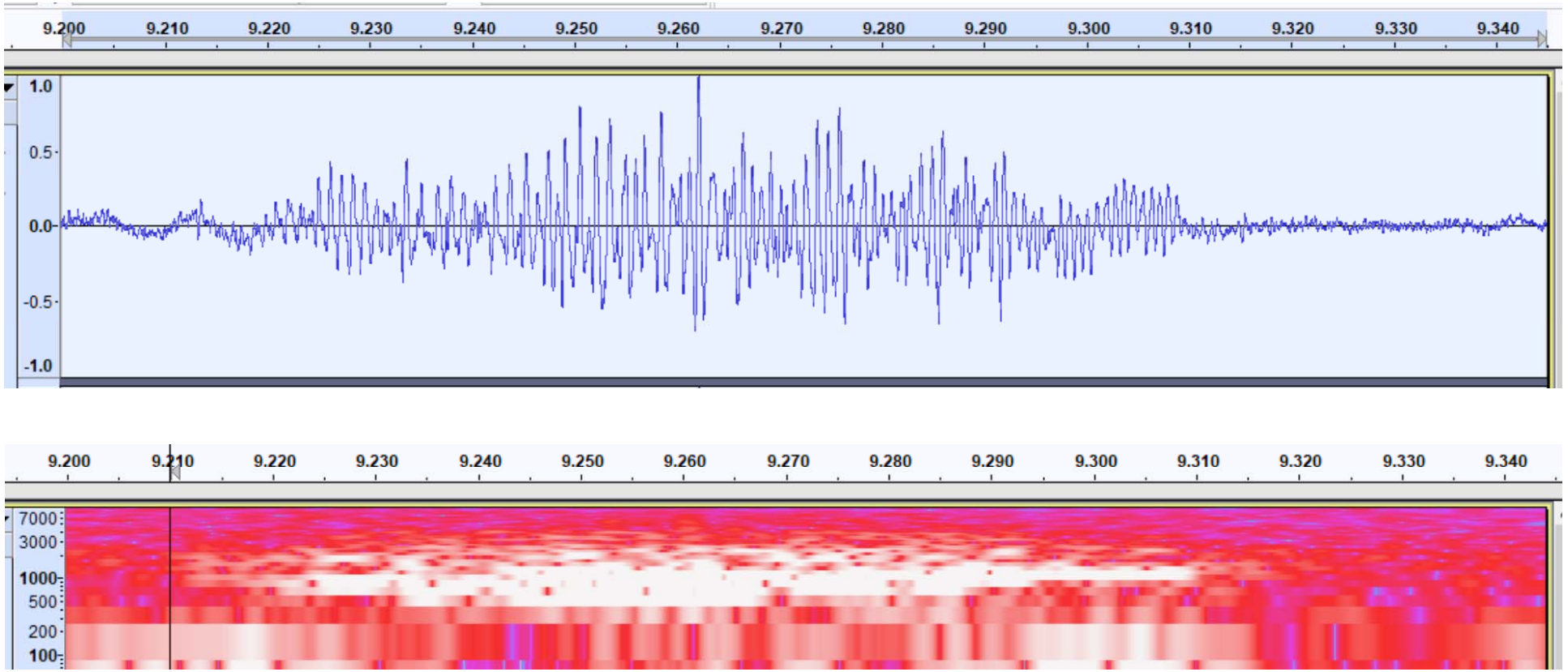
UiO : Department of Informatics
University of Oslo

Hot chocolate effect, singing sand, and other everyday physical acoustics phenomena

Sverre Holm


Om tanker og doruller (Abels tårn, Ekko, NRK P2) 19.04.13
Ekko
Ekko 19.04.13
NRK P2
12:03 / 32:28
Scroll for details

Gdansk, Poland


9.200
9.210
9.220
9.230
9.240
9.250
9.260
9.270
9.280
9.290
9.300
9.310
9.320
9.330
9.340
1.0
0.5
0.0
-0.5
-1.0
7000
3000
1000
500
200
100

Nature 1888, Carus-Wilson

Sonorous Sand in Dorsetshire.

It may be interesting to know that I have discovered the existence of "musical" sand on the sea-beach at a spot between Studland Bay and Poole Harbour.

This sand, though not emitting sounds quite so loud as those produced in the Eigg sand, answers all the usual tests, and gives out a distinct note when walked upon or when agitated by the hand or a stick.

