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The Greek engineer who invented the steam engine 2,000 years ago

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Alasdair Wilkins

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Almost two millennia before the rest of humanity entered the industrial age, the Greek inventor Hero invented the steam engine, wind-powered machinery, and theories of light that couldn't be improved for centuries. And then he invented some
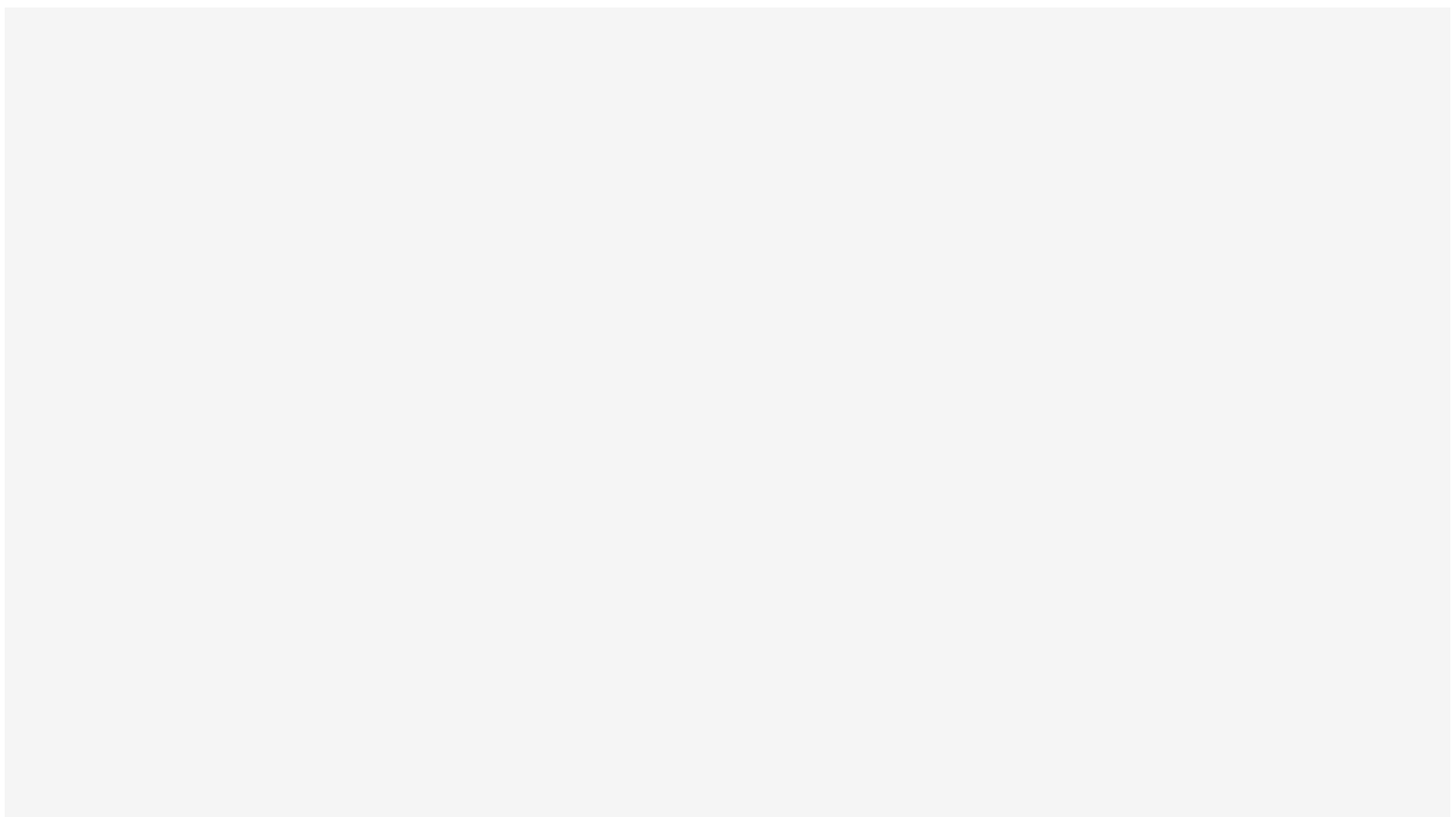
really crazy stuff.

