Sick buildings: The ventilation conundrum

According to the Environmental Protection Agency (EPA), up to 30 percent of new and remodeled buildings trigger illness in some of their occupants. Affected individuals exhibit any of a range of nonspecific complaints, including headache, respiratory irritation, asthma- or flu-like symptoms, chest tightness, and fatigue. Over the past decade, many studies have demonstrated that this "sick building" syndrome contributes to increased absenteeism and reduced work efficiency, not to mention physical discomfort.

To combat the problem among office workers, EPA recommends increasing ventilation with outdoor air to at least 20 cubic feet per minute (cfm) per person. But some Canadian office workers perceived absolutely no difference in symptoms or comfort when ventilation rates in their buildings doubled to 60 cfm, according to epidemiologist Richard Menzies and his colleagues at McGill University in Montreal.

Their double-blind, crossover study altered air-exchange rates at four buildings with sealed windows and mechanical ventilation systems every Friday afternoon for three two-week recording periods. On succeeding Wednesday or Thursday afternoons, the Montreal group questioned 1,546 respondents from upper-floor offices, asking about their overall impressions of the work environment and whether it had changed from the previous week. Questionnaires also polled recruits on any symptoms of illness experienced during that day.

Overall, slightly more than half the participants reported at least one symptom each week, Menzies' group reports in the March 25 New England Journal of Medicine. And while responses differed among buildings, they did not vary within a building during a study period — even though ventilation rates changed up or down (between 30 cfm and 64 cfm) weekly. The recruits' unchanging perception of air quality also appears to confound the role of irritants such as formaldehyde and other volatile organic compounds. Concentrations of both doubled or nearly tripled in the air of some buildings when ventilation rates fell to 30 cfm.

The new report does bring "fresh air to the largely untested hypothesis that the sick building syndrome is related to inadequate ventilation with outdoor air," writes Kathleen Kreiss in an accompanying editorial. Kreiss works at the National Jewish Center for Immunology and Respiratory Medicine in Denver.

"The *design* of this study is very strong and might serve as a model for future research to establish a scientific basis for ventilation standards," comments Mark J. Mendell of the National Institute for Occupational Safety and Health in Cincinnati. However, he cautions, readers "may easily misinterpret this report as having shown that ventilation rate is not related to worker symptoms." And that, he told Science News, would constitute an "overinterpretation" of the findings.

Menzies' team attempted to compare ventilation rates of 20 and 50 cfm. Owing to the structures' leakiness, however, actual ventilation ended up much higher. The study would have yielded more useful information if it had addressed the most important question about current ventilation, Mendell believes: "the relationship between health effects and ventilation rates between 0 and 20 cfm — or even 30 cfm per person."

While the findings do suggest that ventilating far above the current standard will not eliminate sick building syndrome, Mendell says, they are of little immediate importance since there is "[no] serious debate about setting ventilation standards anywhere within the range of 30 and 64 cfm per person."

However, Kreiss says, the study does indicate that "we do not know the cause of the sick building syndrome." Moreover, she adds, "science to support prevention, correction, and the setting of standards is woefully underdeveloped and unsupported." — *J. Raloff*

Jupiter and Saturn: Rare in the cosmos?

When astronomers search for planets orbiting other stars, they often look for bodies similar to Jupiter or Saturn. After all, these behemoths of the outer solar system are both big and bright. Thus, their presence should be easier to detect than the likes of Earth.

But the typical planetary system may not resemble ours, especially in its outermost members, cautions George W. Wetherill of the Carnegie Institution of Washington (D.C.). In fact, he says, Jupiters and Saturns could be downright rare. Last week at the annual Lunar and Planetary Science Conference in Houston, Wetherill reviewed his theory and reported new calculations about the influence of Jupiter on our planet.

According to a popular scenario, all the planets in our solar system evolved from a disk of gas and dust that encircled the young sun. The inner planets arose from dust grains in the disk that clumped into planetesimals, which collided to form the planets. Planets born in the frozen reaches of the outer solar system — including Jupiter and Saturn — probably formed from an agglomeration of ice and dust in the disk (SN: 3/20/93, p.190).

Jupiter and Saturn have huge atmospheres of hydrogen and helium surrounding their cores. Apparently, these giant bodies gravitationally grabbed these gases from the primordial solar disk. But therein lies a problem, notes Wetherill. Observations of disks around other stars indicate that the gases disappear in about 10 million years. Thus, Jupiter and Saturn must have developed their massive cores *and* snared circumstellar gas, all within a few million years. This rapid sequence of events makes it unlikely, contend Wetherill and other scientists, that planets similar to Jupiter and Saturn are produced in assembly-line fashion around other stars. At best, he says, "failed" Jupiters and Saturns that never formed an atmosphere and stayed relatively small — the size of Neptune — might be common in planetary systems.

In addition, notes Wetherill, planets in the outer solar system are not tightly bound to the sun. This enables their mutual gravitational tug to dramatically alter their orbits. In the average planetary system, such forces may move a Jupiter- or Saturn-like body into a highly elliptical or hyperbolic orbit, or perhaps eject the planet altogether.

Wetherill emphasizes that these ideas about Jupiter and Saturn are only speculative. "There could be a natural, self-regulating process that frequently leads to planetary systems resembling our own," he notes. But "more likely, relatively small natural variations in the distribution of angular momentum, mass, and temperature in the [circumstellar] disk, and the timing of loss of gas [from the disk] will lead to a variety of outer planet configurations."

David Black, director of the Lunar and Planetary Institute in Houston, says Wetherill's recent work confirms the view now held by many scientists involved in the search for planetary systems. Future instruments, he says, should have the capability of detecting planets one-thirtieth the size of Jupiter.

Wetherill adds that Jupiter's existence in our solar system has a profound influence on Earth. Through their gravity, both Jupiter and Saturn have acted to eject comets from the solar system early in its history. In addition, Jupiter gravitationally deflects comets that would otherwise bombard Earth.

He calculates that without Jupiter, comets would have struck Earth 100 to 10,000 times more frequently than they have. Moreover, the kind of impact believed to have killed off the dinosaurs — and that could decimate terrestrial life — would have occurred about once every 100,000 years rather than every 100 million years.

Concludes Wetherill: "Perhaps it should be expected that we have a Jupiter: Otherwise we wouldn't be here." — *R. Cowen*