Briefly, I may state that I have been investigating the phenomenon for the last two years, and that an examination of this Dorsetshire sand gives fresh evidence in support of my theory (shortly to be published) as to the cause of the sounds. I may add that I had reasons for thinking that the sand on this particular beach *ought* to be sonorous under certain favourable conditions, but that I had visited it before without success.

It is now over thirty years since Hugh Miller discovered this sand at Eigg, and up to the present instance I am not aware that it has again been found in any other part of Europe.

CECIL CARUS-WILSON.

Bournemouth, August 18.

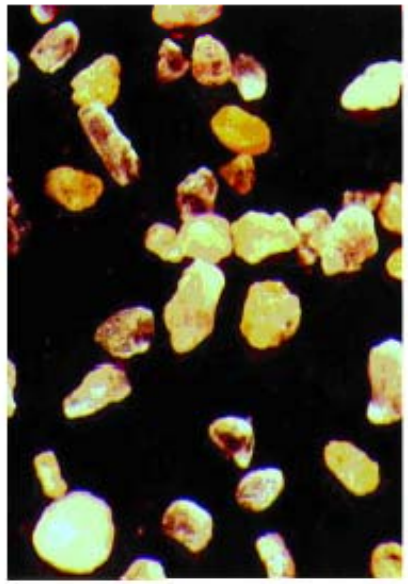
Nature 1891, Carus-Wilson

state that in November 1888 I published a paper[1] in which I propounded a theory to account for the cause of musical sounds issuing from certain sands. After giving various reasons for my conclusions, I said :—"It occurred to me, then, that the music from sand was simply the result of the *rubbing together* of the surfaces of millions of perfectly clean grains of quartz, free from angularities, roughness, or adherent matter, in the form of clinging fragments investing the grains, and that these microlithic emissions of sound, though individually inaudible, might in combination produce a note sufficiently powerful to be sensible to us."

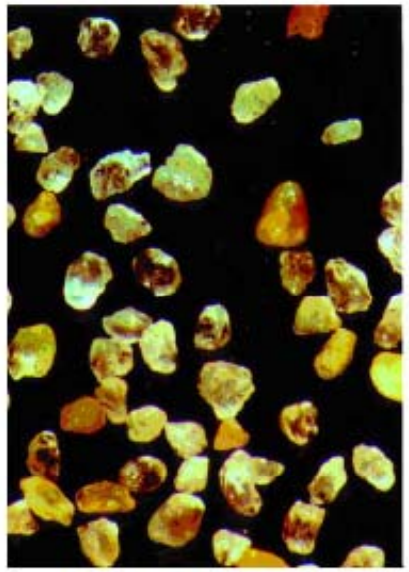
Dueodde, Bornholm

Singing, squeaking sand

- Sign of a healthy, unpolluted beach
- 500-2500 Hz
- Not too dry nor too wet



1 mm



1 mm

Optical micrographs:

