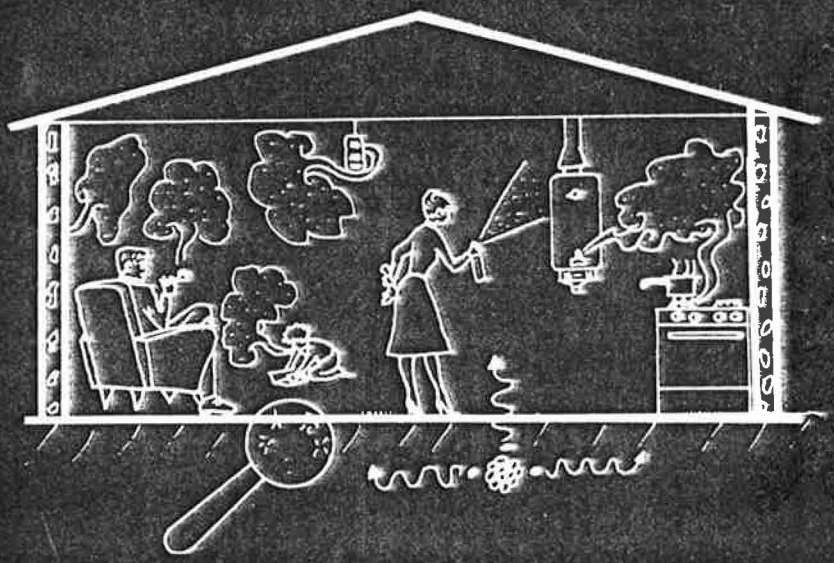
#3239

Our health



and indoor air

Eugène RYLEWSKI

"Traditionally, the engineer has taken the lead in providing a safe and potable water supply and addressing other environmental problems as they arose - arranging for the safe disposal of wastes, ventilating the workplace to control for hazardous dusts and fumes, and so forth.

In recent decades, owing to our increasing population and affluence, th ...*is ha* ...*is as*

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1. MODERN MAN LIVES INDOORS

We spend 9/10 of our time indoors : whether in houses, apartments, means of transport, schools, workshops, kitchens or public buildings. Everywhere indoors, despite all appearances, the air we breathe (henceforth referred to as "indoor air") is quite different from the air outdoors.

A world-wide survey based on some 30.000 persons showed that, depending on the country, an active person spends between 84 and 92 % of his/her time indoors and a housewife about 95 %.

Some persons are particularly sensitive to indoor air pollution.

First of all, children, from birth to adolescence. The growth of all the lung structures of the chest wall and respiratory muscles continues, as a matter of fact, throughout childhood. One example only : the number of alveolar cells which ranges from 20 to 50 million at birth goes up to between 200 and 500 billion at around 2 years of age, then their size increases up to adolescence.

Therefore, it is essential to protect infants and young children from respiratory aggressions by providing them with good ventilation.

This means that the quality of the air they breathe must be as good at home as in all the places where they spend some time, such as day-nurseries, schools, gymnasiums, swimming-pools, welfare centres, hospitals, etc...

Pregnant women, elderly people, patients suffering from chronic cardio-vascular diseases and allergies are particularly vulnerable to air pollution since, owing to their condition, they tend not to ventilate their premises adequately, or even in the case of MCV (mechanically controlled ventilation), to seal any openings which might cause draughts.

It is interesting to see the influence of outside temperature on health. The graphs in Fig. 1 clearly show a correlation between the dotted line representing the average variations in respiratory illnesses in the American population and the solid line showing the mean outdoor temperatures in Boston. (This average is fairly representative of variations in outdoor temperatures in the most densely-populated parts of the United States).

Superimposing the two graphs reveals a striking similarity, with a small time lag.

Respiratory illnesses reach their peak in January and February, the coldest months of the year, and decline markedly in the summer months. This can be attributed to confinement indoors in winter, which favors the spread of disease.

It should be noted that in the warmer seasons, respiratory illnesses, though only about 2/5 of their winter level, do not disappear entirely ; the quality of indoor air is far from being satisfactory even in summer, as we shall see later.

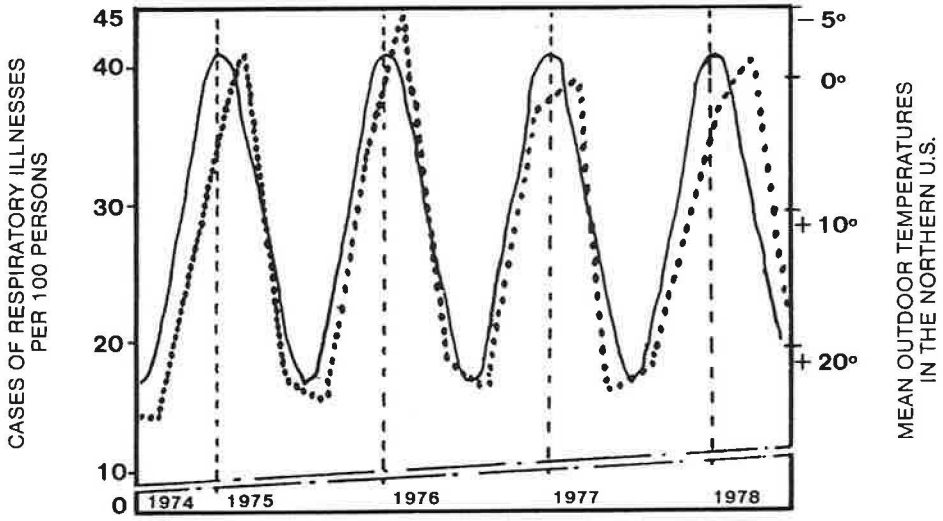


Fig. 1 — *Evolution of respiratory illnesses and of average outdoor temperatures in the northern U.S.*

2. THE VARIOUS POLLUTANTS OF INDOOR AIR

Waste products from the **biological activity** of man and domestic animals are the primary sources of indoor air pollution.

