

Wind Turbines, Noise and Health

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THE EFFECT OF WIND TURBINES ON HEALTH.

I first realised there might be a problem associated with wind turbines when I was introduced to a couple living near a wind farm in Cornwall. The distance from their home to the nearest turbine is about 400 meters. They told me about poor sleep, headaches stress and anxiety symptoms brought on when the wind was blowing in certain directions. At times, they told me that they have been so disturbed by the noise that after several disturbed nights sleep, they have sought refuge in a nearby bed and breakfast establishment (far enough away not to be similarly affected by the noise).

Since that meeting I have spoken to and / or corresponded with 39 people living between 300meters and 2 km from the nearest turbine of a wind farm all of whom were suffering from the consequences of the noise coming from the turbines. This disturbance is by no means always there and is worse in certain wind directions. The cases mentioned below are from several wind farms in the UK with a variety of turbine sizes from the smaller, older turbines to the taller more modern turbines. However I have had correspondence from people living near wind farms in New Zealand and Australia and have evidence from other sources, (newspapers, journals and papers) of people being similarly affected in France, Germany, Netherlands and the USA.

What this shows is that there is number of people suffering from the consequences of noise from the wind turbines. I'm sure that the cases mentioned here are probably the "tip of the iceberg" and further independent investigation is warranted. The cases are kept anonymous in order to protect the individuals concerned. There is much concern within communities that if one is seen to complain about the noise that if they decide to move away their properties will be difficult to sell and possibly devalued as a result. Therefore they feel that they are in a "Catch 22" situation.

METHOD

All people involved in this survey were contacted either by phone or in writing. Questionnaires were completed for all cases. Questionnaires were sent to people already known to be suffering from problems which they felt was due to their proximity to wind turbines.

The identity of the people questioned has been with held in order to maintain confidentiality. The respondents were from a number of sites in the UK- Wales, Cornwall and the north of England

Example of questionnaire.

- 1) Name- (preferred but optional)
- 2) Age 18-30 30-45
45-60 >60
- 3) Occupation
- 4) Address and /or postcode

- 5) Which wind farm is near your property?
- 6) How far away from your property is the nearest turbine?
- 7) How long have you been living at this property?
- 8) Do you feel that your health has in any way been affected since the erection of these turbines?
- 9) If yes please answer the following:-
Do you feel that since living near a wind turbine/turbines you have experienced excess of the following symptoms (i.e. more than you did prior to living near these structures)?

Headaches	yes	no
Palpitations	yes	no
Excessive tiredness	yes	no
Stress	yes	no
Anxiety	yes	no
Tinnitus (ringing in ears)	yes	no
Hearing problems	yes	no
Sleep disturbance	yes	no
Migraines	yes	no
Depression	yes	no
Other- please specify		

If you have answered yes to any or the above questions, have you approached your doctor regarding these symptoms? If yes please state any tests and/or treatment initiated.

- 10) Do you feel that your quality of life has in any way altered since living near the wind turbines? Yes no

If yes could you please explain in what way you feel your life has been altered.

RESULTS

	1	2	3	4
Age	45-60	45-60	45-60	45-60
Occupation	Cleaner/ housewife	Retired Ill health	Head chef	farmer
Distance from turbine	400m	300m	350m	400m
Time at property	36 years	3 years	7years	4years
Health altered	Yes	Yes	yes	yes
Headaches	Yes	Yes	yes	yes
Palpitations	No	no	no	no
Excessive tiredness	Yes	No	yes	yes
Stress	Yes	Yes	yes	yes
Anxiety	Yes	Yes	yes	yes
Tinnitus	No	No	no	no
Hearing problems	No	No	no	yes
Sleep disturbances	Yes	Yes	yes	yes
Migraines	Yes	Yes	no	yes
Other				
Approached doctor	No	No	no	no
Altered quality of life	Yes	Yes	yes	yes

	5	6	7	8
Age	45-60	>60	18-30	18-30
Occupation	Housewife	Retired	Electrician	carer
Distance from turbine	300m	300m	300-500m	300-500m
Time at property	2.5 years	2.5 years	6 months	6 months
Health altered	Yes	Yes	Yes	yes
Headaches	Yes	Yes	Yes	yes
Palpitations	No	No	No	no
Excessive tiredness	No	Yes	Yes	yes
Stress	No	No	No	no
Anxiety	No	No	No	no
Tinnitus	No	No	No	no
Hearing problems	No	No	No	no
Sleep disturbance	No	No	Yes	yes
Migraines	No	no	No	no
Depression	No	no	No	no
Other		Thumping in ears		
Approached doctor	No	Yes-Rx with pain Killers-ongoing assessment	No- didn't associate symptoms with the turbines	
Altered quality of life	Yes	yes	Yes	yes

	9	10	11	12
Age	>60	30-45	30-45	30-45
occupation	Retired	candle maker	Retired-nervous Breakdown	Retired-ill health
Distance from turbine	300m	¼ mile	300m	300m
Time at property	4years	10 years	3 years	3years
Health altered	Yes	no	Yes	yes
Headaches	No	no	Yes	yes
Palpitations	No	no	No	no
Excessive tiredness	No	no	Yes	no
Stress	No	no	Yes	yes
Anxiety	No	no	Yes	yes
Tinnitus	Yes	no	No	no
Hearing problems	No	no	No	no
Sleep disturbance	No	no	Yes	yes
Migraines	Yes	no	Yes	no
Depression	No	no	Yes	yes
Other		See comments at end	Stomach upset	
Approached doctor	No	no	Yes-seen psychiatrist- Ongoing review	no
Quality of life affected	Yes	yes	Yes	yes

	13	14
Age	30-45	>60
Occupation	Veterinary nurse and HGV driver	Retired from farming and Teaching
Post code	TR8	SA38
Wind farm	Bears Down	Blean Bowi
Distance from turbine	Too close	1mile
Time at property	19 months	27years
Health altered	Yes	Yes
Headaches	Yes	Yes
Palpitations	No	Yes
Excessive tiredness	Yes	Yes
Stress	No	Yes
Anxiety	No	Yes
Tinnitus	No	Yes
Hearing problems	No	No
Sleep disturbance	Yes	Yes
Migraines	No	No
Depression	No	Yes
Other	No	Emotional turmoil
Approached doctor	Yes- taking sleepers and Headache tablets	Yes-had heart check up
Quality of life affected	Yes	Yes

	15	16	17	18
Age	45-60	>60	>60	45-60
Occupation	Teacher	Retired	Retired	Charity manager
Distance from turbine	700m	650m	650	½ mile
Time at property	26 years	30+	30+years	Bear Down
Health altered	Yes	Yes	No	No
Headaches	Yes	No	no	No
Palpitations	No	No	No	No
Excessive tiredness	Yes	Yes	No	No
Stress	No	Yes	No	No
Anxiety	Yes	No	No	No
Tinnitus	No	No	No	No
Hearing problems	No	Yes	No	No
Sleep disturbance	Yes	Yes	No	No
Migraines	No	No	No	No
Depression	No	Yes	No	No
Other	No	No	No	No
Approached doctor	No	No	No	No
Quality of life altered	Yes	Yes	Yes	No

	19	20	21	22
Age	>60	>60	>60	>60
Occupation	Retired		Retired	Retired
Distance from turbine			700m	700m
Time at property	20years	20 years	25years	25 years
Adverse health affects	Yes	Yes	Yes	Yes
Headaches			Yes	Yes
Palpitations				
Excessive tiredness	Yes	Yes	Yes	Yes
Stress			Yes	Yes
Anxiety			Yes	Yes
Tinnitus				Yes
Hearing problems				Yes
Sleep disturbance		Yes	Yes	Yes
Migraines				
Depression	Yes		Yes	Yes
Other				
Approached doctor			Yes	Yes- doctor referred me to the hospital. After tests the consultant could find nothing wrong with my ears.
Quality if life affected	Yes	Yes	Yes	Yes

	23	24	25	26
Age	45-60	45-60	>60	57
Occupation	Farmer	Farmer	Retired	Retired police officer
Distance from turbines	430m	430m	1000m	1000m
Time at property	5 ½ years	5 ½	30years	30years
Adverse health affects	No	Yes	Yes	Yes
Headaches			Yes	Yes
Palpitations				
Excessive tiredness			Yes	Yes
Stress			Yes	Yes
Anxiety				Yes
Tinnitus		Yes		
Hearing problems			Yes	
Sleep disturbance				Yes
Migraines			Yes	
Depression				Yes
Other				
Approached doctor		Yes- been under a specialist in Furness General hospital for 1 ½ years	Yes	No
Quality of life affected	Yes	Yes	Yes	Yes

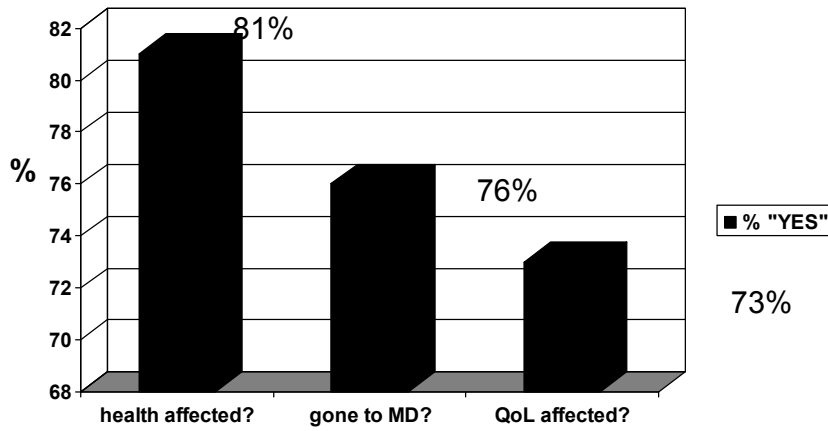
	27	28	29	30
Age	>60	>60	56	79
Occupation	Farmer/ sheep breeder		Pedigree sheep breeder	War veteran
Distance from turbine	½ mile	700m	1/3mile	
Time at property	9 years	33 years	9 years	33 years
Adverse health affect	Yes	Yes	Yes	Yes
Headaches	Yes		Yes	Yes
Palpitations			Yes	
Excessive tiredness	Yes		Yes	Yes
Stress	Yes		Yes	Yes
Anxiety			Yes	Yes
Tinnitus				Yes
Hearing problems				Yes
Sleep disturbance	Yes	Yes	Yes	
Migraines	Yes		Yes	Yes
Depression				
Other			Concentration	
Approached doctor	Yes	No	Yes- have had a 24 hour e.c.g. for investigations of palpitations. Brain haemorrhage 2 years ago.	Yes
Quality of life affected	Yes		Yes	Yes

	31	32	33	34
Age	81	45-60	>60	30-45
Occupation	Retired carpenter	Systems analyst/programmer	Business owner	Retired State registered nurse
Distance from turbine		$\frac{3}{4}$ mile	Less than 1 mile	300m
Time at property	33 years	16 years	16 years	7 years
Health adversely affected	Yes	No	Yes	Yes
Headaches	Yes		No	Yes
Palpitations			No	
Excessive tiredness	Yes	Yes	Yes	Yes
Stress	Yes		Yes	Yes
Anxiety	Yes		No	
Tinnitus	Yes		No	
Hearing problems	Yes		Yes	
Sleep disturbance			Yes	Yes
Migraines	Yes		no	
Depression			No	
Other				
Approached doctor	Yes	Yes	No	No
Quality of life affected	Yes		Yes	Yes

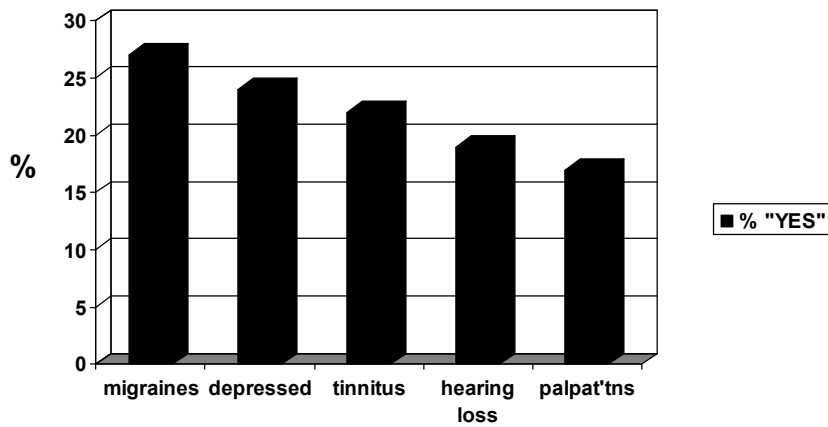
	35	36	37	38
Age	45-60	45-60	45-60	62
Occupation	Retired due to Nervous breakdown	Semi Retired farmer	Semi retired farmer	Retired
Distance from turbine	300m	800m	800m	
Time at property	7 years	11 years	11 years	25 years
Health adversely affected	yes	Yes definitely	Yes	
Headaches	yes	Yes	Yes	
Palpitations		Yes	Yes	
Excessive tiredness		Yes	Yes	Yes
Stress	yes	Yes yes	Yes	
Anxiety	yes	Yes yes yes	Yes	
Tinnitus		Yes	Yes	
Hearing problems		May be		
Sleep disturbance	yes	Yes yes yes	Yes	Yes
Migraines		No	No	
Depression		No	no	
Other	nausea			
Approached doctor	yes	Yes put on antidepressants and anti-hypertensives	Yes	
Quality of life affected	Yes	Absolutely yes	Yes	Yes