Scientific geniuses have to pull off a tricky balancing act before they're even born. Great minds like Albert Einstein or Isaac Newton were born at precisely the right time for their ideas to be really revolutionary - just far enough ahead of their time to be trailblazers, but not so far ahead that people had no idea what they were talking about.

Hero of Alexandria

Hero, or Heron, of Alexandria, on the other hand, had the astonishing bad taste to be born around 10 CE, which made his inventions so far ahead of their time that they could be of little practical use and, in time, were forgotten. If he had been born in, say, 1710, his engineering prowess and incredible creativity might have made him the richest person in the world. As it is, he'll just have to settle for the posthumous reputation of being the greatest inventor in human history. Seriously, unless you invent a warp drive tomorrow, there's no way you're catching up to Hero.

We know precious little about where Hero came from, and it's only in the last century that we actually became certain which *century* he lived in. The best guess is that he was an ethnic Greek born in Egypt in the early decades of the first century CE, one of the many people whose ancestors had emigrated from Greece after the conquests of Alexander the Great.

Hero probably taught at the Musaeum at Alexandria, an institution founded by the Greek rulers of Egypt - you can see an artist's conception of it above. The Musaeum was unlike anywhere else in the ancient Mediterranean, a gathering place for scholars and the sciences that would remain unique until the rise of universities centuries later.

Hero's Steam Engine

But still, Hero doesn't really need a lengthy biography to explain why he's important - his inventions and theories do that quite well. His most famous achievement was a