The air we breathe out contains not only carbon dioxide but also ammonia, carbon monoxide, and acetone, in proportions which depend on diet. In addition it contains some forty other substances, all in the form of highly volatile gases.

Normal **perspiration** to control body heat is over 99 % water. Non-regulatory perspiration and skin secretions contain up to 60 % of proteins, glycerides...

Hair, skin particles and **sebum** all contribute to the formation of household dust. Sebum clumps together the squames *(dried flakes of shed skin cells)* floating in myriads in the air, each one carrying an average of four or more bacteria. All together, human waste products contain about 160 mg of micro-organisms, a fraction of which can be released into the air.

Urine, Stools, Flatus, *(gases expelled from the mouth and the anus)* give off polluting gases.

Microbes, bacteria, viruses, molds, fungi, spores, and **pollen** are present in all confined places : airplanes, subways, offices, schools, hospitals, greenhouses, stables etc. They are a constant threat to health.

Dampness arising from human biological activity, from bathrooms, kitchens, washing machines, dishwashers and so on, is the prime source of deterioration in buildings and of the development of microbes, mites *(acarids)*, fungi and molds.

Household dust, characterized by particles varying in size from 0.1 mm to the size of a grain of sand, comprises a variety of organic and inorganic biological agents such as human sebum, asbestos fibers, bacteria, viruses, and mites.

The minute **house dust mite**, a microscopic spider, is one of the most potent causes of human allergies. It proliferates in bedding, upholstery and carpets, and feeds on the shed skin particles of humans and domestic animals. It dies when the relative humidity falls below 45 %.

Other important sources of dust are wind-borne, such as pollen, highway dust, and insecticides.

The 2.000 components of **tobacco smoke** represent another important source of pollution, not only for smokers themselves, but also for their familiars.

Aerosol sprays, a product of the 1950's, are to be found everywhere in homes ; in the bathroom *(deodorants, shaving creams, hair lotions...)*, the kitchen *(oven and window cleaners...)*. Many varnishes, paint removers, paints and insecticides are sold in this form.

Open flames in gas stoves, fireplaces and water heaters release important amounts of carbon monoxide and nitrous oxides ; they can be dangerous.

Radon, a little-understood source of pollution, is a by-product of the radioactive transformation of uranium. Its nuclear activity is measured in Bequerels (Bq). Common concentrations outdoors are from 0 to 200 Bq per m^3 indoors, between 1 and 400 Bq per m^3.

Swedish studies have demonstrated that there is a clear correlation between a high Bq count per m^3 in dwellings and an increase in the percentage of cancers among the inhabitants.

It is well-known that the domestic water supply and construction materials give off radon, but in quantities too small to account for this increase. Besides, it seems that for a given building, the cellar is more polluted than the ground floor, which in turn is more polluted than the upper floors. From that, it can be concluded that soils with a high uranium 238 content are responsible for the high level of radon in houses.

Negative ions

This survey of sources of air pollution would not be complete without a reference to today's great controversy over the ionisation of air. Many studies have indicated the beneficial effects on man of **natural light negative ions ;** they seem to facilitate the working of the entire respiratory system, in particular **the ciliary system*,** and to have a favorable effect on the metabolism. In unpolluted rural areas, a very high concentration of natural light negative ions has been measured, of the order of several thousands per cm^3 of air whereas it is of a order of magnitude lower in polluted cities and agglomerations. Inside unventilated premises, the number of natural light negative ions is very low and decreases sharply during prolonged human occupation.

However studies show that any mechanically controlled ventilation increases the number of natural light negative ions in any premises, despite the fact that part of those ions is absorbed by the system itself.

* *Ciliary cells are found from nose to lungs, their "cilia" are animated by a permanent upward movement.*

3. THE EFFECTS OF INDOOR POLLUTION ON HEALTH

Despite all efforts to **reduce air pollution outdoors,** there is **a continual rise in the number of illnesses,** among others in cancers of the respiratory tract. Allergy-related illnesses such as asthma, allergic rhinitis and eczema have nearly doubled over a fifteen-year period. In France in 1984, 1.700 persons died of asthma, more than 200 of them under fifty years of age.

Confined conditions favor airborne transmission of many infectious respiratory ailments, caused by viruses or bacteria : colds, rhinitis, rhino-pharyngitis, sinusitis, flu, bronchitis, diphtheria, mumps, measles, German measles, and chickenpox.

As was shown in Fig. 1, the frequency of these illnesses is highest in autumn and winter, when most time is spent indoors. For flu alone, France registers an annual average of 4,250,000 victims, with 8,000 deaths, and a loss of 24,000,000 working days and 2 billion francs' worth of production. On average, 7 % of the population is affected each year.

House mites *(acarids)* are responsible for more than two-thirds of allergy-related cases of asthma. Various dusts, pollens, micro-organisms, and chemical and physical irritants also induce allergies. In France more than 5,000,000 persons *(10 % of the population)* suffer from allergies, of which three-quarters are respiratory disorders.

