AEML, Inc.
Microbiology Laboratories

Originally Broadcast April 30, 2010
Rebroadcast on March 17, 2023 as Part 1 of the 2 part Hal Levin IAQ Legacy Series.

The IAQ Legacy of Hal Levin, Part 1

Good Day wherever you are reading from and welcome to the Indoor Air Quality (IAQ) Radio blog for Friday, April 30th 2010. Episode 164 was recorded in Studio B which was in Coraopolis. Radio-Joe and the Z-Man were there along with our engineer "intrepid Environmental Annie Ann Kowaleki" at the controls. The episode was recorded in pre-blog days. Fortunately, we have archived the recordings of all IAQradio Episodes. It was great to hear Hal's voice sharing his wisdom again.

Nuggets mined from this episode:

Your educational background is interesting you attended Cornell in Ithaca, NY from 1959-1961 then went to Cal Berkley throughout the 60s what part of the country were you raised in?
West Coast - Born in Portland, moved to LA to attend K-12.

You attended Cal Berkley during a rather interesting time in history graduating in 1969 with a B. Arch. Any interesting stories from the 60s?
It was an exciting time. I was there in Sproul Plaza for the beginning of the Free Speech Movement. I left to go in the Peace Corps in Colombia, South America, and returned in January 1969. I was there in '69 for the Third World Strike and later for People's Park.

In 1972 you started Hal Levin Design and Construction and the Building Ecology Research Group did you build homes and/or buildings during that time 70s?
Hal was a second-generation builder, Hal's initial introduction to construction was by working on some of his father's projects.
Hal designed and built and remodeled a few houses to learn more about construction so that I could help others design and build their own homes. I moved from the Bay Area to Santa Cruz County to do thatand helped a lot of people.

Owner-building was an incredibly effective way for people to acquire home ownership. The owner-builder movement was blossoming in those days.

Since the 60's and 70's construction of residential and commercial buildings has gone through some significant changes. You started using the term building ecology in the late 70's first please tell us what building ecology is to you?
Hal saw the lack of connection between dynamic relationships between the complex interdependency of building systems, people and the outdoors.

Hal coined the term Building Ecology in 1978 when he started teaching in Architecture and doing research at UC Berkeley and also teaching at UC Santa Cruz in Environmental Studies. I studied the ecology textbooks and saw that the approach of ecologists was applicable to buildings.

Were you able to get owners to buy into the concept of building ecology when you first started building and designing projects?
In a sense and in a piecemeal way. Most of my clients wanted energy-conserving, environmentally sensitive homes. But I hadn't coined the term yet.

When did you stop designing homes and move into research and consulting?
The last house I designed was in 1981. It was for a professor at UCSC that I met through our common interest in energy conservation. It was off the grid with solar PV installed on the roof as soon as the roof went on. The house was completed using the electricity generated on site. It was a passive solar house, of which I had done several previously. Some of my Santa Cruz students said I was the first passive solar house designer there, with my first one around 1975. I ran into the professor a couple of years ago and asked about the house. His response was: "you designed a really good house." So I quit while I was ahead.

Since that time, all my design efforts have been as a consultant including to some of the biggest architect names in "green" or "sustainable design."

What types of building ecology concepts would you like to have seen catch on more than they did?
Understanding the dynamic interdependence of the indoor and outdoor environment and the building occupants, including the impacts of the building on

the occupants and vice versa.

What building ecology concepts have caught on as well as you would like?
I see in the indoor environmental research, especially the best science on indoor air quality, and especially those looking at indoor air chemistry an implicit understanding of the dynamic nature of the building in relation to its occupants and the outdoor environment. Charles Weschler, Bill Nazaroff, Glenn Morrison, and Rich Corsi are among the leaders in this field. Charlie's recent lecture at Lawrence Berkeley National Laboratory, available for viewing on YouTube, is an excellent example of this kind of science.

But the design community still approaches building design as a set of related but somewhat independent specialized activities that the architect or other design team leader simply sorts out and produces a single solution.

What one or two key mistakes have we made over the past 30-40 years that we should not repeat if possible?
Separation of ASHRAE Standard 62 (Ventilation and IAQ) and Standard 55 (thermal comfort). These are affected by and ought to be addressed by the same building solutions. ASHRAE Guideline 10P tries to get at these connections and interactions for the first time anywhere, well, except for papers I wrote a long time ago. ASHRAE Guideline 10, now out for Public Review, brings together a lot of what we know about the interactionsand also discusses interactions with light and noise. There is far less know than we would like but far more known than we tend to reflect in our standards, codes, and practices.

