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INTRODUCTORY GUIDE TO NOISE

by

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and

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WHAT IS NOISE ?



The difference between sound and noise varies from one human being to another.

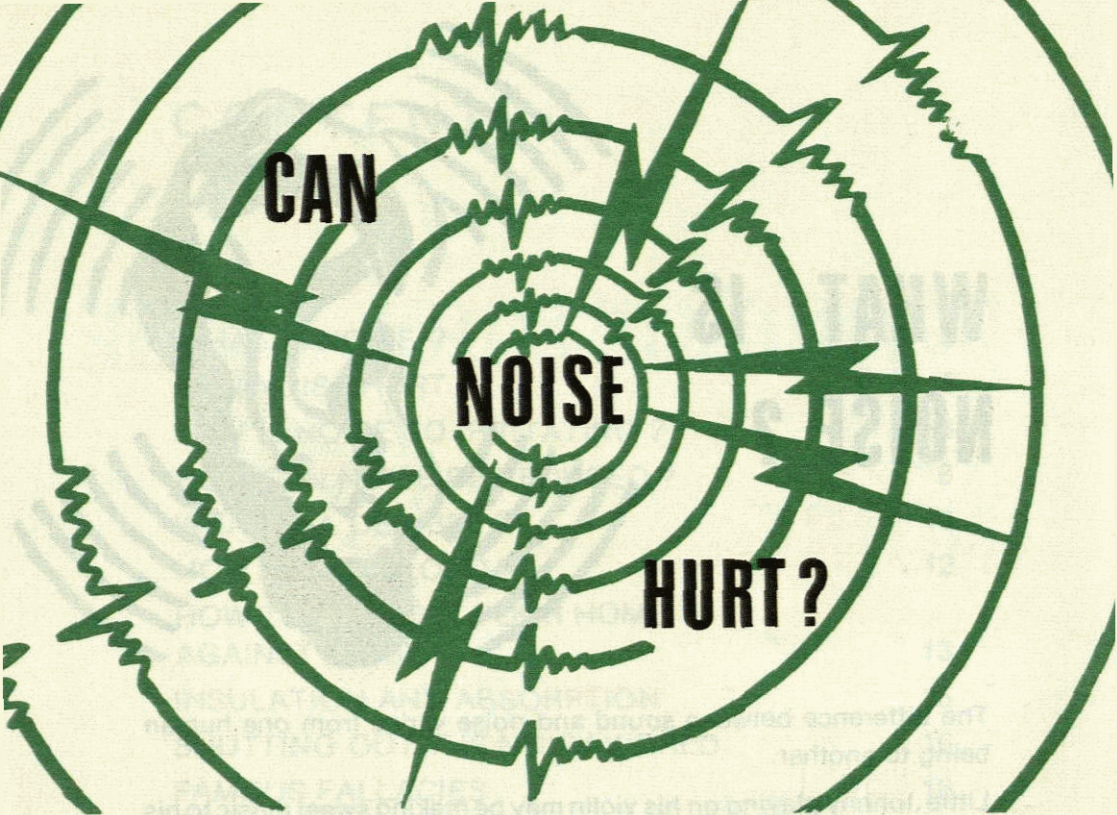
Little Johnny playing on his violin may be making sweet music to his proud parents' ears, but to the neighbours...

Noise, then, is simply unwanted sound and to understand how it can be combatted we must know more about its nature.

Sound is carried by the air around us, and is simply small variations in air pressure spreading outward from the source like ripples from a stone dropped into a pond.

When these meet a solid object such as a wall they bounce back like a rubber ball but in so doing set up a vibration in the wall which carries a small percentage of the sound through to the other side. The more massive the wall, the smaller the amount of sound that penetrates.

Recent years have seen the mass production of the radio, record player, power mower, motor car, aeroplane, road drill and many other noisy devices, with the result that we are being bombarded with an ever-increasing barrage of sound.