Chemical pollutants, apart from their influence on allergies, cause serious illnesses such as certain forms of cancer. Radon likewise induces fatal cancers which are estimated at several thousands annually in the United States.

The by-products of combustion, especially oxides of carbon and nitrogen, are among the most insidious and least-known forms of pollution. At the present time, gas stoves are not equipped with any device capable of reducing the level of toxic fumes given off during combustion. In France, this results in over 400 deaths annually.

4. WHO IS CONCERNED ?

When water treatment was introduced, people wouldn't pay for what they considered to be a gift of Providence.

But as the development of large industrial cities led to ever-larger concentrations of population, waste water had to be separated from pure in order to avoid fatal epidemics. Water treatment and sewage systems became necessities.

It is now time to realise the necessity of bringing in clean air and evacuating stale air.

We must get used to the idea of investing in pure air just as we invested in pure water.

The main aspects of the difference between air and water are the following :

— air surrounds us completely ;

— outdoor air is cleansed of its micro-organisms by the sun's ultra-violet rays and by rain, which precipitates a large part of the dust particles and chemical products onto the ground.

Therefore, except in areas where air pollution is particularly high, fresh air can be drawn in from outside, and stale air expelled.

However, as the temperature of the outdoor air is constantly changing, it is necessary to influence that temperature **before** it is introduced into the premises in order to ensure the thermal comfort of the occupants.

This problem is of special concern to :

a) Employers

It is to be hoped that employers will realize the need of ensuring good-quality air at the workplace, and of encouraging better air quality in the home.

It is interesting to note that an employee spends only one-fifth of his time at his place of work, and a good part of the remaining four-fifths in his home. Better air quality at home would ensure better health and, on the professional level, greater efficiency.

b) Members of the building professions

The installation of an extractor fan in kitchen, bathroom, and toilet is by far the cheapest and therefore the commonest form of ventilation in a new building ; it has been given the pseudo-scientific name of MCV *(mechanically controlled ventilation).* It is common knowledge that, at the first sign of cold weather, many users carefully block the ducts in order to avoid draughts. In addition, it is almost impossible to clean. The consequences of such pseudo-ventilation are disastrous both to health and to buildings ; the damage to the latter from excessive dampness due to inadequate ventilation is well-known.

c) Members of the medical profession

Some 17 % of the work of general practitioners nowadays comes from recurring illnesses which are especially frequent during the heating season. At present, patients are rarely examined by doctors in the surroundings where the illness has developed. The doctor is short of time and takes little interest in his patient's environment. On the other hand, he has at his disposal a powerful arsenal of drugs, highly effective in the short run. Nonetheless, chronic illnesses, asthma and even cancer continue to increase at an alarming rate.

d) The country at large

In the United States in 1975, the direct cost of all respiratory illnesses went up to 7.6 billion dollars.

The indirect cost — deaths and other diseases due to respiratory illness — was 12.2 billion, mounting up to a total of 20 billion dollars.

In 1987, these figures should be multiplied by four, giving a sum of 80 billion dollars. This does not include the cost of cancers attributed to ground radiation.

To sum up, the general pollution in the USA costs the country in the region of 1,900 to 2,500 French francs per person per year. By cross-checking, we can admit a total cost for France of about 80 billion francs per year. To these purely medical costs should be added cost of days, months, or even years of absence from work due to illness.

5. COMFORT AND THE CLIMATE INDOORS

Take, for example, the end of a day in the life of a family. Everyone has returned home from work. The house was well aired in the morning, and now everyone is busy at their own tasks. A meal is being prepared on the gas stove, and combustion will release CO, CO^2, NO_x, and many other gases which, even with. the use of a cooker hood, will spread quickly through the other rooms. The occupants' respiration will add CO^2. Washing the dishes, and perhaps doing the laundry, will produce a large quantity of water vapor.

When they go to bed, the family members will enter rooms which already contain a significant quantity of pollutants. During the night, each person will give off about 20 liters of CO^2 per hour, plus some twenty other toxic substances (ammonia, acetone, acetic acid, creatinin, ethane, methane, nitrogen dioxide, etc...) If the window is shut, these will be inhaled by the sleepers.

Let's consider the case of a couple sleeping in a bedroom of about 30 m^3. The sleepers give off 40 liters of CO^2 per hour and thus raise the CO^2 content of the room by 1.33 l per m^3 every hour. At the end of 8 hours' sleep, the CO^2 level will exceed 10 l per m^3. As a result the sleepers'heart rate will have increased by 20 %, toxins will have accumulated in their bloodstreams and on awakening, they will not feel well rested.

We have just seen the reasons why it is absolutely necessary to change the indoor air permanently and adequately. The quantities of non polluted fresh air that are to be furnished would be small if that air came directly near our respiratory tract - 16 inspirations per minute with 4 liters per inspiration, make about 0,4 m^3/hour.

Unfortunately, the air brought into a confined area mixes up with the polluted indoor air. That is why the quantity of fresh outdoor air to be introduced depends on the way it is introduced and how the polluted air is expelled.

On non-smoking premises, the law provides for a renewal rate of 18 m^3 of air/hour/occupant, that is about 5 liters of air/second. On smoking premises, it provides for a renewal rate of 25 m^3 of air/hour/occupant, that is about 7 liters/second.

The law is quite prolific for all that concerns public places and working premises, owing to trade-union requirements. However, it is not often complied with. On the other hand, considering that only one-fifth of one's time is spent on working premises, it is worth examining what's going on at home. Now, it is at present possible to build a house with a "natural" ventilation, which means no ventilation at all.

