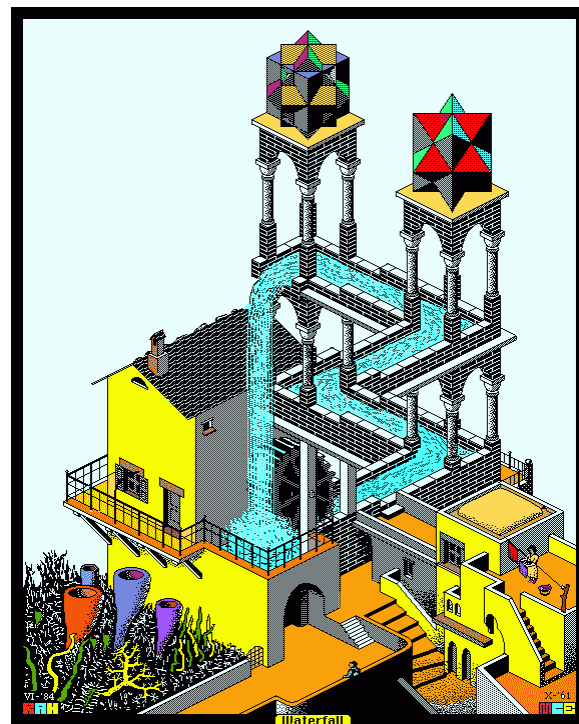# The Museum of Unworkable Devices

Versão em português

This museum is a celebration of fascinating devices that don't work. It houses diverse examples of the perverse genius of inventors who refused to let their thinking be intimidated by the laws of nature, remaining optimistic in the face of repeated failures. Watch and be amazed as we bring to life eccentric and even intricate perpetual motion machines that have remained steadfastly unmoving since their inception. Marvel at the ingenuity of the human mind, as it reinvents the square wheel in all of its possible variations. Exercise your mind to puzzle out exactly why they don't work as the inventors intended.

This, like many pages at this site, is a work in progress. Expect revisions and addition of new material. Since these pages are written in bits and pieces over a long period of time, there's bound to be some repetition of ideas. This may be annoying to those who read from beginning to end, and may be just fine for those who read these pages in bits and pieces.

Galleries

- The Physics Gallery, an educational tour. The physics of unworkable devices and the physics of the real world.
- The Annex for even more incredible and unworkable machines.
- Advanced Concepts Gallery where clever inventors go beyond the classical overbalanced wheels.
- New Acquisitions. We're not sure where to put these.
- Will They Work? These ideas don't claim perpetual motion or over-unity performance, nor do they claim to violate physics. But will they work?
- Whatever Were They Thinking? The rationale behind standard types of perpetual motion devices.
- The Gallery of Ingenious, but Impractical Devices. Not perpetual motion but certainly ill-conceived.
- The Basement Mechanic's Guide to Building Perpetual Motion Machines.
- The Basement Mechanic's Guide to Testing Perpetual Motion Machines.
- NEW! Fake Perpetual Motion Machines You Can Build.
- Perpetual Futility, A short history of the search for perpetual motion.
- The John Worrell Keely Memorial Gallery.
- Hall of Machinery. Watch these machines turn forever.
- Unworkable Devices as Fine Art. Special exhibit now open.

- **Themed Galleries: The evolution and persistence of unworkable concepts.**.

- [Center of gravity analysis of machines](#).
- [The shifting-mass overbalanced wheel.](#)
- [Self-acting pumps.](#)
- [Belt and pulley Devices](#).
- [The Roberval balance.](#)
- [Back to Basics.](#) Simpler isn't always better.
- [The bucket-brigade wheel.](#)
- [Buoyancy misconceptions.](#)
- **NEW!** [Siphon misconceptions.](#)
- [Surely they can't be serious?](#)
- **NEW!** [Theory of perpetual motion machines.](#)

- **The Reading Room.**

- [Nature's impossibilities](#).
- [Why won't my perpetual motion machine work?](#) For those who want quick answers.
- [Things to consider before you rewrite classical physics.](#)
- [Basic concepts of classical physics.](#)
- **NEW!** [Are physics laws universal?](#)
- [Violating Newton's Laws.](#)
- [On a frictionless level plane, will a cylinder roll forever?](#) No, but the reasons are interesting.
- [A defense of the quest for perpetual motion](#). by Ken Amis.
- [Letters to Ken Amis](#).
- [Patents for unworkable devices](#).
- [Physics 101 for perpetual motion machine inventors](#).
- [What is Energy?](#)
- [The psychology of perpetual motion machine inventors](#).

Related Galleries.

- [Gallery of artistic impossibilities](#).
- [Gallery of 3d stereo artistic impossibilities](#).

- [Donald Simanek's Front Page](#).

Web resources.

- [Deceptions](#) by Peter Parsons. We don't talk much about deliberate contemporary scams and deceptions on these pages. We don't have to, for this excellent site debunks them thoroughly. Click on the "scams" tab for more. The site also has information on both genuine and bogus energy saving strategies.

The Main Gallery

- [It'll never work!](#)

> *Insanity: doing the same thing over and over again and expecting different results.*
>
> *—Albert Einstein.*

> *The seekers after perpetual motion are trying to get something from nothing.*

- [Overbalanced wheels.](#)
- [Stevin's problem.](#)
- [More on Stevin's Principle.](#)
- [Friction and idealizations.](#)
- [Tapping quantum weirdness.](#) NEW!
- [What about free energy?](#)
- [Buoyancy motor 1.](#)
- [Buoyancy motor 2.](#)
- [Buoyancy motor 3.](#)
- [Buoyancy motor 4.](#)
- [Capillary motor.](#)
- [Capillary wheels.](#)
- [George Sinclair's siphon.](#)
- [The Schadewald gravity engine.](#)
- [Simanek's bouncing ball engine.](#)
- [Gravity shield engine.](#)
- [The Classic magnetic shield engine.](#)
- [Links to other sites.](#)
- [Bibliography.](#)

—Sir Isaac Newton

If at first you don't succeed...

Somebody said it couldn't be done
But he, with a grin, replied
"You shouldn't say it can't be done
At least until you've tried."

So he set to work; armed with a ton
Of zeal he got right to it.
He tackled that thing that couldn't be done;
But he couldn't do it.

        —Anon (Parody of Edgar Guest.)

It'll never work!

Closed-cycle mill, 17th century.
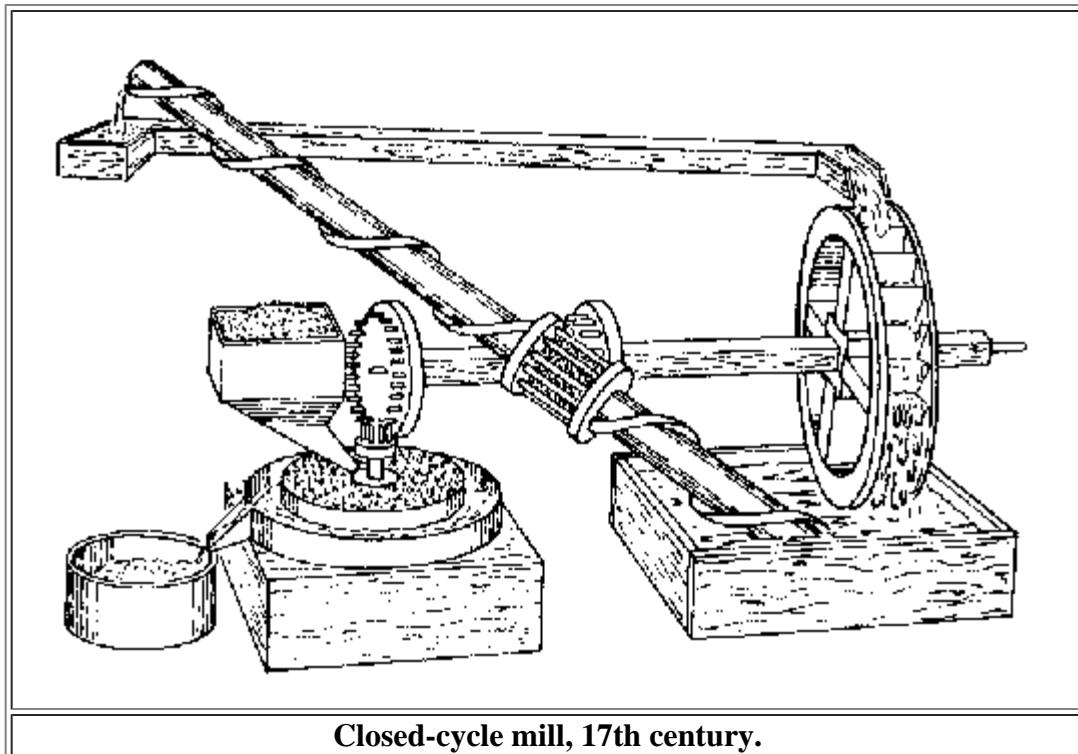
The term "perpetual motion machine" has several definitions.

1. Any device that continues its motion forever, without any speed reduction. This is a literal interpretation of the words.

2. Any device whose operation would violate established laws of physics, or would depend upon purely speculative laws unknown to physics. This is the colloqual usage.
3. A machine that perpetually puts out more energy than it takes in. Nowadays this is called an "over-unity machine" since its power efficiency would be greater than one.
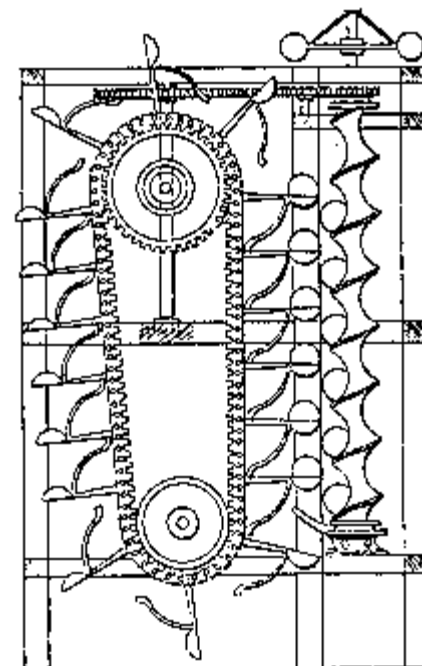
I will include the last two of these under the term "unworkable devices". The first one does not violate any fundamental physics, but it does not happen in large scale structures because of two facts of nature: (1) no materials are perfectly rigid bodies and (2) friction and other energy-dissipative processes are always present. The only systems we know of, such as atoms, that seem to exhibit constant energy and momentum forever (if undisturbed) are such a nature that we cannot directly verify whether there's really any **motion** going on within them. Our concern is not with these, but with systems that would *appear to* violate physics laws on the macroscopic scale—machines that have cyclic operation and could be made to produce useful work forever, without energy input.

Perpetual motion machine proposals are often dismissed by scientists in a manner that appears to the layperson as hasty rejection using dogmatic assertions that such machines are prohibited from working by the "laws of thermodynamics". This does not satisfy the person who "knows" a little physics, but considers the laws of thermodynamics a bit mysterious. The very character of such laws is off-putting to the average person, because they have an air of finality and negativity.

> *The Perpetual Quest*
>
> *Seekers of Perpetual Motion,*
> *Have fervent faith and saint's devotion.*
> *The Gods of Physics duly smite them*
> *To be reborn ad infinitum.*
>
> —Jonathan Harris

Thermodynamics laws and conservation laws have great power because they allow us to predict certain things about a system without analyzing all aspects of the mechanism. They even allow confident predictions in spite of our ignorance of some details or experimental difficulties in examining them. The experienced scientist will use these to evaluate a proposed device, which seems to the non-scientist to be a failure to consider all the details.