primitive steam engine, which was known as the aeolipile. Others before Hero had mentioned aeolipiles, but he was the first to actually describe in any sort of detail how to make one, and it's unclear whether his predecessors had actually been talking about the same device anyway.
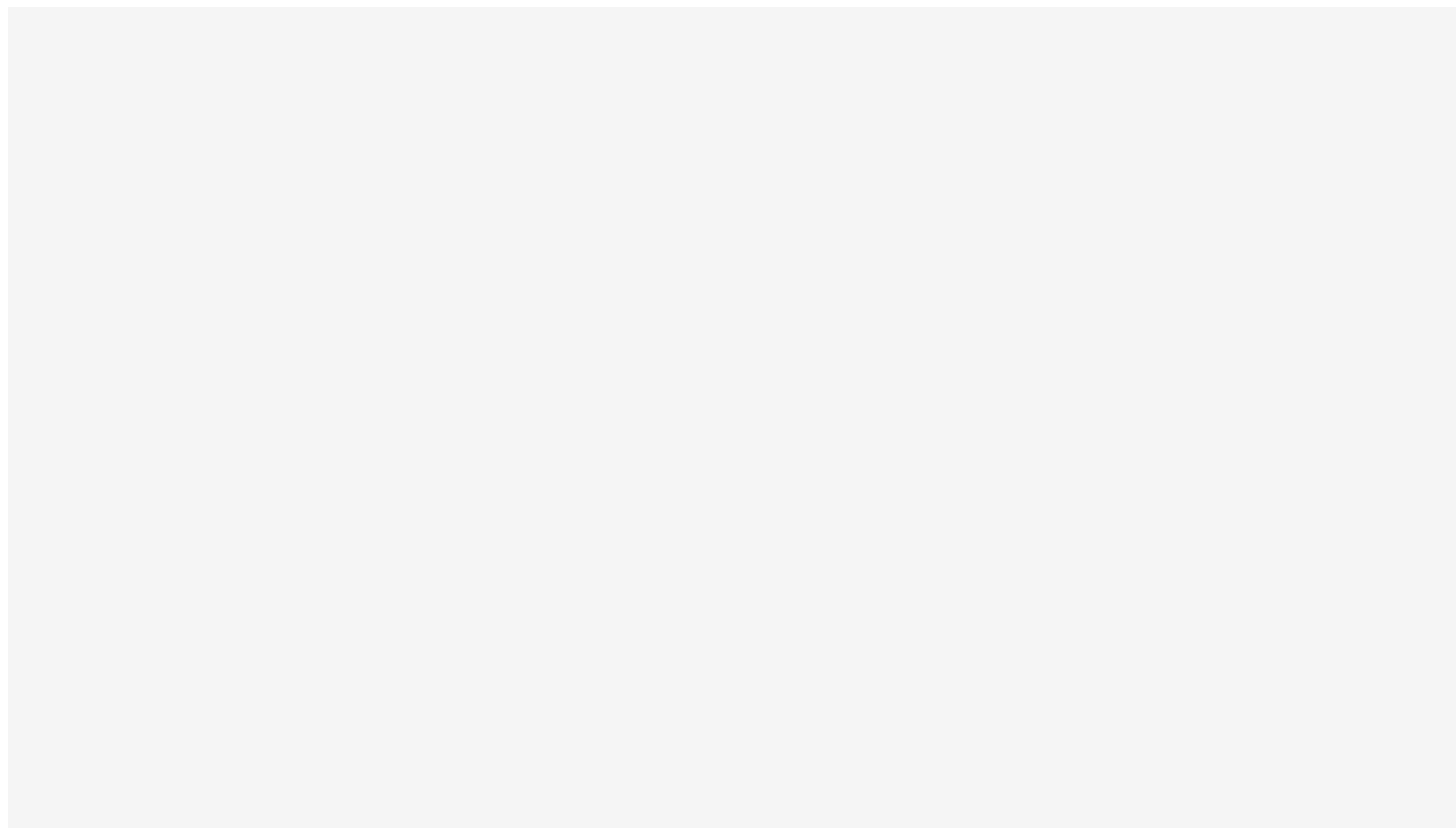
Here's how an aeolipile works. A sphere is positioned so that it will rotate on its axis, and curved nozzles are placed on either side perpendicular to that axis. Water is then heated, either inside the sphere or in a boiler underneath. As the water heats up, steam is emitted out of the nozzles, which creates force and torque that, in turn, makes the sphere start accelerating until friction and aerodynamic drag are strong

enough to bring the sphere to a steady rotating speed. You can see a video of the aeolipile in action below:

The Ancient Railroad

Now, Hero's aeolipile was more a interesting curio than an actual machine that

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could be used to do work, but we need to keep in mind just how far ahead of its time this machine was. Once Hero's aeolipile was forgotten, we don't know of any other person inventing a steam engine until the Ottoman inventor and all-around genius Taqi al-Din in 1577 - and he was considered the greatest scientist on Earth by his contemporaries. So if Taqi al-Din was the greatest mind of his time, what does it say about the man who invented basically the same thing 1,500 years before he did?