The minimum requirement of 10 m^3 of fresh air/hour/person would seem reasonable and would be easier to comply with than the current norms. It would enable everyone to enjoy a better health.

LET US EXAMINE THE CONDITIONS NECESSARY FOR A TRULY COMFORTABLE INDOOR ATMOSPHERE

Four essential factors bear an influence on man's comfort indoors :

— TEMPERATURE,
— HUMIDITY,
— AIR QUALITY,
— AIR MOVEMENT.

a) TEMPERATURE

Two ways of propagating heat may be distinguished, **by radiation, by convection.**

Radiation is the emission of heat from surfaces in the room.

Convection is the transmission of heat by air movement.

Ideally the temperature of the walls should be as near as possible to that of the air in the room, and movement of the air inside should not exceed 0.3 m per sec.

An air temperature between 19 and 22 °C in the middle of a room is considered comfortable in Europe, between 20 and 24 °C in the United States. In summer it may be higher, though it should not go above 27 °C.

b) HUMIDITY

Humidity has been the subject of numerous publications, often contradictory as far as human comfort is concerned.

In the air-conditioning circuit, a base of 40 to 60 % of relative humidity is generally admitted. Relative humidity is the quantity of water vapor in air at a given temperature, compared to the saturation point of the same air at the same temperature. The higher the temperature of the air, the more moisture it can hold.

The curse of badly-ventilated interiors is excessive moisture. It encourages the growth of micro-organisms, house dust mites, fungi, molds, and saltpeter.

Studies have shown that it is preferable to keep the relative humidity below 50 %, one reason being that dust mites die when it is below 45 %. It is certain that the elimination of these dust mités and of their spores brings considerable relief to patients suffering from allergies particularly to asthmatics. Nonetheless the human respiratory tract needs a certain amount of moisture. The 20 to 60 % range of relative humidity tolerated by Americans seems to be an acceptable standard, though 20 % seems to us to be too low.

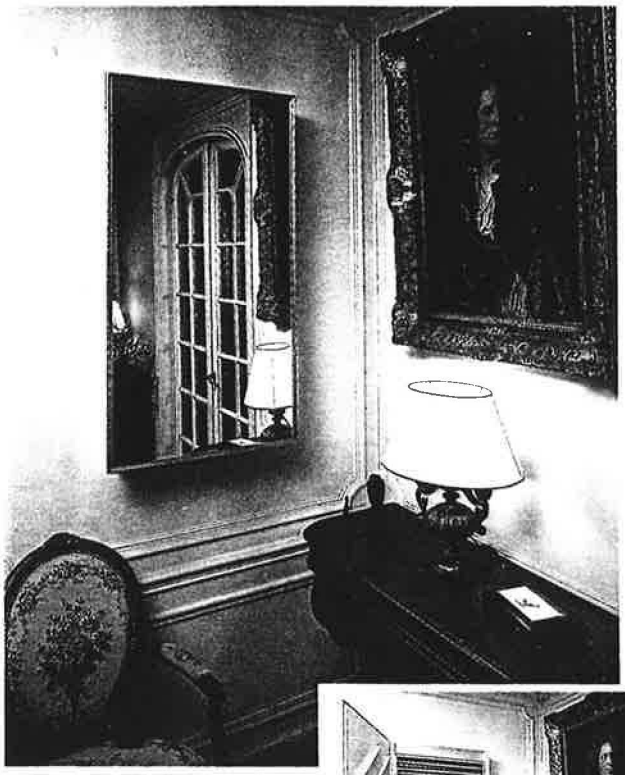
c) AIR QUALITY

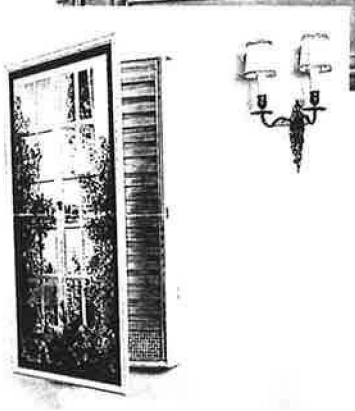
Indoor air contains several thousands of pollutants at more or less high concentration. Legislators are trying to introduce a scale of maximum permitted levels according to the amount of time spent in a particular environment - 1 hour, 8 hours, or even longer. The levels acceptable over long periods are more difficult to determine and require research covering a period of several years.

On the one hand, it is difficult to compare experiments on animals with those on humans, since body weights and behavior are quite different.

On the other hand, and in spite of scientific progress, our understanding of the synergy of pollutants is still at a very early stage. That is to say each pollutant acting separately produces no harmful effects for some time, while the presence of two pollutants simultaneously in the same concentrations can cause disease in a much shorter time.