IAQ The Early Days

Industry veterans often point to the EPA's 1989 Report to Congress on Indoor Air Quality as the tipping point for IAQ, the time when the term IAQ became understood and appreciated among a wide array of professional and trade disciplines. From your perspective, why was that report so important?
That was a very valuable report that brought a lot of things together very clearly. But almost ten years earlier was the National Academy of Sciences report, "Indoor Pollutants." That was the first American report that acknowledged that buildings could cause human health effects.

I don't see any single event as a "tipping" point. IAQ is a "construct" - a concept that has different meaning for each person -- that has meant different things at different times. In Europe in the early 70s it was about tight buildings and formaldehyde and other VOC emissions from materials in the context of low ventilation rates for energy conservation, and about the growing number of reports about building-related symptoms. In the U.S. EPA and DOE funded IAQ research starting in the mid-70s. CPSC got into the act back then too. HUD looked at formaldehyde emissions in the later 70s and early 80s.

Lance Wallace's work on VOCs is probably the most often cited -- 'IA is 10 X worse than outdoor air." IAQ means different things to different people - formaldehyde, radon, asbestos, lead, carbon monoxide, VOCS, environmental tobacco smoke, mold, moisture, SBS, pesticides, fire retardants, plasticizers, ultrafine particles, ozone, etc. People are starting to see the connection to outdoor air quality more clearly now too. Now we are seeing attention to IAQ more commonly in "green" or sustainable design, but IAQ is still not "mainstream," and the majority of buildings are designed, built, operated, and occupied without any regard to IAQ unless there is a problem.

One could easily argue that the EPA's ETS report in the early 90s, the carpet problems at EPA HQ at Waterside Mall in May 1988, the Carpet Policy Dialogue of the early 90s, and other newsworthy events were mini-tipping points.

Here in California, the problems at a new state office building in Sacramento, the Bateson Building, gave the media lots to write about and Legislators lots to talk about. The California Department of Consumer Affairs held two days of public hearings on indoor pollution in December 1978, and we got a lot of press coverage of that. The CA Dept of Consumer Affairs did a report on indoor pollution that was released about the same time as the National Academy of Sciences report, in early 1982, and we got a lot of coverage on that. Shortly after that, the first state program on IAQ was established in California and continues to be important today.

Since the 1989 EPA report, even IAQ professionals have recognized a lack of scientific research sufficient to establish a causal relationship between poor IAQ and chronic health conditions. But that seems to be changing, especially with the push toward Healthy Homes under President Obama's chiefs at HUD, EPA and CDC. Does the

industry have sufficient scientific evidence today to state unequivocally that poor IAQ makes people sick?

This kind of generalization resists scientific evidence because science inherently is skeptical. For specific pollutants and specific health outcomes, there is abundant scientific evidence. But as is always the case, in scientific terms, the "weight of the evidence" may or may not meet everyone's criteria for "sufficient evidence."

Scientific inquiry is self-limiting and then the paucity of funding for it further limits what we know and can learn from indoor air science, The necessity of limiting the number of variables involved in a scientific study for both economic and practical reasons reduces the ability of science to fully understand what I have called "building ecology." In ecology, we know that everything is connected to everything. In science, there is a strong tendency to narrow the focus of the inquiry in laboratory or field studies. In epidemiology, the main source of our knowledge about the relationship among environmental factors and health outcomes, the data used to characterize exposure are critical and they are almost always deficient. This is because the sources of the exposure data are usually too narrowly focused. In other words, most building science and health science applied to the built environment is not "building ecology." It is too often reductionist, narrow, deterministic science. There is a place for this, but it must be part of a broad spectrum of tools we use to understand the impacts of buildings on our health. We must study at the microscopic level, the macroscopic level, and the meta level. We must find a way to integrate the knowledge at all these levels in a meaningful and useful way. This problem is not limited to indoor air quality. It is similar to the study of ecosystems, of climate change, of human anatomy, of almost all advanced technology for "real world" application.

