

Pseudoscience

Bozo the clown

Science is having an interesting idea about something, then going out of your way to prove yourself wrong. Pseudoscience is having an interesting idea about something, then going out of your way to prove yourself right. [Cross Madame Perlmina's palm with silver](#).

Pseudoscience rears its head in so many places these days, you'd think that it was astral projection rather than engineering that got human beings onto the Moon, and that a good treatment for ovarian cancer isn't Taxol, but [monoatomic-iridium clustered-water](#). There are at least three distinct strands within this marching army of idiocy, so we should first mention pseudoscience's two lesser consorts, pathological science and bad science. Although not true pseudosciences, bad and pathological science help explain pseudoscience's origins, and its unfortunate appeal.

Cold fusion is a technique whereby electrolysis of heavy water (deuterium oxide) by a palladium electrode produces more energy than is put in. Most scientists believe that cold fusion is impossible, and that this technique is bunk.

Pathological science

Pathological science occurs when someone has an interesting idea, tries to prove himself wrong, but on the first bash, doesn't manage to do so. Hence he thinks he must be right. However, everyone else who tries to replicate his results fails miserably, gets bored, and goes home. However, the inventor still thinks his pet theory is sound, and [will keep insisting it's correct long after everyone else has forgotten all about it](#).

Scientists are only human. Some bad ideas (phlogiston, [polywater](#)) have had currency in the scientific world at some point, only later to be discarded. Contrarily, some good ideas (plate tectonics, the enormous age of the earth) have been discounted as false initially, only later to be adopted when new evidence to support them comes in. However, it is the whole point of science that the better model will win out eventually. For every case you can point to where 'they laughed at So-and-so, you know' (Wegener, Galileo, *etc.*), I can point out a hundred people with challenging ideas that they didn't laugh at (Einstein, Planck, Newton, Bohr, *etc.*) Being laughed at usually means *not* that you're a tortured genius with a revolutionary idea, but far more often, that you are - as Sagan said - Bozo the Clown. That's not to say scientists should have closed minds, far from it, but there is such a thing as having a mind so open that your brain falls out.

"But the fact that some geniuses were laughed at does not imply that all who are laughed at are geniuses. They laughed at Columbus, they laughed at Fulton, they laughed at the Wright brothers. But they also laughed at Bozo the Clown." [Carl Sagan](#).

Science is a human endeavour, and as such is subject to human flaws and frailty; however, to suggest that science goes out of its way to disregard new ideas, as part of a huge establishment conspiracy is laughable. Science *is* a constant throwing out of the old and bringing in of the new. That's the whole point of it: good science is about criticising results until you run out of reasonable criticisms. Pathological science is believing that an inability to answer criticisms is the same thing as these criticisms being unjustified. "There are more things under heaven than are dreamed of in your philosophy" is not a good retort if the data don't support it.

Planes fly by chucking air downwards, and therefore receiving an equal push upwards. Running to catch up with air going under the wing has nothing to do with it.

Junk science

Junk science rears its head when someone has an idea that is either (a) common knowledge (*i.e.* wrong), or (b) a poor analogy to some real science, which is then peddled as dogma without ever asking whether it is really true. The former of these types of bad science is exemplified by the factoid that vortices in emptying sinks turn in a clockwise direction in the Northern hemisphere, and *vice versa* (or is it the other way round?) in the Southern. Its fallacy can be simply demonstrated by emptying a few sinkfuls of water down the drain. The effect that this is supposed to demonstrate is the Coriolis force, which (although quite real, for some co-ordinate system's value of 'real') is far, *far* too weak to manipulate sinks of water in any significant way, unless your sink happens to be the size of the North Atlantic. Common-knowledge factoids of this sort are just new wives' tales.

How do planes fly? I'm sure at some point you will have been told the following:

Equal transit times: the air has to run more quickly over the top of the longer, curved surface of an aerofoil so as to catch up with the air travelling *via* the shorter, flatter undersurface. Hence by applying Bernoulli's relationship ($p + \frac{1}{2}\rho V^2$ is a constant), the pressure (p) must be lower on the fast moving (V) upper surface than the lower surface. Hence the aerofoil is sucked up into the sky.