Of course physicists don't claim that any physics laws represent final and unalterable truth. The perpetual motion (PM) machine inventor pounces on this and says "Such laws would have us give up trying to discover anything new! What if there were a flaw in these laws, a flaw that we could discover and exploit?"

It's a historical fact that the laws of thermodynamics were initially proposed to describe the fact that all previous attempts to

> *The only way of discovering the limits of the possible is to venture a little way past them into the*

achieve perpetual motion had failed. We've learned more about these laws since then, and have a much better understanding of them and why they are so powerful in describing what can and can't happen in nature.

Any particular classical mechanical PM machine can be shown to be faulty in concept or execution by far simpler and conclusive means. The obvious way is to simply test the machine to see if it lives up to the inventor's claims. Fraudulent claims may sometimes be exposed this way. But the inventor's usual reaction to the failure of his device is to say, "It just needs a bit more work to refine and improve the design or reduce the friction."

On another level are **proposals** that haven't yet been built. Such proposals may come from honest (though perhaps misguided) people who know some physics or engineering (but not enough). How can we determine whether these are worth the time and trouble to develop? We may not have to go to the trouble and expense of building them. Perpetual motion proposals can be shown to be based on faulty reasoning, or on misunderstanding or misapplication of well-known and well-tested basic laws and principles of physics.

This can be a useful exercise for interested laypersons, and for high school and freshman college students taking physics, even before they have been exposed to the laws of thermodynamics. My purpose, in this document, is to subject some of the classic perpetual motion machine proposals to such analysis. In the process we will come to better understand the basic physics laws, and understand how they can be misunderstood, misinterpreted and misapplied. This exercise can strengthen one's understanding of physics.

I will be interested in examining examples of these classes of proposals and claims:

(1) **Devices that are claimed to remain in continual motion without input of energy and without producing output work.** Obviously such devices would require energy to get them moving, but none thereafter. This description is nothing more than a statement of what **perpetual motion** means. These devices (if they actually worked) would have no purpose other than to amaze onlookers and annoy physicists and engineers. Such devices would not necessarily violate any fundamental physics laws or principles. Stable atoms are physical objects whose internal processes continue forever without loss of energy, if the atom is not disturbed. So they are examples of "perpetual motion" (moving forever), but in the physics literature these aren't called "perpetual motion machines". That term is reserved for a device that would violate one or more of the laws of thermodynamics. This is because the word "machine" is reserved for devices that produce an output of useful work, while these continually turning systems don't output any work and therefore aren't machines.

Some folks cite the motion of planets around the sun as an example of perpetual motion. On the macroscopic scale we can show that perpetual motion isn't happening, even without waiting around for an eternity. If the motion of a system is observed for a finite time and found to be decreasing in speed, then clearly it is losing energy continually, and can't move perpetually. This is the case even for the solar

system, as mechanical energy and tidal deformations dissipate mechanical energy into thermal energy. There are no macroscopic (large scale) mechanisms known that move without slowing down, and it is usually due to those ever-present energy dissipative processes such as friction. The fact that these dissipative processes are always present is a fact of nature, though we don't usually elevate that fact to the status of a "law of nature". This fact, however, is not the sole cause of failure of all perpetual motion machine proposals, as we will see.

(2) **Devices that are claimed to remain in motion without energy input while still producing output energy.** Such proposed devices may require a push to get them started, but no input energy thereafter. This is the kind of machine inventors seek. Sometimes the inventor refuses to disconnect the starter battery after the machine is moving. This is suspicious.

(3) **Devices that require energy input to remain in motion, but are claimed to produce output energy greater than the input energy.** These days some folks call these "over-unity" machines, because their inventors claim they have energy efficiencies greater than one. Clearly such a machine (if it existed) could be engineered to be a class (2) machine by simply diverting part of the output energy and feeding it back to the input to drive the machine. Curiously, inventors who claim to have made an over-unity machine

> *Human opinion is scarcely anything more than the history of human errors.*
>
> —Voltaire

resist any suggestions that they do this in order to conclusively prove their claims for the machine. This is also suspicious.

(4) **Devices that tap some hypothetical universal all-pervasive "free energy" that the inventors imagine fills all of space.** Back in the 19th century it used to be the energy of the luminiferous ether that was supposedly being tapped. Now that we no longer take the existence of the ether seriously these folks claim to be tapping some sort of "energy of the vacuum." Anyway, they claim, it's "out there" and free for the taking. If there really were such an energy source, these machines wouldn't be violating any physical laws. Unfortunately the postulated source of energy is often concocted just to suit the purposes of the inventor, and is entirely a product of the inventor's imagination, unsupported by any other independent evidence. So, to the objective observer, these machines are experimentally and theoretically indistinguishable from type (3).

> Since inventors (seekers) of free energy devices claim that such machines do have energy input, they reject the label of "perpetual-motion machines". They also reject any suggestion that they could divert some output energy to the provide the necessary input, on the excuse that the machines are only capable of taking in energy from a "free energy" source, or that the "free energy" is of a subtly different character from ordinary energy.

Scientists classify PM machines by reference to the thermodynamics laws they would violate.

- Perpetual motion machines of the first kind violate the first law of thermodynamics. They produce more energy output than input, that is, they have an efficiency greater than one.
- Perpetual motion machines of the second kind violate the second law of thermodynamics. They would involve zero or negative changes of entropy.

I won't use this classification much, for I want to avoid any appeal to the laws of thermodynamics in this

document. My intent is to show that all unworkable devices violate more fundamental laws, laws that have been well-tested, well-established, and well-integrated into physical theory. Usually these are laws presented in undergraduate physics textbooks. But the examples I intend to analyze are those that are given inadequate analysis in standard books and articles. Many were originally proposed not as workable machines, but as clever challenge puzzles and paradoxes to test understanding of physical principles.

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Overbalanced wheels.
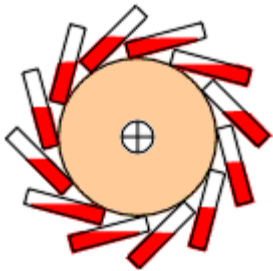
The overbalanced wheel perpetual motion idea apparently originated in India, in the 8th century CE. In his *Sysyadhivrddhida Tantra* (748 CE) the Indian astronomer Lalla described a self-rotating wheel driven by mercury moving along its curved spokes.

A variation of this idea was described by the Indian author Bhaskara (c. 1159). It was a wheel with containers of mercury around its rim. As the wheel turned, the mercury was supposed to move within the containers in such a way that the wheel would always be heavier on one side of the axle. [GIF by Hans-Peter Gramatke, used with permission.]

This idea appears again in Europe in the year 1235 when the French architect Villard de Honnecourt described an overbalanced wheel with hinged hammers equally spaced around its rim. The picture displays ambiguous perspective. The wheel is actually supposed to be perpendicular to the frame and to the horizontal axle. Villard's description (translated) is:

> Various spellings are seen: "Honecort" and "Honnecort". "Villard" is sometimes seen as "Vilars", "Wilars" or "Willars".

> *Many a time have skilful workmen tried to contrive a wheel that should turn of itself; here is a way to make such a one, by means of an uneven number of mallets, or by quicksilver.*

The reference to quicksilver (the liquid element mercury) indicates that Villard was familiar with the Bhaskara device, whose design had reached Europe by way of Arabia. Villard claimed his machine would be useful for sawing wood and raising weights.

Villard's diagram shows seven hammers, and he insisted on an odd (uneven) number of hammers, explaining

> *...there will always be four on the downward side of the wheel and only three on the upward side; thus the mallet or bag will always fall over to the left as it reaches the top, ad infinitum.*
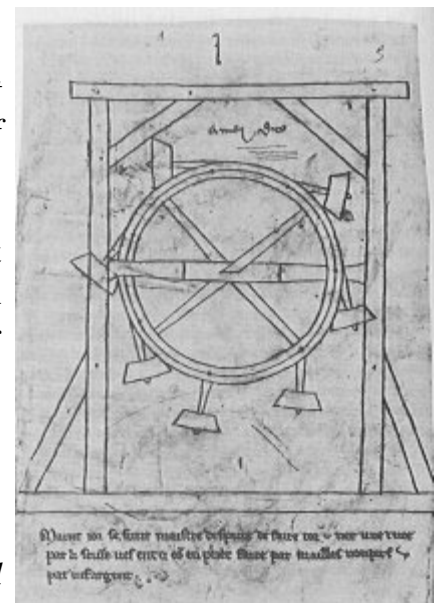
But, whether the number of hammers is odd or even, such a wheel comes to rest very soon. You have to give it a forceful push to make it execute even one revolution.
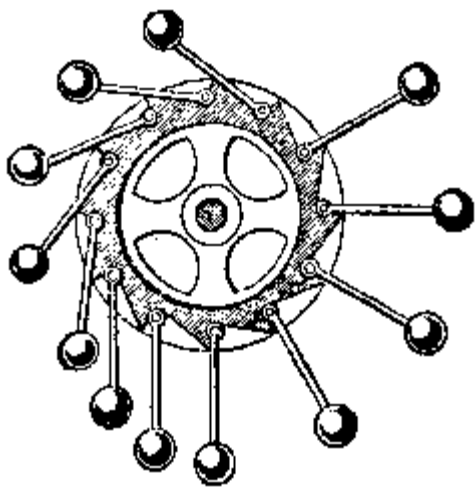
This "overbalanced wheel" idea reappeared in an astounding variety of forms over the centuries. We show a better diagram from a later time. A system of pegs or stops was required to hold the hammers at a large distance from the axle after they flipped over the top and allow them to hang freely as they came around the other side. Perhaps the rationale was that the balls had more moment (of inertia) on one side due to the larger lever arms (even though the principles of torque hadn't yet been formalized at this time).

Even though there are fewer balls on one side of the axle at any given position, these have larger lever arms and therefore greater torque. As a hammer swings and falls near the top of the wheel, the wheel slows during the hammer fall, then gains some speed when the hammer hits its peg. There's no net gain in speed, and there's irreversible energy loss when hammers hit pegs. If given a push, the wheel will turn jerkily for a while. If it were given a very forceful initial push, the hammers would assume radial positions and the wheel would turn much more smoothly and efficiently, but would gradually lose speed and rotational energy because of air drag and bearing friction, just as any spinning wheel would.

We have mostly second-hand accounts of Villard's understanding of the principles of this machine. However, I do not think that the folks who were fascinated with this idea were unaware of the static balance condition of the wheel. I speculate that they supposed the wheel would only work after it was manually set in motion, with the hammers giving it extra boost as they rapidly flipped across the top, perhaps (they may have thought) this was due to some "advantage" obtained from the motion of each weight flipping to a position with a larger lever arm.

This flipping action is much like that of a sling that gives a person the ability to throw a rock a greater distance, or the sling siege engine catapult known as the Trebuchet. Honnecort wrote about these machines of war, describing one with an 8x12x12 foot box of sand as counterweight (which could weigh 80 tons). Some had arms 50 feet long and were capable of slinging a 300 pound stone 300 yards. This connection to the swinging hammers of Honnecort's wheel and Trebuchets is speculation on my part, unsupported by any historical study I've seen.

Even though the sling action of a Trebuchet allows a greater efficiency of energy conversion compared to the rigid-arm catapult, the machine still puts out no more energy than that of the falling weight that drives it. Modern Trebuchets (built by hobbyists) have achieved energy conversion efficiencies of greater than 65%.

