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# INDOOR AIR AND HUMAN HEALTH REVISITED: A RECENT IAQ SYMPOSIUM<sup>1</sup>

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## ABSTRACT

Indoor Air and Human Health Revisited was a speciality symposium examining the scientific underpinnings of sensory and sensitivity effects, allergy and respiratory disease, neurotoxicity and cancer. An organizing committee selected four persons to chair the sessions and invite experts to give state-of-the-art presentations that will be published as a book. A summary of the presentations is made and some critical issues identified.

## DESCRIPTION AND SCOPE

The 'Revisited' in the title refers to the reholding of a symposium of the same title held in 1984. I had the privilege of cochairing both events. The current symposium was the eleventh in a series of Life Sciences Symposia organized by Oak Ridge National Laboratory. The symposium was held at the Hyatt Regency Hotel in Knoxville, Tennessee, March 28-31, 1994. Manuscripts provided by speakers will be published in book form by Lewis Publishers.

The organizing committee insisted on as much hard science being presented as was possible. The committee also wanted to invite some speakers whose research was little known to the IAQ community in order to introduce some fresh ideas. As the title suggests, the focus of interest was on the adverse human health effects stemming from deficits in indoor environmental quality. Issues perceived as being dominated by emotion rather than scientific understanding, such as sick building syndrome and multiple chemical sensitivity, were omitted from the program.

Invited chairpersons selected a few experts to present state-of-the-art research and their opinions concerning sensory and sensitivity effects, allergy and respiratory disease, neurotoxicity and cancer. A small audience and informal atmosphere allowed extensive questioning and exchange of ideas among researchers.

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## FOCAL TOPICS

### Sensory Response

The following questions were targeted in this session: What properties endow a molecule with the ability to stimulate odor and arouse particular odor quality; how well characterized are the receptors and neural apparatus for this mediation; are there predictive models of odor and irritant potency; can one objectively show a person has experienced odor or irritation and does odor influence behavior?

Considerable progress is being made on furthering the understanding of irritation and odor based on the makeup of the olfactory system, structure-activity relationships and other physicochemical parameters. Charles Greer, Yale University, showed just how advanced our understanding has become of receptors and neural apparatus for mediating odors and irritants.

Are there predictable models for the potency of odors and irritants? Enrique Cometto-Muniz and Bill Cain at Yale University provided a partial "yes" to this question by being able to separate trigeminal (pungency) from the olfactory (smell) component of response using normosmic (normal) and anosmic (no sense of smell) subjects. By investigating responses to homologous series of volatile organic compounds, they are searching for the relevant physicochemical determinants. Major factors are shown to be water and lipid solubility.

Coming at the problem from a different angle, Michael Abraham, London University, has developed a mathematical model for gauging nasal pungency and odor threshold. His model is based on a compound's characteristics of lipophilicity, hydrogen bonding and polarizability. There is good success at predicting nasal pungency but a lower rating for prediction of odor threshold.

The use of microelectrodes inserted in the nose is being used to detect changes in electrical potential when a subject is exposed to a chemical vapor. This work, described by Gerd Kobal of the University of Erlangen, Germany, is a superior and objective means of gathering human response data.

The influence of odors on human behavior, has attracted sparse research, according to Susan Knasko, Monell Chemical Senses Center, Philadelphia, Penn. Task performance studies do not lend much support to the idea that addition of pleasant odors to the environment actually improve task performance. The pleasantness or unpleasantness of odors are to some extent related to mood and health in daily life. But psychological determinants, such as association, conditioning, placebo effect, recall bias and expectations, can easily muddy scientific studies.

### Respiratory and Allergic Effects

Cecile Rose, National Jewish Hospital, Denver, organized presentations focusing on bacterial agents, fungi, endotoxins, and allergens.

Hypersensitivity pneumonitis (HP) is a serious and more widespread disease than is currently recognized, according to Rose. Antigens causing HP are abundant where water damage creates favorable growth conditions, but the disease is often quite difficult to diagnose.

The rapid growth in the incidence of asthma is, according to Tom Platt-Mills, University of Virginia, attributable largely to dust mites thriving in commonly installed wall-to-wall carpeting. Air-tight buildings and central heating maintain humidity and temperature conditions that allow dust mites to thrive. Vacuuming redistributes but does not kill the mites. Cool wash detergents even allow the mites in our clothes to survive laundering. Children of less than two years of age are particularly prone to becoming sensitized to mite allergen.

