THE SICK BUILDING SYNDROME

Alan Field looks at the evidence for relating sickness to the office environment.

In spite of air conditioning (or as some maintain, because of it), the internal environment is no longer the best of places to be. Popular, and even informed opinion, tends to the view that indoors the atmosphere is in danger of becoming more polluted than the air outside. Occupants are beginning to suffer various specific maladies now labelled "office building syndrome", or sometimes "tight building syndrome". In Sweden the problem is identified as a "sick building".

Concern about the indoor environment is becoming widespread. Two years ago ASHRAE felt compelled to issue a position statement urging government backing for long-term research and advocating the creation of a national inventory of aerial contaminants and their effects. The Swedish Council for Building Research is funding investigations by the SIB, the Royal Institute of Technology, the National Institute of Environmental Medicine, and the Department of Psychology (University of Stockholm) which, apart from classic research includes urgent short term projects aimed to resolve what are called acute problems.

In West Germany research is fragmented between the universities, although a few centres stand out — the Federal Health Department in Berlin, and the Institute for Water, Earth and Air Hygiene (also in Berlin). In Switzerland some aspects of the problem have been explored by the Federal Institute for Health and Hygiene, and at the Institute for Hygiene and Work Physiology — both in Zürich.

In France, where air conditioning has had a consistently bad press — not only for its "claustrophobic effects" and its implication in disseminating various micro-organisms but its so called squandering of energy — the reaction has been mainly defensive. The official viewpoint of the industry has been put over by the French representatives of the principal international organisations (CECOMAF, CIFCA, EUROVENT and GCI), but little definite research has in fact been reported.

In the UK the recommendations of the Royal Commission's 10th report on environmental pollution have been taken up by the BRE who are studying ventilation and indoor pollution, and the National Radiological Protection Board who are working on the radon question.

It would be easy to define office building syndrome (obs) if it were one specific thing — but its manifestations are various and the basic causes still in doubt. Essentially obs is a dissatisfaction with the environment other than feeling too warm or too cold. It can include lassitude, headaches, dizziness, nausea, irritation of eyes, nose and throat, and feelings of stuffiness, disorientation and oppression. These are compounded by the belief that air conditioning spreads diseases, and still worse that it can generate indoor photo-chemical smog.

What is odd about obs is its relatively recent rise to prominence. Air conditioning has a history going back to the 1920s but obs has been in the news only during the last five years or so.

One of the contributing factors was undoubtedly the introduction of the various regulations on energy savings, the most important among which being the increased air tightness of buildings (better sealed windows and doors), and the limitation of room temperatures in winter and summer. For non-air conditioned buildings the role of air tightness is the obvious one of reducing natural air interchange to the point where humidity and contaminant concentrations rise, and the fresh air supply rate is too low for comfort. This can be remedied by mechanical ventilation. For air conditioned buildings air tightness is more of a psychological factor, occupants seeing the building as a hermetic, and therefore oppressive, environment.

In the USA air conditioned buildings had to save on refrigeration load in summer by raising internal temperatures 3°F to a maximum 78°F (26°C). It is perhaps not a coincidence, says Dan Int-Hout III[1] that many of the obs complaints began after 1979 when the emergency regulations were introduced. He points out that a rise of 3°F may be sensed as stuffiness rather than overheating, with the associated symptoms of headaches and increased odour sensitivity.