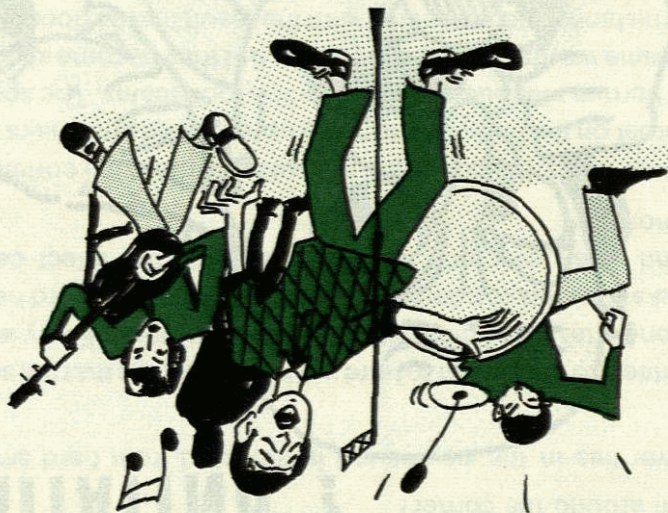
Yes, loud noise can cause real physical pain and can do damage by permanently reducing the sensitivity of human hearing.

If a very faint signal is slowly increased in volume a point will be reached when a listener will perceive it for the first time. This point is called the threshold of hearing. As the volume is increased still further a second point will be reached where pain will be experienced.

In young people these two points are 120 or so decibels (dB) apart but as they grow older sensitivity decreases and pain comes sooner.

'What's that you say?' asks the old man and then, 'Don't shout — I'm not deaf'. This narrowing of the gap between hearing and pain is responsible for a great deal of suffering in old people's homes — especially in city areas where it is difficult to keep noise down to acceptable levels.

Normal noise is not a danger to hearing but there are an increasing number of working environments, such as factories and engine rooms, that pose a threat to the hearing of the occupants.



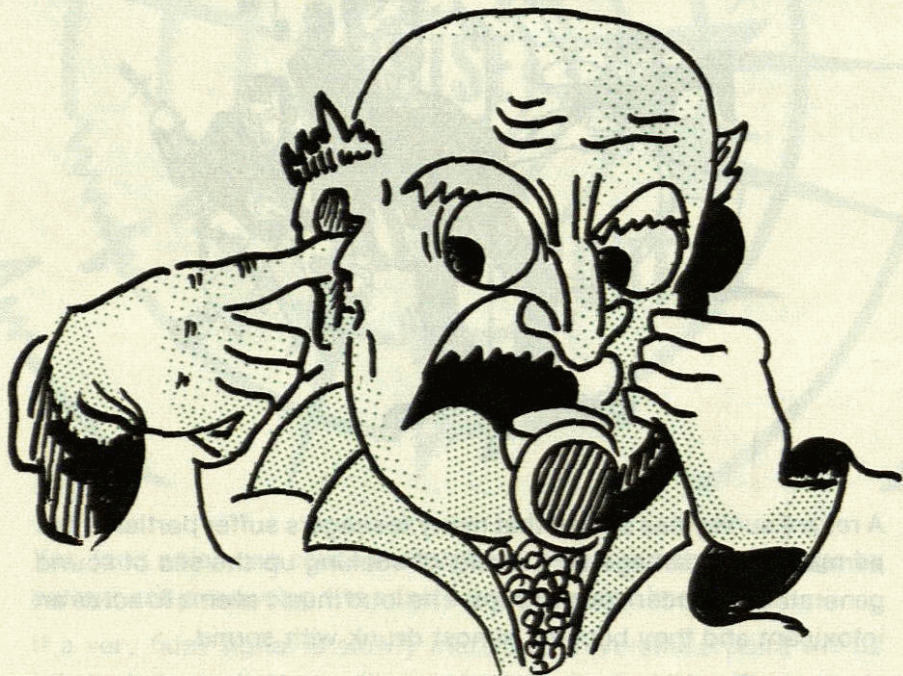
A recent survey has shown that many teenagers suffer partial — but permanent — damage as a result of soaking up the sea of sound generated by modern pop groups. The loud music seems to act as an intoxicant and they become almost drunk with sound.

It will not therefore come as a surprise to learn that noise has a very real effect on the human body. It can raise the blood pressure and affect digestion in addition to its known ability to destroy concentration and cause irritation.

People — even the same people — are not always annoyed by the same noises. If you are feeling a bit tender after a late party the slightest sound can be irritating. The dog's barking next door will be far worse if you don't like your neighbour than if you happen to be friends.

