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CoverArticles

Homeopathy

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Homeopathy is a type of alternative medicine based on two ideas: that "like cures like" (*similia similibus curentur*¹), meaning that a substance that causes disease symptoms can also cure those same symptoms; and that dilution increases potency.² Both ideas are not only the opposite of what medicine usually observes, but the opposite of common sense, too.

Compared to other alternative or complementary medicines and practices which (at least purport to) date back thousands of years, homeopathy was invented in the late 18th century by a German physician, Samuel Hahnemann.

The current scientific and medical consensus, based on numerous studies and meta-studies, is that homeopathy has no effect above that of a placebo. Aspects of homeopathic practice such as its elaborate "provings" and one-on-one consultations can raise a patient's expectations and thus position homeopathy to be an especially convincing placebo — but still a placebo. The theories behind its purported efficacy beyond a placebo would, if true, overturn all of modern chemistry as well as most of physics and biology.

¹ A phrase Hahnemann used in his "Organon", and continues as the motto of homeopathy.

² Hahnemann wrote: "Although theorists may imagine there should be a weakening of the action of the dose of medicine by its dilution with a large quantity of liquid, experience asserts exactly the opposite, at all events when the medicines are employed homoeopathically." *The American Homoeopath*, 1998, p128

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Homeopathy

Principles and history

Homeopathy is fundamentally different from herbal medicine, with which it is often confused. While some "homeopathic" medicines are simply standard herbal supplements labelled as homeopathic, true homeopathic remedies actually contain no active ingredients. The only measurable ingredients are water and/or alcohol,¹ which is used to "preserve the medicinal power for a long period of time during storage".²

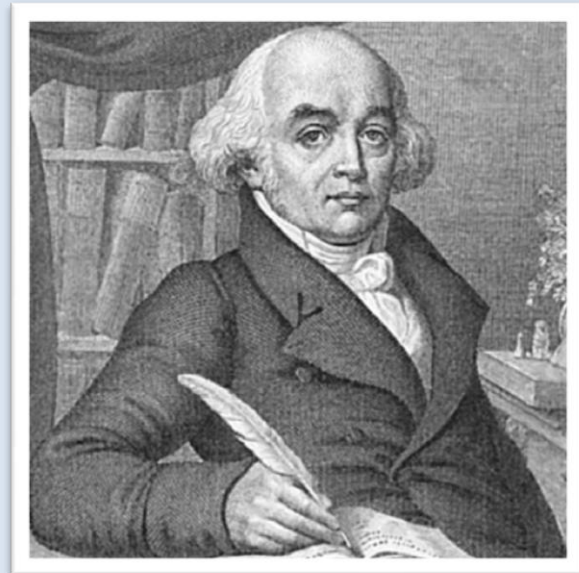
The term "homeopathy" was coined by a German physician named Christian Friedrich Samuel Hahnemann in the 18th century. He based his ideas on the "Principle of Similars", the concept that "like cures like". His reasoning was simple: if, in large doses, a substance creates symptoms, then in a lower concentration it will remove those symptoms. Hahnemann's homeopathic theory held that the more diluted a solution of such a substance is, the more effective it is at removing the symptoms it would otherwise cause. Since many of the original homeopathic compounds were based on potent toxins, this is fortunate.

"Like cures like" has no scientific basis and should not be confused with concepts used in modern immunology. For instance, when someone is vaccinated to induce immunity, antibodies are produced against the specific infectious agent, which is introduced in a less potent or disabled form and in a measurable concentration. Vaccines require an enormous amount of testing to prove efficacy and, most importantly, safety. They involve relatively large numbers of molecules or infectious agents and have a proven mechanism of action — namely, a small exposure generates a clone of memory lymphocytes that will be available to fight a real infection later. The mechanics of how vaccines work is well understood, observable, and scientifically testable.

¹ To be fair, alcohol is an active ingredient (and possibly the only one) in the cure remedy for "chronic cubicle syndrome". Source: *Dilbert the animated Series*, Season 1.

² Homeopathy World Community - post by Aejaz Husain

There is no similar evidence or even plausible hypothesis for "like cures like."



Samuel Hahnemann, founder of homeopathy, purveyor of what eventually turned out to be completely wrong.

Homeopathy originated before medicine established germ theory, and before it had even dispatched the idea of Humors. Hahnemann's patients fared better than those of his contemporaries because the prescientific treatments of that era carried incredible risk to patients, often more so than the diseases they were meant to treat. Thus his inert "remedies" reduced patients' risks to those of the disease itself, rather than adding even more risks from the primitive treatments of the times.

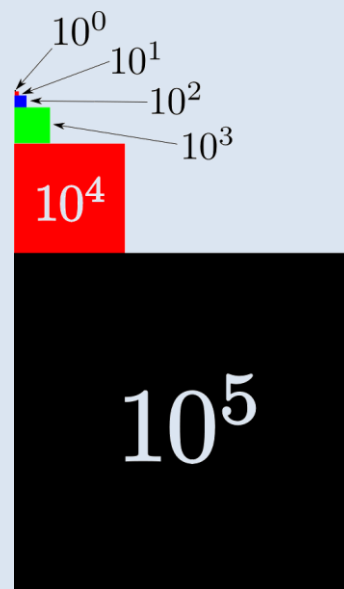
Principle of Similars

The "Principle of Similars" - even though it can trace its roots back to ancient Greece - is completely made up with no supporting evidence. Basically, Hahnemann just decided that this was the case one day.