AIR AND BEAUTY





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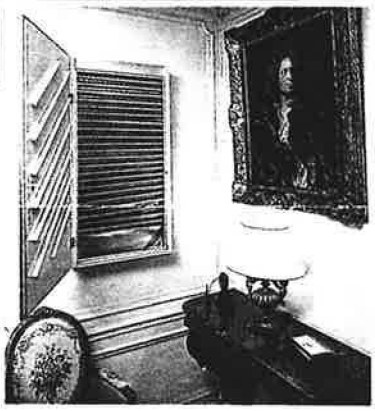
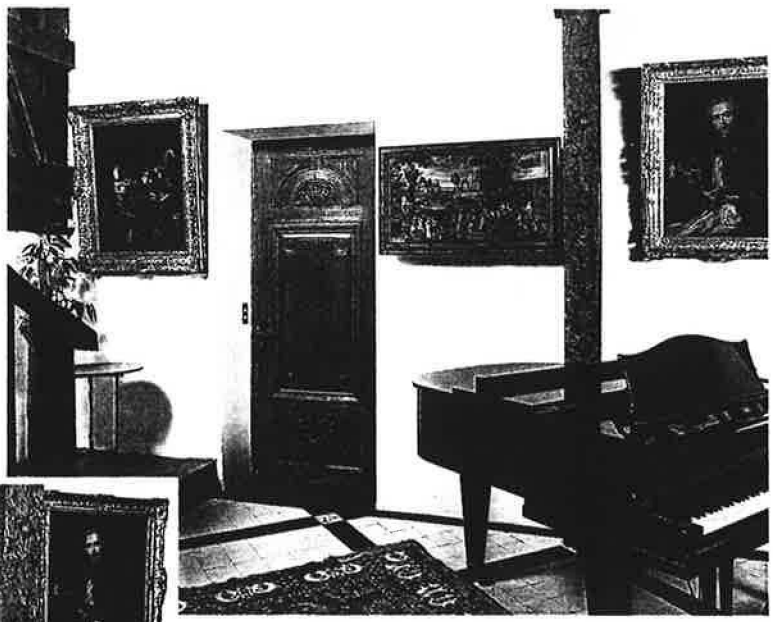
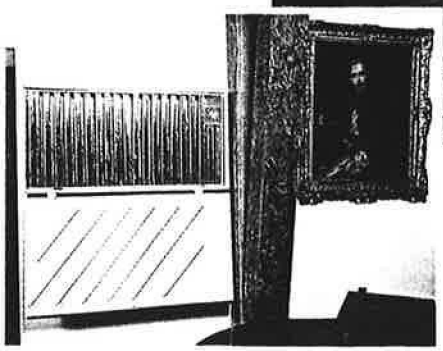
RylkAir®

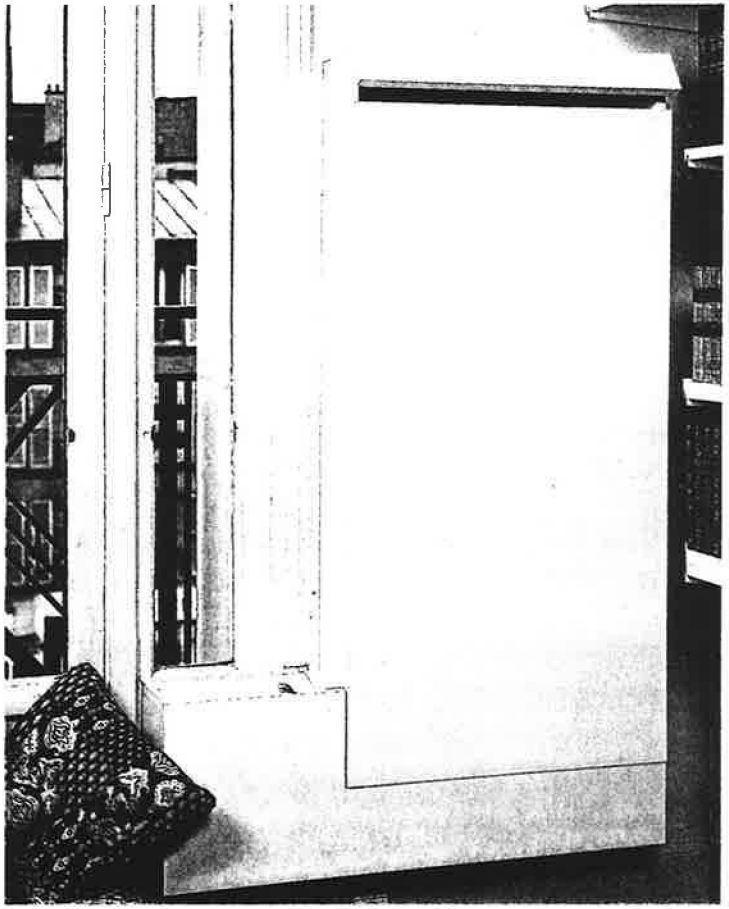






To match every interior

placed horizontally
behind a painting



RylkAir

equipped
with a lateral
outlet
through a
window corner

STANDARD VERSION

* Flows from 30 to 120 m³/h
* Consumption from 3 to 10 W
* Safe Direct Current
* Dimensions : 1,1 m x 0,6 m x 0,12 m

OTHER VERSIONS

Flows up to 1000 m³/h

for public places, gymnasiums, schools...

After examining a whole series of pollutants, it can be stated that an acceptable standard for air quality would be fairly close to the level of pollution found in the open country. Using CO^2 as a basis of comparison, three times the 0.035 % level *(the level regularly found in the open country)* that is about 0.1 % should be the upper limit over long periods. This level was suggested by Pettenkofer in Germany during the last century. This proportion of three should be applicable to other pollutants as well.

d) AIR MOVEMENT

Air that is moving either too slowly or too fast is a source of discomfort.

In the first case, the regulation of body temperature is affected, and pollutants are not evacuated ; in the second case, the surrounding micro-climate is perturbed and dust particles and other forms of pollution are stirred up. A slight movement of the air, of about 0.2 to 0.5 meter per second, would seem desirable. Higher velocities are advantageous for higher temperatures of about 25 to 27 °C or more.