The only problem is this explanation is that it is quite seriously wrong. How could aerobats fly upside down without plummeting to their deaths if it were true? More pressingly, why on Earth should the air on the upper surface run to catch up with the air on the lower surface anyway? Molecules don't have friends. Although Bernoulli's relationship is perfectly up to the task of describing suction *given* a difference in speed, the 'equal transit times theory' doesn't explain *why* the air should travel more quickly above the aerofoil in the first place. In fact, the air *does* travel more quickly over the top surface, but in fact quite fast enough to easily outpace the air going underneath! 'Equal transit times' has about as much explanatory power as saying that magic pixies hold the plane up with invisible string.

The real reason aerofoils generate lift is not amenable to simple explanation. 'Equal transit times' is wrong and misleading. Replacing it with something better is made difficult because the trying to explain the Navier-Stokes equation without a primer in university-level maths is next to impossible. However, if you want a slightly less misleading story, consider the following: air tends to follow the contours of a surface it is blowing over. If you put an aerofoil in the flow of air (a neatly angled brick will do), the flow will be partly diverted *downwards* off the trailing edge. Since this means the aerofoil is exerting a downward force on the air, by Newton's third

law, the air must exert an equal but opposite (upwards) force on the aerofoil. Therefore the [aerofoil generates lift](#). Although this doesn't give a completely satisfying explanation of why the streamlines tend to follow the shape of the aerofoil, at least the factoids in this story are true, and make some vague intuitive sense.

Staying in the air for a moment, we shall consider how clouds are made. When air in the atmosphere rises, it expands and cools, its water holding capacity drops, and so clouds form. Again, this is simply untrue, and needlessly introduces magic pixies (water-holding ones), when an equally simple explanation that is on speaking terms with the truth is readily available. When water vapour cools, it becomes a liquid. This is common knowledge, as any kettle can show you. When air containing water gets cold, the condensation of water vapour into tiny liquid drops tends to outpace the evaporation of tiny liquid drops into vapour. Thence do drops large enough to deserve the name 'rain' grow. To put it even more simply: if you cool water vapour, it becomes a liquid. It's that simple. Aquarian magic pixies are not required. Plenty more examples of [bad biology can be found here](#).

Pseudoscience

True pseudoscience, takes half-baked science, long Graeco-Roman words, shoddy experimentation, old and new wives' tales, and complete assurance that criticism must mean you *are* a tortured genius, and runs with them. By backing up outlandish claims with what appears, on the surface, to be science, they try to claim a legitimacy that they in no way deserve. The results would be hysterically funny if it weren't for the fact that they are taken seriously by so many.

This diagram tells you everything you'd ever need to know about Jesus. And everything you'd ever need to know about astrology too, obviously.

And there are so many pseudosciences to chose from: astrology, remote viewing, crystal therapy, acupuncture, iridology, urine therapy, clustered water therapy, unclustered water therapy, chiropractic, *feng shui*, dowsing, homoeopathy, aura photography, and on and on and on. As noted above, it helps if there's some grain of truth in these pseudosciences (at least you know the area of science you should steal your words from), and in *some* of them there indeed is. Pseudosciences range from the partly effective (herbalism) to the completely useless (astrology). Acupuncture may give some temporary relief to pain, because sticking needles into bodies makes them produce pain killing neurotransmitters (eating [chillies](#) has a similar effect). Likewise, massage and yoga will likely do the body some good, and *feng-shui* may well make your living space a tidier place, but *not for the reasons claimed*. Acupuncture and *feng shui* do not act on the flow of universal *qi* energy, for which there is absolutely no empirical evidence: they work on the body's hormonal response to pain, and the fact that rooms full of dead flowers and clutter are not conducive to interior decoration. The concept of *qi* is neatly cut away by Occam's razor.

Freeing a pseudoscience from such encumbrances is generally not welcomed by its practitioners. I think this is mostly because whittling away a pseudoscience until you find the bit that works (if any) leaves the pseudoscience in such a denuded state that no-one could possibly make money out of it. "You mean I can get all the benefits of *feng shui* by just chucking all my old crap out? I don't have to employ a consultant? How splendid". By the time you've whittled away most pseudosciences of the medical sort down to what works, all you're left with is a big, fat placebo

effect. For some reason medical practitioners of the run of the mill sort don't seem to elicit quite the same degree of placebo effect. Is this due to GPs not spending enough time talking to their patients because of underfunding? Or because people understand too much science, and are no longer impressed by MRI machines or antibiotics in the same way they are by lumps of crystal and foot massage, which seem so much more exotic? Or is it simply because the NHS is free at the point of need, but with an alternative practitioner, you feel you ought to be getting something for your money? Now that's something that would be worth finding out.