The overbalanced wheel idea was re-invented many times over the centuries, sometimes in fantastically elaborate variations. None ever worked as their inventors intended. But hope never dies. I've seen
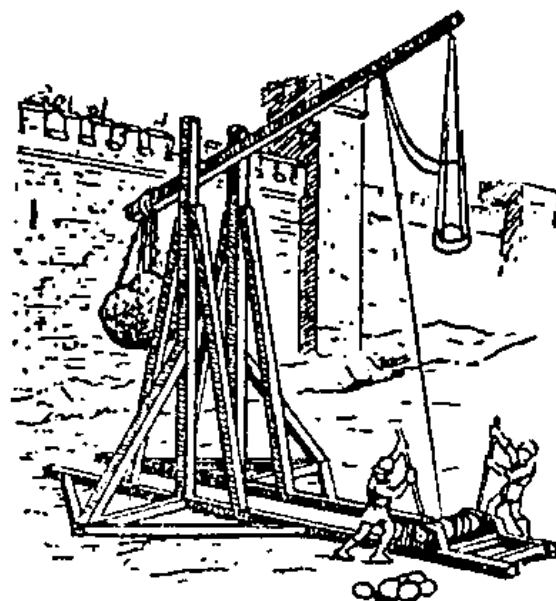
examples made by country blacksmiths and basement tinkerers. The classical mechanics necessary to analyze mechanical systems is now well known, and when one takes the trouble to do this there's no mystery at all why they don't turn forever, and no reason why they should.

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Simon Stevin's problem

| Simon Stevin (1548-1620) | Stevin's ball-ramp experiment, the "clootcrans" (chain of balls). |
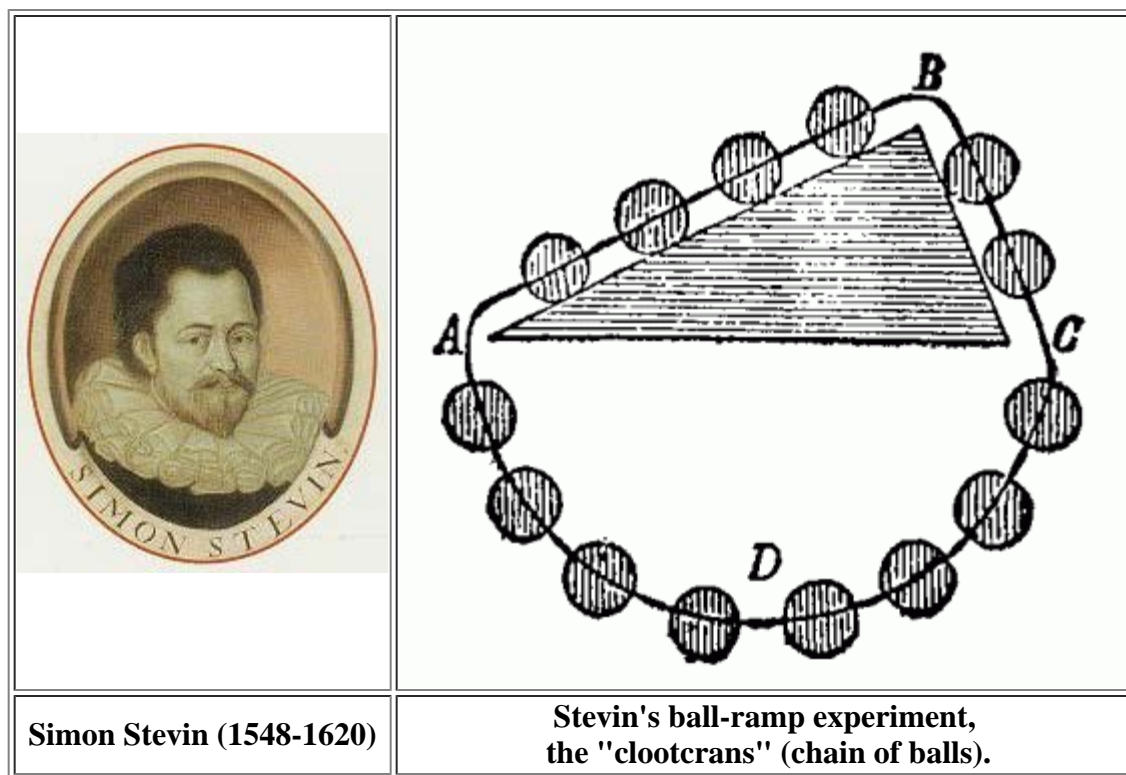
Flemish mathematician and engineer Simon Stevin (1548-1620) studied the principles of mechanisms and machines. He was a forceful critic of much of Aristotle's mechanics, his own studies were more in the Archimedian tradition.

One of Stevin's most acclaimed contributions to mechanics was his use of a chain of balls (clootcrans) on two inclined ramps as a means for developing a method of what we would today call the force parallelogram.

Stevin made use of this ball-chain in a creative way. He forthrightly asserted that any notion that the chain might move of its own accord was obviously absurd. He gives no reason for this, perhaps assuming that none was necessary. Perhaps underlying this was the fact that if the chain were to move a distance equal to the separation of the balls (in either direction), the new position would be identical to the previous one. In effect, no physical change had occured, therefore it won't happen without external influence. If so, this is an early use of what is today known as the "principle of virtual work", or sometimems "Stevin's principle."

Taking his starting point as the fact that the chain does not move perpetually, Stevin derived the

equivalent of the modern law of composition of forces. Stevin considered this to be so important that this picture of the ball-chain appears on the title page of Stevin's book on mechanics, as his "trademark".

Stevin's achievement was an early example of how one can carefully analyze a mechanical system to determine whether (and how) it works. Stevin accomplished this long before the vector methods of force analysis was understood, and before formulation of conservation of energy and the laws of thermodynamics. Stevin also adopted the useful tactic of analyzing mechanisms in the "ideal" case where friction is assumed absent.

Some books cite this as Stevin's proof of the impossibility of perpetual motion. That was not the case, for Stevin simply *assumed* the impossibility of perpetual motion, at least in this situation.

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More on Stevin's principle

Stevin's principle is useful for problems in equilibrium, and is mathematically equivalent to force analysis. In a mechanical system where things are free to move, will they? One way to find out is to mathematically analyze the sum of forces on each part of the system (and also do the same for torques). If they add to zero, the parts won't accelerate.

Stevin's principle allows us to do this in an alternate (yet equivalent) way. The method starts by imagining a "virtual displacement" of the system, then calculate the net work during this "virtual" motion. This is called the "virtual work". If the net virtual work is zero, the system is in equilibrium, and will not accelerate. In practice the analysis is usually carried out by imagining very small displacements.

[The virtual displacements need not be actual or even likely ones. For example, to calculate the tension force in a bridge girder, one may imagine the girder being broken or cut and the pieces that are allowed to move.]

This method is particularly useful for systems that are frictionless or nearly so. This is ideal for examining perpetual motion machine proposals. It's a Gedanken (thought) experiment, but when no working model of the machine is supplied, that's all we have to work with. We imagine the system to be frictionless (giving the inventor the advantage) then if we can show that even with this advantage the machine **still** can't work as claimed, we can consign the proposal to the Museum of Unworkable Devices.

Before we return to Stevin's problem of the double ramp and chain let's first consider the related problem of a double ramp of height z and ramp lengths x and y. Let's say that $x < y$. A weight A is on the x ramp and a weight B is on the z ramp. They are connected by a rope passing over a pulley at the top.

Reminder: Work is done on a body
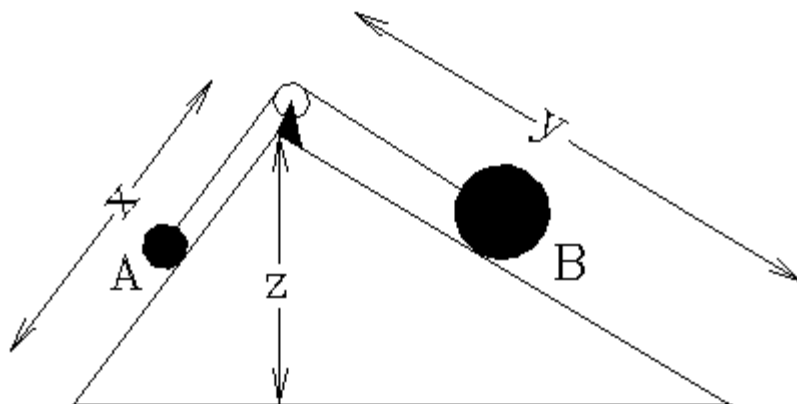
when it moves under the action of a force. Work is the product of the force component in the direction of motion and the distance the body moves.

Imagine a motion of *A* up the ramp length *x* that moves mass *A* a vertical distance *z*. This causes *B* to move the same distance *x* down its ramp, or a fraction *x/y* of the length of that ramp, and therefore a vertical distance *(x/y)z* down. We conclude that for equilibrium these weights and distances must satisfy $Ay = Bx$, or $A/B = x/y$.

Returning to Stevin's problem, using the same ramp, the portion of chain on ramp *x* has length *x*. The portion on *y* has length *y*. The weights of chain are in proportion to the lengths, so $A/B = x/y$ automatically satisfies the condition for equilibrium. Therefore the system will not move on its own initiative. The lower loop of chain obviously contributes nothing that would disturb equilibrium.

> **Be skeptical of any perpetual-motion proposal in which the assumed motion causes no change in the position of the center of mass of any part of the system.**

The principle of virtual work can be extended to torques, and in modern form is:

> *If the virtual work done by all external forces acting on a particle, a rigid body, or a system of connected rigid bodies with ideal (frictionless) connections and supports, is zero for all virtual displacements of the system, then the system is in equilibsrium.*

Let's not dismiss that lower loop so casually, for it **is** doing something very important here. During any virtual (imagined) motion, it is supplying new mass to the portion of chain lying on one side of the ramp exactly as fast as the portion of chain on the other side of the ramp loses mass. It is supplying momentum to one segment of chain at the same rate as momentum is lost from the other segment. This, however, does nothing to improve the PM machine's chances of working. It is a mechanism that keeps the ramp portion of the system unchanged over time, even during virtual motion. We will see this process at work (virtual work, of course) in many other perpetual machine proposals.

We may restate Stevin's principle in a form more directly applicable to devices claimed to be perpetual motion machines:

> *If an assumed (virtual) motion of the machine results in a final state of the system (the machine and its interactive environment) indistinguishable from its initial state, and zero net work is done on the system during this motion (no work in; no work out) then that assumed motion will not occur.*

Stevin's principle is a particularly appropriate first step in analyzing cyclic and wheel-type machines where a finite rotation of the wheel changes nothing but but its position. It is particularly useful when analyzing those machines for which the inventor's initial casual analysis (usually containing a flaw of physics or reasoning) leads us to think "That machine will surely turn." It immediately discredits the Honnecort wheel and also Stevin's original problem of the ball-chain on ramps. Most of the textbook examples of Stevin's principle show only cases where the initial and final states of the system are very obviously different (things are in different places). But the real power of the principle is that it can also be applied to cases where the final state "looks just like" the initial state.

For machines that have a "cyclic" behavior (most do) the analysis must be carried out over a complete cycle, for energy may be stored during part of a cycle and released during another part.

Refer back to the double ramp picture. If the chain is imagined to undergo a virtual motion carrying each ball to the position occupied by the next one, then the initial and final states are identical. Stevin's principle then says that the chain will not of itself undergo this motion.

[Top.](#)

Friction and idealizations.

> **Friction is never the only reason why a perpetual motion machine won't work. Remove the friction and it still won't work as the inventor intended.**

To assert that a device "Will not work **because** of friction" diverts our attention from far more fundamental flaws of the proposal. Friction is ever-present in nature. Yet, in analyzing PM proposals, it is useful to assume frictionless components, for in all non-trivial PM proposals, friction is never the sole problem. Remove all dissipative process such as friction, use idealized components, and at best the devices will be only our type (1). They cycle uselessly forever without additional input or output work.