6. EXISTING SOLUTIONS

In order to form a pertinent opinion on existing systems, one ought to keep in mind that ventilation **should :**

— **be permanent,** as is the vital process of life ;

— **ensure a comfortable temperature** whatever the external conditions ;

— **protect** man **against** all the physical, chemical and acoustical **external aggressions.**

Windows

It is the simplest and commonest ventilation system. It does not answer any of the above criteria, therefore it is totally inadequate.

Let's consider, for instance, a bedroom of about 30 m³ with two persons during an 8 hours' night sleep. In order to ensure an adequate quantity of air, a minimum of 20 to 30 m³/hour should be brought into the room, which is impossible unless one of the occupants gets up at regular intervals to open the window.

Permanent openings

Louvers, air inlets or partly-open doors and windows are difficult to regulate because of temperature changes during the day; nor do they ensure satisfactory ventilation. In fact, they induce a loss of heat and are a source of discomfort.

It can therefore be concluded that none of the "natural" methods of ventilating guarantees enough fresh air.

The opposite graph shows the extent of variation of "natural" air renewal.

It is known that air movement is caused by the difference in temperatures: warm air being lighter goes up while cooler air replaces it; this is equally true of the wind.
Consequently, in spring and autumn, when the weather is calm, the air renewal of a room is minimal, whereas in winter, the colder the air, the more it tends to penetrate into the building.

At point A, on the third day, the air renewal is close to one volume of the house per hour, which is nearly too much.

At point B, on the eighth day, the air renewal is close to zero, which is unacceptable.

Centralised mechanical ventilation of an apartment or house

Such a system ensures the introduction of a constant amount of fresh air into the entire building; but as certain rooms are only used intermittently, it is very difficult, if not almost impossible, to regulate the flow to each room as it is needed. Moreover, to avoid a significant waste of energy, recuperators are installed to preheat incoming air with the heat from the stale air going out.

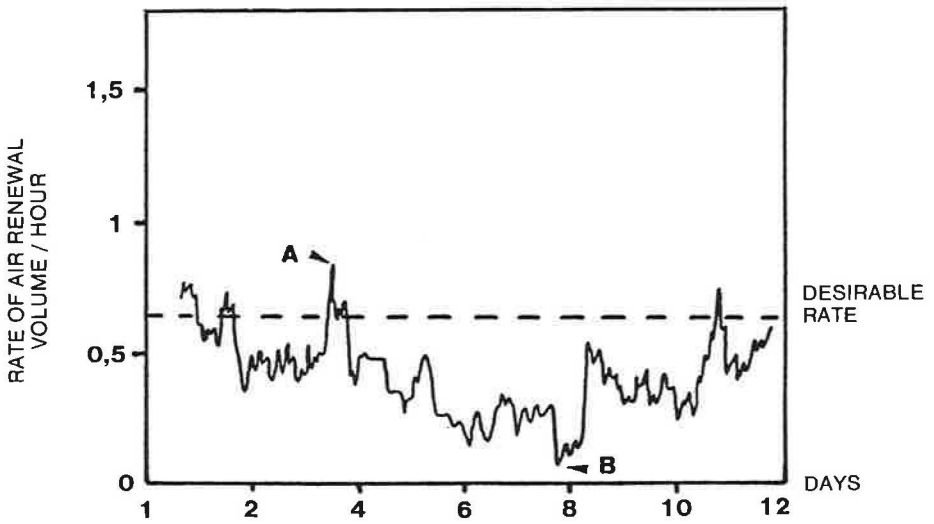


Fig. 2 — *Typical variation in the hourly rate of renewal of the air in a house in the USA whose only means of ventilation is windows, doors and other openings.*

The drawbacks of centralised mechanical systems are as follows :

a) The impossibility, for both esthetic and economic reasons, of installing air ducts in existing buildings ;

b) The noise level, often unacceptable, due to the long distance over which the air must be conveyed ;

c) The component parts of the system are inaccessible and cannot be cleaned. In the ducts, on the vanes of the exchangers, and in the humidifying systems, a profusion of bacteria and viruses develop freely.

The analysis of the above facts demonstrates that the only valid solution for one of our most basic needs is individual ventilation, room by room, operated on demand, exactly as a light can be switched on in a dark room.

Such a system requires complete separation of incoming and stale outgoing air, and easy access to all the components for cleaning. Thus the risk of contamination of the occupant of a room by a preceding occupant, or by someone in an adjoining room, can be avoided. Only a good ventilation system can evacuate all the pollutants efficiently.

7. THE RYLKAIR AIR EXCHANGER - OPTING FOR COMFORT

Principle of operation : RYLKAIR is a device designed to draw fresh air into an enclosed space and evacuate the stale air. It contains a heat exchanger which recovers the energy from the stale air being evacuated. For example, if the outside air is at 0 °C (32 F), the inside air at a temperature of 20 °C (68 F) flowing through Rylkair is cooled down transferring part of its heat to the outside air. The latter, therefore, entering the room at around 13 °C (55 F).

Description : RylkAir takes the form of a cabinet fixed on the inside of an outer wall. It has two main parts, a frame containing a heat exchanger, and a door, both pivoting about a vertical axis. This provides two ducts, through which the flow of air entering the room in question and the outgoing flow circulate in opposite directions. Gaskets ensure that the two flows are completely sealed off from each other. The entire surface of both ducts is accessible for periodical cleaning.

Two fans, one for evacuating stale air and the other for bringing in fresh air, make almost no noise and are also easy to clean.

The interior of the RYLKAIR unit is fitted with baffles in order to collect a maximum of dust and other particles. Since all parts of the unit are easy to get at and to clean, the dust deposits can be removed regularly. The time has come to acquire the habit of cleaning air ducts just as we clean recipients for drinking water and food.