	39	40	41	42
Age			45-60	>60
Occupation	Retired phlebotomist	Running own business	Database administrator	Retired farmer
Distance from turbine		600m	3/4mile	1 mile
Time at property	20 years	24 years	7 years	26 years
Adverse affect on health	Yes	Yes	Yes	Yes
Headaches		Yes		Yes
Palpitations				Yes
Excessive tiredness	Yes	Yes		Yes
Stress				Yes
Anxiety		Yes	Yes	Yes
Tinnitus				
Hearing problems				
Sleep disturbance	Yes	Yes		Yes
Migraines				
Depression				Yes
Other	Lack of concentration And irritability		Nausea	
Approached doctor	No	No		Yes
Quality of life affected	Yes	Yes	Yes	Yes

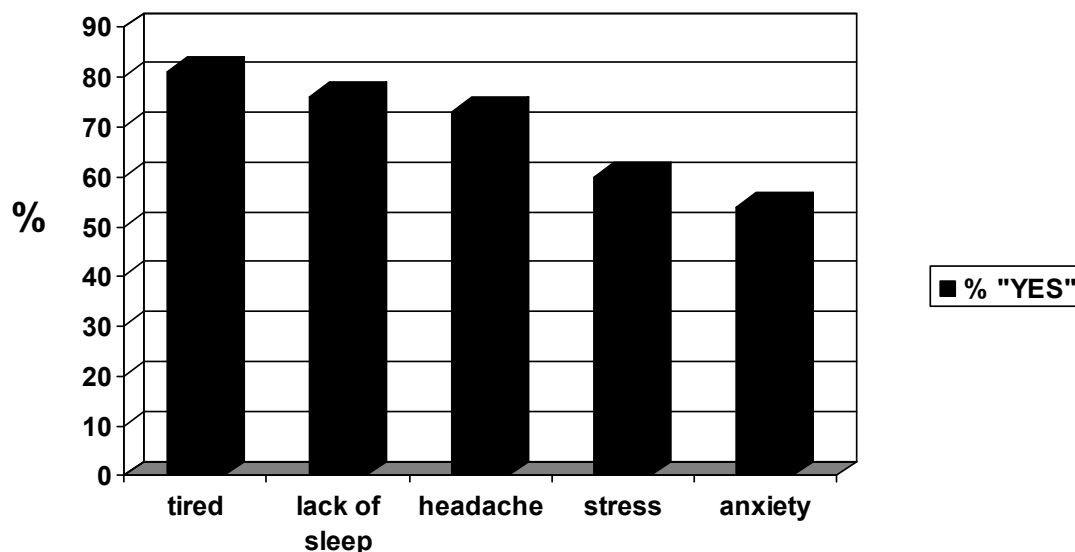
- *Has your health in any way been affected since the erection of these turbines?*
- *As a result, have you gone to see your doctor?*
- *Do you feel that your Quality of Life has in any way been altered since living near the wind turbines?*



Top 5 Self-reported Health Symptoms



Next 5 Self-reported Health Symptoms



ADDITIONAL COMMENTS MADE BY RESPONDANTS

1) I get little sleep when the noise from the turbines is constant in its low frequency noise. I feel so depressed I want to get away and stay away until I know the wind direction has changed.

2) My symptoms are due to lack of sleep when the wind is in the east or northeast

3) I get headaches frequently especially when the turbines are running at a fast rate towards us.

4) I get headaches and thumping in the ears. I also find its continual noise very distressing.

5) Suffer with headaches more and feel tired more so find daily tasks difficult to do.

6) I also find that the sound we get from the farm affects my metal heart valve.

7) I couldn't say whether or not the strobing effect wakes me up but it is impossible to go back to sleep with it there.

8) Constant worry about noise. I feel sick when the turbines are running fast and towards the property. I came here to a rural area for peace after a busy city life. I feel this has been ruined by the turbines.

9) Stressed and extremely anxious as I am constantly disturbed by them when they are turning fast and facing towards me. We are having to live our lives around them due to the constant noise when they are working causing wind pressure throbbing.

10) The strobing even when curtains are closed is "HELL". The noise is a pain. TV blocks it, night and day. Can't sit and read a book or write letters.

11) My plan was to stay here- in my newly converted barn (7 years old) (we farmed here) until I died. We have our own private water supply, a good supply of fire wood, my own painting studio- VERY IMPORTANT TO ME! And a good workshop for my husband; friends nearby, brother and sister nearby. I was born 2 miles away- Now WE HAVE TO MOVE. This move has been forced upon us. We planted 7,000 trees here. Etc.etc.etc.....

12) We will probably have to move, I can see no future for me here.

13) I dare not sleep at home.

14)

Noise disturbance at night –when wind in certain direction, interferes with sleep patterns, causing restlessness. During the day- makes it difficult to stay out of doors for any length of time through excessive thumping sound. Both can cause headaches, anxiety and irritability.

15) Certain wind directions mean excessive noise, like a thrashing machine constantly pounding, making it unpleasant to be in the garden or to have windows open. With strong wind conditions, double glazed windows vibrate and cause an intrusive, almost sub audible interference in some rooms.

16) Tired, disturbed by noise. Feel it as much as hear it. Developers deny there are any problems unless we can prove, but how can we do that?

17) Irritating noise from wind farm in easterly winds. You can almost feel it as well as hear it. It drives you mad over extended periods because of the nature of the noise, not the level per se. Unable to have front doors/windows open when winds are easterly, or use front bedroom if all 7 turbines are in operation.

18) Our quality of life we had before the wind farm came has gone. We no longer control the way we live our lives e.g. if we can work or sit in the garden, or at times, even where we can sit in our own home or get a full nights sleep.

19) I never suffered from any problems before the turbines. I am convinced that living in a continual state of anxiety over the past four and a half years since the noise nuisance started has contributed to my present problems (hypertension and stress). Prior to 1999 I always enjoyed excellent health and rarely visited the doctor's surgery. As my husband and I have been retired since 1994 and our family grown up and living in different areas of the country we do not have any other problems that are likely to cause stress or anxiety.

20) Not being able to choose when I work or sit in my own garden. Not getting full nights sleep. Waking with headaches when the noise is bad and feeling sick. Ears feel like I experience when travelling by plane- feel as if they are swollen inside. I cannot work more than 2-3 hours in the garden when the wind direction if from the east. We cannot see the wind farm from our property but at times the noise is horrendous.

- 21) My quality of life has been affected by the shadow flicker and the noise
- 22) I am bothered by the shadow flicker, and the noise while working behind the building.
- 23) I feel generally off colour
- 24) As we leave the house, the turbines are always there, menacing, always drawing your attention, depressing, in a beautiful area. Normally I sleep with the bedroom windows closed, if in summer we have a heat wave and the windows are open, I find I am wheezing in time with the turbine noise, it seems to come inside my body. This is an old stone gatehouse south of the site.
- 25) Quality of life has almost disappeared. No longer able to relax in the garden (when wind speed/ direction cause noise). Glinting and reflection also cause disturbance. Visual dominance is oppressive- extremely angry.
- 26) Constant sleep disturbance. Unable to work within certain areas, for noise levels, when wind is in certain directions, very stressful.
- 27) Disturbed sleeping. View blades whishing in the wind. Drawn to blades going round. Little concentration. Ugly to look at. Dominant. Not able to work in yard for long periods of time.
- 28) Our lives and home have been trashed and must be seen to be believed. We seem to be short tempered, unable to concentrate. Every thing we have such as mattress, duvets, cushions 4" thick, 3 rolls of sound deadening quilt, 3 sheets of corrugated asbestos, blankets, curtains, pillows even floor carpet stacked against the walls to try and keep out the sound. Not the peace I volunteered to fight for.
- 29) constant noise
- 30) Constant noise when turbine is facing us and away from us. Sleepless nights which make me irritable. Stress due to husbands anxiety about the turbines.
- 31) Noise from turbines effects my sleep patterns, I sleep less. I get nausea when the turbines face our home and causes a drumming at low noise frequency. I worry about the turbine blades coming off and killing me
- 32) Alienation from mainstream community that have the erroneous impression that wind power is a good alternative. Forced to sell property at a reduced rate- that was meant to be our retirement home. Health improved since moving from the property
- 33) As soon as the wind farm was operating I experienced horrendous continuous noise when the wind was from the east. This was both inside and outside my home. There were many times I had to leave the garden because of the noise. It was like a Chinese water torture, it was a constant pulsating noise. It was almost a feeling of compression as much as noise. I had to move bedrooms at times in order to escape the noise. It imprints on you, if you have had it all day in the garden, it stays with you,

once it's in your head it's hard to get rid of. It's weird. It's a feeling as much as a noise. It's torture.

34) It's an irritating and tiring noise, especially when you have not had any sleep because of it.

35) Even if you shut the window, the noise is still there, but not as much. The problem is, once you get the noise in your head, it's always there, it does annoy you and it is difficult to disregard.

36) The noise is like a whooshing noise. It is intrusive. It keeps me awake- it doesn't affect my husband as much as me but my being awake keeps him awake.

37) Once the noise gets into your head, it also seems to beat at the same frequency as my heart and I find it annoying and am unable to get any sleep- this can go on for nights on end. It's not always the level of the noise, it's the intermittent nature. You think "Oh it's stopped" then it starts up again.

38) If the wind is from the East or the South the noise is horrendous- you can't get away from it. It's inside and outside the house. It's worse at night- I have to bed hop. It's a whooshing, drumming, constant drumming noise. It's annoying. It's frustrating. It wears you down. You can't sleep at night or concentrate during the day. Once it gets inside your head you can't get rid of it. You get up in the morning, tired, agitated and depressed and it makes you short-tempered.

39) Our lives are hell, they have been ruined and it's all due to those turbines.

40) The noise from the wind farm is different and I can't explain why, it just is. All you ever want to do is to get out of the way of it, by whatever means you can.

CONCLUSIONS

I think it is clearly evident from these cases that there are people living near turbines who are genuinely suffering from health effects from the noise produced by wind turbines. These neighbours of turbines clearly state that at times the noise from turbines is unbearable. The developers are usually heard to say that noise is not a problem. Clearly this cannot be the case.

A discussion follows which clearly explains why the characteristic noise from these turbines can be producing the symptoms that are being described above. On searching through the current literature I can find no papers written showing that turbines are harmless, only statements from acousticians giving their personal thoughts. In addition to this some of these acoustic experts have made statements categorically saying that the low frequency noise from turbines does not have an effect on health. I feel that these comments are made outside their area of expertise and should be ignored until proper medical, epidemiological studies are carried out by independent medical researchers.

DISCUSSION

As shown in the case studies, people living near wind farms in the United Kingdom have been complaining of health problems since the construction of the wind farms near their homes. Inquiries reveal that some wind farms located close to peoples residences in Europe, Australia and North America have reported similar problems

The range of symptoms mentioned by complainants includes headaches, sleep disturbance, anxiety, depression, stress, vertigo and tinnitus. People complain of the noise, vibration and shadow flicker (caused by rotation of the blades and the reflection of the sun).

The following seeks to explain why these symptoms and problems could be caused by the wind turbines.

The evidence supplied has been made by a prolonged study of research available worldwide. Some acousticians have expressed the opinion that the level of low frequency noise (in dB (A)) emitted by a wind turbine will not produce health problems. However during my extensive search of the published literature, I have been unable to find any medical evidence to support this opinion.

Although the papers researched are generally not specific to wind turbines they are specific to the type and intensity of noise produced by wind turbines. The noise produced by wind turbines is quite complex therefore our response is likely to be complex also. In addition wind turbines produce a repetitive visual stimulus which goes to reinforce annoyance.