A guide to acceptable levels and a few words about the decibel unit of measure will be found on pages 10 and 11.

WHY IS NOISE SO IRRITATING ?



Our ears are used primarily to communicate with others, to give warning of danger and to absorb sensory pleasures such as from music.

The degree of irritation is related to the extent to which a sound interferes with these uses or (by remaining at the 'alarm' level) prevents us from sleeping or resting.

Some noise comes into buildings from outside, such as when a passing jet plane drowns a telephone conversation or when traffic noise prevents one from hearing an interesting speaker.

Other noises are internal. In the factory canteen or cocktail party so much speech noise can be generated that everyone has to shout to make himself heard above the din.

Why, you may ask, does this happen in the canteen but not in the restaurant around the corner?

The answer lies in the way sound is reflected from hard smooth surfaces.

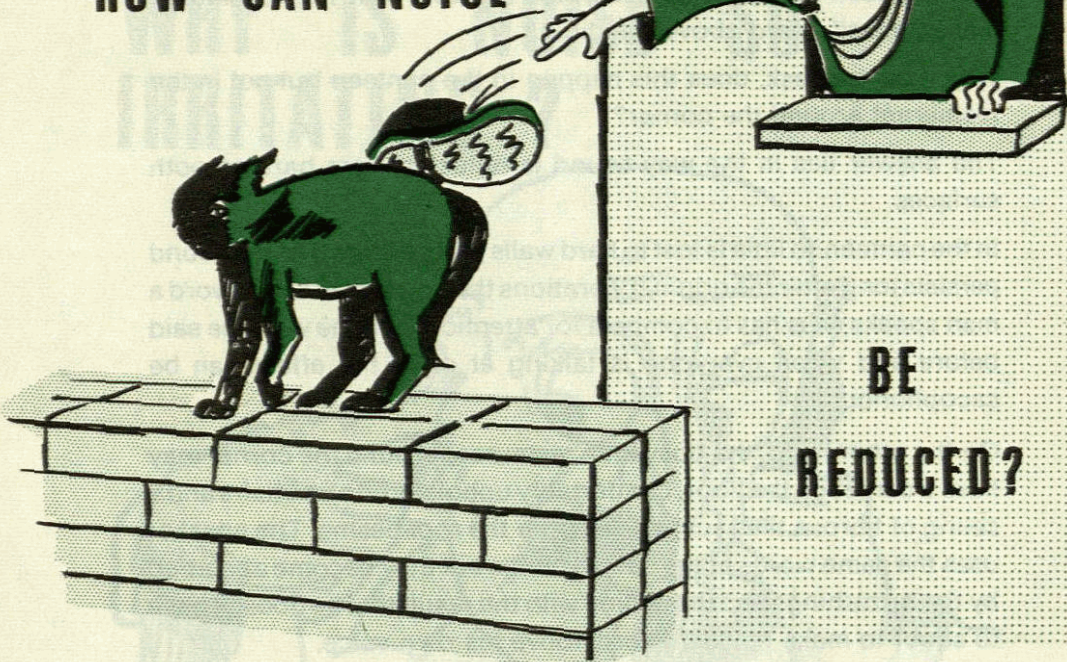
In the canteen so little is lost to hard walls and ceilings that the sound persists long after the original vibrations that created it. Every word a man speaks thus has to compete for attention with the word he said before and when everyone is talking at once the effect can be cacophonous.

On the other hand, the cosy little restaurant around the corner may have a carpet on the floor, comfortably upholstered arm chairs and a ceiling of fibrous tiles suspended from the roof beams. The speaker uses the same words at the same volume but they become absorbed by the furnishings and the ceiling with the result that he doesn't have to shout to make himself heard above his own voice.

Between speaker and listener the volume remains the same: only the interference has been removed.

Sound itself, like other forms of energy, cannot be destroyed. However, when unwanted sound enters the tiny narrowing airspaces between the fibres of a loose or open textured material it uses up its energy by moving the air particles against friction, which turns sound into inoffensive heat. Very low frequency sound sometimes even manages to move the fibres themselves but the end result is the same: the sound is absorbed.

HOW CAN NOISE



BE
REDUCED?