And, though the aeolipile wasn't built to do useful work, it's worth remembering that there was no work it could actually do. There wasn't any real use for a steam engine in the pre-industrial world of ancient Alexandria. Although, across the Mediterranean, there actually *was* something that would have been perfect for a steam engine: a railway.
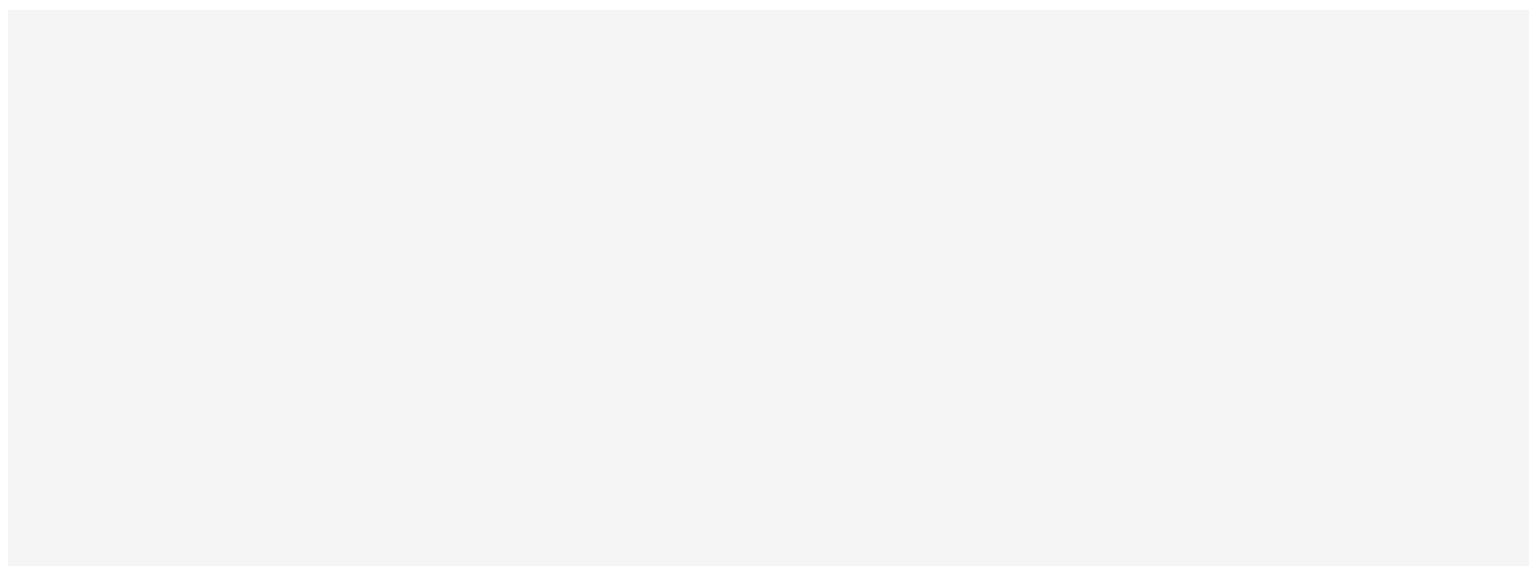
Yes, the ancient world had a number of rudimentary railways. Of course, trains didn't run on them, but these ancient trackways had grooved paths along which vehicles were pulled, likely by some combination of horses, humans, and gravity. The most famous of these was the Diolkos, which cut across the narrowest section of the Isthmus of Corinth and allowed ships to be quickly transported overland by placing them on top of the track's carts.

The Diolkos operated from roughly 600 BCE to the time of Hero...and if it had operated just a little longer, someone might have had the bright idea of powering the trackway's vehicles with Hero's aeolipile. In that case, Hero would have indisputably been the original steampunk, but I think we can give the title to him anyway.

The World's First Roboticist

Hero of Alexandria, in his way, invented robots. His engineering work often used automated devices that could be programmed to do specific tasks, and then left to themselves to complete the work. He's been credited as one of the great-grandfathers of cybernetics, which doesn't emerge as a proper science until the mid-19th century.