Don Milton, Harvard School of Public Health, stressed the importance of endotoxins produced by gram negative bacteria in producing building-associated respiratory illness. Small amounts of endotoxin can cause a massive and damaging immune response. Humidification devices in the home or office can be sources of endotoxin. There have been significant advances in measurement technology.

A growing infectious disease problem is that of drug-resistant tuberculosis. The only effective means of control in a hospital environment is UV-germicidal irradiation, according to George Kubica of Atlanta. Andy Streifel, University of Minnesota, dealt with other airborne microorganism problems in hospitals. Stringent attention needs to be given to preventing transmission from construction zones to patient rooms, identifying air leakage pathways, restricting numbers of visitors and employing point-of-use HEPA filtration.

Other important issues that were discussed included upper-airway reactivity to environmental tobacco smoke by predisposed individuals and ozone's ability to exacerbate allergic responses.

### Neurotoxicity

The neurotoxicity session arranged by Hugh Tilson, EPA, was twofold in its scope. First, if the indoor air quality causes discomfort or annoyance, does it manifest itself in reduced productivity, measured as a loss in human vigilance? Second, can it serve as a low-level stressor that alters immune-system function?

Techniques available for assessing distractibility in humans and animals, and considerations of how they might be applied to IAQ problems, were discussed by Vernon Benignus, EPA, and Christopher Newland, Auburn University. Benignus concluded that there has been only one convincing study that shows the effects of a chemical irritant (formaldehyde) on task performance. He suggests that a testing strategy for chemical irritation should begin with either a wide-range dose effects study or a high-level single-exposure study. Newland focused on animal models of assessing vigilance. Particularly promising is where two or more response alternatives are presented. The choice of alternative activities and an opportunity to persevere are possible procedures for detecting neurobehavioral effects of indoor air. Dependable measures need

validating with known chemicals and should be functionally similar to those of concern with humans.

Donald Lysle, University of North Carolina, showed that conditioned rats (previously shocked with electricity), when returned to the shock chamber, undergo pronounced alterations in immune function. This alteration occurs even without any further shock treatment, a process called exposure to conditioned aversive stimuli. This phenomenon of immune response may be significant for persons who experience unpleasant air pollution or other stressful events in the indoor environment. Bruce Rabin, of the Brain, Behavior, and Immunity Center, Pittsburgh, reviewed the literature showing that for humans, events perceived as stressful can activate the release of neurotransmitters and endocrine hormones. This altered immune function decreases resistance to disease and increased susceptibility to autoimmune disease.

The neuroscience presentations underscored the possibility of indoor air pollutants having effects on the nervous system other than alteration in sensory function.

### Cancer

This session focused on the three traditional indoor air carcinogens of radon (Jon Samet, John Hopkins University, Baltimore, Maryland), asbestos, (Rashid Shaikh, Health Effects Institute, Cambridge, Mass.) and environmental tobacco smoke (ETS) (Doug Dockery, Harvard University, Boston) that can cause lung cancer.

The latest estimate of excess lung cancer deaths in the U.S. due to radon is 14,000 per year. This estimate is based on a dose ratio of 0.7 in homes versus mines. For ETS, combined epidemiological studies indicate a 20% increased risk. The main benefit of stricter ETS rules, however, will be to reduce active smoking. Based on recent asbestos levels measured in buildings, the lifetime risk of cancer for general occupants appears to be relatively low, especially when compared to risks from radon and ETS. It is custodians and maintenance workers who are at greatest risk and who must be afforded the proper protection.

Other types of cancer were not discussed in the session. Perhaps the time is ripe to turn some attention to other types of cancer that have increasing death rates in the USA, the causes of which are suspected to be unknown environmental factors. Exposures to a diverse group of post-World War II synthetic chemicals in indoor air might be contributing to the increases in one or more of non-Hodgkin's lymphoma, multiple myeloma, and cancers of the prostate, brain, kidney, esophagus, and breast.

### SPONSORSHIP

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## KEYWORDS

Symposium, sensitivity, sensory, allergy, respiratory disease, neurotoxicity, cancer.