Frictionless components do not violate fundamental macroscopic principles of physics. If removal of all dissipative processes results in a perpetual motion device of type (1), you know you've probably done the analysis correctly, making no blunders.

But other idealizations **do** violate fundamental **macroscopic** classical physics principles. Remember that we are speaking now of the macroscopic (large scale) physics processes, not those at the microscopic scale of atoms or smaller.

- Massless components that are capable of exerting forces on other components would violate Newton's second law.
- Components that exert forces without accompanying reaction forces would violate Newton's third law.
- Perfectly rigid bodies capable of exerting forces on other such bodies violate Newton's laws also. All matter can be compressed or stretched, giving rise to elastic forces. If bodies were perfectly rigid we'd have infinite forces acting for infinitesimal times. We cannot assume such things in the real world.

- A material macroscopic body cannot be observed in two places simultaneously.
- No information can travel between two separated points instantaneously. This is another reason why perfectly rigid bodies can't exist. If you pushed on one end of a perfectly rigid stick, the other end would move instantaneously. But that's not possible, for it would mean the other end received information about the push instantaneously.
- Mass cannot vanish from one place and time and reappear at another place and time.

Top.

Tapping quantum weirdness

Nature's prohibitions listed in the last section apply to macroscopic (large scale) physical objects. Is it possible that these can be violated on the microscopic (small scale) world of atoms and smaller entities? Certain currently popular speculative theoretical ideas suggest that.

> **Nature abhors macroscopic perpetual motion.** — D.E.S.

Nature does not prohibit perpetual motion. No laws of nature would be violated by something existing forever in a non-zero energy state. Presumably undisturbed atoms can do that. Whatever is "going on" within an atom continues undiminished forever if the atom is left undisturbed. What nature does seem to prohibit is a system that produces useful work in amount greater than its energy input.

In these pages I have indeed neglected current speculations in physics such as string theory, vacuum energy, black holes, wormholes, dark energy, dark matter, parallel universes, etc. I'm probably not sufficiently knowledgeable about these matters to discuss them effectively. I do note that many of these concepts are "virtual" entities that are part of the mathematical theory, but are not

> **The perpetual motion machines that seem to work best are those that turn out to be fraudulent.** — D.E.S.

directly observable. And when these do have observable (experimentally measurable) consequences, nature seems to prohibit them being converted to continuous output of useful work on a macroscopic scale. So our hopes of making a macroscopic perpetual motion device based on them is apparently futile. The more we learn about nature, the more evidence we accumulate that "Nature abhors macroscopic perpetual motion." A very interesting book discussing these matters is "How to Build a Time Machine" by Paul Davies. It is now out in paperback from Penguin Books at $13.00. The cover blurb says "A quick...lucid romp [through] wormholes, naked singularities, alternative universe, cosmic strings, exotic matter, negative energy, imaginary mass, gravitational time dilation, rising entropy and falling information" —San Francisco Chronicle. Davies' book concludes that nature does have taboos: "No time machines, no perpetual motion machines, no naked singularities! Etc."

Top.

What about "free energy"?

> **Shouldn't all perpetual motion machines come with a**

When analyzing PM proposals, one must watch out for "hidden" energy sources. If the chain of the Stevin machine consisted of interlinked cylindrical rollers, it might be made to move if there were a small battery and a motor within each cylinder. Many classic perpetual motion machine scams are done this way. But in this case, the initial and final states are not identical, for the state of the batteries changes as power is drawn from them. Some of the early fraudulent demos of PM machines may well have been driven by hidden internal stored energy, allowing a massive, well-balanced and low friction wheel to turn for a very long time before slowing perceptibly.

"Free-energy" enthusiasts claim that if a machine were tapping some invisible energy source that fills all of space, that energy would, like the hidden motors, keep the machine going, even though we could not detect the free energy source by any other experimental means. In effect, the machine itself would be the "free energy detector". They remind us that physicists once ridiculed the idea of energy stored in atoms. Yes, they did, as these quotes indicate.

> *There is no likelihood man can ever tap the power of the atom. The glib supposition of utilizing atomic energy when our coal has run out is a completely unscientific Utopian dream, a childish bug-a-boo. Nature has introduced a few fool-proof devices into the great majority of elements that constitute the bulk of the world, and they have no energy to give up in the process of disintegration.*
>
> *- Robert A. Millikan (1863-1953) [1928 speech to the Chemists' Club (New York)]*
>
> *...any one who expects a source of power from the transformation of these atoms is talking moonshine...*
>
> *- Ernest Rutherford (1871-1937) [1933]*

So, do the "free-energy" proponents have a valid point here? Are they justified in devoting their time to seeking a "free-energy" or "over-unity" systems? Should mainstream scientists take up such research to solve our energy problems? I think not. Scientists generally pursue something only when there's clear evidence pointing to a need for extending, clarifying or otherwise changing physical theory. So far, not one scrap of credible or even suggestive evidence for the existence of this "free-energy" has been seen. To return to the comparison with atomic energy, the initial skepticism of Millikan, Rutherford, and Einstein was well justified. But they changed their opinions as new evidence came in. Their initial skepticism did not in any way retard our progress toward discovery and utilization of atomic energy. My hunch is that if there is anything like "free-energy" anywhere in the universe, it will not be discovered by the kind of people now making wild and unfounded claims about it, nor by the methods they are using to try to tap it. It helps to have evidence for, and know something about, a source of energy before one attempts to figure out how to utilize it. All the ingenuity in the world can't extract energy from something that isn't there, has no energy to extract, or no way to convert it to useful work.

What about possible "accidental" discovery of free energy by some basement PM tinkerer? Weren't X-rays discovered accidentally, when no one even suspected their existence and certainly had no idea what they were? Yes, that's one of the (very few) examples of a truly accidental important discovery in physics. Quite a number of

Production of useful work is limited by the laws of thermodynamics, but the production of useless work

people stumbled on evidence for X-rays before Röntgen but failed to follow up with experiments to see what was going on. Anti-serendipity? But during that same period of history we have the interesting phenomena of other people "discovering" things that did **not** exist, such as N-rays, and later M-rays (mitogenetic radiation). So in which category will "free energy" fall, if and when someone claims to have found experimental evidence for it? Only time will tell.

seems to be unlimited.
—Donald Simanek

On the whole, scientific discoveries, even accidental ones, are most likely to be made, investigated, and exploited by folks who have a very good understanding of the relevant principles of existing science. Ignorance of well-established science causes many sincere and dedicated people to waste lives and careers chasing moonbeams. The sincere PM proposals of the past illustrate the fact that their inventors did not have sufficient understanding. Many of them believed that such understanding wasn't necessary, or they rejected it out of hand.

Top

Buoyancy motor #1

John Phin describes this one in his classic book *Seven Follies of Science* (Van Nostrand, 1906), attributing it to a correspondent named "Power".

> *A J-shaped tube A, Fig. 14, is open at both ends but tapers at the lower end, as shown. A well-greased cotton rope C passes over the wheel B and through the small opening of the tube with little or no friction, and also without leakage. The tube is then filled with water. The rope above the line WX balances over the pulley, and so does that below the line YZ. The rope in the tube between these lines is lifted by the water, while the rope on the other side of the pulley between these lines is pulled downward by gravity.*

Phin says that the "inventor offers this device as a kind of puzzle rather than as a sober attempt to solve the famous problem," and Phin concludes by asking why it will not work.

As usual, Phin misses the point (and the fun) of the challenge in his analysis of this puzzle. He trots out the usual lame dismissals such as bearing friction, work required to bend the rope, and friction of the rope at the water-seals, then, supposing the case is closed, moves on to something else.

I rephrase the challenge, and show a simpler picture.

To generator
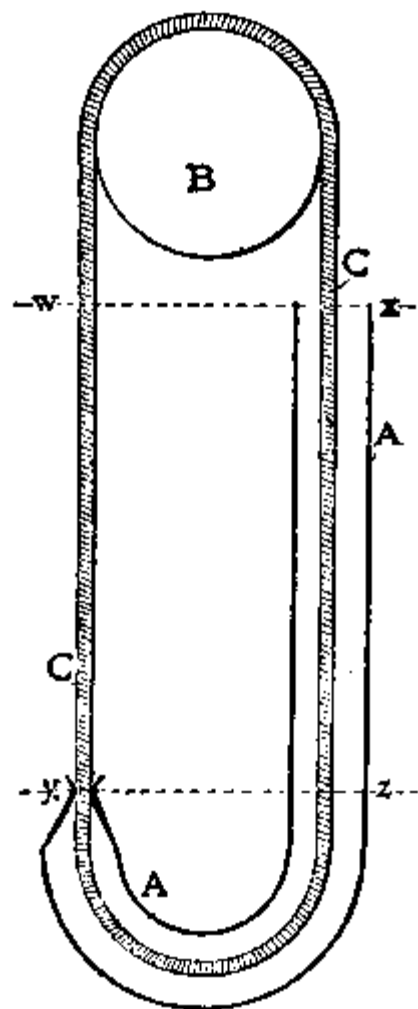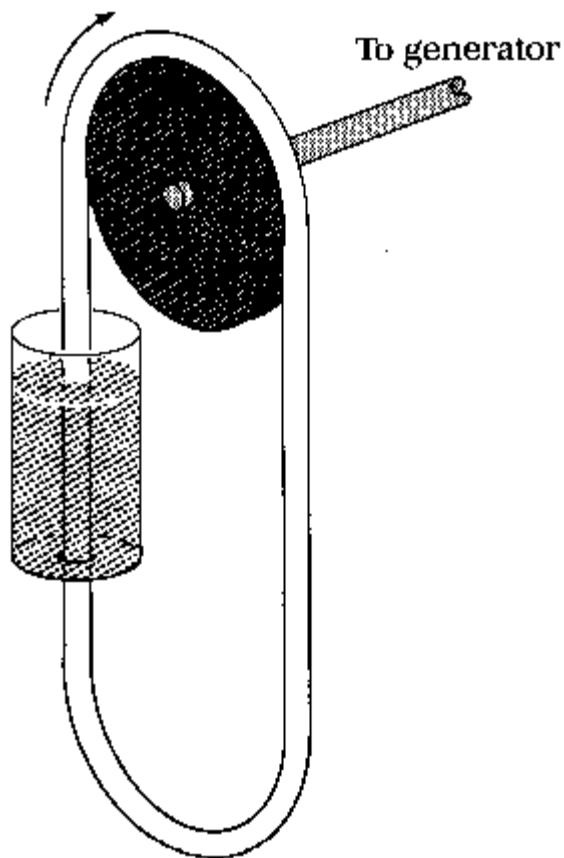
The smooth rope passes through a container of liquid, with an impermeable frictionless seal in the bottom.

I also set a ground rule to deflect irrelevant responses: Assume everything is perfect. No friction, leakless seals, perfectly flexible impermeable rope, no viscous drag between rope and liquid. Even with these ideal conditions we can easily and simply show that this machine will not work as claimed. Why did the inventor of this problem think it should seduce us into thinking it might work? It's his phrase "lifted by the water". He is, of course referring to the buoyant force of Archimedes' principle: "A body immersed in liquid experiences and upward buoyant force equal to the weight of the displaced liquid." This principle is found in every elementary physics textbook, but seldom understood by students. They use it blindly, not knowing why it is true nor under what conditions it is true, and they haven't paid attention to how it is derived.

The claim is that the upward buoyant force on the portion of the rope in the liquid causes the rope to move upward there.

This claim is false. Why?

