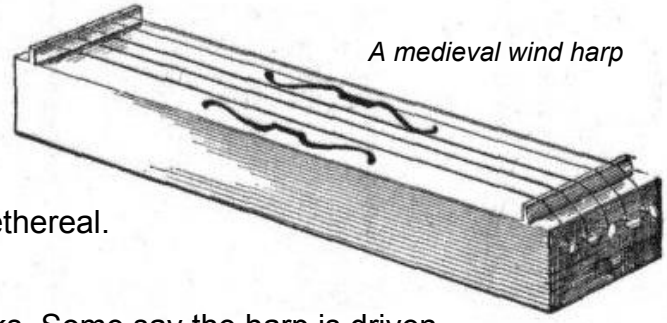
WIND HARP PHYSICS

When you pluck the string of a regular harp, the string sounds a *fundamental note.* But when the wind blows across the string and you hear it, the note is much higher - it is a *harmonic* of that fundamental note.

Harmonics

The ancient Greek mathematician Pythagorus is credited with the first historical description of harmonics. He discovered that if a string was shortened to exactly half of its original size, the resulting tone would be an octave above the original note. If he took only half of the second string's length, the result would be another octave higher. Other divisions of a string will result in other interval relationships, like “fifths” (five tones above the fundamental) and “thirds” (three tones above). These related notes above the fundamental are harmonic *overtones*.



A medieval wind harp

When a string is plucked, we hear mainly the fundamental note, but in addition, the harmonic overtones are also present. When the wind plays a string, it does not play the fundamental tone, but only a series of overtones. That is why the sounds are so ethereal.

Aeroelasticity and Vortex-Shedding

Physicists do not agree how a wind harp works. Some say the harp is driven by an *aeroelastic* effect. When the wind blows across the wire, the pressure on the leading side is greater than on the trailing side. The strings are pushed sideways until the tension stops them and they snap back. For each string diameter at a specific tension, there is a specific wind speed (sometimes called a flux speed) that will cause it to oscillate. The oscillation produces sounds – octaves, fifths, and thirds. The effect can sometimes be seen and heard in utility lines during a stiff wind.

Others maintain the oscillations are due to complex air currents. When the wind blows past a string, little spirals of air move to either side (the wind stream "sheds vortices"). These spirals or vortices form alternately on each side of the string and create an *oscillation*. The number of oscillations in a given time is the *frequency*. If the frequency of this oscillation matches the frequency of the fundamental tone to which the string is tuned, the string will produce a sound.

Aeolian Harps and Wind Harps

The proper name for a wind harp is an *Aeolian harp,* named for Aerolus, the Greek god of wind. These usually have a rectangular sound box, the size of which is determined by the window in which it will be placed. Aeolian harps have several strings of equal length, tuned to the same fundamental note. But although their frequency is the same, the diameters of the strings are all different. Because of this, the wind cause different strings to sound as its speed varies. The fluctuating wind speed will also produce a variety of harmonics. Consequently, the harp will sound as if it is being “played.”