Another advantage, and not the least, of being able to clean the RYLKAIR air exchanger, is that its thermal efficiency can be maintained throughout its lifetime. It is a known fact that the clogging-up of an exchanger diminishes its efficiency because the deposits are a form of thermal insulation.

Efficiency : The thermal efficiency of this air exchanger in normal use is about 60 %. If, however, it is run according to the need for fresh air in a particular room and shut off when that room is not in use, its efficiency calculated over the entire heating season can reach 80 %. This is very different from natural means of ventilating, which constitute a continuous loss of heat.

Power consumption and saving : Direct current driven fans give total electrical protection and use, in normal operation, 3 Wh, which over 24 hours amounts to 3 x 24 = 72 Wh or 0,072 kWh. Translated into dollars, it gives 0,0072 $/day, if the price of one kWh is 10 cents.

In comparison, the gain in energy over a day with outside and inside temperatures of 0 °C (32 F) and 20 °C (68 F), the exchanger supplying 36 m^3/h with an efficiency of 60 % is :

$$(36 \times 0{,}33) \times (20 - 0) \times 0{,}6 \times 24 = 3456 \text{ Wh or } 3{,}45 \text{ kWh}$$

$$\text{or } 0{,}1 \times 3{,}45 = \mathbf{0{,}35\ \$ \text{ saving per day.}}$$

Installing a **RylkAir** air exchanger in a room ensures renewal of the air and eliminates the dependence on windows as a means of ventilation. It is, therefore, possible to insulate and equip the shutters with seals for both savings in energy and better protection from the outside noise. Referring again to the same room of 36 m^3 (271 ft^3) with 2 m^2 (21,5 ft^2) of shutters closed during 12 hours at night, the loss coefficient k through windows being reduced from 5,7 to 0,7 W/m^2 °C, the gain in energy due to insulated shutters amounts to :

$$(5{,}7 - 0{,}7) \times (20 - 0) \times 2 \times 12 = 2400 \text{ Wh or } 2{,}4 \text{ kWh}$$

$$\text{or } 0{,}1 \times 2{,}4 = 0{,}24\ \$ \text{ saving per day}$$

Therefore, **the total gain for this room is 0,59 $ per day.**

Between seasons and in all cases where indoor and outdoor temperatures are nearly equal, absence of ventilation makes the air relatively immobile. At such a time the flow of air generated by the RYLKAIR air exchanger is greatly appreciated.

On a summer day the outside air brought in through the first duct of the RYLKAIR is cooled by the outgoing air. For example, with an outside temperature of 40 °C (104 F) and an inside one of 20 °C (68 F), the air entering the room will have a temperature of 26 to 27 °C (80 F). Simply to open the windows would soon raise the room temperature to 40 °C. Moreover, during the night, which is usually cool, a a simple adjustment allows the outside air to come in without any exchange of heat, and the room is cooled while being aired. Thanks to these two operations, air conditioning is unnecessary in most instances.

Humidity : The RylkAir air exchanger is very effective in eliminating humidity. For example, if 4 kg of cotton linen have to be dried, it is necessary to evaporate 3,5 kg of water. One kg of outside air at 0 °C (32 F) with 50 % of water vapour is preheated in RylkAir by outgoing air and can absorb more than 9 g of vapour at 13 °C (55 F). After an additional heating, this air, leaving the room at 20 °C (68 F) and 80 % of relative humidity carries away : 11.7 − 1.9 = 9.8 g which for a flow of 72 kg/hour through RylkAir gives 72 x 9.8 = 0.7 liters of water per hour. The linen is dry after five hours. The fibers are not broken, the linen is not worn out and is easy to iron.

Noise : The baffles installed in the compartment for the incoming flow isolate it from the outside noise and allow the installation of RylkAir in a very noisy street. The ventilation can be provided for, windows closed, without increasing the noise level inside the room.

Standard or special versions of RylkAir can be installed in all places where human beings, animals or plants reside : apartments, offices, hospitals, schools, gymnasiums, hotels, mobile homes, stables, grenhouses.

8. CONCLUSION

Certain diseases, widespread before the advent of water purification, have been brought under control in countries where good hygiene has become the norm.

In the same way the decline of certain respiratory diseases can be foreseen, once people can renew the indoor air wherever they happen to be.

COMMENTS ON 18 COMMON SITUATIONS

1 — Every day I go out for some fresh air.

Walking outside for a quarter of an hour, or even for an hour, will not make up for the other 23 hours spent in a polluted atmosphere. It is equivalent to drinking one glass of treated water when all the rest of the water drunk is contaminated.

2 — I go to the mountains every year to get some pure air.

Here one should know the percentage of time spent in the open air, and that spent cooped up with other skiers in an air that is polluted due to overcrowding and insufficient ventilation. On top of all this, the body must strain to adjust to the demands of the rarefied mountain air. Therefore, a few hours in the open are unlikely to bring any marked benefits.

3 — I open my window for a while every morning.

Opening a window once a day in a room is not enough. It should be opened every hour for a least a few minutes. It is the frequency and not the length of time that counts.

4 — I dislike opening the window because of the noise outside.

It is generally admitted that about 40 % of the French people present neurological and behavioural disorders provoked by an excessively high level of outside noise. Of course, it is practically impossible to act on the external noise, it seems therefore necessary to install a permanent ventilation system, preheating the incoming air with the ability to reduce outside noise at least as well as a window.