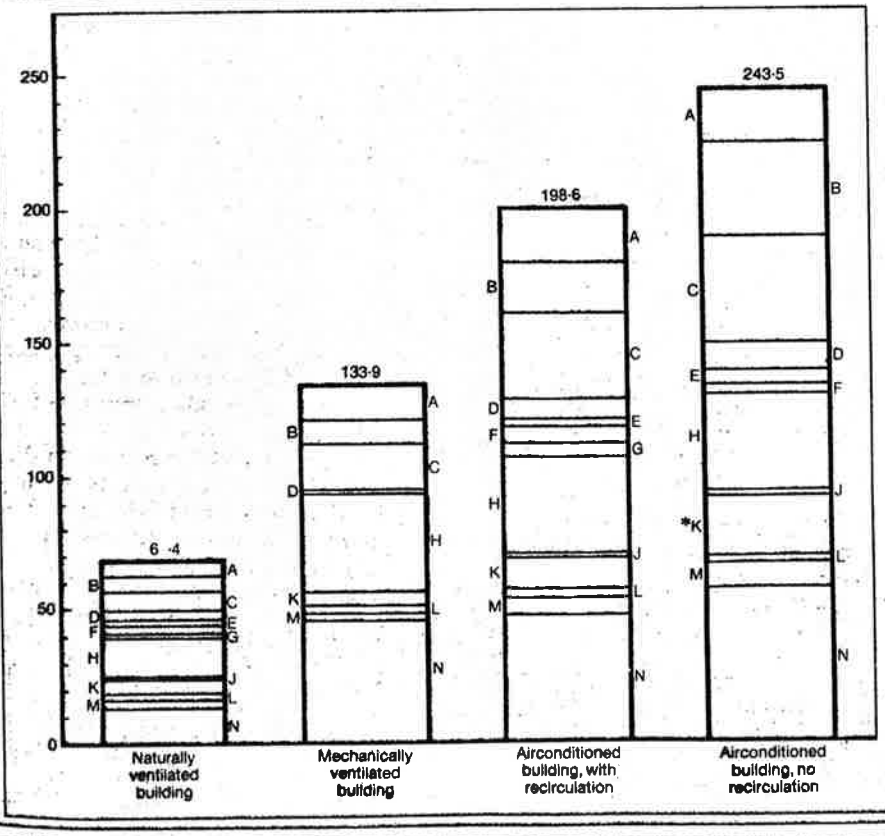
A practical example of turning back the thermostat is reported by Dr Carlton-Foss[2] where most of the complaints of air "quality" in Canadian government office buildings were resolved simply by reducing the thermostat setting in summer from 77 to 72°F (25 to 22°C).

Temperature is nevertheless only one facet of the obs story. Another is particulate and gaseous contamination from building materials, furnishings, the occupants, and other sources. These contaminants include formaldehyde, carbon monoxide, oxides of nitrogen, tobacco smoke, chemical cleaning fluids, bacteria, fungal spores, and odours. Radon may also be present.

The action of these various constituents of the indoor atmosphere is complex. Any given contaminant can exert different effects depending on its concentration, and a cocktail of contaminants can cause distinct symptoms of discomfort even though individually each component may be below the known threshold of sensitivity.

A report made after a very extensive gas sampling survey in the San Francisco Social Services building (mentioned by Gersh Major[3] concludes: "No one contaminant was identified in the air within the building that would clearly account for the symptoms reported by occupants. The possibility cannot be ruled out, however, that a number of contaminants acting synergistically may be responsible for the higher incidence of symptoms among the building occupants."

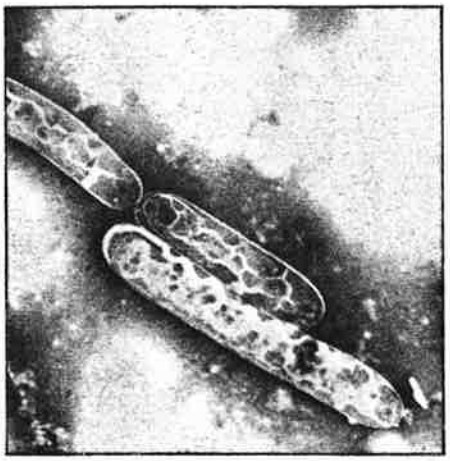
The most intensive research in the field of aerial contamination is centred in Sweden where a mobile environmental laboratory for on-site sampling and evaluation is being used. This is made up of three units using standard 6·5 m long transport



Results of a survey of six office buildings. Cumulative percentage of complaints of various ailments. *Associated with low relative humidity.

containers and forming a basic environmental chamber where subjects are exposed to indoor air, and to pure air. One of the containers houses gas dosing and sampling equipment so that, for example, formaldehyde can be introduced to the building air and its effects studied.