Answer:

There is no buoyant force on the rope. This deception is a based on a common misunderstanding of Archimedes' principle. The principle requires that the submerged body have liquid beneath it so that the net force due to the liquid acting on the body has nonzero upward component. The principle also works if a body is totally immersed, with water above and below, or floating, with water only below. After all, what is the **source** of the buoyant force? It is the pressure difference between upper and lower surfaces. Consider a totally immersed cylinder with its axis vertical (very appropriate in this case). Pressure on the sides of the cylinder provides only horizontal forces that also add to zero, and more importantly, have no vertical components. Only forces due to pressure on top and bottom surfaces have vertical components. The pressure on the bottom is greater than that on top by amount r gh, where r is the liquid density. So there's a net upward force on the cylinder.

In this PM puzzle, there's no liquid above or below the rope capable of providing an upward component of force. All the forces on the rope due to the liquid are strictly horizontal, and because these forces are symmetrically distributed around the circumference of the rope, they add to zero.

An astute correspondent notes that my argument here lacks generality. He proposes a variant in which the rope passes through the liquid at an angle, say making an angle of 45° to the vertical. Now there **is** liquid above and below the rope. And if there's now a buoyant force on the rope, it surely has a upward component in the direction of the rope, and therefore this version of the machine should work. Why doesn't it?

Solution left as exercise for the student. The solution might require calculus. Here's a helpful hint. That Buoyant force mentioned in Archimedes' principle is not some new "magic" force that arises when a body is immersed. The buoyant force is a resultant (sum) of pressure forces acting on the immersed body. Archimedes' principle is merely an expression of a useful relation between the densities of the bodies involved, resulting from geometric laws and the fact that pressure exerts force normal to a surface.

[Top](#)

Buoyancy motor #2

Here's yet another PM machine claiming support in Archimedes' principle. Poor misunderstood Archie really takes a beating.

Claim:

A wheel in the form of a perfect sphere or cylinder rotates about a frictionless horizontal shaft. The left side is in a chamber filled with water, perfect (frictionless and leakproof) seals around the rotating wheel prevent the liquid from escaping. The left side of the wheel therefore experiences an upward buoyant force due to the liquid it displaces. So that side will rise, and the wheel rotates clockwise.
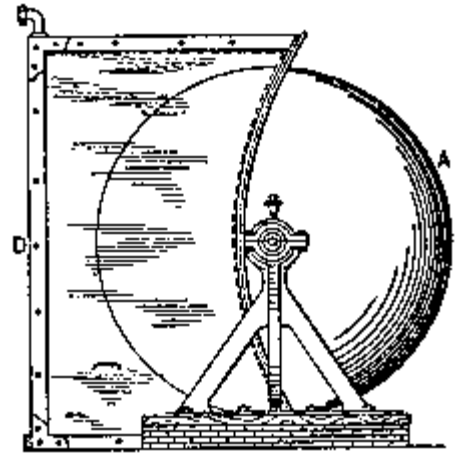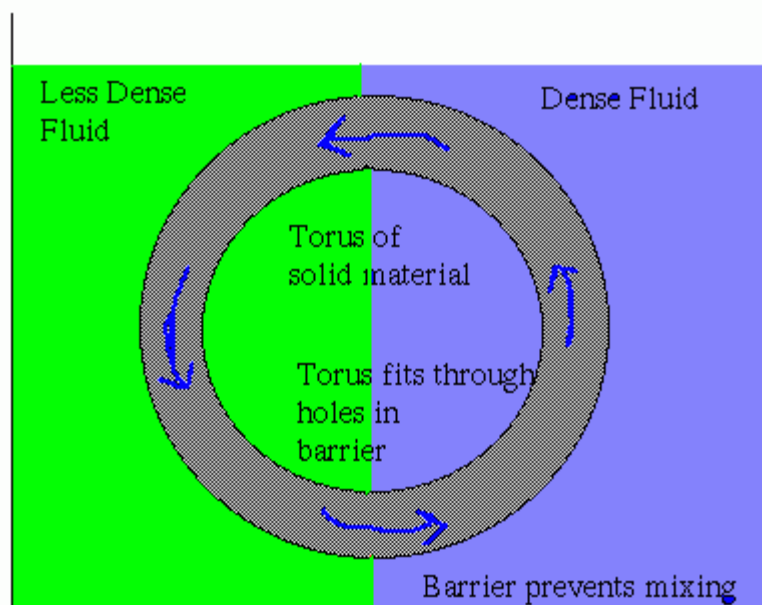
Answer:

All forces exerted by the liquid upon the circumference of the wheel are normal to the wheel's surface, and therefore pass through the wheel's rotation axis. All of these forces have zero lever arm with respect to this axis. The liquid therefore provides no torque about the wheel axis and the wheel won't turn.

Stevin's principle of virtual work demolishes this PM device neatly. We know the wheel will have no tendency to rotate because if we imagine a virtual displacement of the wheel through any angle, the system would still be just the way it was before, with no change in its energy and no change in configuration. No work is done in the process.

> **Be skeptical of any cyclic perpetual-motion proposal that can be operated equally well in either direction.**

Richard G. Clegg's [Perpetual Motion Page](#) has a clever variant of this buoyant motor. Instead of a wheel it has a torus (doughnut-shaped ring) passing through two seals separating two chambers having liquids of different density. There is no axle. One half of the ring is surrounded by liquid, inside and outside. The seals are of course frictionless and leakproof. There's no axle to provide reaction forces. Here the forces on the ring

Less Dense Fluid

Dense Fluid

Torus of solid material

Torus fits through holes in barrier

Barrier prevents mixing

due to pressure do have upward components. Why won't this one work? [Picture used with permission of Richard G. Clegg.]

Answer left as exercise for the student.

Top

Buoyancy motor #3

This perpetual motion machine probably dates from the mid 1800's. The main drum is filled with a liquid. In it are round chambers filled with air (or a vacuum) and connected by rods to the weights outside. The rods slide in frictionless leakproof seals, of course. As with many such proposed mechanisms, this picture is more complicated than necessary to illustrate the principle upon which it is supposed to work. The drawings below show just one weight and one air chamber immersed in liquid.
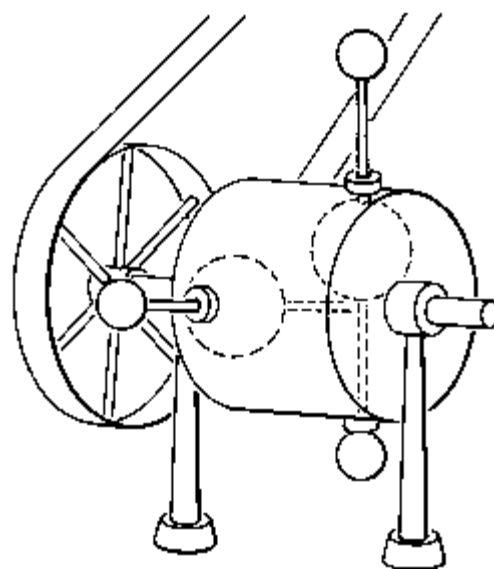
When in position 1, the buoyancy of the lower sphere is enough to lift the weight to its highest position. If the drum is now pushed so it moves counter clockwise, the weight stays at this large radial distance at least until it has rotated 90°.

1   2   3   4
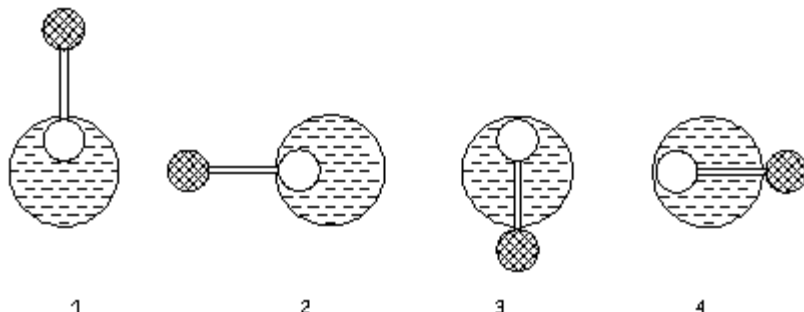
During the next quarter turn the weight has a large lever arm. At the end of this quarter turn, position 3,

the air chamber rises to the top of the drum, and the weight is now is at its smallest radial distance, (and smallest lever arm) where it stays for the next quarter turn. During the last quarter turn the air chamber's buoyancy causes the weight to rise until it is at its largest radius.

Since the torque during the second quarter turn is greater than during the third quarter turn, the wheel will gain more energy there than it needs to move upward during the fourth quarter-turn.

The principles that are supposed to make this thing work allow the machine to be started by a push in either direction, and it would work just as well clockwise as counterclockwise. That's a bit suspicious, isn't it? Also, if we imagine motion of this wheel through a full cycle, the final and initial states are indistinguishable, so Stevin's principle tells us that it won't turn. Yet we'd still like to analyze the details to see exactly where the inventor went astray.

We'll give you a grant to buy frictionless bearings, a liquid with zero viscosity, and leakproof frictionless seals for the movable rods. With all of this advantage, why will it **still** not work?

**Solution** by Ben Mitch.

Top

Buoyancy motor #4

Here's a new addition to our museum, contributed by Dave Carvell. This one has some innovative details to challenge your understanding of physics.

The sealed container has two vertical tubes. The right one contains a liquid (cyan) such as water, and a very light ball (red), much lighter than the liquid. As usual we'll let you use a liquid with zero viscosity. (We **are** generous about these details that don't matter anyway.)

Two "gates" G1 and G2 are made like iris diaphragms that can open and close quickly. They are, of course, watertight when closed.

Now we all know that when a light object, like a cork, is underwater, then released, it pops to the surface and can even pop above the surface. We take advantage of that fact. Our machine, with its viscosity-free liquid, should allow even greater speed at the top. The machine is started with the ball at the bottom. As it rises, a high-tech sensor quickly opens gate G1 to let it through, closing the gate immediately, and **then** opening gate G2 in time for the ball to pass through.
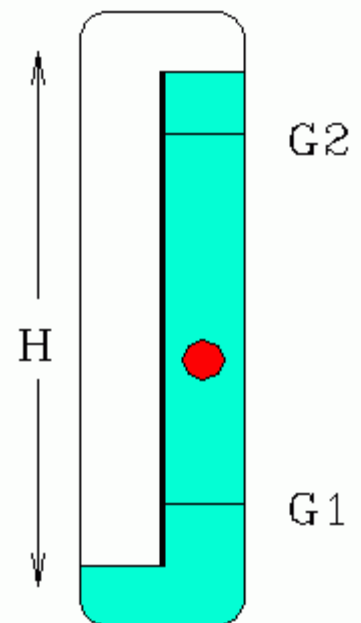
Since one of the gates is closed at all times the water levels are maintained.
The ball pops above the surface with some momentum, and the curved top of the apparatus deflects it to the other tube, where it falls, gaining speed and momentum in the fall, enough so that it goes under the liquid surface there and is bumped over into the right tube, where, of course, it begins to rise. This should

go on forever, gaining speed each cycle.

Surface tension and viscosity present real problems here. But before we go to the trouble to find a perfect fluid for this device, we should look for even more fundamental flaws.