5 — I live in a green belt, so the air in my house must be clean.

Nothing could be further from the truth than such a statement. Numerous studies have shown that the air in a relatively airtight house in unpolluted surroundings can be seriously polluted and detrimental to health.

6. — I do exercises regularly to keep in shape.

Yes, but under the condition that the room be well-ventilated. In the course of intense physical effort, an individual will consume up to 400 Watts (at rest he consumes 80). Therefore, he needs an air intake 5 times greater, and without fresh air he will absorb 5 times more pollutants.

7 — At night, we turn off the heat and sleep with the window open.

Despite the drawback of a great loss of heat, it is better to sleep with the window open. But the outside temperature, especially in winter, drops sharply during the night, and the sleeper must struggle to maintain his body temperature in spite of the cold surroundings ; he sleeps less well. At the same time, he breathes in all the dust, pollen, and other forms of pollution coming into the room.

8 — I light a candle to counteract the smell of smoke.

Burning a candle can only add to the fumes inside, because it consumes oxygen and releases waste products which add to the existing pollution.

9 — I've put gratings at the bottom of the doors.

Most of the gaseous by-products of combustion are heavier than air. They enter through the grating and stagnate in the room, which turns into a sort of gas chamber.

10 — What I really dislike are the bad smells.

In fact, these are the least harmful. A large number of the deadliest gases used in warfare are odorless. Several hundred deaths annually from carbon monoxide poisoning could have been avoided had the victims

been warned by an unpleasant smell. Suppressing bad smell with an array of the gadgets and ionizers to be found on the market does not solve the problem of indoor pollution, it conceals it.

11 — If smoking is prohibited, airing isn't as necessary.

When there is a smoker in a room, non-smokers, ill at ease, open a window. If noone smokes, the occupants get a false impression of non pollution and the room is not ventilated as often. As a matter of fact, the confinement of a place is neither **felt** nor **smelt** by its occupants.

12 — The kitchen is not near the bedroom, so we don't run any risk.

The fact that the kitchen is at one end of the house is not a criterion for the quality of the air in the other rooms. The fumes released by combustion have been shown to spread rapidly even when the doors are closed. The presence of CO, CO^2, and nitrous oxides above the norm has been registered in bedrooms the evening a meal was prepared.

13 — We have just moved into a new house, so we know it's clean and safe.

This is the case where indoor pollution is most to be feared, because construction materials are known to give off a maximum of pollutants when they are new. The rate at which they are released decreases over a period of about 5 years. This holds true for renovations and repainting as well. It is imperative to ventilate as much as possible during the early years in the life of a building.

14 — What's the use of ventilating my house when the air outside is polluted anyway ?

All surveys show that under normal conditions, pollution levels indoors are always higher than those outdoors. The preceding examples have clearly demonstrated that cooking over an open flame raises the level of CO and CO^2, whence the advisibility of airing the kitchen. The only exception is in certain emergency situations, where all openings should then be closed.

15 — Why clean the indoor air as our food itself is polluted ?

When a consumer buys some food, he has no means of depolluting it efficiently himself, whereas thanks to the unlimited outside air supply, we have the possibility of immediate action. Indeed the outside air is sanitized by UV rays and pollutants are precipitated by the rain.

16 — I have an air purifier at home.

An air filter captures only dust particles, and only those of a specific type and size. It does not remove gases nor microbes or viruses. To filter out the few hundreds of existing polluting gases, filters with activated charcoals impregnated with selective salts for each gas should be used. Moreover, a purifier (a small appliance for recirculating indoor air, not connected to the outside) wil not, in any case, supply **the oxygen necessary for life.**

17 — You should install a humidifier to combat respiratory diseases.

Installing a humidifier in a polluted room does not solve the problem. The pollution is still there, and high humidity encourages the growth of dust house mites, one main source of allergies.
On the contrary, the relative humidity should be reduced below 45 % and the room aired ; house dust mites die when the humidity falls below 45 % and airing eliminates other types of pollution.

18 — I live in a damp region, and so my house will always be damp.

As a general rule, houses are damp because human and domestic activities generate considerable water vapor. Humidity inside a building can be eliminated by proper ventilation. The effect is greater when the incoming air is preheated, reducing its relative humidity and permitting it to absorb the moisture indoors.

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EXTENT OF THE PROBLEM

The introduction of water treatment and central heating has reduced a considerable number of illnesses and prolonged man's life expectancy.

At the same time, man stayed longer indoors which resulted in the increasing importance of the quality of indoor air ; indeed, when its quality is poor, the damage to man's health and buildings is considerable.

This damage arises from the following factors :

— *Ventilating by opening windows is never satisfactory.*

— *The different mechanically controlled systems are generally sealed by the users : a unique situation in which a product is paid for and not used.*

— *Users of air-conditioning systems keep complaining that they cause allergies and discomfort, which shows that in order to protect the user's health, every part of any kind of ventilation system should be made in such a way that it can be thoroughly cleaned.*

— *Inside pollution shouldn't be connected with atmospheric pollution, it has its own causes and is, in every respect, at present, a lot higher than atmospheric pollution.*

— *Long-term effects of indoor air pollutants are generally underestimated. Only unexpected deaths, due to direct causes draw public attention.*

— *At present, the Law provides a regulation to cleanse the air on working premises, but man spends only one-fifth of his time at the place of work.*

Therefore, it is absolutely necessary to deal with the cleansing of ALL enclosed premises, including places where little time is spent, such as gymnasiums, theatres, etc...