The man who throws his boot at the tom cat on the garden fence is practising the simplest of all noise reduction measures — removal of the source.

It is no longer always possible to contemplate this step in our technological world but whereas in the past we have not worried much about noise it is now time to look at what can be done.

The aircraft industry has shown quite clearly that it is possible to bring down noise levels — but only under pressure of the total ban enforced by some countries on aircraft that make too much noise.

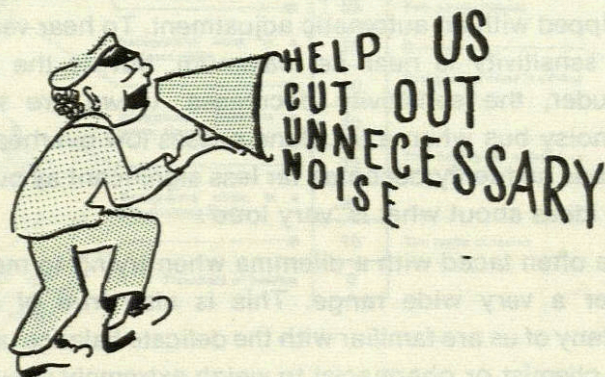
Motor cars, buses, buzz-bikes and vacuum cleaners can be effectively quietened but until now the public has not been prepared to pay the price of legislation. Also, many young sports-car enthusiasts still think that the greater the noise the more the power, and enjoy the throaty roar of an unsilenced engine.

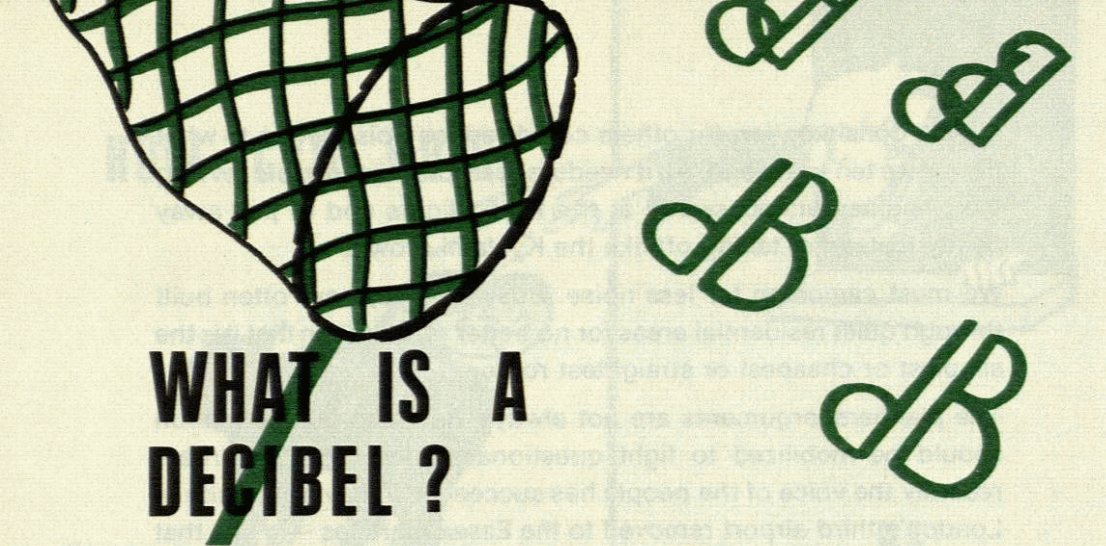
Simple consideration for others could reduce noise levels to what they were ten years ago. All it needs is for motorists to avoid revving their engines unnecessarily at the traffic lights and to pull away gently instead of taking off like the Kyalami crowd.

We must campaign for less noise. Busy highways are often built through quiet residential areas for no better reason than that it is the simplest or cheapest or straightest route.

The planners' arguments are not always valid and public opinion should be mobilized to fight questionable decisions. In Britain recently the voice of the people has succeeded in having the site of London's third airport removed to the Essex marshes — a site that many people now consider to be more suitable in every way.

When a radio or recording studio is built, acoustic technology is used to ensure that external transmitted noise is kept to an absolute minimum. This same basic technology is available to make other buildings quieter and even if the processes are sometimes too expensive to use for private houses, at least office buildings, auditoriums, churches, schools and hospitals should benefit.