Charmingly, Hero mostly used his automatons to put on plays. A lot of his engineering research went towards improving the operation of Greek theater, and his crowning achievement was a completely automated play that was over ten minutes long - yes, he essentially created the ancient Greek equivalent of Disney World's Hall of Presidents. The play was perhaps more of a Rube Goldberg machine than a work of cybernetic brilliance, as it was held together by a system of knots, ropes, and simple machines powered by a big rotating cylinder.
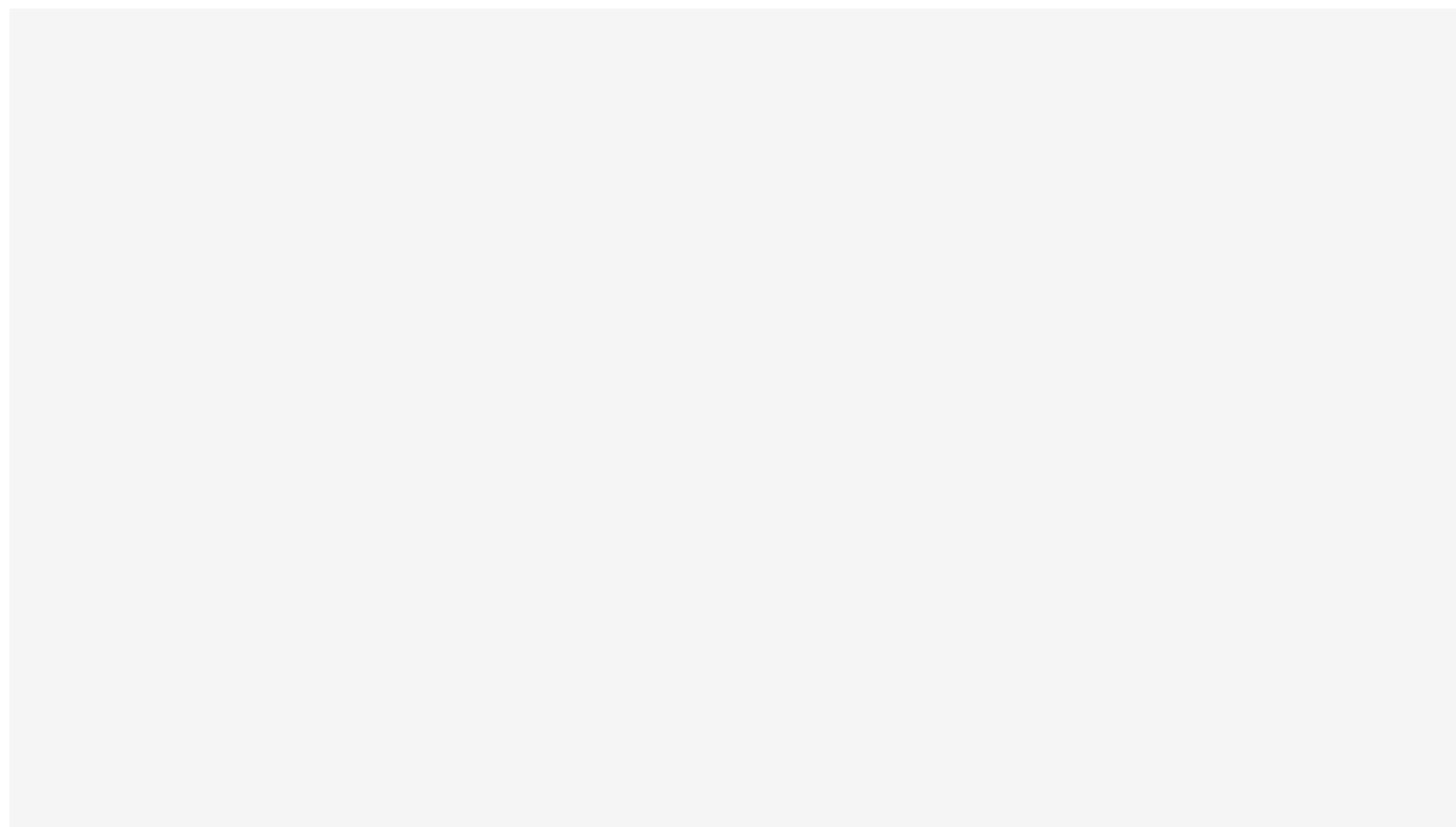
But even then, the mechanical play had a robotic feel to it. Each segment of the play

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- in this case, the ropes, knots, and machines - had two different settings, and they could be programmed to do different things depending on how they were arranged. That means that Hero's play was arguably the first ever program written in binary code.