- a normal beach in Bay City, MI

- a squeaking beach in Luddington, MI

  Scholtz, Bretz, Nori, Sound-producing sand avalanches, 1997

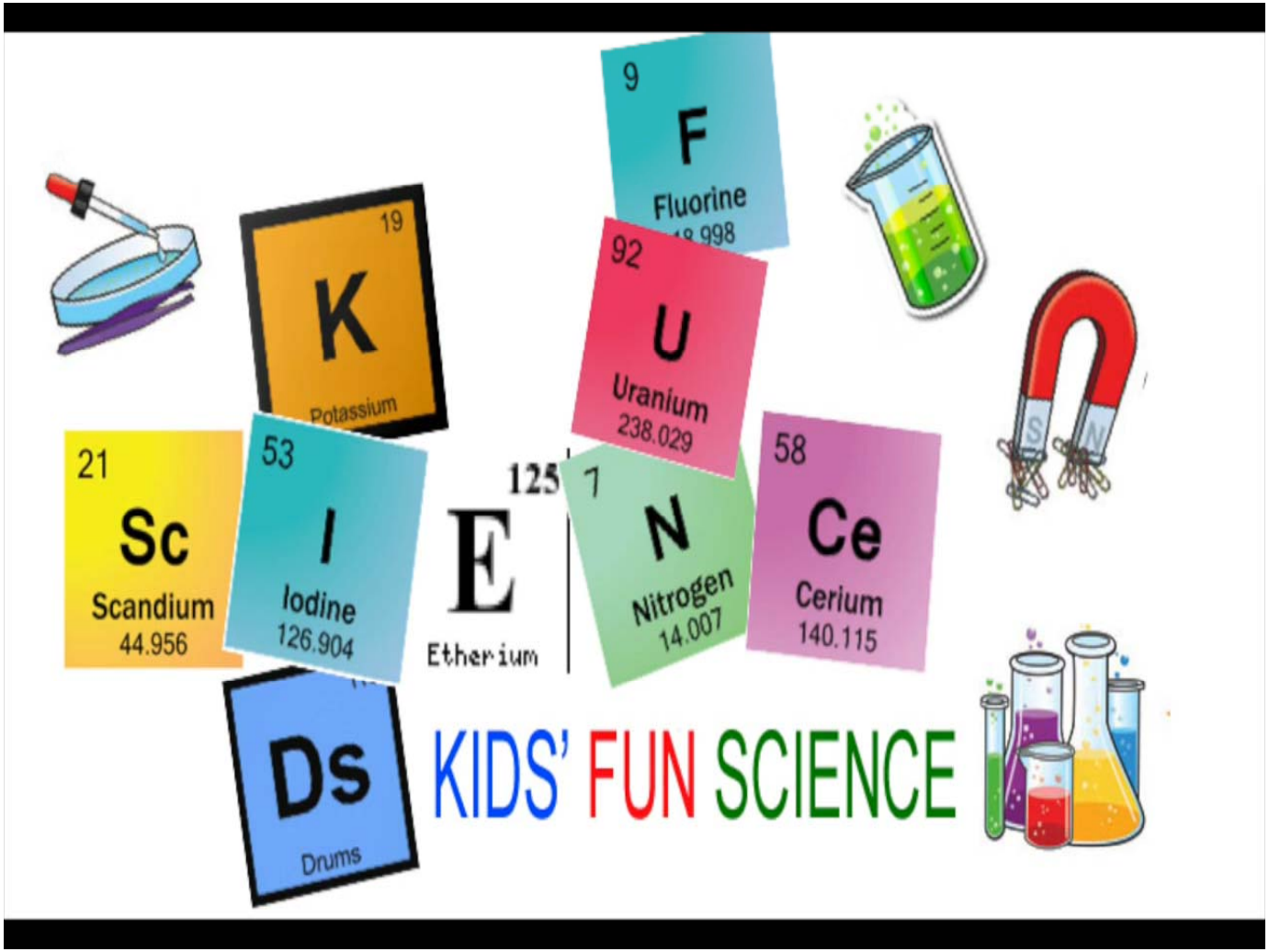
A high degree of

1. size-sorting, typ 0.3 mm
2. sphericity
3. roundedness (small surface roughness)
4. resistance to shear

- Carus-Wilson, C., 1888. Sonorous Sand in Dorsetshire. *Nature*
- Lindsay, J.F., Criswell, D.R., Criswell, T.L. and Criswell, B.S., 1976. Sound-producing dune and beach sands. Geological Society of America Bulletin.
- Miwa, S., Hidaka, J. and Shimosaka, A., 1983. Musical sand. KONA Powder and Particle Journal.

Hot Chocolate Effect

https://www.youtube.com/watch?v=ao0rOystxzA



Proc. Camb. Phil. Soc. (1969), **65**, 365
With 1 *text-figure*
PCPS 65–31
Printed in Great Britain

On the note emitted from a mug while mixing instant coffee

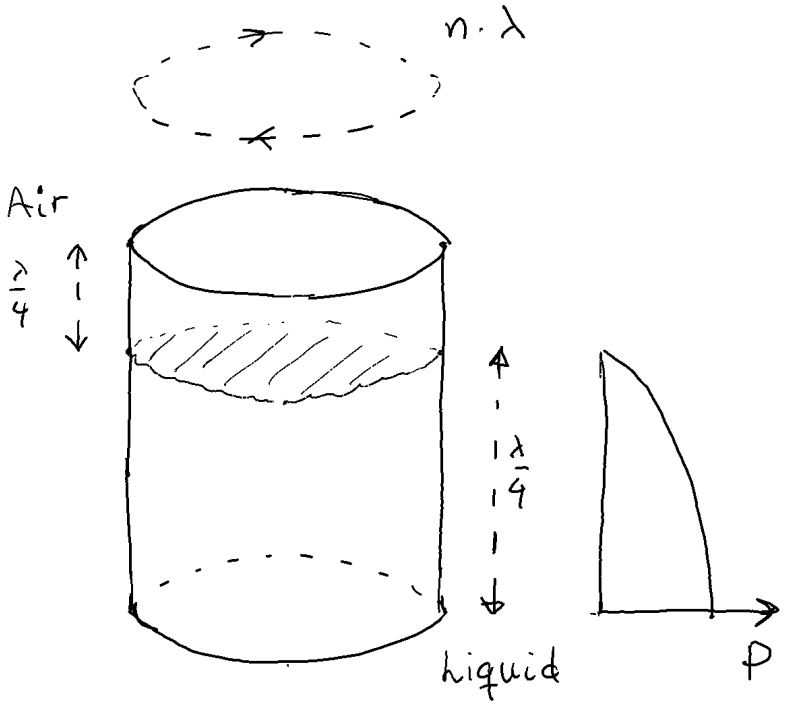
BY W. E. FARRELL, D. P. MCKENZIE AND R. L. PARKER
Institute of Geophysics and Planetary Physics, University of California, San Diego, La Jolla, California