WHAT IS A DECIBEL ?

The human ear is extremely sensitive, but unlike most delicate instruments it can cope with a fantastic range of volumes. It can hear the whisper of a blade of grass, but can also understand words shouted above the roar of a jet aircraft. The first sound lies near the threshold of hearing or the sensitivity limit of the human ear. The second sound approaches the point where the ear starts overloading. This is called the threshold of pain, because at this point our ears start hurting, and for a very good reason, namely to warn us of damage to the hearing mechanism. Between these two thresholds lies a sound intensity range of about one million million units.

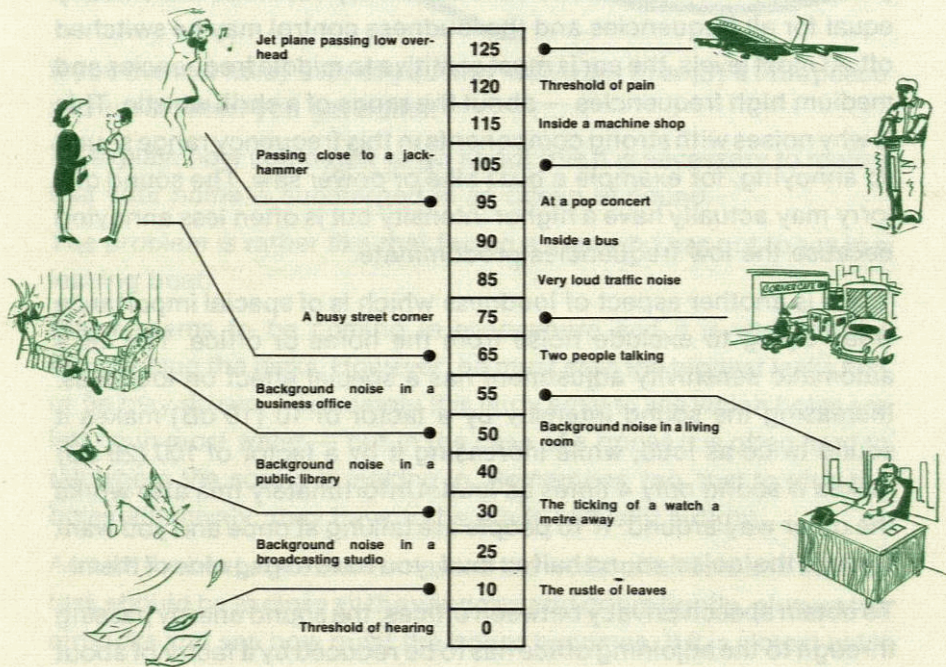
Our ears can handle this wide range of sound intensities because they are equipped with an automatic adjustment. To hear very soft sounds, the sensitivity is near its maximum, but as the sound becomes louder, the sensitivity decreases. If we are talking alongside a noisy bus when a jet plane passes low overhead, the noise of the bus suddenly becomes far less significant as our ears change their ideas about what is 'very loud'.

Scientists are often faced with a dilemma when trying to measure anything over a very wide range. This is also true of sound intensities. Many of us are familiar with the delicate balance used by the research chemist or pharmacist to weigh extremely accurately

or to dispense minute quantities of medicine, accurate to a thousandth of a gram or less. Imagine what would happen if the chemist or pharmacist himself, weighing 100 kg or 100 000 000 times as much were to step on to the scale. To complete the analogy with the range of ear sensitivities, a balance capable of the same range as the ear would in fact also have to be capable of weighing 1 000 000 kg or about 20 times the weight of the pharmacist's brick house.

Scientists have therefore devised a special scale in which the first division represents ten units, the second a hundred, the third a thousand, and so on. Each of these divisions is called one bel, and is further subdivided into ten units, called decibels (dB).

TYPICAL NOISE LEVELS MEASURED IN DECIBELS



HOW LOUD IS



All sounds of the same intensity do not sound equally loud to the ear. The low frequencies and the very high frequencies usually sound softer, especially at low levels. This is why a good hi-fi set has a built-in loudness control which boosts the bass at low listening levels. As you turn up the volume, the ear's sensitivity becomes more nearly equal for all frequencies and the loudness control may be switched off. At most levels, the ear is most sensitive to middle frequencies and medium high frequencies — about the range of a shrill whistle. This is why noises with strong components in this frequency range sound so annoying, for example a buzz bike or power saw. The sound of a lorry may actually have a higher intensity but is often less annoying because the low frequencies predominate.