I believe we have had sufficient evidence for many indoor pollutants for a very long time. Carbon monoxide, formaldehyde, asbestos, lead, certain VOCs such as the industrial solvents such as toluene and xylene, not found much anymore or found only at low concentrations, benzene, environmental tobacco smoke. What's most difficult is "proof." But if one adopts the precautionary principle, we have sufficient evidence to know that we need to 1) reduce pollutant sources, and 2) ventilation adequately to control concentrations of those pollutants that are unavoidably present indoors.

In the early 1990s, EPA convened a stakeholders meeting under a loosely knit group

called the Indoor Air Quality Interdisciplinary Forum – IAQIF. It seems like that could have been the start of an organization like IAQA or ISIAQ, but instead it took another ten years for those groups to really come together. What happened in the 1990s that prevented industry from coalescing, and why have things changed so dramatically in the last 10 years?

EPA convened that meeting to learn about the possibilities of training, certification, etc. for professionals. but not to initiate anything on its own. EPA did not have the authority to establish any professional groups for indoor air quality. There were a lot of little fiefdoms including AIHA which had not been converted yet to the belief that IAQ was a significant health risk and, more importantly, a significant area for professional societies to be active. Sure, there was an IEQ committee at AIHA, and an IAQ committee at APCA, now A&WMA, and the Environmental Health Committee was established at ASHRAE in 1985, and the American Institute of Architects established its Committee on the Environment in 1990. But these were all marginal activities in all of these organizations. Then, as various professionals and industrial interests saw the market growing for services and products, groups like IAQA were formed. These are more trade and industry-oriented than scientific and professionally oriented.

Current Events, CIRCA 2010

What are your thoughts with respect to moisture, dampness and mold? Why do people living in damp buildings get sick is it the mold, the bacteria, something else or the combination?

The scientific evidence for a connection to moisture is the strongest. There is some evidence for certain species of mold and bacteria but it is generally far weaker for mold and bacteria. An exception, of course, is *Legionellap*, the cause of Legionnaire's Disease, but exposure to *Legionella p.* may not be dominated by bacteria found in the air. It is my opinion that certain molds and bacteria are probably involved and moisture is quite relevant to the health-relevant exposures causing the reported health effects.

We had Jim White who was with CMHC on the show recently and he talked about passive vs. natural ventilation. What are your thoughts on the issue is passive ventilation worth pursuing?

Passive ventilation and natural ventilation are synonyms. There is no doubt that we should use passive or natural ventilation whenever and wherever it can provide

acceptable indoor environmental conditions, primarily with respect to air quality and thermal conditions. It is under-utilized today in the US, and the trend is to require mechanical ventilation. That's wrong-headed. The focus should be on pollutant source reduction, then natural ventilation, and only after those two are fully implemented, use mechanically assisted ventilation as required.

You are very active in ASHRAE and they have a goal of Zero-net energy in buildings. What are we going to have to do to reach that goal?

This question deserves a full one-hour or even a one-day show of its own. In ASHRAE, zero net energy means building operational energy, not life cycle energy. But truly zero-net-energy would also look at the full life cycle energy to construct the building and to dispose of it at the end of its life as well as the energy involved in transporting people and goods to and from the building. Simply stated, we already have buildings that use 10 to 20% as much energy as the average or code-mandated buildings of today. Getting buildings lower than that requires some sort of very elegant solution such as cascading energy - using higher temperature waste heat to drive other processes requiring lower temperature heat, for example. Taking waste heat from a supermarket refrigeration system and using it to heat apartments in the neighborhood. The Dutch have been looking at this kind of solution. But commuting, transport of materials and people to buildings uses as much energy as the buildings themselves, and we need to think about net-zero in terms of community net zero. We can go beyond that with virtual conferencing, like this phone call, for example.

Also, there is a huge difference between site energy use intensity, what is usually reported and discussed, and source energy -- the total energy involved in all the energy consumed. This must include the energy involved in mining, processing, and transporting fossil fuels to the power plants or buildings where they are used, and the energy used in these processes are large. For electricity, it is approximately three times the energy delivered to the building site.

My opinion is that we will shift our focus to look more at greenhouse gas emissions than at energy use per se as we begin to address the human contribution to climate change more seriously. There is not a one-to-one ratio between energy use and greenhouse gas emissions. For four years now, I have chaired an ASHRAE committee that is developing tools for calculating buildings' carbon emissions. We have a lot of work to do to understand the consequences of our actions, another

example of building ecology.

