Microwave auditory effect

From Wikipedia, the free encyclopedia

The microwave auditory effect, also known as the microwave hearing effect or the Frey effect, consists of audible clicks induced by pulsed/modulated microwave frequencies. The clicks are generated directly inside the human head without the need of any receiving electronic device. The effect was first reported by persons working in the vicinity of radar transponders during World War II. These induced sounds are not audible to other people nearby. The microwave auditory effect was later discovered to be inducible with shorter-wavelength portions of the electromagnetic spectrum. During the Cold War era, the American neuroscientist Allan H. Frey studied this phenomenon and was the first to publish (*Journal of Applied Physiology*, Vol. 17, pages 689-692, 1962) information on the nature of the microwave auditory effect; this effect is therefore also known as the Frey effect.

Dr. Don R. Justesen published "Microwaves and Behavior" in *The American Psychologist* (Volume 30, March 1975, Number 3).

Research by NASA in the 1970s[*citation needed*] showed that this effect occurs as a result of thermal expansion of parts of the human ear around the cochlea, even at low power density. Later, signal modulation was found to produce sounds or words that appeared to originate intracranially. It was studied for its possible use in communications. Similar research conducted in the USSR studied its use in non-lethal weaponry.[*citation needed*]

Pulsed microwave radiation can be heard by some workers; the irradiated personnel perceive auditory sensations of clicking or buzzing. The cause is thought to be thermoelastic expansion of portions of auditory apparatus.[1] The auditory system response occurs at least from 200 MHz to at least 3 GHz. In the tests, repetition rate of 50 Hz was used, with pulse width between 10-70 microseconds. The perceived loudness was found to be linked to the peak power density instead of average power density. At 1.245 GHz, the peak power density for perception was below 80 mW/cm^2. The generally accepted mechanism is rapid (but minuscule, in the range of 10^{-5} °C) heating of brain by each pulse, and the resulting pressure wave traveling through skull to cochlea.[2]

The existence of non-lethal weaponry that exploits the microwave auditory effect appears to have been classified "Secret NOFORN" in the USA from (at the latest) 1998, until the declassification on 6 December 2006 of "Bioeffects of Selected Non-Lethal Weaponry" in response to a FOIA request. Application of the microwave hearing technology could facilitate a private message transmission. Quoting from the above source, "Microwave hearing may be useful to provide a disruptive condition to a person not aware of the technology. Not only might it be disruptive to the sense of hearing, it could be psychologically devastating if one suddenly heard "voices within one's head".

The technology gained further public attention when a company announced in early 2008 that they were close to fielding a device called MEDUSA (Mob Excess Deterrent Using Silent Audio) based on the principle.[3]

Contents [hide]

Natural sources of electromagnetic perception [edit]

For centuries, humans have reported hearing unexplained noises in conjunction with meteors including "thunder-like sounds" at the scene of the Tunguska event on June 30, 1908. Astronomer Edmund Halley collected several such accounts after a widely-observed meteor burned up in the sky over England[4]. The Leonids meteor shower in November 2001 also led to many reports of observers hearing crackling or fizzing noises.[5] Similar observations have been reported by soldiers near the site of nuclear explosions.

Colin Keay, a physicist at the University of Newcastle in Australia, has advanced a hypothesis that purports to explain these phenomena. According to Keay's theory, meteor trails give off very low frequency (VLF) radio signals that the human ear cannot sense directly but are heard because a transducer on the ground must be converting the radio waves into sound waves. He has produced experiments that demonstrate that materials as commonplace as aluminum foil, thin wires, pine needles, and wire-framed glasses can act as suitable transducers.

Powerful VLF waves can induce physical vibrations in these objects, which are transmitted to the air as sound waves. Keay defines the field of geophysical electrophonics as "the production of audible noises of various kinds through direct conversion by transduction of very low frequency electromagnetic energy generated by a number of geophysical phenomena."[6] Some scientists state that electrophonic effects may also be caused by lightning strikes, very bright auroras[1], and earthquakes.[*citation needed*]

Electroreception has also been studied in the animal world. Ritz *et al.*, in *Biophysical Journal*,[7] hypothesize that transduction of the Earth's geomagnetic field is responsible for the magnetoreception systems of birds. Specifically, they propose that this transduction may take place in a class of photoreceptors known as cryptochromes.

Primary Cold War-era research in the US [edit]

The first American to publish on the microwave hearing effect was Allan H. Frey, in 1961. In his experiments, the subjects were discovered to be able to hear appropriately pulsed microwave radiation, from a distance of 100 meters from the transmitter. This was accompanied by side effects such as dizziness, headaches, and a pins and needles sensation.

