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MILITARY AIRCRAFT NOISE

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HEALTH EFFECTS

1. You have heard how the United States Air Force address the potential hazard of noise induced hearing loss from exposure to the very high noise levels generated by military jet aircraft engines. In the Royal Air Force, we have our own hearing conservation programme but do not yet have a software progamme, although we are moving slowly down that path. Although occupationally derived noise induced hearing loss is clearly by far the most important health problem associated with military jet aircraft noise, I want now to broaden the discussion and will touch on one other occupational noise problem before addressing the topic of environmental exposure.

2. In the early days of the prototype Tornado, people working inside our hardened aircraft shelters when the aircraft engines were running, complained of vague symptoms of abdominal discomfort, headache, nausea and "the morning after". This was thought to be due to the relatively high low frequency component of Tornado engine noise and the German Air Force supplied - and still do - leather body belts to counteract these symptoms. I understand that their continued supply may reflect more a perceived need for goodwill than a clearly defined clinical requirement. It is said that motorcyclists find them very comfortable! Subsequent work with the full production Tornado showed that the particularly high low frequency peak demonstrated earlier had gone and we decided against the provision of body belts. However some individuals are particularly sensitive to body cavity resonance from low frequency sound and so we do get complaints from time to time, but since recorded levels are well below Von Gierke's criteria we are confident there is no risk to health from this particular effect. Although the principal symptom - that of chest wall vibration - has been associated with most of our noisier jet aircraft for a great many years,

the Tornado appears to have been singled out for special attention and it is relevant that the spectrum of that aircraft has a low frequency bulge and, of course, the "A" weight is said to under represent the annoyance from low frequency noise. The thoracic cavity is not the only one to resonate, I well remember during one early trial experiencing maxillary antral resonance from a wavelength of 1-2 paces in length. Not an unpleasant experience by any means!

3. I want to spend my remaining time with a necessarily superficial consideration of environmental health issues. Military fast jet aircraft are noisy and various constraints and operational requirements have not enabled us to take advantage of the technology used to quieten civilian aircraft. Most work in connection with aircraft noise has been directed toward civil aviation. Most military airfields are in rural locations and their pattern of activity is different from that of civil airfields in days and hours of operation and in their variability. For example, although far less flying is carried out at the weekend, high intensity activity occurs during exercises. Peak noise levels and operating characteristics are also very different. Furthermore, as you have already heard low level flying training is essential if the RAF is to remain an effective deterrant. Such training is now conducted over most of the country in order to reduce the burden in any particular areas as would be the case if it were to be restricted to certain parts of the country. Noise levels directly underneath the aircraft are quite high and also differ from those of civil aircraft in frequency, onset and delay times and special characteristics. It is quite clear that the noise from aircraft flying at 250 feet above ground and at 420 knots will startle many people. It may also startle horses, which could throw their passengers who might sustain injuries.

4. As for the other environmental effects, I shall summarize in a very general way some of those reported health effects of noise on man that I have come across and which I think are relevant in the military aircraft noise context and which I hope will reinforce our view of the need for additional research, thereby preparing the ground for the next speaker who will underline the difficulties of such research.

5. There can be no doubt that noise annoys many, can create stress and therefore has the potential to affect health in the broadest sense. What is uncertain is the level at which noise contributes to disease other than noise induced hearing loss and even in that condition there is considerable variation in individual susceptibility. Man produces a number of physiological responses to noise but there is no clear, incontrovertible evidence that repeated elicitation of these responses leads to irreversible changes and permanent health effects. For example, most physiological reactions that have been reported are less than the reactions caused by mild exercise and laughing and such normal response to repeated stress is not harmful to the healthy heart.

Hearing.

6. We have no evidence that living near a military airfield poses a risk of developing noise induced hearing loss. We have inadequate knowledge of the effect of noise from fast jets at low level on hearing. Some authors have suggested that a single brief exposure to noise from this source in excess of 115dB(A) has the potential to damage hearing. They have largely derived this figure from impulse criteria and others, who believe that equal energy principles are perfectly satisfactory have suggested that a level of 130dB(A) might be a better estimate. We think it highly unlikely that there is any risk to hearing from a single overflight under normal operating conditions. Although there have been suggestions that repeated exposure might have some effect, there is so far little in the way of solid evidence.

Noise and Communication, Performance and Behaviour.

7. A great deal of work has been done in these areas and I hesitate to make detailed comment since much of it is outside my strictly medical background. However I do sometimes wonder how far we can extrapolate data gathered in the laboratory, particularly using unrepresentative noise, to a local community living near a military airfield. One specific area

which has aroused concern is the potential effect of repeated exposure to such as military aircraft taking off in close promimity to a school. At present, our sound insulation grant scheme does not apply to schools. Some authors have reported that bright children can resist auditory distration for 30 months or so and then show reduced ability to resist and suffer attentional deficits - which may interfere with the development of such as reading and puzzle solving skills. Others suggest greater effects on the less bright children. However, in this context I cannot resist referring to one particular noise dosimetry study of children during a normal school day which recorded 8 hour LAeqs of 75dB! Nevertheless, we really do need more information before coming to firm conclusions.

Noise Induced Sleep Disturbance.

8. Much of the work I seem to have come across in this field has been carried out on young adults in a laboratory setting. Although I am well aware of the difficulties associated with doing otherwise I do wonder how relevant are some of the conclusions to real life. Estimates of acceptable background noise have ranged from 30-60 dB(A) and many estimates have been made of the number of allowable peaks during the night and the most disruptive time for those peaks.