And it wasn't a completely dull production, either, as Erik Davis explains in his book *Techgnosis: Myth, Magic & Mysticism In The Age Of Information*:

> one of which rolled itself before the audience on its own power, cranked through a miniature three-dimensional performance, and then made its own exit. Another staged a Dionysian mystery rite with Apollonian precision: Flames lept, thunder crashed, and miniature female Bacchantes whirled madly around the wine god on a pulley-driven turntable.

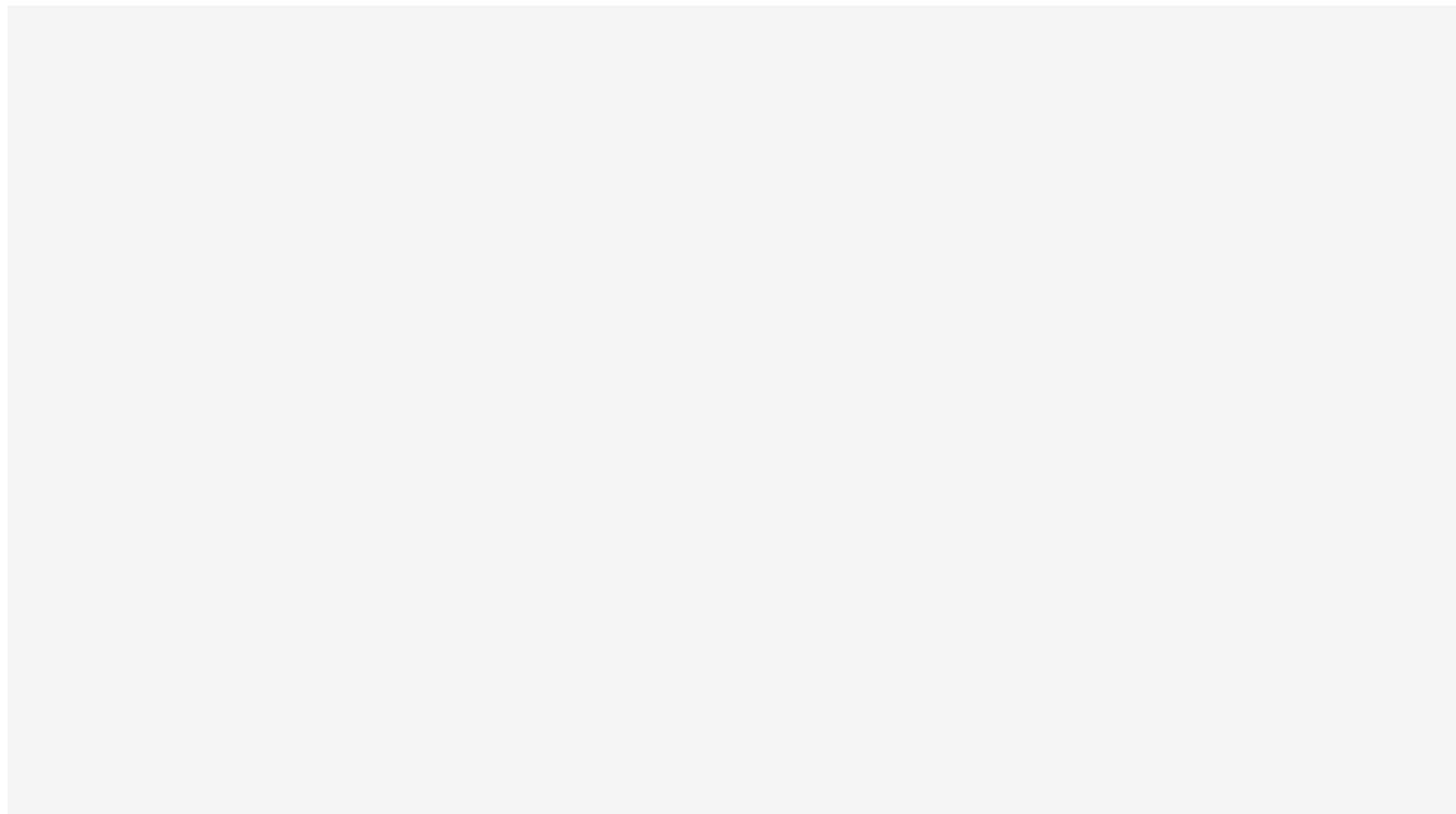Yeah, I'd buy a ticket to that revival.