SOUND AND NOISE

Recently the European Union Noise Committee stated that noise is the biggest pollutant and the fastest growing pollutant in Europe.

Noise can be defined as unwanted sound and is commonly associated with annoyance reactions. It is commonly perceived as an environmental stressor and nuisance. Environmental noise is ubiquitous and annoyance is one of the most widely studied adverse reactions to noise. Noise interferes with task performance; cognitive performance modifies social behaviour and causes stress and irritation.

According to the World Health Organisation (WHO), health should be regarded as “a state of complete physical, mental and social wellbeing and not merely the absence of disease or infirmity”- WHO 2001. Under this broad definition, noise induced annoyance is an adverse health effect. As with any psychological reaction, annoyance has a wide range of individual variability, which is influenced by multiple personal and situational factors.

WHO also defines noise annoyance as “a feeling of resentment displeasure, discomfort, dissatisfaction or offence which occurs when noise interferes with someone’s thoughts, feelings or daily activities- (WHO paper on Environmental noise- Passchier and Verneer 1993.

Noise annoyance is always assessed at the level of populations, using questionnaires. There is consistent evidence for annoyance in populations, exposed for more than one year to sound levels of 37dBA and severe annoyance at 42dBA.

There is no doubt that annoyance from noise adversely affects human wellbeing.

The level of annoyance can only be described by listeners themselves. These descriptions are often fuzzy and not quantified most of the time. In addition to this different people have different subjective responses on the grade of annoyance. There are many theories regarding noise nuisance and many factors are thought to have an influence e.g. the types of noise source, noise energy, frequency, age, previous noise exposure, types of building structures and weather conditions. Subjective annoyance relates not only to the sound level and frequency but also to the physiological and mental factors of the sound recipients.

Field studies performed among people living in the vicinity of wind turbines showed that there is a correlation between sound pressure levels and annoyance but that annoyance is also influenced by other factors such as attitude to wind turbines and the landscape. However noise annoyance from wind turbines was found at lower sound pressure levels than in studies of annoyance from road traffic noise. This is because the absolute noise level is less important than the character of the noise produced.

Non-auditory effects of noise, can be defined as all those effects on health and well being which are caused by noise exposure with the exclusion of effects on the hearing organ. Non auditory effects include stress, related physiological and behavioural effects and safety concerns. There have been studies showing that aircraft noise can decrease cognitive function resulting in decreased scholastic achievement.

It is obvious that the health issues relating to wind turbines are caused by these non-auditory effects as the sound pressure levels are not high enough to cause an auditory effect (e.g. hearing impairment resulting from excessive noise exposure).

How does noise affect health?

It is generally considered that noise can be an intrusion into daily activities and tasks, causing annoyance. In certain circumstances in certain susceptible individuals this annoyance may lead to a stress response which in turn may lead to symptoms and subsequently illness.

The response to noise probably depends upon the characteristics of the sound, including intensity, frequency, and complexity of sound, duration and meaning of the noise i.e. whether the noise is perceived as threatening or not.

Alternatively, noise may affect health directly and not through annoyance. E.g. studies show elevated cortisol levels in individuals subjected to; vibroacoustic disease caused by excessive exposure to low frequency noise resulting in abnormal proliferation of extra cellular matrices.

Any severe extreme imposed on the sonic environment has a profoundly destabilizing effect on the individual.

This is evident in both the areas of high intensity acoustic energy and also its complete absence.

Anechoic chambers, which create an environment void of sound, have the ability to produce similar feelings of disorientation and disturbance that are evident with high intensity sound. The silence envelops the individual in a suffocating manner causing both psychological trauma and also physiological disturbance in the form of balance problems and other related body functions. It is clearly apparent that the human organism is in an extremely delicate state of equilibrium with the sonic environment and any profound disturbance of this system will have profound ramifications to the individual

The auditory system is an extremely complex system .Because of the complexity of the auditory and cerebral systems it becomes easy to understand why the issues surrounding noise annoyance/ disturbance and associated health effects is not a simple one.

Studies in USA have shown a relationship between anxiety and vestibular disorders such as dizziness and migraines vertigo. Anatomical and electrophysiological evidence suggests that serotonin modulates processing in the vestibular nuclei in the brain. Therefore a disturbance in the serotonin balance which occurs in anxiety and depression syndromes can cause vestibular problems.

Low frequency noise is also produced from wind turbines. Low frequency sound is predominately the result off the displacement of air by a blade and of turbulence at the blade surface. The low frequencies contribute to the overall audible noise but also produce a seismic characteristic which is one of the common complaints from neighbours when they say that not only can they hear the noise but they can also feel it.

The various parts of the body have a specific natural frequency or a resonance frequency. The human body is a strongly damped system, therefore, when a part of it is excited at its natural frequency, it will resonate over a range of frequencies instead of at a single frequency.

(fig. 1).

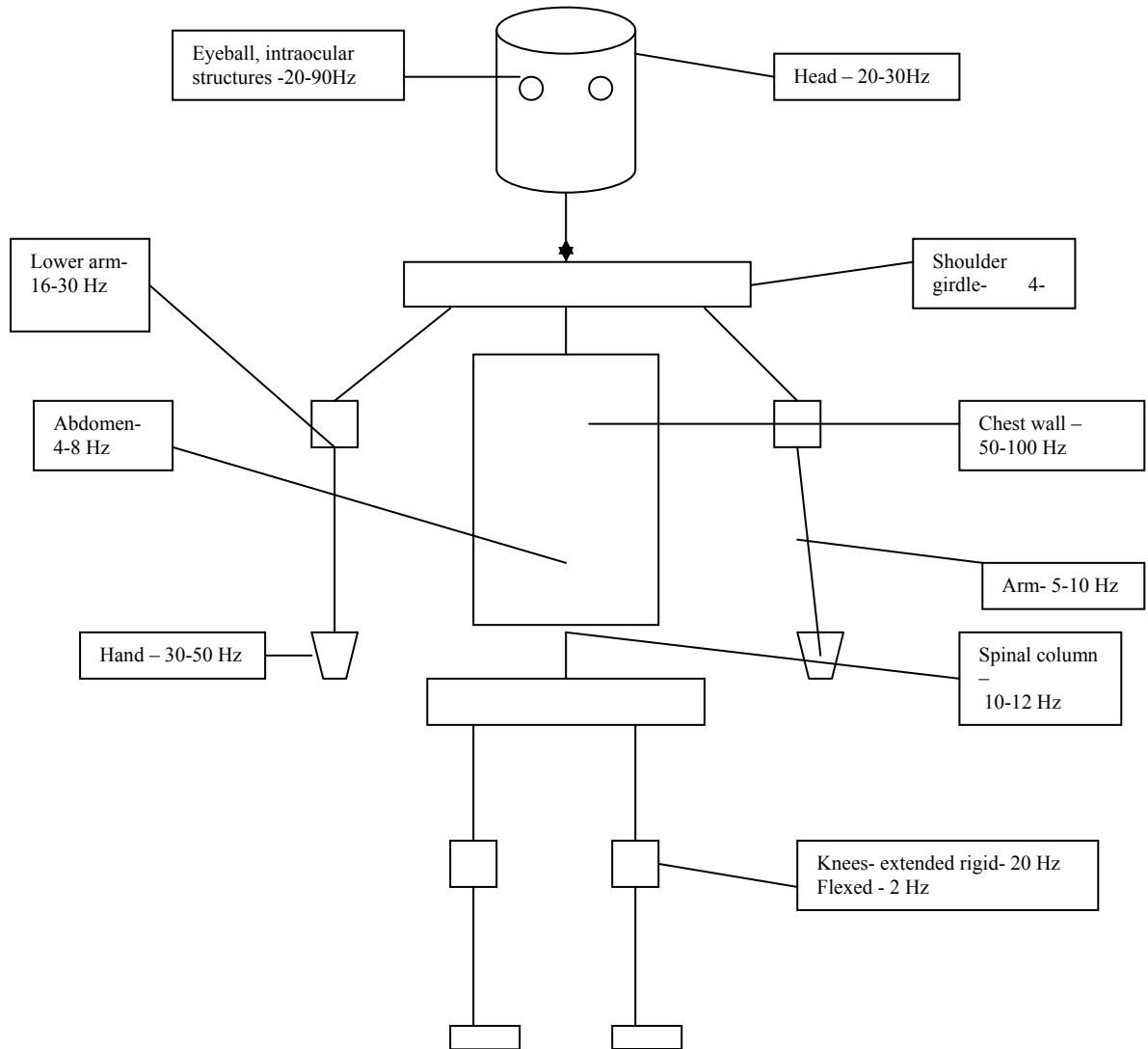
A research paper by G Rasmussen looked at body vibration exposure at frequencies of 1-20 Hz. Part of a table shows:-

Symptoms	Frequency
General feeling of discomfort	4Hz – 9Hz
Head symptoms	13Hz – 20Hz
Influence on speech	13 Hz – 20 Hz
Lump in throat	12 Hz – 16Hz
Chest pains	5Hz – 7Hz
Abdominal pains	4Hz – 10Hz
Urge to urinate	10Hz – 18Hz
Influence on breathing movements	4Hz – 8Hz

Also in the region 60-90 Hz disturbances are felt which suggest eyeball resonances, and a resonance effect in the lower jaw/skull system has been found between 100-200 Hz

Fig. 1

The resonance frequency ranges for various parts of the human body- values taken from the International Standards Organisation –ISO standards 2631



An important contribution to the low frequency part of the sound spectrum may be the result of the sudden variation in air flow the blade encounters when it passes the tower: the angle of attack of the incoming air suddenly deviates from the angle that is optimised for the mean flow. This effect has not been considered important as the blade frequency is of the order of 1Hz where humans' hearing is relatively insensitive. However low frequency modulates well audible, higher frequency sounds and thus creates periodic sound. This effect is stronger at night because in the stable atmosphere there is a greater difference between rotor average and near tower wind speed. In addition to this multiple turbines can interact with each other to further multiply the effect. The effect will be greater for the larger more modern wind turbines.

As wind is variable and not consistent, the nature of the noise produced is also impulsive and unpredictable.

Low frequency noise issues have been researched extensively in Portugal and have been found to cause a complex disease known as vibroacoustic disease. Although this research has been mainly concerned with high levels of low frequency noise, it is felt that over years lower levels of low frequency noise may cause similar problems. It appears that the low frequency noise compromises the mechanotransduction signalling of cells which lead to structural changes of tissues and cells. This damage sustained is dose dependent and it is only in the latter stages that routine medical investigations will become positive. The syndrome can be broken down into various stages:-

Stage 1 - MILD (*1-4 years*) Slight mood swings, indigestion, heartburn, mouth/throat infections, bronchitis

Stage 2 - MODERATE (*4-10 years*) Chest pain, definite mood swings, back pain, fatigue, skin infections (fungal, viral, and parasitic), inflammation of stomach lining, pain and blood in urine, conjunctivitis, allergies.

Stage 3 - SEVERE (*> 10 years*) psychiatric disturbances, haemorrhages (nasal, digestive, conjunctive mucosa) varicose veins, haemorrhoids, duodenal ulcers, spastic colitis, decrease in visual acuity, headaches, severe joint pain, intense muscular pain, neurological disturbances.)

Low frequency noise exposure has also been shown in many studies to interfere with performance and cognitive function in the workplace. The effects are greatest in noise sensitive particularly low frequency noise sensitive individuals. In this group of people salivary cortisol levels are elevated during exposure.

For many years research has been carried out using noise as a non lethal weapon. Recently the Israeli army used such a weapon for crowd dispersal. Witnesses described a minute-long blast of sound emanating from a white Israeli military vehicle. Within seconds, protestors began falling to their knees, unable to maintain their balance. The technology is believed to be similar to the LRAD — Long-Range Acoustic Device — used by U.S. forces in Iraq as a means of crowd control.

Professor Pratt a professor of neurobiology specializing in human auditory responses at Israel's Technion Institute explains that by stimulating the inner ear, which houses the auditory and vestibular systems, with high intensity acoustic signals that are below the audible frequencies- below 20 Hz, the vestibular organ can be stimulated and create a discrepancy between inputs from the visual system and somatosensory system and the vestibular organ will erroneously report acceleration (because of the low- frequency inaudible sound). It doesn't have to be a loud sound This will create a sensation similar to motion sickness. Such cases have been reported in relation to air conditioning systems.