Obviously, there's no real need for a pseudoscience to have *any* grain of truth or usefulness whatsoever to be successful. Pseudosciences can always invoke some form of 'energy' or other if there's a problem convincing people how it's supposed to work. Of course, this energy, by necessity, must be hitherto unknown to science. However, ask them how this energy is produced, how it propagates through space, what sorts of material absorb and emit it, and how it can be detected and measured, and you'll get a blank look at best, or some gibberish at worst. "It's energy, innit?". Ah, you mean the time component of a body's momentum 4-vector in spacetime? "Er, no, energy, you know, E-n-e-r-g-y."

Everyone's favourite pseudoscience appears to be astrology, judging by the number of column inches devoted to it. Astrology claims that by knowing the relative positions of *completely* arbitrary stars, planets, planetary satellites and your own good self at the time of your birth, you can predict certain personality traits and the future. Fortunately, for your amazement and delight, I have enlisted the astrological skills of [Madame Perlmina](#), who has kindly agreed to make three astrological predictions for you for nothing more than a bit of feedback on how well she's doing. See how well she does...

There are many ways of distinguishing between science and pseudoscience, and astrology clearly falls into the latter camp, for the following reasons. Science has an annoying habit of creating new, objectively verifiable knowledge as time goes by. On the other hand, astrology is essentially the same hotchpotch of nonsense the Babylonians and Greeks cobbled together between 1000 BCE and 200 CE. They believed the planets to be [manifestations of their gods](#) (hence the names: Mars, Venus, *etc*; originally, they had Babylonian names like Marduk and Ishtar), and imbued with the characters of those gods (Mars, god of war, Venus, goddess of love, *etc.*). Of course, this lack of progress might mean that astrology is perfect, and needs no further meddling with its eternal truths. However, given that two astrologers cannot even agree on a single horoscope, there doesn't seem to be much substance to this claim. The cornerstone of science is reproducibility. If you gave Francis Crick or Joe Bloggs a PCR machine, a fruitfly, and a neat list of instructions, and either of them should be able to churn out DNA, regardless that one is the discoverer of DNA, and the other is a investment banker from Stowe. Give two astrologers the same natal details, and all they'll be able to agree on is a brief list of trite features that 'Leos' ought to have, based on the 'fact' that the constellation of Leo looks like a lion (it doesn't), and therefore Leos should be like lions, *i.e.*

- Energetic (that's actually rubbish: they sleep about 22 hours out of 24);
- Confident (ever seen one run from a Masai? King of the jungle my arse. They don't actually live in jungles either);
- Like children (actually, lions are male exogamous, which means that a wandering groups of male lions will look to oust another group of males currently in charge of a pride, then go about killing all the other males' cubs to bring the females back into heat);
- Sociable (infanticide is such a crowd pleaser at parties).

I 'am' a Capricorn, hence I should be cautious, **responsible**, **scrupulous**, conventional, businesslike, **perfectionist**, traditional, practical, hardworking, economical, serious, **egotistic**, domineering, unforgiving, fatalistic, stubborn, brooding, inhibited and status-seeking. I am definitely not a Cancer (opposite side of the year), so I guess the following should not be a very good description of me: tenacious, intuitive, maternal/paternal, **domestic**, sensitive, **helpful**, sympathetic, emotional, patriotic, **good-memory**, traditional, brooding, touchy, negative, **manipulative**, overly cautious, lazy, selfish, self-pitying. I have highlighted the words that I think apply to me. Unless my parents lied to me, and I am in fact a bastard born out of wedlock in November or some such, I think you'll agree this is not a very good score for astrology. Pigeon-holing people's personalities into twelve arbitrary character classes like they were colours of corn kernel, or wing mutation in fruitflies is ridiculous at best, offensive at worst. Astrology doesn't seem to do a very good job of doing what it claims (poor Madame Perlmira), and even worse, it asks us to believe that there is some force or other that connects our fates with a rag tag bunch of fusion-reactors and lumps of rock in a small barred spiral galaxy somewhere in the [Virgo supercluster](#) (see, the science of *astronomy* can do the long words too, only here they actually *mean* something).