There is another aspect of loudness which is of special importance when trying to exclude noise from the home or office. The ear's automatic sensitivity adjustment has a special effect on loudness. Increasing the sound intensity by a factor of 10 (10 dB) makes it sound twice as loud, while increasing it by a factor of 100 (20 dB) makes it sound only 4 times as loud. Unfortunately this also works the other way around. If 10 people are talking at once and you want to make the 'noise' sound half as loud, you have to gag nine of them!

To obtain speech privacy between offices, the sound energy passing through to the adjoining office has to be reduced by a factor of about 100 000 (50 dB). To obtain such high values of sound insulation, however, requires special measures.



HOW TO PROTECT

YOUR HOME AGAINST NOISE

If you live in a noisy district you may well want to enjoy a little peace and quiet when you get home.

To explain how you ought to go about this it is necessary to realize that your home is submerged in an ocean of sound.

The problem is rather like that facing a man who has put to sea in a leaking boat.

Water seems to be coming in everywhere and it is vital that he quickly plug the leaks. However, he must stop the biggest leaks first or he may drown. Fortunately it is fairly easy to see which holes are letting in most water — but in the case of a house it is often hard to tell where the sound is leaking in. Remember, too, that to plug the holes effectively, they have to be made virtually airtight.

As with the boat, the actual holes are the worst offenders and the first task should be to close all the windows and doors tightly, plug up the airbricks and see how quiet the house becomes. If it is almost quiet enough it can be improved somewhat more by putting a sealing compound around the windows and blocking off the chimney.

It will now be necessary to ventilate the home artificially and this can be done by means of a fan in a soundproof box. Such a box is quite easy to design in such a way that it will filter off the particular noises with which you are plagued. Easy, that is, if you know how. The men with the know-how are to be found at the National Building Research Institute and if you write to them they will be happy to help.

Be wary about going to the expense of lining walls with acoustic tiles and putting sound absorbing material in the roof. Absorbing materials generally do not improve insulation appreciably. Moreover the opening beneath the front door could easily be letting in more noise than walls and ceiling combined.

If you have teenage pop fans in the family, your best approach will probably be to learn to like their music! If this is beyond you, remember that closed doors do seal off some sound and that two doors are better than one so that the more closed doors you can get between you and the children the better. Sealing the crack around a door and fitting one of those self-closing weather strips at the bottom will also help to confine the noise.

Even if it were possible to put the children in a room lined with sound absorbing materials, it would probably not help much, because the level of sound in the room would drop and in self defence they would turn up the volume. One thing though — they would get beautiful hi-fi pop in such a room.

Probably the best way to solve home noise problems is to spend your money on making one room really quiet. Seal it off everywhere and fit a heavy tight door with good rubber sealing materials around the edges. This one room can then be fitted with a ventilation system or even air conditioning to give you a cosy retreat where you can get away from it all.