Work by Fritz van den Berg shows why the characteristics of the noise produced by wind turbines increases and alters at night . He showed that the noise at night can be 15-18dBs higher at night time than during the day because of atmospheric changes (ref. Fritz van den Berg).

Therefore when we are resting in bed at night, the noise from the wind turbines can be at their loudest and most disturbing.

Those people who are disturbed by the noise are often particularly aware of the problems at night. – this statement can be partially explained by lower background noise levels at night, and also the fact that atmospheric stability increases at night giving a greater differential between rotor averaged and near tower wind speed . This explains why the characteristic of the noise emitted from turbines takes on a “beating” character early evening and night-in agreement with the blade passing frequency.

Noise induced sleep disturbance is well known to have adverse health effects and has been studied extensively although not with particular reference to wind turbines. Due to the indisputable restorative function of sleep, noise induced sleep disturbances are regarded as the most deleterious effects of noise.

Nocturnal noise disturbance has been shown to disrupt nocturnal cortisol secretion. Nocturnal noise excites areas of the brain such as the amygdala (functions as the fear centre) and cortical areas (arousal, annoyance and awakening). Noise –even levels below awakening threshold – can induce cortisol secretion. Repeated night time disturbance will result in an accumulation of cortisol levels in the blood. In the long term this can result in long term stress activation.

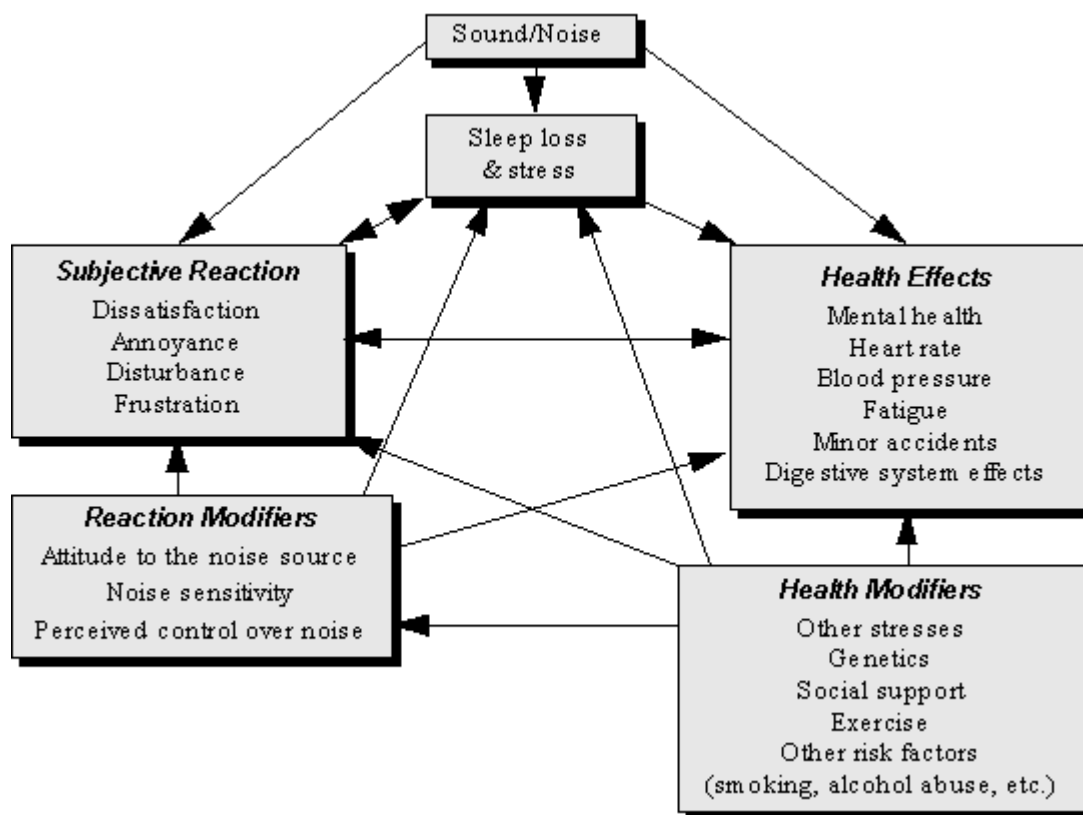
Several epidemiological studies in patients with primary insomnia found to be at a higher risk of developing major depression in the following years.

It has also been shown that women with increased morning cortisol levels show a higher risk of a major depressive episode within the next 12 months.

Psycho physiological reactions such as effects on heart rate and respiration rate have been observed during exposure to noise whilst subjects sleep. These have been found to be induced by road traffic noise with levels exceeding 40 dB LA max (both in lab and in field studies). Hardly any habituation occurs during or between nights. Children have higher psycho physiological reactivity than adults. In addition for these types of reactions, the difference between the background noise levels and the maximum sound pressure level is of more importance than the absolute sound level. (Vernet 1983).

The potential adverse health effects are usually classified according to the type of noise. Sudden or impulsive noise appears to create more disturbance than non impulsive noise (Job 1996). Intermittent noise has a greater effect than louder more continuous noise (Westman and Walters 1981). Predictability and controllability are clearly influencing factors in an individual’s response to noise and this has been born out by surveys conducted by Eja Pederson in a paper presented in Berlin in Oct 2005.

It has been shown in several studies that depressed people and the elderly have a diminished variability in circadian cortisol levels and a raised morning cortisol in common. (Kern et al in 1996, Van Cauter et al 1998, Deuschle et al 1998). It would therefore be likely that the elderly and patients already suffering depression might be more susceptible to noise induced arousals.



However we as humans experience our environment through multi sensory channels e.g. acoustic, visual, proprioceptive, vibrational and psychological and emotional issues.

Therefore all these factors have to be considered when we try to explain why people might be disturbed by wind turbines. When discussing noise with people who are disturbed by turbines, frequent complaints are of vibration leading to an intrusional

and invading noise that they feel they cannot get away from. People say that they can "feel the noise".

I would suggest that several factors are therefore concerned in this annoyance. The "periodic noise" as described previously and the low frequency component. I think that the presence of these two together has an additive effect compounding both. The periodic noise draws the attention to the vibrational component and therefore becomes more annoying than if either were present individually.

In addition to this there is the visual stimulation of the turbine blades rotating- this is particularly disturbing in certain light conditions where strobing occurs, but provide a constant reminder of the presence of the turbines by their movement.

Psychological and social issues must also be considered. E.g. pre-existing psychological problems and also perceptions of having a wind turbine built close to their homes. Most people live in the countryside because they appreciate the quiet and the visual amenity. Therefore reluctance to having a wind farm nearby will exacerbate any problems.

SUMMARY

There are many people living near wind turbines who are suffering from problems with their health.

The noise produced from wind turbines is an extremely complex one and I feel that it is the complexity of the noise and vibration which causes the disturbance.

From my discussions with people suffering from ill health who live near wind farms, it seems that the symptoms suffered can occur up to a mile from the wind farm. Until further independent medical and epidemiological research has been carried out I would suggest that no wind turbines should be sited closer than 1.5 miles away from the nearest wind turbine.

The current UK guidance for establishing a safe distance between turbines and dwellings is the ETSU-R-97. This document was produced when turbines were approximately 20% the size of the currently proposed turbines. The guidelines pay scant reference to low frequency noise and the complexity of the noise profile produced by the turbines.

The continued use of ETSU-R-97 has been publically condemned by Professor Ffowcs-Williams and G.P. Van den Berg.

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Appendix 1

Something in the Wind

THE SUNDAY TIMES - JANUARY 20, 2002

To some people they are “grotesque” blights on the countryside; to others, graceful machines that offer a welcome alternative to nuclear power and a way of tackling global warming. There are now more than 60 **wind** farms in Britain – the windiest nation in Europe – with 853 **turbines** producing enough power to run 500,000 homes a year. The numbers are set to rise as the government cranks up its drive to generate 10% of Britain’s electricity from green energy sources by 2010. Last week Powergen announced that it is considering building one of the biggest **wind** farms in the world in the Thames Estuary, sinking several hundred **turbines** into a sand bank in a project worth £500m. It comes in the wake of plans announced in December for a huge onshore **wind** farm on the Hebridean island of Lewis. If the project gets planning permission, 300 **turbines** will be built, eventually meeting 1% of Britain’s electricity needs. An increasing number of homeowners therefore have to get used to the prospect of living near the whirling blades. Margaret Gough, for one, cannot stand the sight of the towers that straddle the grassy slopes near her mid-Wales home. When she and her late husband retired to a village outside Aberystwyth 15 years ago, they chose a bungalow which had stunning views – until the Mynydd Gorddu **wind** farm opened several years later. “The reason we bought this property was for the scenery,” says Gough. “It was such a beautiful skyline: if I stood in the garden and looked around all I could see was tree- covered hillsides. Now when I look out I can see about eight or nine **wind turbines**.”

I stand under the turbine in Swaffham in Norfolk [the world’s most efficient turbine and at 67m, thought to be Europe’s tallest] and you don’t know it’s turning.” Surveys have found that although up to 96% of people say they approve of **wind** farms, about a quarter would not like to live close to one. Householders’ main objections are that **wind turbines** are “ugly” and they may bring down the value of their properties. Michael Williams, manager of estate agent Shearer & Morris in Aberystwyth, says that unless homes are very close to **wind turbines** property prices are unaffected. “I’ve sold quite a few properties within a mile of **wind** farms without any bother,” he says. Nevertheless, some homeowners are fighting back. Martin Wright, Chairman of the Cefn Croes Campaign, is trying to halt the construction of the biggest **wind** farm in Britain. Under the £35m project – already approved by Brian Wilson, the energy minister – 39 **turbines**, each 100m high, will be sited at Cefn Croes, near Devil’s Bridge in Ceredigion, mid-Wales. Wright says he objects to **wind** farms because he fears that vast swathes of rural Britain will be lost to the machines. “Mid-Wales is full of them,” he laments. “The reason I oppose them isn’t because I don’t want them in my back yard – there’s a **wind** farm on the mountain above my house and I can’t say it disrupts my life – it’s to do with the wider issue of the value of our landscape.

“**Wind** power is a good idea, but the only way it is going to have any impact on our energy needs is to cover the whole country with **turbines**. So unless we are going to go down that path, why bother?

“We are going to ruin some of the lovely wildernesses that have been protected since the war: you can’t build bungalows, but you can put up a 100m high turbine. That doesn’t seem right.”

Archaeologist **Dr Stephen Briggs**, also from Wales, claims he moved because infrasound, sound with a frequency below an audible level, from a **wind** farm made his wife ill. Problems started not long after the Llangwryfon **wind** farm, 12 miles from Aberystwyth, opened 10 years ago. The **Briggs**’ house was 350m from three of the 20-plus **turbines** and 650m from six of the machines. “Our initial intention was to stay put, even though we were disturbed by the changes and damage,” says **Briggs**. “We had been assured the **turbines** would make no noise, but we were so close we could hear the **wind** whistling through them. “We also discovered that not only did they broadcast audible sound, they produced infrasound. It started to make my wife sick.” Finally, six years ago, the **Briggs** decided to sell their house and move to a new home five miles away.

Dr Peter Musgrove, head of development at National **Wind** Power, which used to own Llangwryfon, says; “The issue of the infrasound has been looked into in considerable detail and no evidence has been found that it is emitted by the **turbines**.” Not everybody objects to **turbines**, however. John Theobald and his wife Sue are more than happy to live in the lee of a **wind** farm. Their bungalow overlooks Delabole in Cornwall, the oldest commercial **wind** farm in Britain, which attracts thousands of visitors a year. From their windows, they have a clear view of all 10 **turbines**. “My wife and I are inveterate supporters of renewable energy anyway, but I love them,” says Theobald, who runs a woodturning business and a bed-and-breakfast. “They change colour depending on the weather: some days they look thunderously grey and broody; other days, when the sun goes down, they turn pink and purple. “Having said that, I don’t think anyone would like to live right underneath the tower.” “We live about four or five fields away and only occasionally hear the noise from the **turbines** if the **wind** is in the East.”

In fact, the noise is diminishing all the time as technology advances.

“Noise is no longer an issue,” asserts Peter Edwards, owner of Delabole farm.

Blowing hot and cold: Martin Wright, above, from mid-Wales, fears turbine blight

The Theobalds: see no problems with **turbines**

Source: *The Sunday Times*, 20 January 2002

Appendix 2

Flurry of complaints after wind change

Jul 25, 2005

A wind change at Meridian power company's giant wind farm on the Ruahine Ranges has prompted a flood of complaints from nearby residents.