9. It seems clear that night time noise can affect the pulse rate, electroencephalogram and the amount of time spent in rapid eye movement sleep (REM) - even without waking. Indeed, exposure to noise during sleep can induce changes in the amount of time spent in REM sleep. Although noise in the early and middle part of the night is said to be the most disturbing, it is possible to compensate for evening noise disturbance by sleep later on during the night. Habituation does occur, though only by improved ability to sleep during noise and not to the physiological changes I mentioned earlier. Noise induced sleep disturbance can also adversly affect mood and sense of well-being but I am not aware of any good evidence of any real effect on the subsequent performance or health of those affected, although the number of those reporting tiredness after a night's sleep is said to increase at exposures above 65 dB(L Aeq). It is also said that there is increased need for a good night's sleep after a noisy day.

One particular worker, after an extensive review of the literature, was unable to find a reliable basis for the calculation of annoyance for noise induced sleep disturbance and could find no more distinct threshold than for daytime annoyance. Most of our problems in this respect arise from the airfield environment. Our aircrew must include a proportion of night flying in their training, although this is really hours of darkness flying and can be carried out in the early evening during the winter. We also avoid ground engine running at night unless operationally necessary - this can be a particularly tiresome source of disturbance. We recognise the problem in our compensation scheme if night flying is a particular feature at the airfield in question and, under certain circumstances, allow an extension of the compensation contour.

Non-Auditory Effects of Noise.

10. The most frequently reported physical response to noise (other than hearing loss) is a rise in blood pressure, but the rise is small, it is not clear whether a rise in the short term is of any significance in the long term and there is insufficient dose response data. Some workers have found an increase in the number of hypertensives living in noisy areas and others an increase in the number of patients with hypertension or other cardiovascular disease among those living nearest to a civil airfield - and incidentally, a greater use of sedatives and tranquillisers. A rise in blood pressure has also been reported on exposure to other stresses, whether mediated by an increase in cardiac output or a rise in total periperal resistance. Such changes vary from stress to stress and are all short term and I sometimes wonder if task demand may have a greater effect on blood pressure than noise. One study considered aircrew referred for cardiovascular workup to one particular centre over a 23 year period. They had been exposed to cockpit noise levels ranging from 87-115dB(A), their audiograms were examined and no relationship was found between noise exposure and blood pressure levels. However, I believe there is still no definitive answer on the relationship of noise to blood pressure and thus there is a need for research to consider noise as a potential risk factor in the long term development of cardiovascular disease. Other studies have shown changes in blood cortisol, cholesterol and

stress hormone levels in response to noise, but the long term significance of these findings is uncertain and the reported changes have been variable.

11. Although concern is often expressed for the effect of outside agencies on pregnancy, there is no clear evidence of any ill effect from noise. This view is supported by a study of 23,000 pregnancies which did, however, show some negative effects from long working hours, shift and heavy work. One study suggested that on average, children born to mothers living near a civil airfield were just a few grams lighter than those born to mothers from quieter areas. Even so, this had no effect upon subsequent growth rates. It has been suggested, on empirical grounds, that pregnant women should not be exposed to more than 90 dB(L Aeq), but background intra uterine noise levels have been recorded at 70-85 dB and abdominal wall attenuation is of the order of 25-30 dB. As for the psyche, some correlation has been reported between noise sensitivity and neurotic depression.

Community Response.

12. Noise annoyance may be the most widely researched of those responses I have skated over today and was well recognised as long ago as 720BC by the Sybarites who passed zoning laws. Noise undoubtedly causes annoyance but there are very many variables, ranging from the nature of the neighbourhood and it's inhabitants to individual sensitivity to noise. I have mentioned some physiological responses that have been demonstrated but what is less certain is whether or not increasing annoyance leads to increasing health risk. I fear I am left with more questions than answers, for example, what is the scientific basis for man's reaction to noise and what is the social impact of noise on families? Do we really know enough about the effects of pre-existing noise on newcomers to an area or the effect of a change in the pattern, type and level of noise on people already living in a particular area? In the case of low flying military aircraft, are there any long term effects from repetitive startle? Just some of the confounding variables that should be considered include:

a. Age, sex, race, social class, leisure activities, occupation.

b. Family health history, presence or absence of diabetes, obesity or stress, and information of general health.

c. Use of alcohol and cigarettes and nature of dietary habits.

d. Nature of the area, type of housing, length of time in the area, presence or absence of air or other pollutants, presence or absence of other noise and the pattern of the noise exposure that is of interest.

Despite our general concern there is still much we need to learn though it may be reassuring to reflect on what I think is still said to be true that most noise complaints arise from domestic noise from such as children, dogs and radios.

13. The majority of studies on the effects of noise on general health that have so far been undertaken have been incomplete and contain many uncontrolled variables and therefore we believe the problem has still not been adequately addressed. Because of continued allegations of ill effects and very few suggestive findings, good, well controlled research must be encouraged and supported. I believe there is a clear need for long term research into health effects, both in the neighbourhood of military airfields and among those who are regularly exposed to noise from low flying aircraft. I do not underestimate the difficulty of such research and Bob Kull will be going in to bat on that subject.

In the meantime it remains for me to wish researchers in this field the very best of fortune!