Solution

Top

Capillary motor

Claim:

This is one of my favorite PM proposals for challenging student understanding. Most students know that liquids will rise in a very narrow tube, the process being called "capillary action". Suppose we have such a tube capable of lifting the liquid to a height h. Now lower the tube to a height less than h. Or make a hole in its side below the top of the liquid column. The liquid, trying to rise to height h will then spill out the top of the tube, where a very tiny waterwheel can capture its energy as it falls.
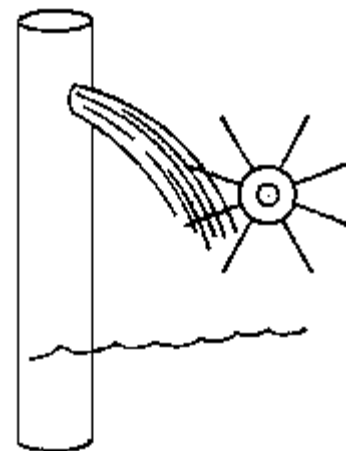
Answer:
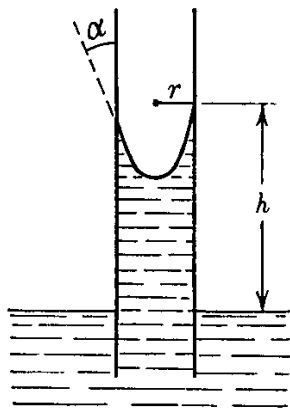
This is only likely to fool people who haven't considered **why** capillary action occurs. The usual textbook diagram is shown at the left. Surface tension acts at the liquid surface where it contacts the walls of the tube. These intermolecular forces between liquid and glass are greater than those between the liquid molecules themselves. This gives rise to a curved "meniscus" shape of the upper liquid surface. The forces around this interface act at an angle with a significant upward component that can hold the water column in static equilibrium.

The pressure of the water at the surface of the reservoir is atmospheric pressure, both outside and inside the capillary tube. This is due to Pascal's principle that the pressure at all points at a given height *within a liquid* is the same. Also, by the same principle, the pressure within the capillary tube, just below the meniscus, is *less* than atmospheric pressure by amount rgh. This accounts for the pressure difference across the meniscus which in turn accounts for its shape. The atmosphere is pushing down on the meniscus, but molecular adhesion forces around its edge oppose that. It acts like an elastic sheet restrained at its edges.

If one now gradually lowers the tube, the supported column of liquid remains the same length. The top of the tube moves down to meet the meniscus. Continue to lower the tube and finally the liquid column reaches the top of the tube. But, remember, the pressure just below the meniscus is still **lower** than atmospheric pressure, so the meniscus still bulges downward. It does not spill over the top of the tube. The liquid surface always contacts the upper rim of the tube, and as the tube is lowered even more, the

meniscus follows it down.

This picture shows situations you might have imagined possible. The version shown in the second figure, with a hole in the side, is easily discredited. The hole must be smaller than the tube diameter, so it, too will exhibit surface tension forces. The pressure just inside this hole is still lower than atmospheric pressure, so the water will bulge inward, not outward, and no liquid will pass through it.

Pressure increases downward in a liquid, by the law r *gh* where r is the liquid density. The pressure at the liquid surface outside the capillary tube is atmospheric. So the pressure within the tube must decrease with height up to the meniscus. It's the pressure difference across the meniscus that is responsible for its curved shape. The second figure depicts an outcome that just can't happen.
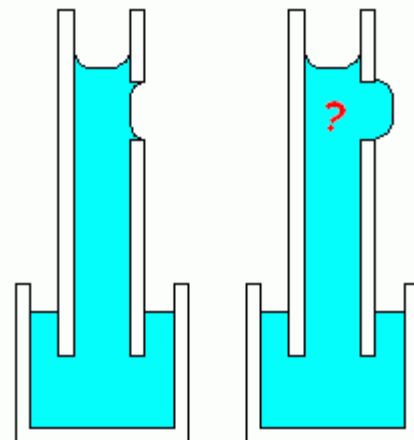
Top

Capillary wheels

Claim:

This idea appeared in the correspondence column of the April 22, 1911 issue of **Scientific American**. The editor invited readers to "search out the fallacy of this ingenious device."

Imagine two very carefully machined wheels with parallel axes on frictionless bearings. They are partly immersed in a liquid. There's a **very** narrow space between the flat portions of the wheels, causing liquid to be drawn up between, by capillary action. The weight of this sheet of liquid exerts downward forces on both wheels; therefore they should rotate in opposite directions as shown by the arrows. Since the force is small, the speed will be low also, giving the capillary column plenty of time to rise to compensate for this motion, maintaining a steady height.
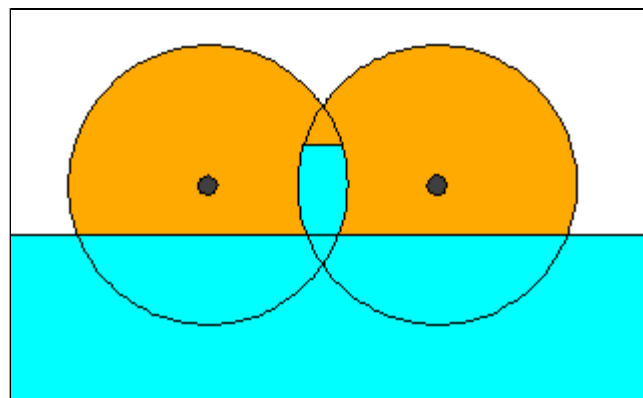
As usual, ignore friction and viscosity. The column of liquid is certainly being supported by an upward force provided by the wheels. Newton's third law requires that the column of liquid exerts a downward force on the wheels. This surely provides a torque on both wheels. So why don't they move?

Another version, using pulleys and belts is shown at the left. The principle is the same, so we expect this to work just as well as the wheel version.

This is another case where indistinguishable initial and final states and Stevin's principle
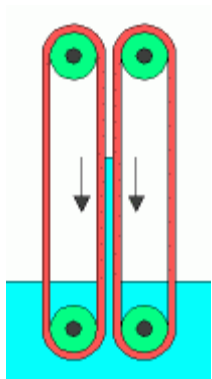
should have aborted this project at the conceptual stage.

Answer and discussion.

Top

George Sinclair's siphon.

This curious device appears in a 1669 book on pneumatics (in Latin) by philosophy professor George Sinclair of Glasgow University. Dircks mentions it in his 1870 book **Perpetuum Mobile** (p. 42) from which we took this picture.

Apparently the upper bulb has reduced pressure of air within it, sustaining the liquid drawn up from the dish. One end of a siphon transfers liquid from this bulb up through the bent rod and back to the dish. This loss of liquid from the bulb is replaced by more liquid drawn from the dish, due to the low air pressure in the bulb. Result: an endless circulation of liquid. A little water wheel might be run by the water exiting from the siphon into the dish. Well, maybe not.

Sinclair must have thought this device pretty neat, for he devoted 18 pages to discussion of its merits. You, dear reader, should easily demolish it in a few paragraphs.
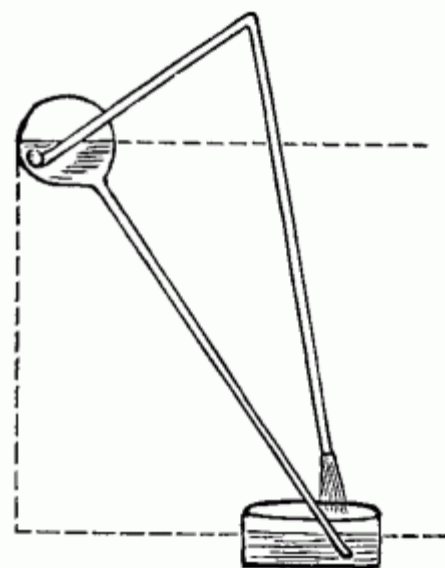
Answer and discussion.

Top

# Bob Schadewald's gravity engine.

Artist's conception of the gravity engine power station. The engine is an overbalanced

wheel or off-axis weight with (of course) frictionless bearings. Based on the assumption that the universal gravitational constant is continually decreasing this engine exploits the small energy that can be gained from this during each revolution. In keeping with the philosophy of the engine itself, power is transferred to the electric generator by a linkage of devious pulleys and belts.
[Drawing © 1992 by Donald E. Simanek.]
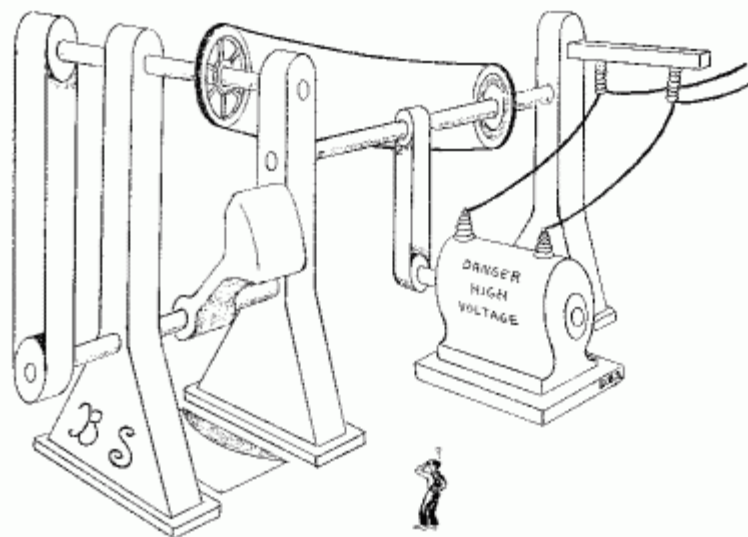
First, let's be very clear that Bob's BS Gravity Engine is a parody, a joke. His intent was to tease, and amuse, and to tweak physicists and engineers whose understanding of physics was shaky. It was a challenge to readers to show conclusively whether or not it could work, given the "decreasing gravity" assumption. He was careful never to fully answer that question or to explain the joke.

The suggestion that the universal gravitational constant might be declining came out of speculative theoretical work of Paul A. M. Dirac. In 1937 he suggested that the universal gravitational constant G might be weakening, proportional to the age of the universe. He even predicted that in 10 billion years it might be only half what it is today. Since then the notion that fundamental constants, including the speed of light, might change over time has fascinated speculative theorists. It has also fascinated new-age wackos, who shamelessly adapt and pervert the idea to fit their own agendas.
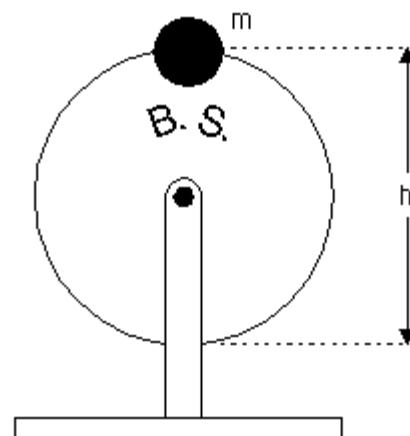
Obviously the BS engine falls into my class (2) and possibly (4).

Stevin's principle does not kill this proposal, for the initial and final states of the system (including its environment) after each cycle are not identical. This wheel would operate equally well in either direction, however, that is always suspicious.

Scott Morris discussed some PM machines in OMNI magazine in 1990 (July, p. 98 and 99; August p. ?), and quotes Bob Schadewald as saying "My description is a subtle deception. The velocity of the moving weight will never exceed what it was when it passed the bottom, dead center, the first time, even if there is no friction. The weight may pick up speed at the top, but never at the bottom, so there is never any real speedup in the wheel."

How does Bob arrive at that conclusion? Can this unexpected result be justified by elementary physics? And why does Bob say that "the weight **may** pick up speed at the top, but never at the bottom"?

Answer and discussion.

Simanek's bouncing ball engine

This PM proposal works just as well at Bob Schadewald's Gravity Engine (SGE) and it may be easier to analyze. Doing so might shed some light on the principles behind the SGE.