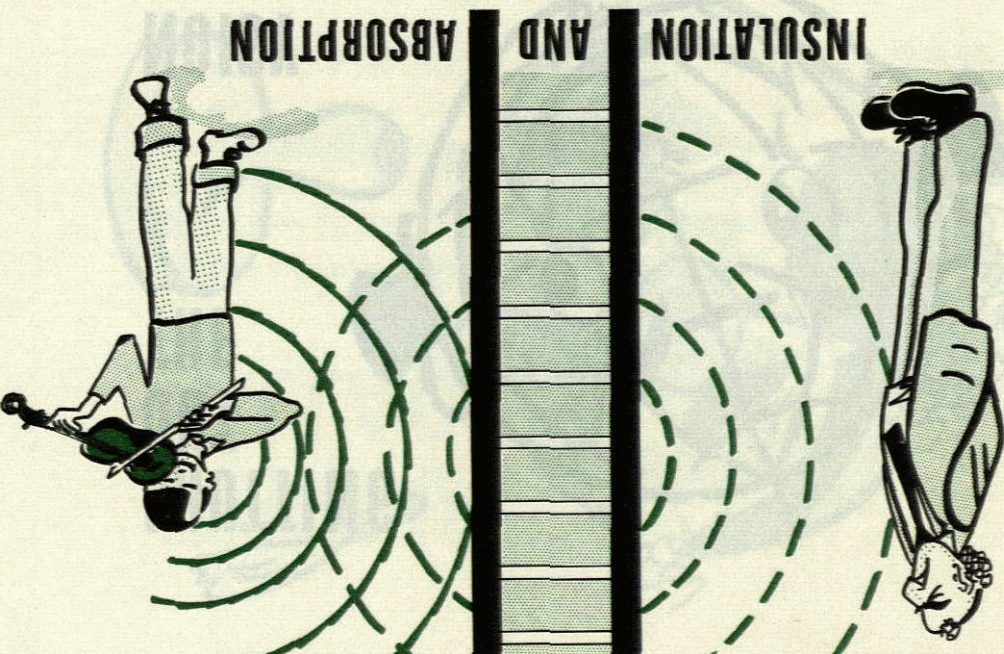
Insulation, therefore, is the reduction of transmitted sound while absorption is the reduction of reflected sound.

Now suppose that a thick layer of glass or mineral wool is fastened to the surface of the wall on the side where the sound is generated and the noise is repeated. The man on the other side of the wall will still hear the same sound almost as loudly as before. The difference, however, will be that the man who made the sound will hardly hear the echo, because it will be absorbed by the glass wool and not reflected.

The trouble is that a sound, once it has been born, is determined to live out its life. If it approaches a thick stone wall most of the sound will, as already stated, be reflected back again and this, believe it or not, is 'insulation' to the man on the other side of the wall.

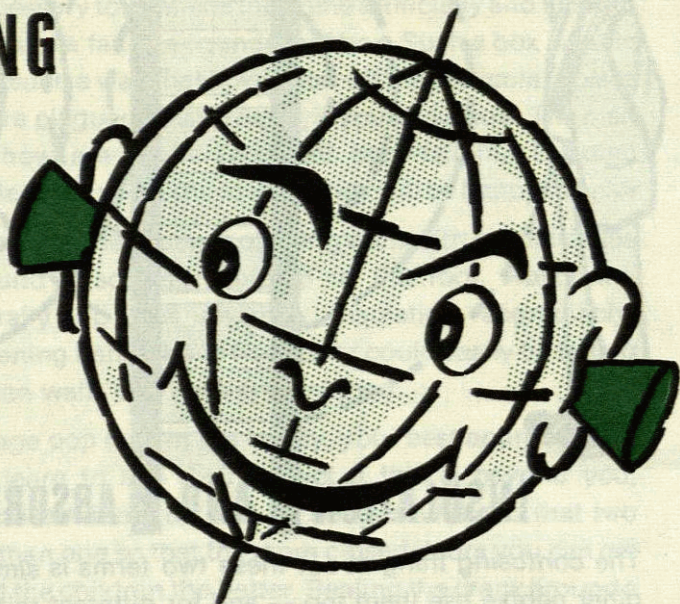
What the electrician thinks of as insulation comes in rolls and can be taped into place, while what the heating engineer would unhesitatingly call an insulation material turns out to be used in acoustics for absorption.

The confusing thing about these two terms is simply that a lot of other people use them too — and for different things.



**SHUTTING
OUT
THE**

**NOISY
WORLD**



We said earlier that to keep out sound it was vital to plug up the air-holes.

The ultimate air-holes are those in your head.

It is interesting to note that in a very noisy place it becomes impossible to hold a conversation no matter how loud one shouts, simply because the ear becomes overloaded. Once you don ear muffs or plugs, however, the level of sound drops to the point where the ear can once more separate the wanted from the unwanted sounds. You therefore hear better when you close off your ears.

There are several ways of doing this. You can, for instance, use ear muffs, which are rather like headphones; they are lightweight and quite comfortable but many people find that if they are worn for long periods they cause a sweat rash where they press against the sides of the head.



Alternatively you can use earplugs. One type is made of plastic and fits into an ear like a hearing aid. Their disadvantage is that they rarely fit everyone's ears exactly and they may therefore irritate.