Not all obs problems are difficult to resolve. Some can be traced to failure of building services equipment or inadequacies of the original design. Carlton-Foss reports the case of an office block in New York where the air conditioning had not been serviced for 30 years. Some vav systems supplying inner zones can deliver insufficient air when control is based on temperature alone. Energy savings measures may also be based on reducing the amount of fresh air.



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Legionella pneumophila in close up.

The question of occupational psychology — generally neglected in most case studies — is undoubtedly an influencing factor in obs. A discontented workforce may be more disposed to blame the environment.

Significant, but so far largely unquantifiable, is the influence of the architectural treatment of the internal space.

Climatic constancy — what all good control systems are supposed to produce — could also have a negative effect. Work in 1982 by Dr Ranscht-Froemsdorf in West Germany[4] suggests that people feel better if temperature is lower at the start of the day (18°C) although they need higher temperatures as the day goes on, rising in the afternoon for example to 21°C.

Finally there is the question of air ionisation. In what seems to be incontestible research, Dr Leslie Hawkins at Surrey University's Department of Human Biology and Health, showed that negative ionisation of the air in offices at the Norwich Union Assurance block dramatically reduced the incidence of headaches, nausea and dizziness.

One thing is certain — obs will provide enough material for research for at least the next five years.

References
1) Tight building syndrome: is it hot air? Dan Int-Hout III, *Heating Piping Air Conditioning*, p 99, January 1984.
2) The tight building syndrome, J A Carlton-Foss, *ASHRAE Journal*, p 38, December 1983.
3) Air conditioning and health: What is the problem? Gersh Major, *Australian Refrigeration Air Conditioning and Heating*, p 25, January 1984.
4) Ein Problem beheizter Räume, G Keller, *Clima Commerce International*, p 7, No 10, 1984.

WATER, WATER EVERYWHERE

Jonathan David reports on a conference which looked at water borne ailments and diseases, their causes and prevention.

Legionnaires Disease, Pontiac Fever and Humidifier Fever all cause great media interest but are relatively unimportant compared with other potential hazards from water borne substances and organisms. But if they are to be taken seriously by the building services engineer there are major implications for system design. Specifically, any building services installation which stores or produces water at between 25 and 45°C must be avoided.