Bob cast his SGE in the form of a wheel. This introduces the feature of rotation that is a "red herring" for some people. They think that the paradox somehow depends on rotation or requires consideration of centrifugal effects. It doesn't, as this non-rotating bouncing ball engine illustrates.
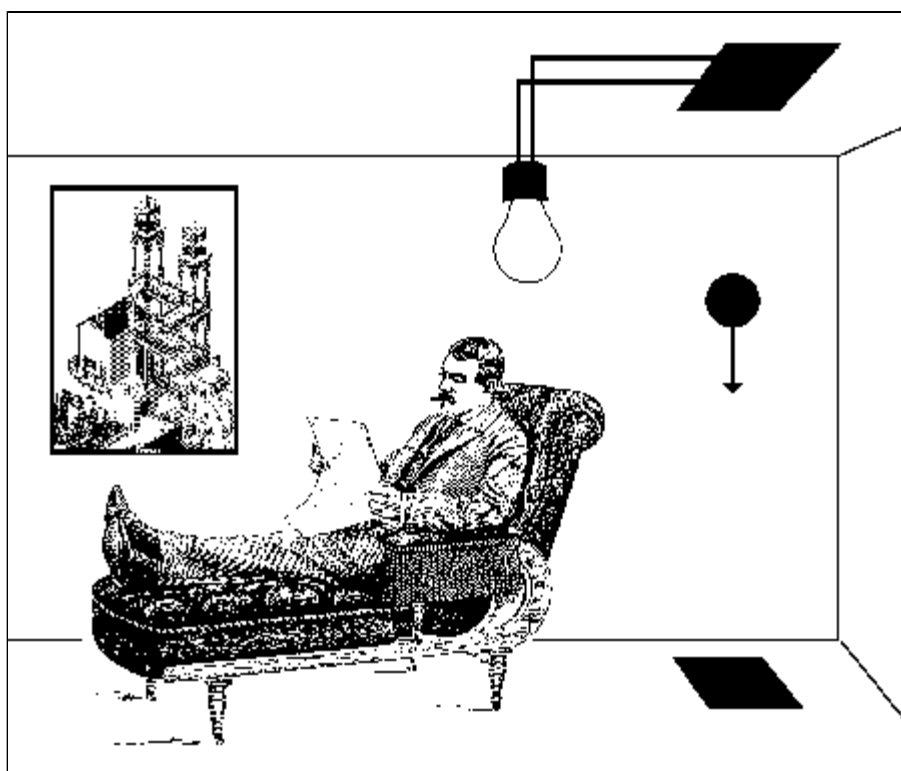
**Inventor reads by light powered by
electricity provided by the ceiling transducer of
a bouncing ball engine. He's wearing earplugs.**

A ball bounces up and down between floor and ceiling, both rigid and massive. The bounces are assumed elastic, that is the ball's velocity after impact is the same as before impact, but with reversed direction.

Now imagine that the gravitational constant g is slowly but steadily decreasing. The ball is released at rest from the ceiling. The ball attains a certain speed when it reaches the floor, and rebounds with that same speed. But since g is now smaller, the ball still has a small velocity when it hits the ceiling. Clearly this means that on completion of this ceiling-to-floor-to-ceiling cycle it has gained a small amount of kinetic energy, which we could extract with a slightly inelastic ceiling panel. The panel would steal just

that extra amount of energy, bringing the ball to rest there momentarily. The ball would then start the next cycle with zero speed, as in the previous cycle. The gravitational force, though slightly smaller than before, would cause the ball to fall to the floor and bounce back to the ceiling, where we again steal the excess energy gained in this cycle, and so on forever, or until gravity runs out, whichever comes first.

The assumptions of perfectly elastic impact and infinite mass floor are no more unreasonable in posing this apparent paradox than the assumption of frictionless bearings in the wheel. Given these assumptions we still ought to be able to analyze the machine and show whether it could work as claimed.

Answer and discussion.
Top

The Gravity shield engine

Claim:

This proposal is at least a century old. Classic simplicity! A wheel has a frictionless axle. Now just insert a gravity shield under one side, making that side lighter and this will initiate and maintain rotation. Indeed, you'd better extract energy from it continually, or put a brake on it, or it will spin so fast it will tear itself apart.

I've often seen this without reference to its inventor. If anyone knows who the inventor is, please let me know. Nicola Tesla described it, in his article **"The Problem of Increasing Human Energy"** in *Century Illustrated Magazine*, June 1900.
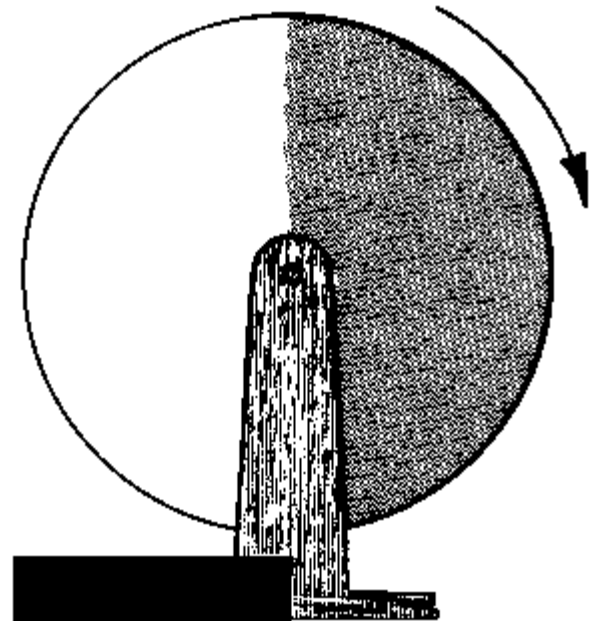
> It is possible, and even probable, that there will be, in time, other resources of energy opened up, of which we have no knowledge now. We may even find ways of applying forces such as magnetism or gravity for driving machinery without using any other means. Such realizations, though highly improbable, are not impossible. An example will best convey an idea of what we can hope to attain and what we can never attain. Imagine a disk of some homogeneous material turned perfectly true and arranged to turn in frictionless bearings on a horizontal shaft above the ground. This disk, being under the above conditions perfectly balanced, would rest in any position. Now, it is possible that we may learn how to make such a disk rotate continuously and perform work by the force of gravity without any further effort on our part; but it is perfectly impossible for the disk to turn and to do work without any force from the outside. If it could do so, it would be what is designated scientifically as a "perpetuum mobile," a machine creating its own motive power. To make the disk rotate by the force of gravity we have only to invent a screen against this force. By such a screen we could prevent this force from acting on one half of the disk, and the rotation of the latter would follow. At least, we cannot deny such a possibility until we know exactly the

nature of the force of gravity. Suppose that this force were due to a movement comparable to that of a stream of air passing from above toward the center of the earth. The effect of such a stream upon both halves of the disk would be equal, and the latter would not rotate ordinarily; but if one half should be guarded by a plate arresting the movement, then it would turn.

Critics will be quick to observe that if one imagines a virtual rotation through a small angle, the wheel is physically the same as before. The small portion at the bottom that was in the gravitational field becomes weightless over the gravity shield, but at the same time an equal segment of the wheel moves from weightless condition back into the gravitational field. They therefore argue that nothing has changed, and there is no reason there should be such motion. This is a nice application of Stevin's principle of virtual work.

The unknown inventor might argue thusly: *Remove the gravity shield. Imagine an equivalent: a half-wheel. It would rotate under the action of gravity and then continue to swing like a pendulum. You can hardly deny that if one half of the wheel suddenly had no gravitational force upon it, the other half would move due to the unbalanced torque.*

This suggests a better design. *Don't use a wheel. Use an unbalanced weight as in the SGE (see previous item). Start the machine with the weight at the top of its range. Give it a slight nudge toward the unshielded side, and it will fall, gaining kinetic energy. This kinetic energy at the bottom remains unchanged during its upward motion over the shield, and is still there when the weight reaches the top, carrying it into the unshielded side where it picks up still more energy, and so on forever.* What prevents that?

There's always the possibility that you may assume some part of the machine that is itself physically impossible. If one too readily grants its possibility, much time can be wasted analyzing the other parts of the machine. Here the suspect part is the gravity shield. Can we simply and conclusively show that a gravity shield is or is not possible? Can we show that its very existence would violate some fundamental law?
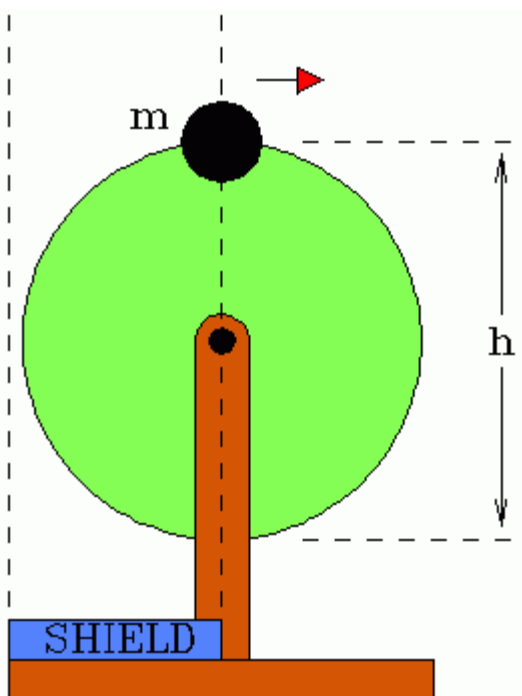
This puzzle doesn't require a perfect shield. A shield that reduces the gravitational force by only a few percent would seem to meet the requirements of a perpetual motion machine. We need to show, by simple physics that (1) the very existence of such a shield would violate fundamental laws of physics, or (2) even with such a shield, the wheel would not turn perpetually and would not gain speed or (3) some fundamental law of physics is wrong, and so is Stevin's principle and the laws of thermodynamics.

The rationale for this wheel says that it will only gain speed in one direction. If turned in the other direction it would lose speed. This may be a clue. Stevin's principle demolishes the version with a uniform wheel, for the initial and final states of the system and environment are identical for any virtual displacement of the wheel. Therefore the wheel cannot move on its own. So why did we mistakenly think that it **should** turn by itself? Stevin's principle also discredits the eccentric weight version, for a virtual displacement of one revolution returns the wheel an identical state. But that doesn't help us understand

what's going on during each cycle.

[Discussion and answer.](#)

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The Classic magnetic shield engine

A reader informs us that a device of this sort was given as an extra credit homework problem by an MIT professor back in 1985. Chris Cheng, a high school student from Sydney, Australia, sent us a simple version, from which this one evolved through a process of tinkering.

How it's supposed to work.

Magnetic shielding materials are available. They aren't perfect shields, but for the purposes of this motor they don't need to be perfect.

A freely rotatable armature in the center consists of a permanent magnet partly covered with a magnetic shield (solid black). The shield has openings at the right, near the poles. An outer ring has magnets in a radial array with their north poles inside, firmly fastened to a rigid frame. These magnets are long, so the south poles are at a considerably greater radius than the north poles. The magnetic field from a magnet pole decreases in strength with distance.
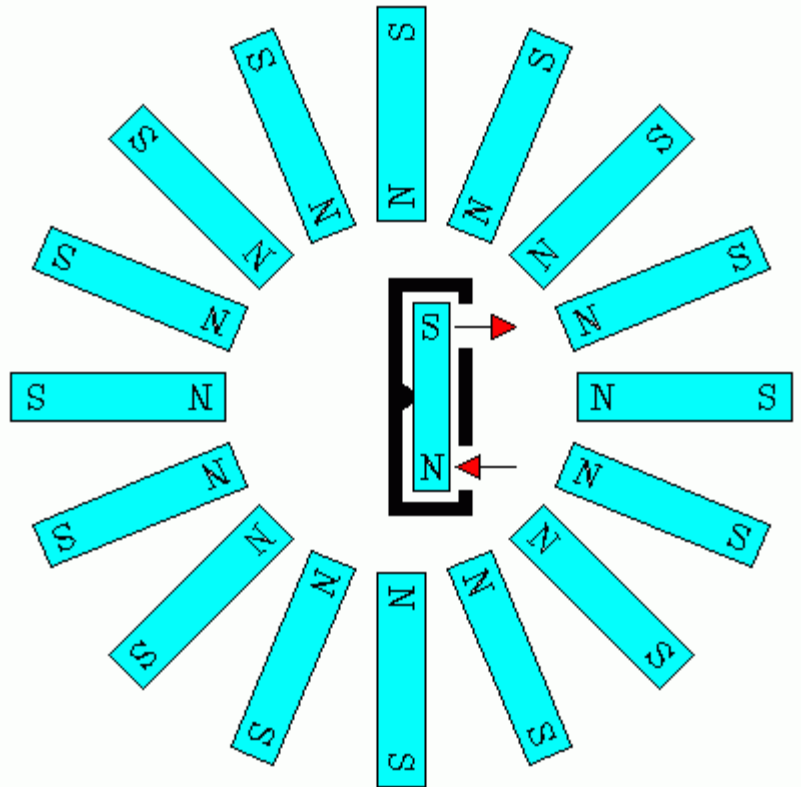
The shield apertures permit each armature pole to "see" only a couple of the magnets of the outer ring. Each armature pole is affected primarily by the north poles of the ring, those being nearest. Therefore, in the position shown in the picture, the N pole of the armature is repelled, experiencing a force to the left. The S pole of the armature is attracted, experiencing a force to the right. These two forces make a couple, which rotates the armature clockwise.

