College of Medicine
Howard University
Washington, D.C. (1975-present)

Adjunct Professor
Epidemiology and Environmental Health
College of Medicine and Allied Health
George Washington University
Washington, D.C. (1975-present)

Lecturer
Department of Environmental and Industrial Health
School of Public Health
University of Michigan
Ann Arbor, Michigan (1981-present)

Adjunct Professor (Environmental Medicine)
College of Medicine
Michigan State University
Lansing, Michigan (1981-1983)

Adjunct Professor of Occupational and Environmental Health Sciences
Howard University
School of Human Ecology
Washington, D.C. (1976-present)

Lecturer (Environmental Health)
School of Public Health
Harvard University
Cambridge, Massachusetts (1983-present)

Adjunct Professor (Environmental Health)
School of Public Health
Boston University
Boston, Massachusetts (1983-present)

AWARDS AND HONORS

1. The Distinguished Health Scientist Award (1972)
Presented by the National Environmental Health Association for outstanding achievement in environmental health services.

2. Editor's Award (1975)
Presented for the most outstanding paper submitted to the Journal of Environmental Health.

3. The Most Distinguished Alumnus Award (1975)
Kentucky State University, Frankfort, Kentucky.

4. 1978 Browning Prize for Disease Prevention
$5,000 honorarium and bronze medal presented by the American Public Health Association for leadership in the prevention of acute and chronic diseases.

5. The U.S. Attorney General's Special Commendation for Outstanding Service (1979)
Presented by United States Department of Justice for outstanding work in preventing environmental and occupationally-related diseases in the nation's jails and prisons.

6. The Resolution of Commendation for Extraordinary Achievements (1979)
Presented by unanimous vote of the District of Columbia City Council for extraordinary accomplishments in municipal public health services.

7. The Environmental Health Scientist of the Year Award (1979)
Honorarium and plaque presented by the International Association of Health Scientists for outstanding and dynamic leadership in environmental and occupational health services and teaching

8. Distinguished Service Award (1980)
Metropolitan Washington D.C. Public Health Association
Presented for exemplary work in modern public health administration.

9. 1981 National Merit Award
Delta Omega Honor Society
Presented for outstanding achievements in public health service and teaching.

10. Resolution of Commendation for Outstanding Achievements in Public Health Services in Michigan - Unanimous vote of the Michigan Legislature (Senate and House of Representatives Concurrent Resolution No. 18)
Michigan State Legislature, February 1, 1983

11. Mangold Award (1984) Plaque and Stipend, representing the highest award of the National Environmental Health Association, "for excellence in the application of science to the prevention and control of environmentally-related diseases".