Master of Optics and Math

Hero wasn't just a brilliant engineer - he was also an accomplished mathematician and theoretician. He came up with the basics of what is now known as Fermat's principle. Hero predicted that a light ray travelling between two points would always take the shortest possible path. It's a simple enough idea, but a very powerful one -

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indeed, until our understanding of light became more complicated in the last century or so, that was pretty much the definition of what a light ray was, and it took a thousand years before the Arab scientist Alhazen could offer any improvement on Hero's original notion.

Hero's work in math was also nothing short of extraordinary. He came up with a simple way to quickly calculate the square root of any number (well, assuming you can do long division quickly, at any rate), and he came up with what is now known as Hero's formula. This formula makes it possible to calculate the area of a triangle with no other information than the lengths of its sides. But his most awesome math accomplishment has to be the discovery of imaginary numbers, which he ran into while working out a formula for the volume of a pyramidal frustum.

Wind and Fire

But for all his theoretical work - frankly, I'm surprised he didn't accidentally come up with relativity while trying to calculate a cube root - Hero's greatest achievements remain his inventions. Some of them seem simple enough. For instance, his windwheel used the energy of passing gusts of wind to make an organ play. This didn't require any great technical prowess like his steam engine or mechanical plays, but it did apparently require his unique insight - there aren't any records of wind-powered machines before Hero came along. Sometimes genius isn't just seeing far ahead, but realizing the obvious that's right in front of you.

Now, I know what some of you are thinking - these machines and formulas and things are all well and good, but *where's the practical application?* What has Hero of Alexandria done for me lately? Well, assuming you're an ancient Roman, he might have saved your life. He invented a force pump that could very quickly shoot water towards any location through the power of its pistons. The design you see up above is probably the work of Hero's predecessor Ctesibius, but Hero managed to improve upon this earlier work, and his pump became crucial to ancient Roman firefighting.

And How About A Vending Machine?