Classic simplicity! If you wanted to improve it, those outer magnets could be swung up or down so they were in a cylindrical array of magnets with their axes parallel. Then a similar armature could be placed in the plane of the S poles, operating on the same axle as the armature in the plane of the N poles. This should double the power output!

We caution the reader that this machine has details that could be subtle and difficult to analyze in detail. Gauss's and Stokes' laws in vector calculus form may be required for a full analysis. However, this machine has a simple and fundamental flaw that can be appreciated even at the introductory physics

level.

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Re: Answers left as exercise for the student. Send your answers to the address shown at the right. The earliest good answer(s) that

arrive may be posted here, with credit to author. I will post (at my discretion) answers that are simple to explain, clear, correct, perceptive, and that stimulate thinking and further discussion. Posted answers, whether written by me or by others, do not always represent the final word on a given proposal. On several occasions perceptive readers have noticed things we missed, or suggested simpler ways to explain something. So don't hesitate to skeptically rethink given "answers".

While I welcome submission of new or innovative perpetual motion puzzles, I assume no obligation to respond in detail to all of them. In particular, I cannot be expected to analyze vague proposals, overly and unnecessarily complicated designs, nor ideas that are simply variations of classics found in the literature. I've already received proposals that fail for the same reasons already discussed above, indicating that the person proposing the idea hadn't fully understood this document. Also, I choose not to include devices that would **require** advanced mathematics or physics for detailed analysis. I don't like to post puzzles unless I am reasonably confident what the flaw is, and that the flaw can be explained using elementary physics principles.

To those inventors whose creations I choose not to include in the museum collection, I offer this comment and consolation:
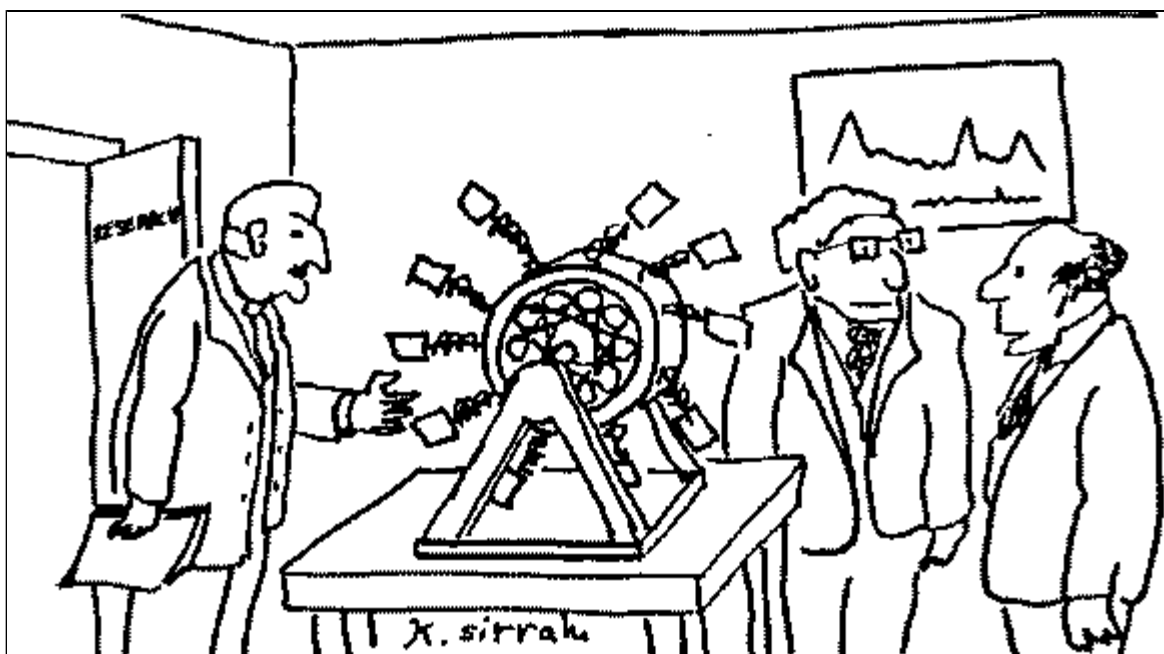
"It may be perpetual motion, but it will take forever to test it."
Cartoon by Donald Simanek.

Links

- [Hans-Peter Gramatke](#) has an excellent site (in German) covering everything you ever wanted to know about Perpetual Motion Machines. He also has a large portion of it in an [English](#) version. Hans-Peter has been an invaluable source of information to me while expanding my site.

- Kevin Kilty's [Perpetual Motion](#) web page has some nice pictures and explanations. Kevin has been most helpful to me in discussions of the finer points of PMM.

- [Eric's history of Perpetual Motion and Free energy Machines.](#) Many other useful links are on this page.

- Bob Jenkins' [Perpetual Motion Machines](#) briefly describes some PMM not found elsewhere on the internet.

- ["PERPETUAL MOTION" SEEKERS. THEIR FASCINATING BUT HOPELESS PURSUIT. With Illustrations of Machines that have been Invented Recently. Harmsworth's Magazine - September 1898](#)

Bibliography

When I first compiled this bibliography, most of these references were rare, hard to find books. I was fortunate to have copies of them. Now [2012] many of them are available as free ebooks. Others may be had in very inexpensive reprint editions. There's now no excuse for any hopeful perpetual motion machine inventor to be ignorant of the long history of this subject.

1. Angrist, Stanley W. "Perpetual Motion Machines" in *Scientific American*, Jan 1968. This article is also in a Sci. Amer. reprint book.

2. Angrist, Stanley W. and Loren G. Hepler. *Order and Chaos*. Basic Books, 1967. [QC311.A5]

3. Dircks, Henry. (1806-1873) [Perpetuum Mobile, or the search for self-motive power during the 17th 18th and 19th centuries](#). London, E. & F. Spon, 16 Bucklersbury, 1861. Rogers and Hall Co., 1916.

4. Dircks, Henry. (1806-1873) [Perpetuum Mobile, or the history of the search for self-motive power from the 13th to the 19th century](#). London, E. & F. Spon, 48 Charing Cross, 1870.

5. Dircks, Henry. (1806-1873) [Scientific Studies or Practical, in Contrast With Chimerical Pursuits, Exemplified in Two Popular Lectures](#). I. The Life of Edward Somerset, Second Marquis of

Worcester, Inventor of the Steam Engine. II. Chimeras of Science: Astrology, Alchemy, Squaring the Circle, Perpetuum Mobile, Etc. London, E. & F. N. Spon, 48 Charing Cross, S. W. 1869.

6. Gardner, Martin [Fads and Fallacies in the Name of Science.](#) Dover, 1952, 1957. This is a classic. This book has no chapter on perpetual motion, but Gardner's comments on the psychology of pseudoscientists and cranks applies equally well to many perpetual motionists. See the next reference for his comments on perpetual motion.

7. Gardner, Martin. *Perpetual Motion: Illusion and Reality*, Foote Prints, (house magazine of Foote Mineral Co., Exton, Pennsylvania.) Vol. 47, No. 2, 1984, p. 21-35.

8. Herring, Daniel Webster, Ph.D (1850-1938) [Foibles and Fallacies of Science](#). Van Nostrand, 1924.

9. Hiscox, Gardner D., M.E. *Mechanical Appliances and Novelties of Construction.* Normal W. Henley Publ. Co., 1927. [Chapter23](#), available online, is a marvelous resource of about 60 failed mechanical devices, with pictures. Inventors' names, dates, and patent numbers are usually not given, nor does this source give reasons why the devices don't work. Hiscox's preamble suggests that scientific opinion is divided on the possibility of perpetual motion. But his description of many of these devices reveals that he has no doubt about their impossibility, and he seems to be saying "Of course you can see why these obviously won't work, so I don't need to spell it out." Alas, that is not at all obvious to many inventors, even today, who peddle minor variations of these old and discredited ideas, fully confident that they **must** work. If you have just invented a seemingly marvelous perpetual motion machine, you'd better look here to see whether it has been done before. If it has, you can be sure it doesn't work.

10. Jastrow, Joseph. *The Story of Human Error*. D. Appleton- Century Company, 1936. Chapter on "Error in Physics," by W. F. G. Swann. Books for Libraries.

11. Moore, Clara Bloomfield. [Keely and His Discoveries](#). (Reprint ed with foreword by Leslie Shepard, University Books, 1972?. Original edition, 1893(?).) Mrs. Moore was one of Keely's most faithful supporters. Keely's explanations of his theories were incomprehensible even to those sympathetic to his work, and this book provides many examples of this.

12. Ord-Hume, Arthur W. J. G. *Perpetual Motion*. St Martins, 1978. Ord-Hume is an engineer, and has written extensively on antique clocks and other mechanisms. But his cavalier "refutations" of many of the perpetual motion machines are trivial and misleading. Some parts, particularly chapter 6, are difficult to follow. But, the book has the virtue of still being in print, in paperback, and as a historical survey of the subject it is well worth owning. However, the drawings in the Barnes and Noble reprint edition are not nearly so clear.

13. Phin, John. [The Seven Follies of Science](#). D. Van Nostrand, 1906. The line drawings are very clearly reproduced. The explanations often miss the mark.

14. Scientific American, 1884, has references to J. W. Keely, generally derogatory and even sarcastic. March 19, p. 196. April 5, p. 213. Oct 11, p. 230.

15. Verance, Percy (Pseudonym!). [Perpetual Motion](#). 20th Century Enlightenment Specialty Co., 1916.

This is an reworking and condensation of material from Dircks' books, "for the general reader", and has many of the original illustrations. It is apparently a Rosicrucian publication, part of a series called: *History, Explanation and Prophecy Illustrated*. Warning: The clever pseudonym has been appropriated by several people recently, who have no connection with the anonymous author of this book.

Some textbooks mention perpetual motion machines, or pose problems about them.

1. Gettys, W. Edward, Keller and Skove. *Classical and Modern Physics*, McGraw-Hill, 1989. End of chapter problems about the Escher "Waterfall" (p. 347), buoyant force paradox (p. 348), and the weighted piston device (p. 348).

2. Hudson, Alvin and Rex Nelson. *University Physics*, Harcourt Brace Jovanovich, Inc. 1982. Section 21.7 discusses perpetual motion devices, with pictures of an overbalanced wheel, a buoyancy motor, the 1618 closed-cycle mill, the ammonia engine, and a picture of the Escher waterfall, all on p. 511.

3. O'Hanian, Hans C. *Physics*, W. W. Norton, 1985. Short description of the two kinds of perpetual motion machines, with a drawing of the articulated-hammer overbalanced wheel (p. 508).

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