Sharp and Grove developed receiverless wireless voice transmission technologies for the Advanced Research Projects Agency at Walter Reed Army Institute of Research, in 1973. In the above mentioned journal entry to The American Psychologist, Dr. Don Justesen reports that Sharp and Grove were readily able to hear, identify, and distinguish among the single-syllable words for digits between 1 and 10 . Justesen writes, "The sounds heard were not unlike those emitted by persons with artificial larynxes. Communication of more complex words and of sentences was not attempted because the averaged densities of energy required to transmit longer messages would approach the [still] current 10mW/cm² limit of safe exposure." (D.R. Justesen. "Microwaves and Behavior", Am Psychologist, 392(Mar): 391-401, 1975.)

Peaceful applications [edit]

A 1998 patent describes a device that can scare off birds from wind turbines, aircraft, and other sensitive installations by way of microwave energy pulses. Using frequencies from 1 GHz to about 40 GHz, the warning system generates pulses of milliseconds duration, which are claimed to be sensed by the birds' auditory systems. It is believed this may cause them to veer away from the protected object.[8]

Patented applications [edit]

- Flanagan GP. Patent #3393279 "Nervous System Excitation Device" USPTO granted 7/16/68.
- Puharich HK and Lawrence JL. Patent #3629521 "Hearing systems" USPTO granted 12/21/71.
- Malech RG. Patent #3951134 "Apparatus and method for remotely monitoring and altering brain waves" USPTO granted 4/20/76.
- Stocklin PL. Patent #4858612 "Hearing device" USPTO granted 8/22/89.
- Brunkan WB. Patent #4877027 "Hearing system" USPTO granted 10/31/89.
- Thijs VMJ. Application #WO1992NL0000216 "Hearing Aid Based on Microwaves" World Intellectual Property Organization Filed 1992-11-26, Published 1993-06-10.
- Mardirossian A. Patent #6011991 "Communication system and method including brain wave analysis and/or use of brain activity" USPTO granted 1/4/00.
- O'Loughlin, James P. and Loree, Diana L. Patent #6470214 "Method and device for implementing the radio frequency hearing effect" USPTO granted 22-OCT-2002.

See also [edit]

- Biophoton
- Brain-computer interface
- Cosmic ray visual phenomena
- Electronic harassment
- Electroreception
- Mind control

Notes [edit]

1. ^ Levy, Barry S.; Wagner, Gregory R.; Rest, Kathleen M. (2005). *Preventing occupational disease and injury*. American Public Health Association. p. 428. ISBN 9780875530437.
2. ^ Kitchen, Ronald (2001-10-02). *Radio frequency and microwave radiation safety handbook*. Newnes. p. 60. ISBN 9780750643559.
3. ^ Hambling, David (3 July 2008). "Microwave ray gun controls crowds with noise". *New Scientist*.
4. ^ "Halley", Colin Keay's personal website
5. ^ "Listening to Leonids", NASA Science and Technology Directorate
6. ^ "Geophysical Electrophonics", Colin Keay's personal website
7. ^ Ritz, Thorsten; Salih Adem and Klaus Schulten (2000). "A Model for Photoreceptor-Based Magnetoreception in Birds". *Biophysical Journal* 78 (2): 707–718. doi:10.1016/S0006-3495(00)76629-X. ISSN 00063495.
8. ^ Kreithen ML. Patent #5774088 "Method and system for warning birds of hazards" USPTO granted 30 June 1998

References [edit]

This article includes a list of references, but its sources remain unclear because it has insufficient inline citations.

Please help to improve this article by introducing more precise citations where appropriate. *(December 2009)*

- R.C. Jones, S.S. Stevens, and M.H. Lurie. *J. Acoustic. Soc. Am.* 12: 281, 1940.
- H. Burr and A. Mauro. *Yale J Biol. and Med.* 21:455, 1949.
- H. von Gierke. *Noise Control* 2: 37, 1956.
- J. Zwislocki. *J. Noise Control* 4: 42, 1958.