(*Received* 17 *October* 1967)

We have recently observed a curious phenomenon, undoubtedly well known, while mixing instant coffee in a mug. If the bottom of the mug was tapped repeatedly with the spoon as the powder was stirred into the water, the note emitted could be heard to rise in pitch by over an octave. This rise occurred in a matter of seconds, about the same time as it took the mug to heat up. Further experimentation showed that almost any powder could produce the effect in cold or hot water, but water alone would not. Vigorous stirring did not seem essential. A full mug showed as pronounced an effect as a half-filled one.

Farrell, McKenzie, Parker, 1969. On the note emitted from a mug while mixing instant coffee

At least three different resonances



$$f = \frac{c}{\lambda} = \frac{c}{4h}$$

Frequency proportional to speed of sound

$$c = \begin{cases} \sqrt{\frac{\gamma p_0}{\rho}} = \sqrt{\frac{1.4 \cdot 101 \cdot 10^3}{1.225}} = 340 \ \text{m/s, air} \\ \sqrt{\frac{K}{\rho}} = \sqrt{\frac{2.2 \cdot 10^9}{1000}} = 1483 \ \text{m/s, water} \end{cases}$$

Bubbles: Bulk modulus reduced to 2%

Density unchanged

$$c = \sqrt{\frac{K}{\rho}} = \sqrt{\frac{0.02 \cdot 2.2 \cdot 10^9}{1000}} = 212 \ \text{m/s}$$

Up to 1:7 pitch reduction with air in water

Syngende kopper, blogg MatNat, UiO
https://titan.uio.no/node/1217

- Farrell, W. E., McKenzie, D. P., & Parker, R. L., 1969. On the note emitted from a mug while mixing instant coffee. In *Mathematical Proceedings of the Cambridge Philosophical Society*
- Frank S. Crawford, May 1982, "The hot chocolate effect", *American Journal of Physics*
- Frank S. Crawford, November 1990, "Hot water, **fresh beer**, and salt", *American Journal of Physics*
- Aljishi, S., & Tatarkiewicz, J. 1991. Why does heating water in a kettle produce sound?. American Journal of Physics

Hot water, fresh beer, and salt

Frank S. Crawford
Lawrence Berkeley Laboratory and Physics Department, University of California, Berkeley, California 94720