Residents in the small Manawatu town of Ashurst say that in an easterly there is an intrusive rumble for days on end. They say the windmills emitted a low frequency noise for three days on end, making their lives a living hell.

The Te Apiti windfarm turbines have a steady sound in the prevailing westerly wind but when the wind suddenly, and unusually, turned easterly last weekend Ashurst residents say it bombarded them with noise and vibration.

"On Monday night the rumbling was so bad it sounded like one of those street cleaning machines was driving up and down near the house. In fact it sounded like it was going to come through the house," says Wendy Brock.

Geoff Keall said whether people were inside or outside it had an impact.

The blades on each of the 55 turbines are the size of a Boeing 747 wing and they produce enough electricity to power 45,000 homes.

Tararua District Council says measuring the noise is difficult, but it is concerned for the residents. Spokesman Mike Brown from Tararua District says he believes Meridian is also concerned and they will be talking together to see what can be done to resolve the issue.

But Meridian says it's a small number of people making a big noise about nothing.

Spokesman Alan Seay says they monitor the sound levels at a number of points and the monitoring has shown quite clearly they were well within the guidelines.

There's growing opposition from the public to windfarms.

Previously people have been generally supportive of windpower, but when a power company recently applied to instal a further 40 wind turbines, it attracted objections from more than 250 people.

However, despite the latest complaints windfarms on the Ruahine and Tararua ranges are expected to expand.

Appendix 3

FEATURE: And the beat goes on . . .and on and on

18.02.2006

KATHY WEBB

They call it the train that never arrives. It's a low, rumbling sound that goes on and on ... and on.

Sometimes, in a stiff easterly, the rumbling develops into a roar, like a stormy ocean.

But worst of all is the beat. An insidious, low-frequency vibration that's more a sensation than a noise. It defeats double-glazing and ear plugs, coming up through the ground, or through the floors of houses, and manifesting itself as a ripple up the spine, a thump on the chest or a throbbing in the ears. Those who feel it say it's particularly bad at night. It wakes them up or stops them getting to sleep.

Wendy Brock says staff from Meridian Energy promised her the wind turbines at Te Apiti, 2.5km from her Ashhurst home in southern Hawke's Bay, would be no noisier than waves swishing on a seashore.

"They stood in my lounge and told me that."

But during a strong easterly, the noise emitted by the triffid-like structures waving their arms along the skyline and down the slopes behind the Brock family's lifestyle block is more like a thundering, stormy ocean. Sometimes it goes on for days. And when the air is still, there's the beat - rhythmic and relentless, "like the boom box in a teenager's car".

"It comes up through the floor of our house. You can't stop it."

Mrs Brock says she can feel it rippling along her spine when she's lying in bed at night. Blocking her ears makes no difference.

"It irritates you, night after night. Imagine you've done your day's work, then you go to bed, and there's this bass beat coming up through the floor and you can't go to sleep. You can't even put headphones on and get away from it.

"My older son sometimes gets woken up by the noise. He gets up and prowls around the house."

She tells of other Ashhurst residents who "feel" the sound hitting their chests in the Ashhurst Domain 3km from the turbines. She says one woman is so distressed by the sensation she has put her home on the market.

Not everyone in the village hears the infrasound - Mrs Brock reels off the names of residents wondering what the fuss is all about - but says those who do feel the sound are distressed by it and have nowhere to turn for redress.

There's little point complaining to the Tararua District Council because all it does is record each complaint and forward it to Meridian, and nothing ever happens.

"What are they (the council) going to do to Meridian - fine them, or shut down the turbines?" asks Mrs Brock.

Meridian is dismissive of complaints about noise from Te Apiti.

"Infrasound is just not an issue with modern turbines," insists spokesman Alan Seay.

"We take it very seriously. We have looked into it seriously, but the advice we are getting from eminently qualified people is that it is just not an issue."

Many people claiming to be putting forward scientific argument about noise from turbines "are not qualified in this area of expertise. I have a problem with some of their statements", Mr Seay said.

He asked Hawke's Bay Today for the names of those complaining about noise from Te Apiti.

Asked why he wanted the names, he replied: "There is a group of people there. They are opposed to wind farms per se".

Asked why he thought they were opposed, Mr Seay said "I don't want to speculate. They just are. Possibly for the visual impact."

Meridian had complied with all legal requirements for sound emissions from Te Apiti, and "the people of Ashhurst are very happy to have those turbines there. They have become an icon," Mr Seay said.

Meridian is currently appealing noise restrictions placed on its proposed 70-turbine wind farm at Makara, near Wellington, where some houses will be about 1km away, and downwind of, the turbines.

John Napier lives on the Woodville side of the Te Apiti turbines, about 2km from the nearest one.

When they first began operating, he couldn't believe the roaring noise they made.

"We can hear it in our bedroom at night."

One night, about 2am, he got out of bed to check whether the bedroom windows were vibrating, and about five times since, he has been woken up and thought "they're making a racket tonight".

He doesn't hear the infrasound beat so much. It's mainly "a roar like a train going through a tunnel or over a bridge, but it never stops".

He complained to Meridian about the noise, and the company put a noise meter on his property for a couple of weeks, but wouldn't tell him the results.

"Wind farm companies say noise from turbines is not an issue, but it is an issue all right. I would be very concerned if I lived in Karori (near Makara, in Wellington)," Mr Napier said.

Harvey Jones, who lives in a valley 3km from Te Apiti, says there is an easterly wind blowing across the wind farm about 10 percent of the time. The wind goes across the top of the hill, but the noise from the turbines rolls down the valley. It sounds like a train constantly passing by, and the stronger the wind, the louder the noise. When there's a westerly blowing, he can even hear the turbines in Woodville, 6-7km away.

"Once you get tuned in to it you can easily pick it up," he says.

Mr Jones says the amount of noise generated by the Te Apiti turbines was unexpected, and landowners prepared to put turbines on their land at Te Pohue should think very carefully about the possibility of a repeat scenario.

He predicts disaster for the residents of Makara and Karori.

"They're going to get hammered, but they don't realise."

Steve Griffin, of Te Pohue, is secretary of the Outstanding Natural Landscape Protection Society, formed to oppose two windfarms proposed for his area on the Napier-Taupo road.

Lines company Unison has resource consent to put up about 50 turbines, and Hawke's Bay Windfarms plans to erect 75 turbines nearby.

The landscape protection society is appealing all the consents in the Environment Court.

Mr Griffin, who is "sick to death of wind farms", says the prospect of 128 giant industrial turbines visually

disrupting pristine skyline and covering more than 16km of prominent mountain range near Te Pohue is bad enough. But he and other residents are worried sick about the noise potential - both normal-range and infrasound - from the turbines. Each turbine will have an 80m tower and three 45m blades. They will be 125m high and 90m wide, each taking up the equivalent of 1.5 rugby fields.

They will encircle Te Pohue village and its school, in a valley downwind of the turbines in prevailing winds - and nobody in authority seems to care, he says.

The Government has thrown the doors wide open to wind farm developers, in a bid to meet its Kyoto commitments; there are no national guidelines specific to wind turbines. That stance is unbalanced and unfair, Mr Griffin says.

"Our view is that while wind farms are part of our energy solution, sites must be selected in a socially responsible manner.

"They should not be placed within 5km of schools, hospitals, rest homes, or the private homes of those not involved with a wind farm development."

They should also be kept out of coastal, and recreation areas, and those with high scenic value, he says.

The landscape protection society wants the Government to establish national guidelines for wind farms, and review noise-testing standards to include measurement of low-frequency sound.

Low-frequency sound - sometimes called infrasound - is controversial.

Dr Geoff Leventhall, a noise vibration and acoustics expert from the UK who looked into infrasound at the request of Genesis Power, says "I can state quite categorically that there is no significant infrasound from current designs of wind turbines".

He says "the ear is the most sensitive receptor in the body, so if you cannot hear it you cannot feel it". Engineer Ken Mosley, of Silverstream, has an entirely different view.

The foundations of modern turbines create vibrations in the ground when they are moving, and also sometimes when they are not moving, Dr Mosley says.

"This vibration is transmitted seismically through the ground in a similar manner to earthquake shocks and roughly at similar frequencies.

"Generally, the vibrations cannot be heard until they cause the structure of a house to vibrate in sympathy, and then only inside the house. The effects inside appear as noise and vibrations in certain parts of a room. Outside these areas, little is heard or felt.

"However, the low frequency components of the noise and vibration can cause very unpleasant effects which eventually cause the health of people to deteriorate to an extent where living in the property can become impossible."

Dr Mosley says that wherever wind farms are built close to houses, people complain about noise and vibration.

He quotes a scientist in South West Wales, David Manley, who has been researching noise and vibration phenomena associated with turbines since 1994.

An acoustician and engineer, Dr Manley writes "it is found that people living within 8.2km of a wind farm cluster can be affected and if they are sensitive to low frequencies they may be disturbed".

Two GPs in the UK have researched the health effects of noise and vibrations from turbines. Amanda Harry documented complaints of headaches, migraines, nausea, dizziness, palpitations, sleep disturbance, stress, anxiety and depression. People suffered flow-on effects of being irritable, unable to concentrate during the day, losing the ability to cope.

Bridget Osborne, of Moel Maelogan, a village in North Wales, where three turbines were erected in 2002, is reported as saying "there is a public perception that wind power is 'green' and has no detrimental effect on the environment, but these turbines make low-frequency noises that can be as damaging as high-frequency noises.

"When wind farm developers do surveys to assess the suitability of a site they measure the audible range of noise but never the infrasound measurement - the low-frequency noise that causes vibrations that you can feel through your feet and chest.

"This frequency resonates with the human body, their effect being dependent on body shape. There are those on whom there is virtually no effect, but others for whom it is incredibly disturbing."

Dr Mosley says wind-power generators in New Zealand are aware of such literature on turbine noise and infrasound from all around the world.

"Are they therefore just ignoring what is happening in the rest of the world in the hope that once turbines are up and running, people will quietly endure, or when the noise/vibration situation really starts to damage their health, the community will cut their losses, leave their homes and quietly fade away? Of course, wherever they end up, they must still pay their electricity bills, which is rather like paying the landlord who has evicted you."

The New Zealand Wind Energy Association, which did not return calls from Hawke's Bay Today, acknowledges that turbines produce infrasound, but insists it is so minimal from modern turbines that human beings cannot perceive it. Its website says "there is no evidence to indicate that low frequency sound or infrasound from current models of wind turbine should cause concern."

Infrasound was more of a problem with older turbines, which had their blades downwind of the turbine tower, the association says.

"That caused a low frequency thump each time a blade passed behind the tower."

In contrast, modern turbines "have their blades upwind of the tower, thus reducing the level of this type of noise to below the threshold of human perception, thereby minimising any possible effect on human health or wellbeing".

The association has published excerpts of a report by Dr Leventhall, who suggests that infrasound is a concept that could be classified as pop-science, seized upon by emotionally-overwrought wind farm opponents.

"When a group of residents decides to object to a development, they often support each other with strong emotions, which can sometimes lead them astray. The emphasis on low-frequency noise is an example of this. Over the past 30 years there has been a great deal of confusion and misinformation about low frequency noise, mainly in the popular media. Much of it can best be described as "hot air" but complainants' uncritical acceptance of what they read in unreliable sources has two unfortunate effects:

- * It detracts from those people who have genuine low-frequency noise problems, often from industrial exhaust fans, compressors and similar.

- * It undermines the credibility of the complainants, who may be harming their own cause in their apparent 'grasping at straws' approach."

Dr Leventhall goes on to say "the rational study of low frequency noise, its effects and criteria for control, has been bedevilled by exaggerations, half-truths and misrepresentations, much of it fomented by media stories over the last 35 years. The result in the UK, and it is probably similar in other countries, is that an incorrect concept - 'low frequency noise is a hazard' - has taken root in the national psyche, where it lies dormant waiting for a trigger to arouse it. The current trigger is wind turbines."

Dr Leventhall says:

- * High levels of low-frequency noise are needed before people can perceive it, and the levels must

increase as frequency reduces.

* The ear is the most sensitive receptor in the body, so if you cannot hear it you cannot feel it.

* When there are problems with predominantly low-frequency noise, that is because assessment methods do not cater for it. That leads to the noises being dismissed as not being a nuisance, which in turn leaves unhappy complainants in a distressed state.

Up on the Napier-Taupo road, the printer in Steve Griffin's office is working overtime in preparation for an Environment Court battle. It might be a David and Goliath confrontation, but there's too much at stake to sit back and take it quietly, he says.

