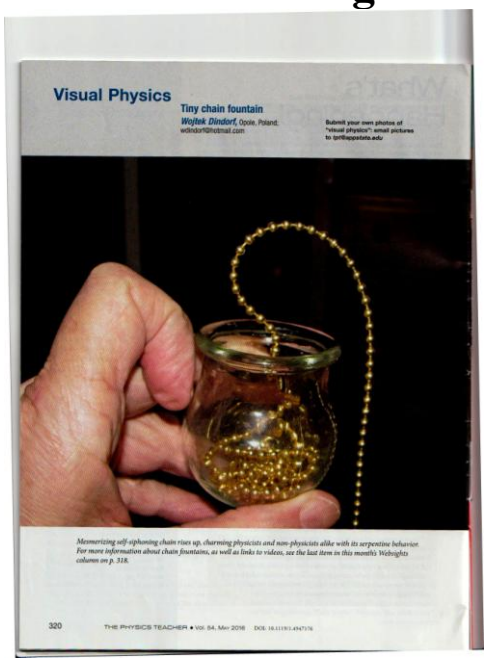
It’s not magic



Visual Physics

Tiny chain fountain

Wojtek Dindorf, Opole, Poland; wdindorf@hotmail.com

Submit your own photos of "visual physics": email pictures to tpt@appstate.edu

Mesmerizing self-siphoning chain rises up, charming physicists and non-physicists alike with its serpentine behavior. For more information about chain fountains, as well as links to videos, see the last item in this month's Weblights column on p. 318.

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photo wd

One appreciates the beauty of the siphoning chain in Internet short films (eg. Steve Mould Demonstrating https://www.youtube.com/watch?v=-eEi7fO0_O0) showing and explaining this intriguing phenomenon (TPT Vol. 54, p. 320). Some performers admit they have no idea how it works. No reasonable explanation is given even by a team from Cavendish Laboratory, Cambridge.

The key word is CENTRIFUGAL FORCE. The train of beads is forced - by condition of experiment – to turn a curve of 180 degrees while moving faster and faster. There is a sharp jerk of gravity forcing a rapid increase in velocity... and a really sharp curve on the way! So the chain must experience an outward push comparable to a car that is thrown off the road when on a curve moving over the speed limit. Nature dictates certain relations between velocity, the radius of curvature, and force. Here –the driving force and speed increase and this is why the radius of curvature gets larger.

A real beauty. An “invisible pulley” of nature changes the sign of velocity caused by the universal pull of gravity and demonstrates the rules revealed by sir Isaac Newton.

To confirm my opinion concerning the reason of the case, I tried to use a horizontal runway instead of a bowl with vertical take off,

1 kg load attached to 6m of metallic beads 0.2 s after start

the last 150 cm (a bit less than 1s later) – the camera catches two pictures of the movie. Shots taken from the video.

I used a 160 cm ladder (three photos above) in my garden. Six meters of metallic beads were laid on a ceramic plate and then pulled down by a falling 1kg weight. A "locomotive" was carefully dropped from the edge of the smooth horizontal plate. It assured acceleration close to *g* right from the start for the first 0.5 second. Now, the turn was only 90 degrees. But still most of the beads were lifted up above the plate to follow a curvilinear motion with the radius of about one meter.

Photos and videos were taken during many trials. All was excitingly fantastic. Most of the chain ended under the edge of the starting platform, except for the end section. The end of the chain reached an average of 1-1.5m distance from the ladder.

Since I address the article mainly to those who have at least a basic knowledge of Physics, I will stop further explanations due to the complexity of these beads' motion. I encourage inquiring minds to produce adequate mathematics for it. It is not simple to write an equation of motion of such a train – believe me.

I have performed many variations of this experiment, and I found that the same effect could be observed using a flexible rope. It is not as

spectacular as with a string of "heavy" beads. The effect (with a rope) was known for ages among sailors and mountain climbers.

During my 60 plus years of teaching, I never came across of any similar problem related to this fascinating siphoning of coral beads.

Wojciech Dindorf