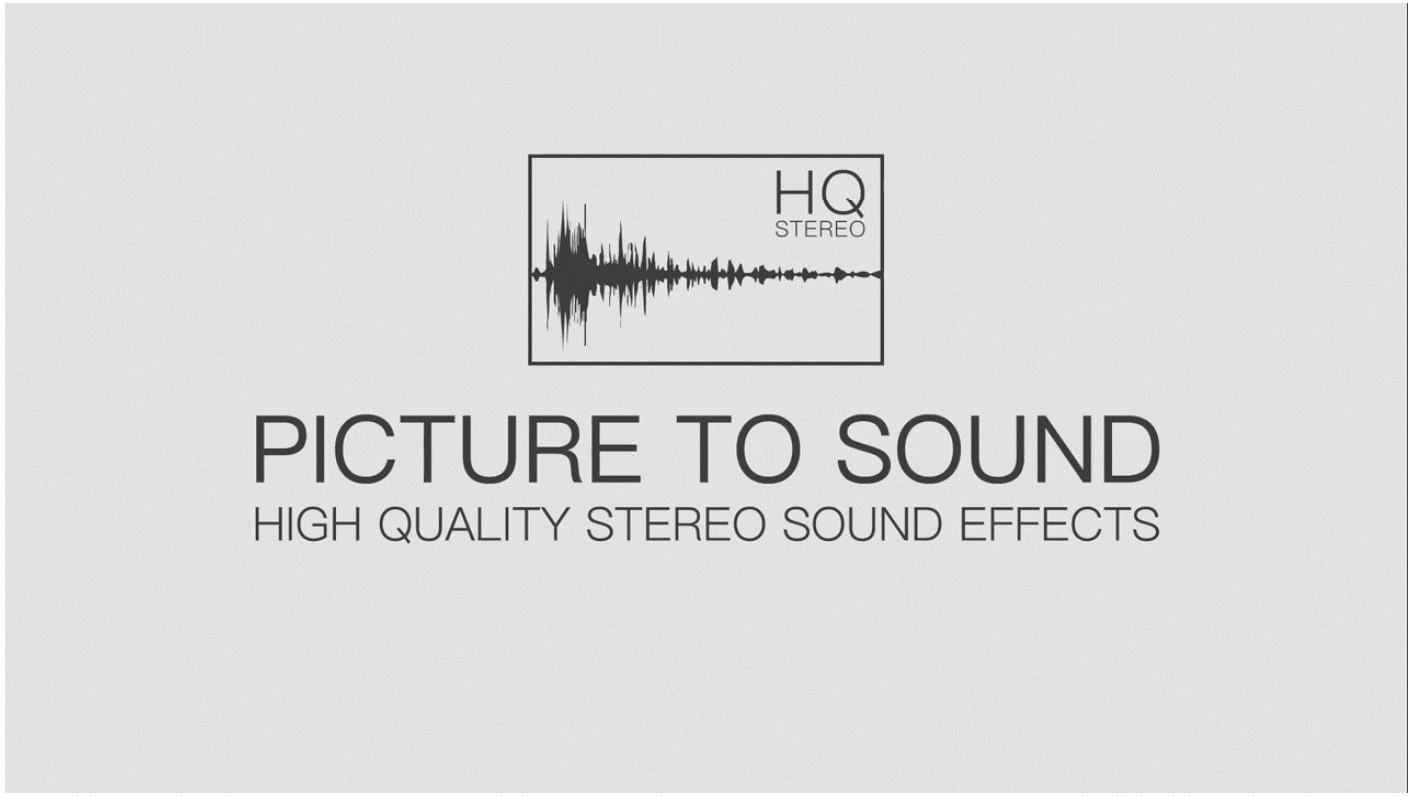
(Received 16 August 1989; accepted for publication 7 March 1990)

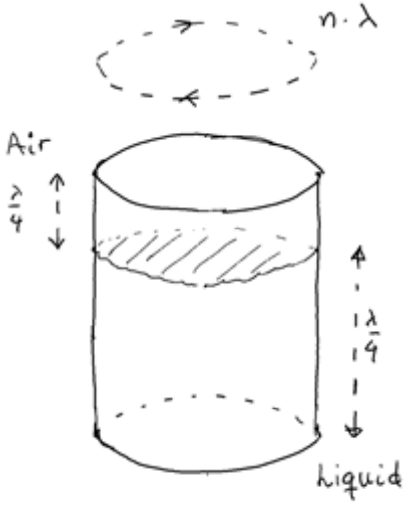
In the "hot chocolate effect" the best musical scales (those with the finest tone quality, largest range, and best tempo) are obtained by adding salt to a glass of hot water supersaturated with air. Good scales can also be obtained by adding salt to a glass of freshly opened beer (supersaturated with CO_2) provided you first (a) get rid of much of the excess CO_2 so as to produce smaller, hence slower, rising bubbles, and (b) get rid of the head of foam, which damps the standing wave and ruins the tone quality. Finally the old question, "Do ionizing particles produce bubbles in fresh beer?" is answered experimentally.