Appendix 4

Guantanamo Serenade

Jon Ronson knew from his investigation into US military intelligence that top brass had adopted some strange practices. Jamal al-Harith, the Briton released from Guantánamo in the spring, confirmed it: here, in our second extract from Ronson's revealing new book, he describes the discordant sounds and apparently random music played to him during all-day interrogation sessions, and four psychological warfare experts give their reaction

Saturday November 6, 2004

The Guardian

The more I've delved into the US military's psychological warfare, the more examples of New Age-style, First Earth Battalion tactics I've been noticing in the war on terror. I learned of one fact in particular that struck me as entirely incongruous, something at once banal and extraordinary. It happened to a Mancunian called Jamal al-Harith in a place called the Brown Block. Jamal doesn't know what to make of it either, so he mentioned it to me only as an afterthought when I met him in the coffee bar of the Malmaison Hotel, near Manchester Piccadilly station, one June morning this year.

Jamal is a website designer. He lives with his sisters in south Manchester. He is 37, divorced, with three children. He said he assumed MI5 had followed him here to the hotel, but he's stopped worrying about it. He said that he keeps seeing the same man watching him from across the street, leaning against a car, and that whenever the man thinks he's been spotted, he looks briefly panicked and immediately bends down to fiddle casually with his tyre.

Jamal laughed when he told me this. He was born Ronald Fiddler into a family of second-generation Jamaican immigrants. When he was 23, he learned about Islam and converted, changing his name to Jamal al-Harith: he liked the sound of it. He says al-Harith basically means "seed planter".

In October 2001, Jamal visited Pakistan as a tourist, he says. He was in Quetta on the Afghanistan border, four days into his trip, when the American bombing campaign began. He quickly decided to leave for Turkey and paid a local truck driver to take him there. The driver said the route would take them through Iran, but somehow they ended up in Afghanistan, where they were stopped by a gang of Taliban supporters. They asked to see Jamal's passport, and he was promptly arrested and thrown in jail on suspicion of being a British spy.

Afghanistan fell to the coalition. The Red Cross visited Jamal in prison. They suggested he cross the border into Pakistan and make his own way back home to Manchester, but Jamal had no money, so instead he asked to be put in contact with the British embassy in Kabul.

Nine days later - while he waited in Kandahar for the embassy to transport him home - the Americans picked him up.

"The Americans," Jamal said, "kidnapped me." When he said "kidnapped", he looked surprised at himself for using such a dramatic word.

The Americans in Kandahar told Jamal he needed to be sent to Cuba for two months for administrative processing, and so on, and the next thing he knew he was on a plane, shackled, his arms chained to his legs and then chained to a hook on the floor, his face covered in earmuffs and goggles and a surgical mask, bound for Guantánamo Bay.

In the weeks after Jamal's release, two years later, he gave a few interviews, during which he spoke of the shackles and the solitary confinement and the beatings - the things the outside world had already imagined about life inside that mysterious compound. He said they beat his feet with batons, pepper-sprayed him and kept him inside a cage that was open to the elements, with no privacy or protection from the rats and scorpions that crawled around the base. But these were not sensational revelations.

He spoke to ITV's Martin Bashir, who asked him (off-camera), "Did you see my Michael Jackson documentary?"

Jamal replied, "I've, uh, been in Guantánamo Bay for two years."

When I met Jamal, he began to tell me about the more bewildering abuses. Prostitutes were flown in from the US - he doesn't know whether they were there to smear their menstrual blood on the faces of the more devout detainees. Or perhaps they were brought in to have sex with the soldiers, and some psychological operations (PsyOps) boffin - a resident cultural analyst - devised this other job for them as an afterthought, exploiting the resources at the army's disposal.

"One or two of the British guys," Jamal told me, "said to the guards, 'Can we have the women?' But the guards said, 'No, no, no. The prostitutes are for the detainees who don't actually want them.' They explained it to us: 'If you want it, it's not going to work on you.'"

"So what were the prostitutes doing to the detainees?" I asked.

"Just messing about with their genitals," said Jamal. "Stripping off in front of them. Rubbing their breasts in their faces. Not all the guys would speak. They'd come back from the Brown Block [the interrogation block] and be quiet for days and cry to themselves, so you know something went on, but you don't know what. But for the guys who did speak, that's what we heard." I asked Jamal if he thought that the Americans at Guantánamo were dipping their toes into the waters of exotic interrogation techniques.

"They were doing a lot more than dipping," he replied. And that's when he told me about what happened to him inside the Brown Block.

Jamal said that, being new to torture, he didn't know whether the techniques tested on him were unique to Guantánamo, or as old as torture itself, but they seemed pretty weird to him. His description of life inside the Brown Block made Guantánamo Bay sound like an experimental interrogation lab, teeming not only with intelligence agents, but also with ideas. It was as if, for the first time in the soldiers' careers, they had prisoners and a ready-made facility at their disposal, and they couldn't resist putting all their concepts - which had until then languished, sometimes for decades, in the unsatisfactory realm of the theoretical - into practice.

First there were the noises.

"I would describe them as industrial noises," said Jamal. "Screeches and bangs. These would be played across the Brown Block into all the interrogation rooms. You can't describe it. Screeches, bangs, compressed gas. All sorts of things. Jumbled noises."

"Like a fax machine cranking up into use?" I asked.

"No," said Jamal. "Not computer-generated. Industrial. Strange noises. And mixed in with it would be something like an electronic piano. Not as in music, because there was no rhythm to it."

"Like a synthesiser?"

"Yes, a synthesiser mixed in with industrial noises. All a jumble and a mishmash."

"Did you ever ask them, 'Why are you blasting these strange noises at us?'" I said.

"In Cuba you learn to accept," said Jamal.

The industrial noises were blasted across the block. But the strangest thing of all happened inside Jamal's own interrogation room. The room was furnished with a CCTV camera and a two-way mirror. Jamal would be brought in for 15-hour sessions, during which time they got nothing out of him because, he said, there was nothing to get. He said his past was so clean - not even a parking ticket - that at one point someone wandered over to him and whispered, "Are you an MI5 asset?"

"An MI5 asset!" said Jamal. He whistled. "Asset!" he repeated. "That was the word he used!"

The interrogators were getting more and more cross with Jamal's apparent steely refusal to crack. Also, Jamal used his time inside the Brown Block to do stretching exercises, keeping himself sane. Jamal's exercise regime made the interrogators more angry, but instead of beating him, or threatening him, they did something very odd.

A military intelligence officer brought a ghetto blaster into his room. He put it on the floor in the corner. He said, "Here's a great girl band doing Fleetwood Mac songs."

He didn't blast the CD at Jamal. This wasn't sleep-deprivation, and it wasn't an attempt to induce the Bucha Effect¹. Instead, the agent simply put it on at normal volume.

"He put it on," said Jamal, "and he left."

"An all-girl Fleetwood Mac covers band?" I said.

"Yeah," said Jamal.

This sounded to me like the tip of a very strange iceberg.

"And what happened next?" I asked.

"When the CD was finished, he came back into the room and said, 'You might like this.' And he put on Kris Kristofferson's greatest hits. Normal volume. And he left the room again. And then, when that was finished, he came back and said, 'Here's a Matchbox Twenty CD.' "

"Was he doing it for entertainment purposes?" I asked.

"It's interrogation," said Jamal. "I don't think they were trying to entertain me."

"Matchbox Twenty?" I said.

I didn't know much about Matchbox Twenty. My research reveals them to be a four-piece country rock band from Florida, who do not sound particularly abrasive (like Metallica and Burn Motherfucker Burn!) nor irritatingly repetitive (like Barney The Purple Dinosaur and Ya! Ya! Das Is A Mountain). They sound a bit like REM. The only other occasion when I had heard of Matchbox Twenty was when Adam Piore from Newsweek told me that they, too (like Metallica and Barney), had been blasted into the shipping containers where detainees were held at al-Qa'im in Iraq. I mentioned this to Jamal and he looked astonished.

"Matchbox Twenty?" he said.

"Their album More Than You Think You Are," I said.

There was a silence.

"I thought they were just playing me a CD," said Jamal. "Just playing me a CD. See if I like music or not. Now I've heard this, I'm thinking there must have been something else going on. Now I'm thinking, why did they play that same CD to me as well? They're playing this CD in Iraq and they're playing the same CD in Cuba. It means to me there is a programme. They're not playing music because they think people like or dislike Matchbox Twenty more than other music. Or Kris Kristofferson more than other music. There is a reason. There's something else going on. Obviously I don't know what it is. But there must be some other intent."

"There must be," I said.

Jamal paused for a moment and then he said, "You don't know how deep the rabbit hole goes, do you? But you know it is deep. You know it is deep."

Subsequently, I talked to Joseph Curtis (not his real name), who worked on the night shift at the Abu Ghraib prison, in charge of the computer network. I asked if he knew anything about the music. He said, sure, they blasted loud music at the detainees all the time. "What about quieter music?" I said, and told him Jamal's story about the ghetto blaster and the Fleetwood Mac all-girl covers band and Matchbox Twenty.

Joseph laughed. He shook his head in wonderment. "They were probably fucking with his head," he said.

"You mean they did it just because it seemed so weird?" I asked. "The incongruity was the point of it?"

"Yeah," he said.

"But that doesn't make sense," I said. "I can imagine that might work on a devout Muslim from an Arab country, but Jamal is British. He was raised in Manchester. He knows all about ghetto blasters and Fleetwood Mac and country and western music."

"Hm," said Joseph.

"Do you think ...?" I said.

Joseph finished my sentence for me.

"Subliminal messages?" he said.

"Or something like that," I said. "Something underneath the music."

"You know," said Joseph, "on a surface level that would be ridiculous. But Guantánamo and Abu Ghraib were anything but surface."

Jamal seemed fine when I met him in Manchester. I asked if he felt at all unusual after listening to Matchbox Twenty and he said no. But one shouldn't read too much into this. There is a very strong chance, given the history of the goat staring and the wall walking and so on that US military intelligence honchos went in for, that they blasted Jamal with silent sounds and it just didn't work.

In late June 2004 I sent an email to Jim Channon and everyone else I'd met during my two-and-a-half-year journey who might have some inside knowledge about the current use of the kinds of psychological interrogation techniques that had first been suggested in Jim's First Earth Battalion manual. I wrote:

Dear ---

I hope you are well.

I was talking with one of the British Guantánamo detainees (innocent - he was released) and he told me a very strange story. He said at one point during the interrogations the MI [military intelligence] officers left him in a room - for hours and hours - with a ghetto blaster. They played him a series of CDs - Fleetwood Mac, Kris Kristofferson, etc. They didn't blast them at him. They just played them at normal volume. Now, as this man is western, I'm sure they weren't trying to freak him out by introducing him to western music. Which leads me to think ... Frequencies? Subliminal messages?

What's your view on this? Do you know any time when frequencies or subliminal sounds have been used by the US military for sure?

With best wishes,

Jon Ronson

I received four replies straight away.

Commander Sid Heal (the Los Angeles Sheriff's Department non-lethals expert who told me about the Bucha Effect): "Most interesting, but I haven't a clue. I know that subliminal messages can be incorporated and that they have a powerful influence. There are laws prohibiting it in the US, but I'm not aware of any uses like you describe. I would imagine, however, that it would be classified and no one without a 'need to know' would be aware anyway. If it were frequencies, it would probably need to be in the audible range or they wouldn't need to mask them with other sounds."

Skip Atwater (General Stubblebine's former psychic spying headhunter): "You can bet this activity was purposeful. If you can get anybody to talk to you about this, it would be interesting to know the 'success rate' of this technique."

Jim Channon: "Strikes me the story you tell is just plain kindness (which still exists)."

I couldn't decide if Jim was being delightfully naive, infuriatingly naive, or sophisticatedly evasive.

Then Colonel John Alexander responded to my email. He remains the US army's leading pioneer of non-lethal technologies, a role he created for himself in part inspired by Jim's First Earth Battalion manual.

Colonel Alexander: "Re your assertion he was innocent. If so, how did he get captured in Afghanistan? Don't think there were many British tourists who happened to be travelling there when our forces arrived. Or maybe he was a cultural anthropologist studying the progressive social order of the Taliban as part of his doctoral dissertation and was mistakenly detained from his education. Perhaps if you believe this man's story you'd also be interested in buying a bridge from me? As for the music, I have no idea what that might be about. Guess hard rockers might take that as cruel and unusual punishment and want to report it to Amnesty International as proof of torture."

Jokes about the use of music in interrogation didn't seem that funny any more - not to me, and I doubt they did to him, either. I emailed him back: "Is there anything you can tell me about the use of subliminal sounds and frequencies in the military's arsenal? If anyone alive today is equipped to answer that question, surely you are."