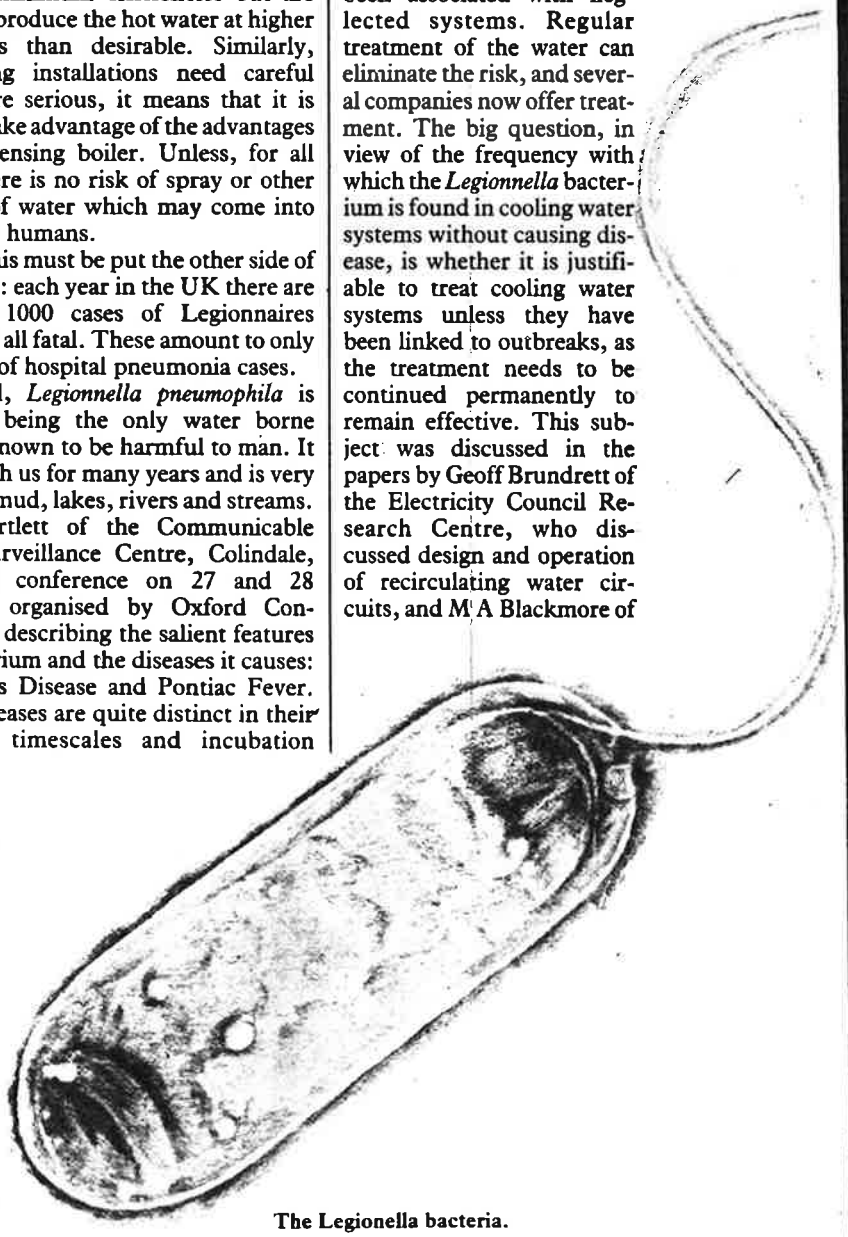
This means that domestic hot water must be stored at at least 55°C and mixed with cold water at the point of use to avoid risk of scalding. It means that heat pumps cannot be run at maximum efficiencies but are designed to produce the hot water at higher temperatures than desirable. Similarly, solar heating installations need careful design. More serious, it means that it is difficult to take advantage of the advantages of the condensing boiler. Unless, for all systems, there is no risk of spray or other carry over of water which may come into contact with humans.

Against this must be put the other side of the equation: each year in the UK there are only some 1000 cases of Legionnaires Disease, not all fatal. These amount to only about 1·6% of hospital pneumonia cases.

That said, *Legionnella pneumophila* is unusual in being the only water borne bacterium known to be harmful to man. It has been with us for many years and is very common in mud, lakes, rivers and streams.

Chris Bartlett of the Communicable Diseases Surveillance Centre, Colindale, opened the conference on 27 and 28 September, organised by Oxford Conferences, by describing the salient features of the bacterium and the diseases it causes: Legionnaires Disease and Pontiac Fever. The two diseases are quite distinct in their symptoms, timescales and incubation periods. Legionnaires Disease is a form of pneumonia. It is in fact quite difficult to catch as most water supplies contain the bacterium, and even in the 1976 Philadelphia outbreak only 29 out of several hundred cases were fatal. Although having the general symptoms of a form of pneumonia it can also give rise to difficulties with speech and balance which may remain for life and affect the patient's ability to work. Pontiac Fever, first identified in 1968 among workers in a health department building in Pontiac, Michigan, USA, is on the other hand highly contagious.

Neither disease appears to be spread from person to person but both are acquired from environmental sources. There is clear evidence that cooling water systems may occasionally serve as sources of infection with airborne transmission of the bacterium in the drift from cooling towers or evaporative condensers. Humidification or air wash units in air conditioning systems have never been implicated as sources of either disease. But of 32 outbreaks of Legionnaires Disease between 1979 and 1982, in only one was a cooling tower implicated. All documented outbreaks from cooling water systems worldwide have been associated with neglected systems. Regular treatment of the water can eliminate the risk, and several companies now offer treatment. The big question, in view of the frequency with which the *Legionnella* bacterium is found in cooling water systems without causing disease, is whether it is justifiable to treat cooling water systems unless they have been linked to outbreaks, as the treatment needs to be continued permanently to remain effective. This subject was discussed in the papers by Geoff Brundrett of the Electricity Council Research Centre, who discussed design and operation of recirculating water circuits, and M A Blackmore of



The Legionella bacteria.