- R. Morrow and J. Seipel. *J. Wash. Acad. SCI.* 50: 1, 1960.
- A.H. Frey. *Aero Space Med.* 32: 1140, 1961.
- P.C. Neider and W.D. Neff. *Science* 133: 1010,1961.
- R. Niest, L. Pinneo, R. Baus, J. Fleming, and R. McAfee. Annual Report. USA Rome Air Development Command, TR-61-65, 1961.
- A.H. Frey. "Human auditory system response to modulated electromagnetic energy." *J Applied Physiol* 17 (4): 689-92, 1962.
- A.H. Frey. "Behavioral Biophysics", *Psychol Bull* 63(5): 322-37, 1965.
- F.A. Giori and A.R. Winterberger. "Remote Physiological Monitoring Using a Microwave Interferometer", *Biomed Sci Instr* 3: 291-307, 1967.
- A.H. Frey and R. Messenger. "Human Perception of Illumination with Pulsed Ultrahigh-Frequency Electromagnetic Energy", *Science* 181: 356-8, 1973.
- R. Rodwell. "Army tests new riot weapon", *New Scientist* Sept. 20, p 684, 1973.
- A.W. Guy, C.K. Chou, J.C. Lin, and D. Christensen. "Microwave induced acoustic effects in mammalian auditory systems and physical materials", *Annals of New York Academy of Sciences*, 247:194-218, 1975.
- D.R. Justesen. "Microwaves and Behavior", *Am Psychologist*, 392(Mar): 391-401, 1975.
- S.M. Michaelson. "Sensation and Perception of Microwave Energy", In: S.M. Michaelson, M.W. Miller, R. Magin, and E.L. Carstensen (eds.), *Fundamental and Applied Aspects of Nonionizing Radiation*. Plenum Press, New York, p 213-24, 1975.
- E.S. Eichert and A.H. Frey. "Human Auditory System Response to Lower Power Density Pulse Modulated Electromagnetic Energy: A Search for Mechanisms", *J Microwave Power* 11(2): 141, 1976.
- W. Bise. "Low power radio-frequency and microwave effects on human electroencephalogram and behavior", *Physiol Chem Phys* 10(5): 387-98, 1978.
- J.C. Lin. *Microwave Auditory Effects and Applications*, Thomas, Springfield Ill, p 176, 1978.
- P.L. Stocklin and B.F. Stocklin. "Possible Microwave Mechanisms of the Mammalian Nervous System", *T-I-T J Life Sci* 9: 29-51, 1979.
- H. Frolich. "The Biological Effects of Microwaves and Related Questions", *Adv Electronics Electron Physics* 53: 85-152, 1980.
- H. Lai. “Neurological Effects of Radiofrequency Electromagnetic Radiation” In: J.C. Lin (ed.), *Advances in Electromagnetic Fields in Living Systems* vol 1, Plenum, NY & London, p 27-80, 1994.
- R.C. Beason and P. Semm. "Responses of neurons to an amplitude modulated microwave stimulus", *Neurosci Lett* 333: 175-78, 2002.
- J.A. Elder and C.K. Chou. "Auditory Responses to Pulsed Radiofrequency Energy", *Bioelectromagnetics Suppl* 8: S162-73, 2003.

External links [edit]

- Seaman, Ronald L., “Transmission of microwave-induced intracranial sound to the inner ear is most likely through cranial aqueducts,“ Mckesson Bioservices Corporation, Wrair US Army Medical Research Detachment. (PDF)
- Lin, J.C., 1980, “The microwave auditory phenomenon,“ Proceedings of the IEEE, 68:67-73. Navy-NSF-supported research.
- Lin, JC., "*Microwave auditory effect- a comparison of some possible transduction mechanisms*". J Microwave Power. 1976 Mar;11(1):77-81. 1976.
- Guy, A.W., C.K. Chou, J.C. Lin and D. Christensen, 1975, Microwave induced acoustic effects in mammalian auditory systems and physical materials, Annals of New York Academy of Sciences, 247:194-218
- Fist, Stewart, "*Australian exposure standards*". *Crossroads*, The Australian, March 1999.
- Microwave auditory effects and applications, James C. Lin; Publisher: Thomas; ISBN 0-398-03704-3

Malech, Robert G., "*US3951134 : Apparatus and method for remotely monitoring and altering brain waves*". April 20, 1976.
- McMurtrey, John J., "*Inner Voice, Target Tracking, and Behavioral Influence Technologies*". Nov. 14, 2004.
- US Department of Defense, Air Force Research Laboratory comprehensive review on RFR-auditory effect in humans
- Thijs VMJ. Application #WO1992NL0000216 "Hearing Aid Based on Microwaves" World Intellectual Property Organization Filed 1992-11-26, Published 1993-06-10.
- Kohn B. "Communicating Via the Microwave Auditory Effect" Defense Department Awarded SBIR Contract # F41624-95-C9007, 1993.
- "Auditory Responses to Pulsed Radiofrequency Energy" Bioelectromagnetics Suppl 8: S162-73, 2003.
- Suppes P, Lu Z, and Han B. "Brain wave recognition of words" Proc Natl Acad Sci 94: 14965-69, 1997.
- Suppes P, Han B, and Lu Z. "Brain-wave recognition of sentences" Proc Natl Acad Sci 95: 15861-66, 1998.
- Assadullahi R and Pulvermuller F. "Neural Network Classification of Word Evoked Neuromagnetic Brain Activity" In: Wermter S, Austin J, and Willahaw D (eds.) Lecture Notes in Artificial Intelligence: Emergent Neurocomputational Architectures Based on Neuroscience Heidelberg Springer, p 311-20, 2001.
- Smith C. "On the Need for New Criteria of Diagnosis of Psychosis in the Light of Mind Invasive Technology" J Psycho-Social Studies 2(2) #3, 2003.
- McMurtrey JJ. "Microwave Bioeffect Congruence with Schizophrenia" In press, 2003.

Categories: Espionage | Human physiology | Non-lethal weapons | Cognitive neuroscience | Hearing | Mind control | Radio spectrum