Colonel Alexander's response arrived instantly. He said my assertion that the US army would ever entertain the possibility of using subliminal sounds or frequencies "just doesn't make sense".

Which was strange. I dug out an interview I'd conducted with the colonel the previous summer. I hadn't been that interested in acoustic weapons at that point, but the conversation had, I now remembered, briefly touched on them.

"Has the army ever blasted anyone with subliminal sounds?" I had asked him.

"I have no idea," he said.

"What's a 'psycho-correction' device?" I asked him.

"I have no idea," he said. "It has no basis in reality."

"What are silent sounds?" I asked.

"I have no idea," he said. "It sounds like an oxymoron to me." The colonel gave me a hard look, which seemed to suggest that I was masquerading as a journalist and was, in fact, a dangerous and irrational conspiracy nut.

"I'm confused," I said. "I don't know much about this subject, but I'm sure I've seen your name linked with something called a 'psycho-correction device'."

Yes, he said, he had sat in on meetings where this sort of thing was discussed, but there was no evidence that machines like this would ever work. "How would you do that [blast someone with silent sounds] without it affecting us? Anybody who's out there would hear it."

How could you blast someone with silent sounds "without it affecting us"? This struck me at the time as an unassailable argument, one that cut through all the paranoid theories circulating on the internet about mind-control machines putting voices into people's heads. Of course it couldn't work.

The thing is, I now realised, if silent sounds had been used against Jamal inside an interrogation room at Guantánamo Bay, there was a clue in Jamal's account, a clue that suggested that military intelligence had craftily solved the vexing problem highlighted by Colonel Alexander.

"He put the CD in," Jamal had said, "and he left the room."

Next, I dug out the recently leaked military report entitled Non-Lethal Weapons: Terms And References. There were a total of 21 acoustic weapons listed, in various stages of development, including the Infrasound ("Very low-frequency sound which can travel long distances and easily penetrate most buildings and vehicles ... biophysical effects: nausea, loss of bowels, disorientation, vomiting, potential internal organ damage or death may occur. Superior to ultrasound ...").

And then, the last entry but one - the Psycho-Correction Device, which "involves influencing subjects visually or aurally with embedded subliminal messages".

I turned to the front page. And there it was. The co-author of this document was Colonel John Alexander.

¹ In the 1950s, helicopters started falling out of the sky, crashing for no apparent reason, and the pilots who survived couldn't explain it. They had been flying as normal and then suddenly they felt nauseous, dizzy and debilitated; they lost control of their helicopters. A Dr Bucha was called in to solve the mystery. What he found was that the rotor blades were strobing the sunlight, and when it reached an approximation of human brainwave frequency, it interfered with the brain's ability to send correct information to the rest of the body.

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• This is an edited extract from *The Men Who Stare At Goats*, by Jon Ronson, published by Picador on November 19 at £16.99. To order a copy for £16.14, with free UK p&p, call **0870 836 0875**. Jon Ronson's three-part television series, *The Crazy Rulers Of The World*, starts on Channel 4 tomorrow. • Jamal al-Harith is one of four Britons released from Guantánamo in March, after more than two years' imprisonment, who claim they were repeatedly tortured at the camp and, it was announced last week, are suing Donald Rumsfeld and other US military leaders for £6m compensation each.

Appendix 5

Western Morning News

SHATTERED DREAM OF QUIET LIFE

09:00 - 06 January 2004

All they wanted was the good life in Cornwall, and they needed it for the sake of their health - but no sooner had Colin and Kathy Bird fled the city for a modest rural home than their dream was shattered by the noise from wind turbines.

Last year at Christmas the couple booked into B &Bs in Newquay rather than endure sleepless nights in their caravan home at St Eval.

This year they have saved up £1,000 to live in Malta for a month because they cannot bear another winter at home when high winds turn the turbines.

When that noise from the Bears Down wind farm begins, says Kathy,

it's like a "a deep throbbing, or a train that never gets there".

For Colin it's worse. "You never rest your brain, you never get away from them," he says.

What makes it worse for the couple is that they moved to Cornwall to escape the noise of the city.

Colin, 48, had suffered a nervous breakdown when he worked as a car factory worker in Coventry. But he was stirred by warm memories of boyhood holidays in Cornwall. And the couple spent six months each year for three years until 2000 in a rented caravan there, and found it blissfully peaceful.

So they plunged what little money they had into their new life. They bought the neighbouring caravan and moved in one year before the 16-turbine wind farm opened in October 2001.

Their caravan is made mostly of aluminium, which exacerbates the tin can effect.

But they point out that they were there before the wind farm, and they don't have the money to move anywhere else.

Kathy, 43, says: "I did put in a letter of complaint about the plans. I was very concerned about the wildlife - buzzards and peregrine falcons. Then, of course, noise was one of my concerns, but I never realised how bad it would be. At first I thought it was something in the home, but it was the turbines.

"They get to a critical speed, which I believe is 40 knots, and then it disturbs us all the time. It's just as if we're in a box and it's reverberating all the time.

"It's almost like a motion sickness, and it always seems to be worst at Christmas.

"It's the constancy of them that gets to you, it can be for anything like three or four days, it's this deep throbbing."

The couple calculate that they booked into B &Bs four times last

year to escape the turbines. But sometimes they just drive around until the wind dies down.

National Wind Power, which owns the Bears Down site, has paid for double-glazing of the caravan to try to curb the noise effect, but this has had little impact.

Kathy and Colin, like their neighbours, complain of headaches, anxiety, sleeplessness and nausea - 97 per cent questioned by Plymouth GP Amanda Harry complained of one symptom or another.

One neighbour, who asked not to be named, describes the effect of the noise as being like "Chinese water torture".

His home is further back from the wind farm, and better insulated against external noise, but he said: "We get a beating sound, it's like a bus engine sitting parked, and we do get headaches. I understand the need for renewable energy, but the problem is that they do not contribute much. To get the things going they have to use electricity anyway."

To add to his sense of injury, he estimates that the wind farm has devalued his property by 25 per cent. Colin's health has got worse since moving to what he dreamed would be the perfect home for the rest of his days. At first he had no opinion of the turbines' appearance, but now he describes them as being "like ogres looking at you".

So what do the couple want, and how do they see a way out of their nightmare?

Kathy wants the turbines stopped at night so that they can sleep, and "some form of compensation" for their misery and troubles. Colin explains: "We can't afford anywhere else, so what's it going to be like for the rest of our lives? We came here thinking we'd get peace and quiet for the rest of our lives. And it's beautiful - Cornwall has everything.

"But then this happens - you'd need to be in a Chieftain tank with earphones not to hear those things."

Kathy adds: "We came here to live simply, and we both had to retire early because of ill-health. Colin just needed a very quiet environment, and we'd been here before and had three years of peace and quiet and it was gorgeous.

"But this is systematically ruining our lives - and I just feel that people are not aware of the damage these things are doing to health."

The issue is set to come to the fore with a legal test case in Cumbria where people living between 600-800 metres from the 60-metre turbines in the village of Askham complained of headaches and nausea. Barrister John Campbell is representing three couples at Kendal Magistrates Court in a fight to get wind turbines near their homes declared a statutory nuisance under the Environmental Health Act.

He said: "There are a number of complaints of sleep disturbance, headaches, and migraines that are driving people mad. They say it's a pervasive thump, thump noise from the blades."

He said that if they won the test case, which is expected to take several days, the turbines would either have to be stopped or removed.

Meanwhile, one couple living in a residential caravan near the Bears Down site have saved up £1,000 to go to Malta for a month because they say they cannot cope with life next to the turbines in winter when the winds are high.

In desperation last year, they booked into B &Bs in Newquay at Christmas.

Kathy and Colin Bird took early retirement through ill health from their jobs in Coventry as they sought a quiet life in Cornwall. Then they moved into their caravan in 2000, before the wind farm was built. But Mrs Bird now says: "It's just a throb when the wind is up - it's like the sound of a car going by with the stereo blaring, but it doesn't pass."

Matthew Spencer, chief executive of the South West Renewable Energy Agency (Regen) yesterday disputed whether the noise from turbines was the cause of their health complaints.

He said: "People may perceive that is their problem, but the turbines are not very noisy. Nothing has been proved about the health effects, but I would take these initial findings with a pinch of salt. These are arguments that people who are opposed to wind farms use."

He pointed out that travelling at 40mph would create a noise of 55 decibels at 100 metres while a wind turbine produced a noise of 35 decibels at 350 metres.

He said there was no evidence that the new generation of larger turbines planned for the South West would be a problem. "They are becoming less noisy as they are being developed," he said.

He added that the guidelines for the turbines were that they should not be within 400 metres of people's homes, and that noise had not proved a problem in the eyes of planners.

National Wind Power, which owns and operates the Bears Down wind farm, yesterday failed to respond to a series of questions put by the Western Morning News.

Appendix 6

Western Morning News

WIND TURBINES HAVE EATEN INTO MY VERY SOUL

09:00 - 09 January 2004

Mark Taplin has lived in the shadow of wind turbines for more than a decade. As part of our on-going debate on the issue, he describes how the experience has affected his life

Opposed: Mark Taplin says turbines have ruined his way of life MY world has been overshadowed by the spectre of wind turbines for 12 years, and I have lived with the reality for the past eight years of generating machines spinning their blades 75 metres above my house, the closest a mere 440 metres away. They have imposed themselves on my life and eaten into my soul - small wonder that I feel compelled to contribute to the deluge of column inches that this latest debate has generated. I live in a modest cottage which nestles in a small secluded Cornish valley, surrounded by a few acres that I can call my own.

I came here to pursue my ambition of an Arcadian existence, growing my own fruit and vegetables and indulging in a bit of self taught husbandry.

I was eager to leave behind the smug and affluent rural neighbourhood where I had grown up, and endured the tiresome label of leading "the good life".

I was accustomed to a degree of hardship and was prepared for the vicissitudes of the Westcountry climate. I was not expecting a rural idyll "preserved in aspic". I had a grasp of the commercial imperatives that exerted control over the countryside as the end of the century approached. However, what I was not prepared for was the impact on my life of my nearest neighbours - the wind turbines at Four Burrows.

I am not the first, nor will I be the last, to find the terms "windmill" and "windfarm" misplaced. Wind turbines do not mill grain, nor do they harvest the product of their own endeavours.

Arguably they save some forms of pollution, but are responsible in turn for some negative by-products, from the concrete in their foundations to the tips of their blades, offending many by their very sight and sound. I have always considered myself as one who was aware of environmental issues, and I try to live in harmony with the countryside. But, sadly, the intrusive neighbours on my doorstep have introduced a massive note of discord into my peaceful existence.

Why? Because whatever the individual thinks of them aesthetically, I cannot avoid the noise. I hear them nearly all the time. It is not easy to equate it to other noise sources, and I find the attempts at comparisons trite. The dilemma for one such as me is that the industry has always argued that as the wind picks up speed and the

power output and noise level produced increases, the natural background noise created by the wind will mask any turbine noise. Where this argument falls down, however, is when you find yourself in a comparatively sheltered position on lower ground than the turbines and not buffeted by the wind. Then you hear a great deal more than if you stand up close with the wind rushing past your ears. When small but violent changes in wind direction shear past the turbines, the chomp and swoosh of the blades passing the towers creates a noise, albeit mercifully brief, that beggars belief. It is as if a ghostly steam engine were pumping an abandoned mine working.

But this surprising and unacknowledged phenomenon does thankfully pass as the wind abates, whereas the bane of my life - the "tonal" (mechanical whine or resonance) noise - does not. It is ever present when a turbine is generating at more than mere tickover, despite the manufacturer's claims.

So, how can I hear tonal noise? It has been so distinct at times that I foolishly assumed everyone would own up and do something about it. Sadly, that is where the technicalities come in, and it boils down to mathematics. The wind industry is better supported than local council environmental health departments, and they were well ahead of the game when they formulated the criteria for establishing tones. It is a loaded issue and not what you might call a level playing field. Whatever I hear, they will claim that it does not qualify as a tone - which means that I am stuck with it. Once you hear tonal noise it follows you around, not in your imagination but because the human ear has a natural habit of homing in on an annoying sound.

