

Noise in the Jet Age

By H. R. BROADBENT

PEOPLE around London Airport are primarily troubled by noise from aircraft: aircraft taking-off, landing and testing. There is an undercurrent of fear of one crashing on their houses, particularly on the line of the runways and under the regular flight-paths; but most people protect themselves with the cloak of "it won't happen to us" and push fear, for themselves and their children, into the background.

The primary nuisance is noise. It interrupts thought, conversation and wireless. It wakes people up and keeps them awake. It does no good. Protests have been made in varying degrees, initially by those close to the airport; but gradually, with more power in aircraft and greater noise, people further and further away have added to the clamour for noise reduction on the ground and in the air. Now, with the advent of the jets, this unwilling audience has grown enormously.

There is, however, a secondary source of irritation which colours the whole background of the approach to the primary nuisance and may indeed be responsible for wrong thinking in the Ministry of Transport and Civil Aviation. Local residents, when they make their protests to the Ministry, are never satisfied that the answers are complete. There appears to be a missing factor. One of the residents' associations refused to take part in a B.B.C. discussion on the subject because, they said, answers not given in free discussion were "frequently ambiguous and sometimes misleading."

The association concerned has had many years' experience in dealing with the Ministry; and, whilst to the inexperienced their remarks may seem to be unduly antagonistic, it cannot be said that the results of official propaganda and the effect of the measures taken have been successful.

The Minister and his officials, on their part, find themselves in the main the foster-parents of a bawling child which they cannot control. The original plans for the layout of the runways and the maintenance area were made on maps with a complete blank outside the airport. In consequence, there is a runway directly in line with an established housing estate only 2,400ft from the threshold and a maintenance area less than 2,000ft from a well built-up area. The Ministry has been committed to a programme of expansion which has led to a conflict between its official commitments and its personal desires to avoid being a nuisance. Aviation and its attendant industries, magnified enormously during the war, carried into peacetime an aura of romance which has since been well exploited by the advertisements for air travel. To the operators of aircraft and to the providers of airports, there could be no other than a common incentive to ensure that air transport should grow and that London Airport should become a main centre in the web.

Financial commitments, with an annual deficit of over £5,000,000 on the airports of Britain, added pressure to this desire. It has been no wonder that protests from local residents were staved off with politenesses and work on noise reduction relegated to a low priority. In addition, since air transport is international, the Ministry has been faced in the past not only with protests about noise from people local to London Airport, but also with a contrary heavy volume of reaction from change, both in public and in private, from the air centres of the world. Local residents are told, in consequence, that if conditions are made too onerous the traffic will go elsewhere and London Airport will sink in importance.

Further, the aircraft industry, with its military research and building programmes cut by the growth of the long-range missiles, pushes for greater subsidies to research into the development of civil aircraft. Larger and more expensive aircraft have been and are to be built with greater power and, it is said, greater noise.

With all this as a background the Minister finds himself faced now with a larger and larger audience for the aircraft he allows to operate. It should be clear that it is the Minister who permits the noise to be made. Parliament, twelve years ago, after a debate which showed its doubts about the wisdom of the Clause, licensed air operators through the Air Navigation Act (1947) to make as much noise as they liked so long as it was produced within the limits of the Air Navigation Order and Air Navigation (General) Regulations obtaining at the time. Fundamentally, therefore, people around the airports have no legal standing for their protests. Action for nuisance has been barred, and the goodwill of the Minister and his officials and the operating companies, urged by public opinion through the Press and Members of Parliament with constituencies adjoining airports, has been practically the only source of effort in noise reduction. Sound insulation can deal sufficiently with the silencing in passenger and crew cabins, so there is little incentive from that angle.

It cannot be said that the protests have been unavailing. The statement of Sir Miles Thomas, a former chairman of B.O.A.C., is

evidence. He said: "We aircraft operators could well consider injecting a new factor into our forward aircraft specifications and refuse to buy machines which do not conform to strict noise limitation." But his advice may not be followed, and the suspicion of residents around the airport that research and the application of research to aircraft noise are well down in the programme of work on aircraft and at London Airport remains.

The attitude of playing down the effects of noise is understandable, but it is one which, in the opinion of a growing number of people, must change. Under present legislation, however, it would seem to be difficult to bring greater pressure to bear, except by the use of the one safeguarding sentence in the Air Navigation Regulations which reads as follows:—

"Regulation 230

... the conditions under which noise and vibration may be caused by aircraft (including military aircraft) on Government aerodromes, ... shall be as follows ...

- (a) ...
- (b) ...
- (c) (i), (ii) & (iii) ...

and such special conditions, if any, as may be prescribed as respect any such aerodrome as aforesaid."

The vagueness of this sub-section appears to be its own advantage, but in defining such conditions the Minister faces a further difficulty—one which has haunted every discussion and led to more than one misunderstanding—in the *assessment* of the noise from aircraft.

Noise is subjective. It is by British Standards definition "sound undesired by the recipient," and by American definition "unwanted sound." In argument, therefore, there is a perpetual reference to personal reactions in which local residents who are disturbed are very clear in their opinion on the sound coming from the aircraft, whereas people in the Ministry, and the operators (whose bread and butter comes from the source of the sound) do not find it so unwelcome.

There is no difficulty in making an objective scientific appraisal of sound. It can be split up into its various frequencies or frequency bands, be measured in terms of sound-pressure levels above a reference magnitude and be read on an instrument. The unit of sound pressure level is the decibel (*db*), which is a logarithmic function related to other levels by the equation

$$n = 20 \log_{10} \frac{p_1}{p_2}$$

where the sound pressure level is in decibels and p_1 and p_2 are sound pressures in dynes/sq cm (microbars).

The reference magnitude for stating sound pressure levels in air is 0.0002 dynes/sq cm.

The comparison between two sound-pressures can be made without resorting to the reference magnitude. If p_r is the reference sound-pressure and p_1 and p_2 two other sound-pressures, the two sound-pressure levels (s.p.l.) n_1 and n_2 are:—

$$n_1 = 20 \log_{10} \frac{p_1}{p_r}$$

$$n_2 = 20 \log_{10} \frac{p_2}{p_r}$$

$$\left. \begin{aligned} p_1/p_2 &= \frac{p_1}{p_r} = 10^{n_1/20} \\ p_2/p_r &= 10^{n_2/20} \end{aligned} \right\} \frac{p_1}{p_2} = 10^{(n_1 - n_2)/20}$$

If there are, therefore, two sound-pressure levels of, say, 100db and 94db, the ratio of sound pressures

$$\frac{p_1}{p_2} = 10^{(100 - 94)/20} = 10^{0.3} = 2.0$$

A difference of 6db in sound-pressure levels means that the sound pressure is double.

Figures of sound as sound-pressure levels are, however, useless to the layman. He may well be told that two sounds which he knows have a different effect on his senses and nerves, one being more unpleasant than the other, have the same sound pressure. He feels he is being misled and distrusts further information from the same source. Sound pressure-levels in isolation are of no use in discussion on noise.

It was not long before the difference between objective measurement of sound as sound pressure and subjective reaction to the sounds became obviously necessary. The stage was reached when the loudness of a sound as measured by the human ear was introduced into the acoustic vocabulary and tests to compare sounds of equal loudness were made with the human ear as the comparing instrument.