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Seriously, steam engines and primitive robots are one thing, but a *vending machine!?* Of all of Hero's inventions, this one really has to be my favorite. He described the device he had built in his work *Mechanics and Optics*. Technically speaking, this ancient vending machine was a holy water dispenser, but just like today's machines, it was coin-operated.
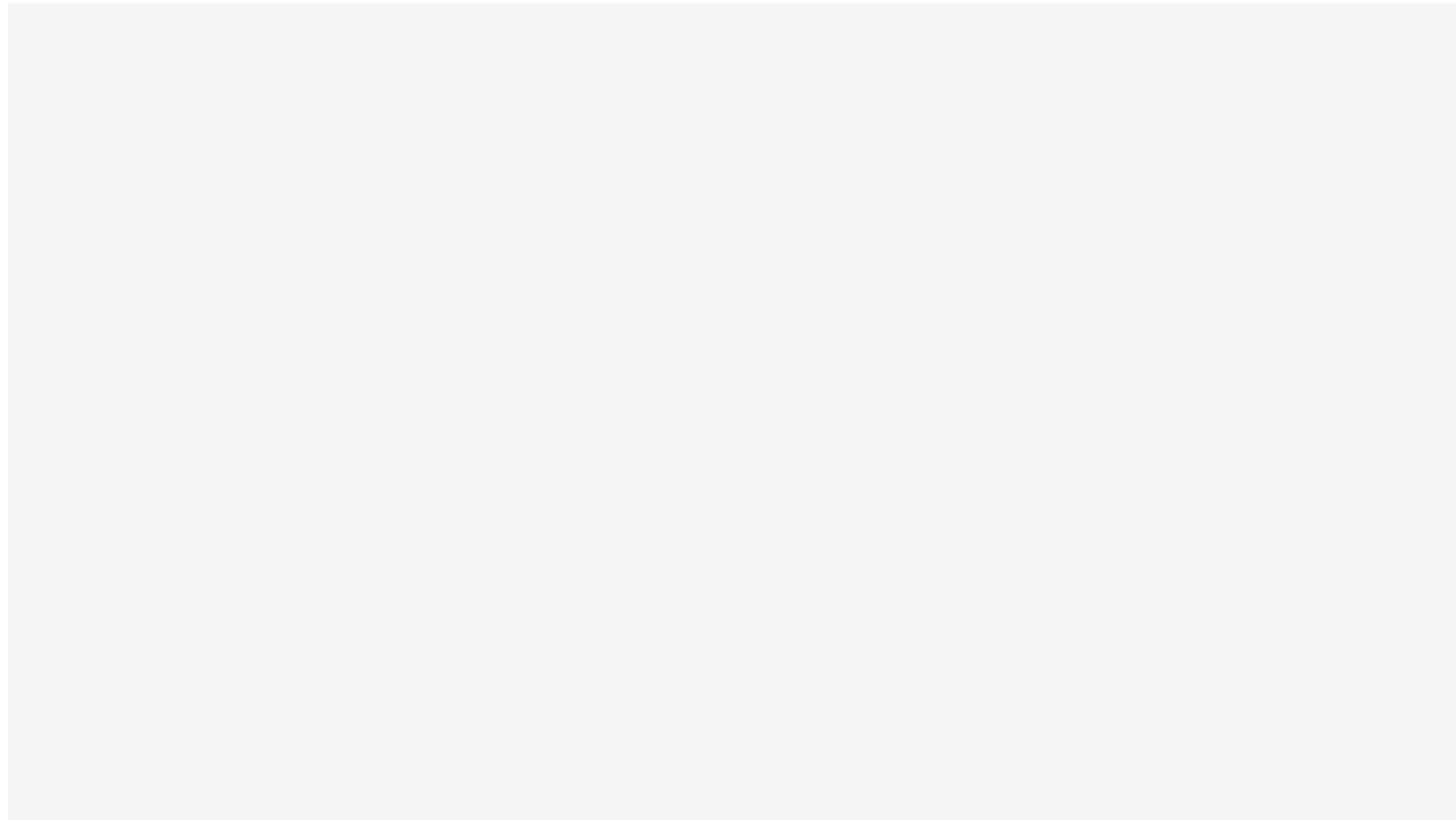
The user would deposit the coin into a slot, and the coin would then fall onto a pan. This pan was attached to a lever, and the introduction of the coin's weight would cause the lever to open up a valve, and holy water would come gushing out. The coin continued to tilt the pan down until it was able to slide off, at which point a

counterweight would snap the pan into place, closing the valve.

So, the next time you're cursing the Coke machine for not accepting your torn dollar bill, just remember: you're looking at a piece of technology that's nearly two thousand years old. Whether it's steam engines, wind turbines, or vending machines, no inventor ever saw further into the future or innovated quite as boldly as Hero of Alexandria. If ever a scientist was well-named, Hero most definitely was.

For more on Hero and other ancient geniuses, check out this great list of Hero's inventions by Michael Lahanas for even more examples of Hero's inventions. Peter James and Nick Thorpe's Ancient Inventions, or this translation of Hero's The Pneumatics translated by Bennet Woodcroft.
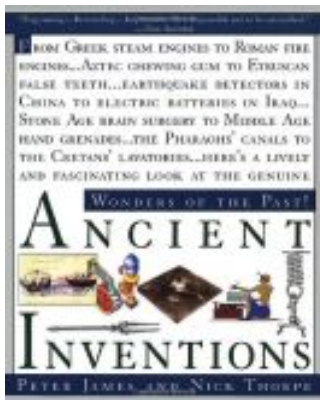
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