Some people find it preferable to use a disposable earplug made from waxed cotton wool; it fits perfectly but is not really re-usable. However, at about one cent a pair the expense is not a serious factor.

Not all of us can stand a plug in our ears for long periods but those who can do enjoy a reduction in the sound level reaching their ears.

This is the one occasion when you can envy the man who is hard of hearing. With a smile he just switches off his hearing aid, and relaxes into a blissfully quiet situation.

Incidentally, by using earplugs your economy car becomes a Rolls-Royce — at least as far as vehicle noise is concerned. However, you are likely to have trouble with the traffic department if you don't respond to whistle or siren. Alas, there are no cheap and easy solutions!

FAMOUS FALLACIES

Tall trees planted round a house reduce noise

False. Trees will have a negligible effect on noise.



Lining the inside walls of a house with acoustic tiles will keep out more noise

False. Just as much noise will get through the walls and since most of the noise comes through windows, doors and airbricks anyway, your ear will not be able to detect any real difference, although the acoustic tiles may reduce the level of *reflected* sound in the room.



Lining the roof with heat insulation material will make a house quieter...

Yes and No. If a house has very solid doors and walls, internally generated sound can sometimes go into the roof, echo through the space among the rafters and bounce back into another room. In this case thermal insulation material can help. In most houses, however, the doors and windows leak far more sound than the ceiling so you will not get any noise reduction benefit from insulating it. However, if you want to keep your house warm in winter and cool in summer insulate it by all means and accept any quietening effect it may have as a bonus, but don't install it simply as an acoustic measure until you have cured all the other noise leaks.

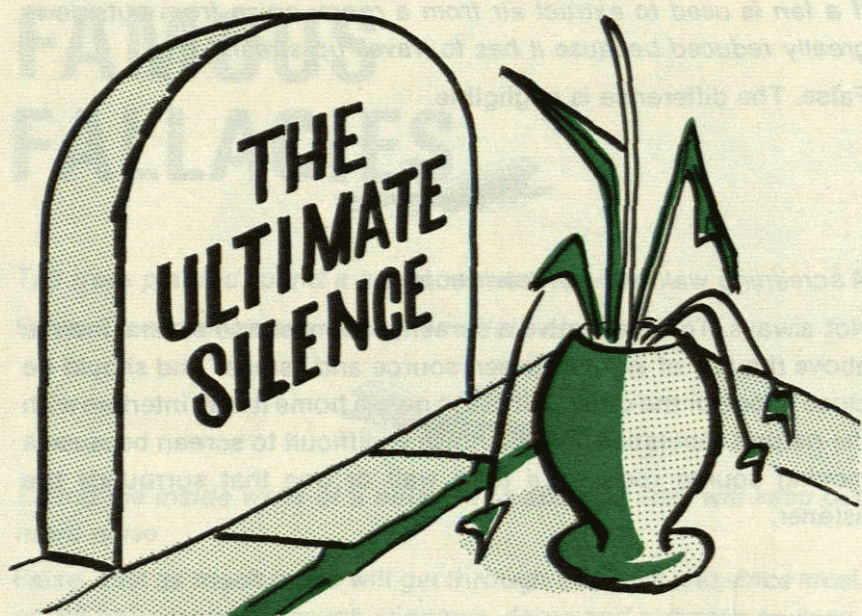
If a fan is used to extract air from a room, noise from outside is greatly reduced because it has to travel 'up-stream'...

False. The difference is negligible.



A screening wall will cut down noise...

Not always. To be effective a screen wall must rise several metres above the line of sight between source and listener and should be close to one or the other. If it is too near a home it may interfere with the natural ventilation. Traffic noise is difficult to screen because a moving source requires a long wall or one that surrounds the listener.



Not all noise is bad. Sound carries a message even if it is only that other life is near at hand. It only irritates when the listener doesn't like the message, cannot understand it, finds it irrelevant or objects to the volume with which it is propagated.

A complete absence of sound is the message of the grave.

The young child may wake up and cry when the silence becomes complete, while old people suddenly feel lonely.

Just as the body becomes bored with the perfect environment, so is it necessary for us to be assailed by a variety of sounds.

It is neither advisable nor economical to strive too hard for a perfect acoustical environment.

Even if you found it it would probably only please you — and then not for long.