There are only four fundamental forces known to physics. Could astrology please point me in the right direction regarding which one it invokes to tie our fates to those of the stars? Is this astrological force some sort of gravitational effect? Is it caused by an electromagnetic force of some variety? Some hitherto unknown long range effect in the weak gauge-boson field? Any ideas? Thought not. For some reason or other, there is a rather stunning lack of peer reviewed literature on astrology beyond those articles that debunk it. Is this a conspiracy by the scientific establishment to prevent untold thousands telling their futures from the stars? Hardly. If there's any conspiracy in science, it's the one that leads to grant money being awarded *only* to people who have a ready-made, handy, practical application of their work ("Cure for cancer, guvna? No? How about a nice bomb then?"). If [research into the landslide dynamics of piles of rice](#) is possible, then a few thousand for a double-blind experiment to prove the validity of fortune telling isn't too much to ask, given how useful it would be to know not to wear red today in case I meet a Taurus with Mars in the ascendant. There's always the [Randi prize](#) for demonstrating psychic ability, which should be a nice little earner for those with training in the paranormal. However, the only evidence offered in astrology's favour is anecdotal in nature, not from a double blind, placebo-controlled trial, and its predictions are generally so vague as to be meaningless. This is not science: it's not even religion. It's dross.

Garbage disposal

How do you stop yourself getting taken in by this junk? The simple answer is that whenever you see an extraordinary claim for something, you should ask for the extraordinary evidence that backs it up. This is likely to get you nowhere, as pseudoscientists are notoriously shy of producing convincing evidence under controlled conditions. However, there are some fundamental tenets of science, the things they *should* teach you in school, whose trashing should make you very suspicious:

- No-one expects the Spanish Inquisition, and no-one defies the [laws of thermodynamics](#). Few scientific theories ever reach the lofty pinnacle of 'Law'. As these four have, beware anyone who casts them off like as though they're only there for oil companies to profit from. The zeroth law is the fairly irrefutable statement that if $A=B$ and $B=C$ then $A=C$. The three other laws state, that as far as energy is concerned, you can't win, and although

you can break even at absolute zero, you can never get to absolute zero, so *you always lose*. There is no such thing as a free lunch, and there is very much no such thing as free energy, a perpetual motion machine, or some way of squeezing more mass-energy out of a process than went in. Beware anyone who then starts invoking $E = m c^2$: this is the last resort of the scoundrel. The flaw is generally much more obvious than overlooking relativistic mass/energy conversions: it's usually the implicit use of [frictionless bearings](#), inextensible string, or similar. Invoking mysterious energies unbeknown to science is another red flag.

- Beware 100% cures, complete proofs, and so on. There's only one branch of science that provides 100% proofs, and that's mathematics (and even here, [Gödel's theory](#) rains on the parade). Likewise, you should beware 51% proofs. If someone claims they can make a coin fall on tails 51% of the time, it's not psychokinesis, it's a dodgy coin. Have a quick shave with Occam's razor: the simplest explanation is probably the correct one.
- Beware those who shy away from the scientific method. In science, a question becomes an idea, the idea becomes an experiment to investigate the truth of the idea, the experiment yields results, these results are analysed, and the analysis gives you the best answer to the question that the experiment allows. Any missing link here is a cause for great suspicion: an assumption is not an answer, an answer without any empirical evidence is not an answer, and an answer produced by flawed analysis is not an answer.

Pseudoscience is increasingly pervasive and utterly pointless. How much time, money and hope is wasted on quack cures that don't cure, predictions of the future a random number generator could make, and insights into your character that have about as much depth as a puddle? I find it tragic that many people have more confidence in iridologists than oncologists, and in astrologers than psychologists. What the reasons are for this, I can only speculate, since if people are prepared to swallow down pseudoscientific nonsense, why they can't swallow real science baffles me. In any case, I think it's about time science did its utmost to take back the ground that it has lost to quackery and superstition, before we get any more painfully skewered on idiocy's trident.