But, going back to the beginning, what turned me into an "anti" soon after I found myself thrown on to the learning curve in 1992? Was it the way that the whole thrust of renewable energy development was being hijacked by the wind lobby, the cavalier attitude of a new breed of opportunistic developers, the obscenely generous price support structure offered at that time under the Non Fossil Fuel Obligation and the greedy scramble for another subsidy? Was it the arrogance of politicians who jumped on the green bandwagon, the pressure group zealots who adopted the moral high ground in the name of saving the planet and the naive level of argument from the "better than nuclear, nicer than pylons" brigade? Was it the exasperating lesson of having to teach myself all about parliamentary statements, planning procedures and the technicalities of noise attenuation, which only served to disenchant me, when all the while I would much rather have been getting on quietly with my life? Or was it just a selfish determination to defend my precious green and pleasant Shangri La from industrial machines which threatened to invade my privacy?

I resent the same old stale public relations lecture from the vested interest lobby who do not appear to know how or when to apologise.

I do not warm to those who disregard for the sensibilities of others who can be passionate about preserving a particular landscape that is special to them. I cannot accept that wind turbine generators are benign.

I have contributed to the debate with this account not to seek sympathy, but as a reminder to those of a different persuasion that the route down which wind power development has been driven in recent years can cause very real harm. Noise apart, it has turned me, a potential supporter, against my turbine neighbours and what they stand for.

Appendix 7

Meridian pays family to move

02 August 2005

By LEE MATTHEWS

Meridian Energy has paid an undisclosed sum of money to shift a family from their farm where Te Apiti's wind turbines are located, because noise and vibration made it too difficult to live in their house.

Company spokesman Alan Seay would not say how much the compensation is, as it is a confidential agreement between Meridian and the Bolton family. He understands they will move off their farm and build elsewhere.

He also said the payout is not a surprise, as it had been anticipated in the initial lease agreements with the land owners. It is not part of any of the 20 conditions imposed by the wind farm's resource consent.

"Te Apiti is built on two farm properties. It was recognised right from the start that this family could have issues with noise . . . their house was only a few hundred metres from the turbines," Mr Seay said.

"The possibility of having to shift was part of the initial lease agreement. These were houses actually in the wind farm, as opposed to neighbouring (houses)." Meridian has also made a confidential deal with the other farm owners affected. Mr Seay said he understands this has involved building alterations, such as double-glazing windows to reduce noise.

There are no other claims for any kind of compensation for nuisance from Te Apiti, and Mr Seay said he does not anticipate any in future. "This one was made because it was a foreseen situation."

Feedback from the Ashhurst community about Te Apiti has "all" been positive, apart from "one or two vociferous" opponents whom he understands to be working with people objecting to Meridian's proposed Makara wind farm.

"Nimby (not in my back yard) syndrome . . . it's what we've got to expect from some of these groups . . . it's misleading and distorting."

Last November, Ashhurst resident Colin Mahy complained that sun reflection flickering into his house from the Te Apiti turbines was "driving him mad". Meridian had told him to draw his curtains.

Mr Seay said that he had given that advice. "Sun flash is a very momentary thing, it only occurs in certain circumstances and it doesn't last long."

Appendix 8

GWEN's Diary

These wind turbines, they're 76m high, there are three of them, they have a looming presence over the beautiful Teifi Valley, I've been trying hard to come to terms with living within a mile of them ever since they appeared there on Moelfre hill twelve months ago. They don't belong here, they shine in the sunlight, they glow in the moonlight, they stand out stark white against the dark rain clouds, unlike everything else surrounding them they never change. No lichen, no birds encircling them, no ivy creeping up their metallic towers. There is nothing of nature within them, they don't belong here on Moelfre overlooking the Tivy Valley.

Those living six, ten, fifteen miles and more away from them agree. They can be seen by the inhabitants of many small towns and villages as totally scarring the wondrous outline of the gentle rise from Moelfre to Frenni Fach Frenni Fawr, Foeldrigarn, Preseli and Caerningly above Newport. The council planners must have been mad to grant them permission.

I've lived here on my farm now with my husband for twenty six years, I know every nook and cranny of the fifty acres. Our farm is only two miles from the farm where I was born sixty years ago, I grew up looking towards Moelfre and was delighted to be farming within my own community. I've been teaching in local schools, I paint landscapes in a converted shed, I've enjoyed good health, twenty six years of hard but rewarding work, I had planned to spend my remaining days here.

Now I sleep in my outhouse shed, it's not comfortable, I don't want to sleep there, I don't choose to be so far from amenities all night and suffer the sounds of mice within a yard of my head. The trouble is that when I am in the house my heart beat seems to alter, there seems to be a repeated slightly thumping pressure on my lungs. There's a slight throbbing in my head, like a headache without the pain. I feel slightly sick. I know that slightly is a term I've used for all the ailments but it is not a normal state of well being. It makes me feel on edge. When I visit a friend on the other side of the valley that's when I feel normal, and that state of normality suddenly seems the most wonderful feeling on earth. To me this is a tragic turn of events. Compared to the total sum of human misery I admit it might sound trivial. Today we had the fire wood cut up for next winter, here we enjoy our own spring water, my garden, my roses and clematis, and oh the first violets and primroses in the woods. The seven thousand trees we've planted, my studio, this is what our life has been about! Now I feel robbed of all I hold dear, and to complicate the situation my husband is not effected by the turbines, he doesn't like the visual impact but they don't make him ill. The low frequency noise/vibrations from the turbines [not the blades] play havoc with my health.

Where do I go from here? When the company was granted permission for the development the local paper reported that this was a lifeline for the struggling Welsh speaking local farmer who otherwise would have had to leave the land, Hey I'm a Welsh speaking local too, where's my lifeline? I belong here, those turbines DO NOT.

06/04/03

Diary Tuesday 8th April.

Sat in the gallery yesterday, in Carmarthen, felt well all day. In the evening went to the Teivy Arts meeting, felt well, enjoyed the company and chat. Came home at ten fifteen sat talking to Henning for a while went to bed [the bed in the house, the wind was fairly light] and the throbbing in my head started. Tried to ignore it, listened to the radio, switched it off, throb throb, feeling of anxiety, tried to sleep, but at twelve thirty I reluctantly took a Nytol tablet. Slept.

This morning I went to see my doctor to have a check up to see if there is some physical cause for my disturbed heart rhythm. She examined my heart, all well, felt my pulse rate, all well, lungs, all well, took my blood pressure, 120/80 that's good. Never felt better, She looked up my records for the hearing test in 1992 but there were no specific detailed figures given for the test only the conclusion that this patient had normal hearing. [had the test because I had been suffering from tinnitus that year] After lunch I sat down in the living room by the window to read, after five minutes I had to move I couldn't stand the heart rhythm and the churning in my head. I tried to override it I really wanted to get on with my book but I could not stay there any longer. The wind is from the south today and the turbines have their backs turned directly at us.

Went outside to do some gardening and took Tess for a walk, it's always better outside. Thought about buying a wooden garden shed to live in, perhaps in the woods. Back in the house I felt extremely uncomfortable. At five o'clock I baby sat for Lindsay in the old farmhouse until her mother arrived. The noise of the children and telly filled the house so I couldn't compare the two houses for turbine noise.

Wednesday 9th April.

Last night I tried something new, I have a C D of the sound of waves called Ocean Spray, it's called white noise, for relaxation and sound masking. I carried my CD player from the studio up to the bedroom. It's not a portable so it was heavy. The wind was from the south so I knew there would be throbbing in my head. It sounded great,[the sound of waves] I slept quite soon but woke up at five o'clock with a dreadful headache, had to take two soluble aspirins. Wind still from the south and my headache was still with me at ten o'clock. Took more painkillers and kept to our plan of walking on the Preselis.

Three hour walk, beautiful weather, felt great. My mind is going around in circles about what to do in this situation. It's clear that no one else suffers from the same symptoms as me on this farm. There are six adults and three children living here. I really don't want to disrupt everyone else's lives.

Plans: Sell the whole place. Sell only this house; Rent a place and find a tenant for this house; Build a small place for me in some "quiet corner of the farm" if there is such a place; My head is reeling with all the pros and cons. Haven't painted for weeks because of my bed being in the studio. Feel sick again. Trouble is that when I feel ill where can I lie down, in my bedroom? That's where I feel ill.

Later on the wind came from the North, then life gets back to normal again and no way are we going to sell up and move away.

Friday 11th April

North wind, yesterday was no problem to me. What a difference it makes, once the pain has gone there's no need to plan an alternative future for us. Have moved the bed from my studio, I really need to get on with my work. Have moved it to the loft, above another outhouse, I shall sleep there next time the wind is from the south. I'm feeling quite hopeful again that I can live with this once I've learned how to, but in order to make it possible some alterations will have to be made to the loft.

Saturday 12th April

I was far too optimistic yesterday, this is typical of how it goes. Last night was the worst so far. I went to my bed in the house and played the CD of the waves, slept quite soon, CD was on repeat mode. At one forty five am I woke up with the throbbing in my head, really bad, weight on my chest and a distinct pain in my heart. Tried to calm myself, CD was still playing, tried to meditate but was filled with a real sense of panic and felt an urgent need to escape. Too cold to go to the loft so I carried my duvet down to the kitchen which is the furthest room away from the turbines. With the cushions from the settee I made a camp bed but there was no sleep so at six o'clock I dragged it all back upstairs, Got up, had only about three hours sleep.

Shall have to try out the loft tonight, it's the sound of vermin that worries me, and the cold, but nothing could be worse than the way I felt last night.

Sunday 13th April

The loft is as bad as the bedroom. I realized this in the afternoon yesterday when I tried to catch up with some sleep. Spent last night at my brothers' house in the village three miles away. Slept. This is really getting us down, it's taking over our lives. We're now back to selling and moving away, it can't go on like this.

Monday 14th April

Wind from the south again, feel really depressed this morning. Phoned the council about noise pollution, someone will 'phone back today or tomorrow [or never]. I've got to get out of here today, all the symptoms are with me again, Henning is quite sick of hearing about them and I'm sick of suffering them.

Tuesday 14th April,

Wind still from the south, slept in the dining room last night but only after taking a Nytol tablet. Estate agent came out this morning, we'll probably have to move I can see no future for me here. I have to go out today to get some relief from the way I feel.

Gwen has now moved and does not live near wind turbines- she says that all her symptoms have settled.

Appendix 9

A) Nick Priest on behalf of 30 families, Chybucca, Allet, Truro, Cornwall, TR4 9DL

.....the only two families who lived near to the Carland Cross wind farm, Newquay, have now moved out because of unsolvable noise problems. At least one home now lies derelict.

Is this positive rural diversification or rural community extinction? The Welsh Affairs Select Committee have recommended that no dwellings should be within 1.5km of a wind farm. There are 30 families within such distance.

(Extract from noise abatement society, July 1997, 'Windfarms certainly do make a noise').

Appendix 10

B) Natalie Gregg, The Courier Mail, Queensland, Australia, 04 Oct 2004

Rural residents in two states can't sleep at night because of noise from a Queensland Government owned corporation's alternative energy plant.

Homeowners in Queensland and Vixctoria have all but resigned themselves to the noise of the Stanwell Corp. wind turbines, which they claim have devalued their properties.

Mrs Newman said the throbbing, thumping noise from the generators could be heard at all hours of the day, "It was very frustrating in the beginning and makes us extremely upset, but there is nothing we can do about it." Within 12 months the couple, who are in their fifties, had had enough and they decided to move but they still cannot find a buyer.

Appendix 11

C) Times on Line, 10 Jan, 2004 “wind farms ruin peace, says judge”

Wind farms can ruin the peace of the countryside and destroy the value of nearby homes, a judge has ruled.

District Judge Michael Buckley said that the noise, visual intrusion and flickering of light through the blades of turbines reduced the value of a house by a fifth. He said that the value of a remote house in Marton, in the Lake District, fell significantly because of the construction of a wind farm 40m high turbines, 500 metres away.

Appendix 12

D) Mag. Lotta Nilson, Laholm, Sweden. (lotta.nilson.fsi@swipnet.se)

Wind turbines produce nothing but a nightmare for neighbourhoods; conflicts between former friends and within families, stress, ill health.....I left my home because of a wind turbine placed 650m from my house. One day in November 1998 mine and my neighbour's lives changed dramatically. The wind turbine, totally about 90m high started to rotate for the first time. The noise is a torture. After one year I understood we would not get any help and that no one can or will measure the sound level.....Hundreds of families in my small, former beautiful community on the west coast of Sweden are suffering enormously.

Appendix 13

E) Murray R. Barber, Bradworthy, Devon. 12 July 2005

I understand that Energiekontour A.G. is responsible for operating the Forestmoor wind farm, Bradworthy, Devon. Our home is located 650m from the nearest of three turbines. I wish to complain about noise nuisance created by the wind farm.....