You have been part of the sustainability movement since the 70s what is sustainability today and should we reconsider the use of that term?
The term has become fairly meaningless. But there is some serious discussion in the scholarly journals and academic publications. This is another one-hour or one-day conversation. Simply put, sustainability is not about smarter growth or efficiency. It is about reducing mass flows - the amount of material used and emitted by society. The dominant use of the term is derived from the Bruntland Commission and the UN conference in Rio in 1992. But the definitions used are largely too vague and do not really help us evaluate the sustainability of our building designs or operations. I'd be happy to come back and discuss this in detail at another time.

We had Dr. Marylin Black and Dr. Elliot Horner on the show recently and they both discussed indoor air chemistry but focused on VOC's. What other indoor air chemistry issues should practitioners be more aware of?

Outdoor and indoor air are a continuum. Many chemicals commonly found indoors react with oxidants such as ozone to form more hazardous chemicals such as formaldehyde, higher molecular weight aldehydes, and ultrafine particles. We must avoid these chemicals including many so-called "green" cleaning products when we know there will be ozone in the outdoor air and enough outdoor air to transport it indoors. In general, we should always evaluate building materials (and all products for that matter) according to the required maintenance and the full life cycle. When will it need to be refinished? How long will it last? What processes or chemicals will be released when it is new and when it is refinished? How will we dispose of it?

What are your thoughts on the use of the precautionary principle when determining how regulations, standards and guidelines are developed?
My extensive experience with pesticides and their regulation and their misuse in the U.S. has firmly convinced me that we make a big mistake not using the precautionary principle. Too many people have to suffer sometimes irreparable harm before chemicals get regulated. And when they do, then they often remain in the environment continuing to affect people.

You worked as an industry practitioner – a researcher, a consultant, an architect and more – for most of your professional career. But now you are in a very different position, as the chief staff executive of an international professional society. What has been the most challenging part of this career shift?

The position with ISIAQ is a part-time position. I am still mostly doing what I have been doing for 40 years or more. ISIAQ just created the position of Executive Director and the Board of Directors still has not figured out how exactly they want the Ex Dir to function. The challenges of being the first Ex Dir include helping the Board members understand how an Executive Director should function.

A lot of people think of the Indoor Air Quality Association as the organization of choice for IAQ consultants and contractors; whereas they view ISIAQ as the organization where researchers and scientists convene. Obviously, the practitioners and the scientists need to come together. What kinds of things are you doing at ISIAQ to bring the two communities closer?

It has always been the goal of ISIAQ to serve our professional members and the larger indoor air community better. We are planning to have a lot more to offer the IAQ consultants and contractors at Indoor Air 2011 in June of next year in Austin, Texas. We are planning to start a publication with more of a focus on practice rather than science. We are co-sponsoring a number ofconferences including one in Colorado this September together with Colorado State University that will have a bit more of a practical focus. We are co-sponsoring several events around the world this year and next year, and we are trying to help our chapters around the world organize regional conferences with more of a practice focus. Many of our chapters' members are more practice oriented.

Anything that you would like to add before we go?

- Children are helpless victims of decisions made by others.
- Architects are often clueless about home buildings work.
- Architects and builders are solution orientated, they need answers fast and don’t have time to research.
- Money as the first design principle and its disastrous effects on the environment and on building occupants. Source control Just a thought on how we can fit these in.
- Zero-net energy buildings, mostly not looking broadly enough at buildings' energy use and the related impacts

- Sadly, "sustainability" has become a meaningless term used mostly for marketing, cannot be taken very seriously any more. But the fundamental question remains: how do we get there? It's not about reducing 10 or even 50% -- It's about setting targets based on the Earth's carrying capacity, then figuring out how to get along on a budget based on reaching those targets. Indoor Air Chemistry
- You can download ASHRAE standards while they are in public review at no charge.
- IAQ measurements are just points in time.

Valuable links:

https://www.youtube.com/results?search_query=charlie+weschler+lecture+ozone watch Charlie Weschler lectures and presentations on ozone and the chemistry of indoor air.
https://www.researchgate.net/publication/267631638_Building_Ecology_An_Architect%27s_Perspective_--_Plenary_Lecture Hal Levin's plenary lecture

https://pubmed.ncbi.nlm.nih.gov/18333994/Outdoor ozone and building-related symptoms in the BASE study

Z-man signing off

TRIVIA
In what year did Hal Levin coin the phrase "Building Ecology*"?*

Answer: 1978