Pouring water into a glass

https://www.youtube.com/watch?v=ayNzH0uygFw&app=desktop

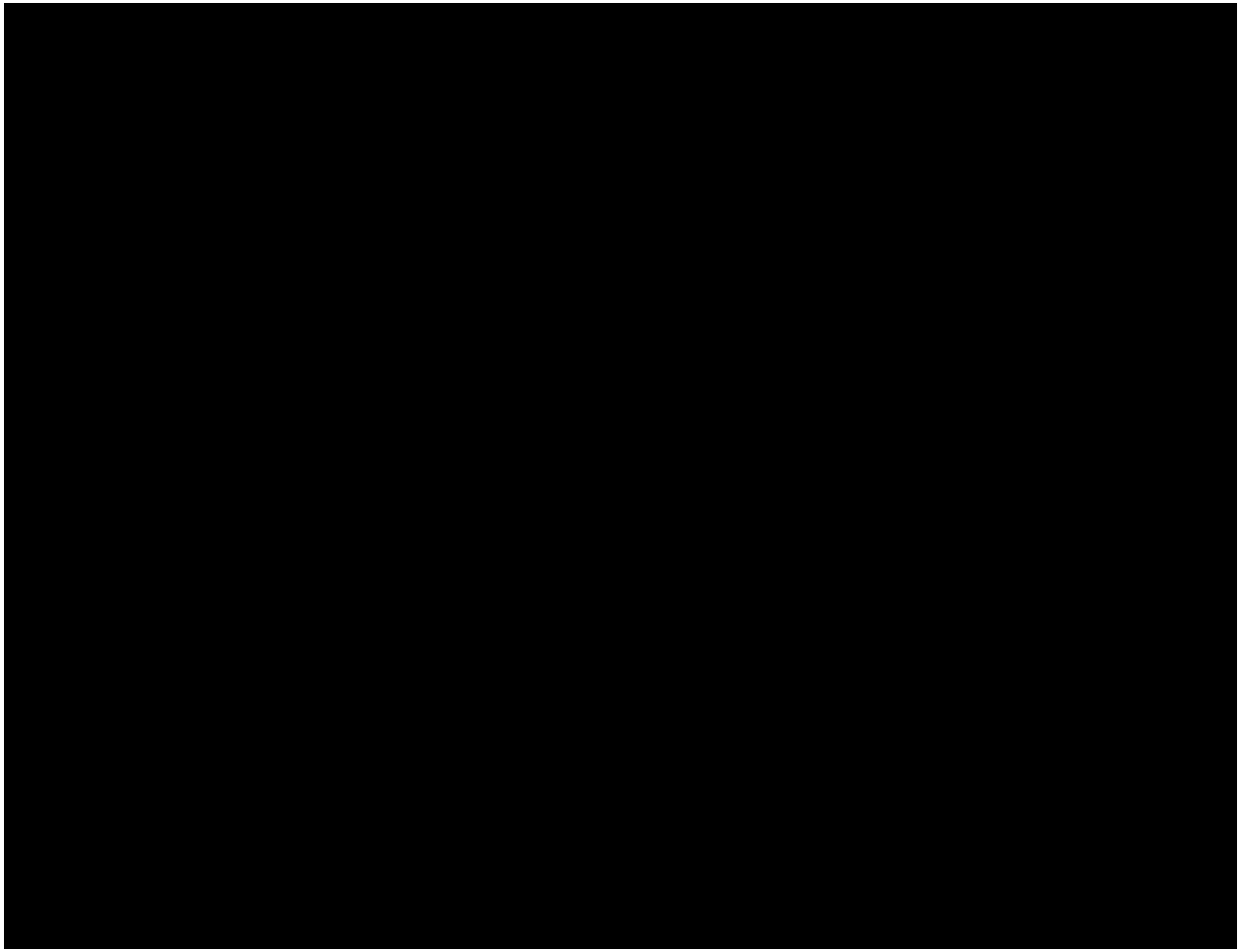
$$f = \frac{c}{4h}$$

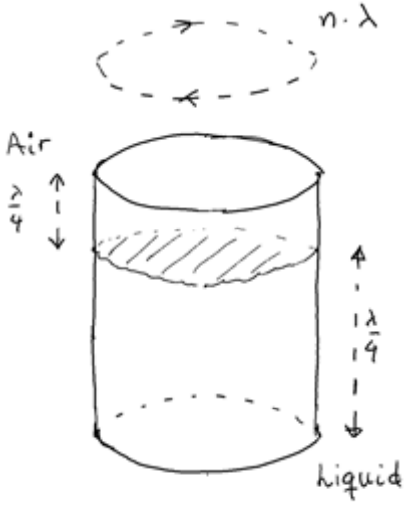




Glass harp

https://www.youtube.com/watch?v=XKRj-T4l-e8&feature=youtu.be





Other daily life phenomena

- Helium voice
- Archaeoacoustics
  - Ancient voices recorded onto pottery?
- Psychoacoustics of chalkboard squeaking
  - Mapping unpleasantness of sounds to their auditory representation