It may, however, have been inspired by the observation that a particular malaria cure induced malaria-like symptoms in healthy patients, and other treatments sometimes exhibit this quirk of causing symptoms while curing or providing immunity. Radiation therapy is used to treat cancer caused by radiation (although melanoma, which is commonly caused by radiation, is radio-

The scale of dilution

To demonstrate orders of magnitude, the area of the largest square in this diagram is only 5 orders greater than that of a single pixel. A square that was 10^6 larger would be just under the size of the average computer screen. By 10^{15} , it would be 1 square kilometre and by 10^{20} it would be the surface area of the Earth. 10^{28} would be a disc the area of the Earth's orbit... So imagine that one pixel on an image the size of the solar system and we're talking homeopathic dilution.



resistant) and antivenin is derived from venom. Although it should be noted that antivenin is not simply venom, it contains the antibodies produced by the immune response (of other animals) to such venom. Similarly, the original smallpox vaccine involved infecting someone with cowpox; inducing symptoms similar to - but not near as deadly as - smallpox. Despite these very specific and quite interesting observations, there is no theoretical reason or supporting evidence to conclude that this can be expanded to a general rule like the Principle of Similars.

Dilution

Potentization: dilution of the active ingredient

Homeopaths prepare their remedies using a ritualized technique of step-wise dilution and shaking, called potentization. First the "active" ingredient is selected, such as belladonna or similar toxic herb, gonorrhoeal discharge (yes, you read correctly^{i,ii}), and more recently, even water.ⁱⁱⁱ

ⁱ Medorrhinum, herbs2000.com

ⁱⁱ Peter Fraser, *The Proving of Homoeopathic Remedies*

ⁱⁱⁱ Misha Norland and Peter Fraser, *The Homœopathic Proving of Newly Formed Water*, 2009

The ingredient is then repeatedly diluted, most often in the ratio of 1 part ingredient to 100 parts solvent. The most common solvent used in homeopathic dilutions/extractions is a mix of 40% alcohol and 60% water that is claimed to act as a "preservative", although as the mixtures don't contain anything, it can't really preserve anything.^{iv} Thus, liquid homeopathic remedies are most commonly about 80-proof grain alcohol, which puts them roughly equivalent to vodka. That happy feeling is not the homeopathic medicine or whacked against a piece of wood 10 times, a procedure homeopaths call succussion. The finer points of the ritual don't particularly matter. What matters is that potentization isn't just simple, straight-forward dilution but contains the "magical step" of succussion that supposedly distinguishes homeopathic remedies from water. Homeopaths hate it when scientists and other rational people refer to potentization simply as "dilution", so naturally we will continue to call it dilution.

The ritual

The succussion step is considered important to homeopaths as it is supposedly the "kinetic energy input" that increases potency. However, this

^{iv} Wiki4CAM – *Myths about homeopathy*

makes little sense as the kinetic input is extremely variable depending on who is doing the succussion, the size, shape and composition of the container, the object it is struck against, and so on. "Precisely 10 hits" is a strange metric for "kinetic input" - you could have the equivalent energy of 5 or 12 or 20 hits just by doing it differently to someone else. The level of energy associated with this sort of shaking or hitting is, of course, very low and will not affect the solution at all - it takes much more energy to induce a physical effect, such as an increase in rotational or vibrational energy level in the solution (and even more energy to induce a chemical effect). In short, any energy "input" will dissipate almost immediately with no consequence. At most a shaking process will act to dissolve molecules present in the atmosphere, but unless the preparation is made using water than has been specifically purged of these gases the difference will be marginal. In any event the dissolved gases will return to equilibrium with the overlying air within a few minutes.

Given that the "magic whacking bit" of succussion doesn't have a mechanism to affect the solution, there remains only one obvious reason for the process – as a homeopathic escape hatch. It lets homeopaths pick holes in and criticize scientific studies of homeopathy so they can reject any negative conclusions. Was it done exactly 10 times? Was it done at the right angle? Was it in the right shaped jar? Was the guy standing on one leg? Was it done in the mountain air of the Alps while a chorus of naked monks played "Good Vibrations" on the bongos? If not then the test is flawed and magic homeopathy still works - although homeopaths are rarely this picky when it comes to positive results.

Originally this process was done by hand but now it is done by machines. While this makes the "kinetic input" more consistent it doesn't lend any real credibility to the idea that "potentization" differs from simple dilution, with or without a bit of shaking.

The ritual of potentization is repeated a particular number of times to create the right level of dilution. Most homeopathic solutions call for this to be done between 30 and 1000 times, with the

resulting homeopathic "strength" referred to as 30C to 1000C respectively. Homeopaths usually state that 30C is the equivalent of "1 part per million";¹ however, this is a severe overestimate as the product is diluted 100 times for every step in the procedure. This quickly builds up the orders of magnitude and the size of numbers required to think about each level of dilution. After the first phase, the dilution is 1 part in 100 (in scientific notation 1 part in 10^2). After the second, it is 1 in 100×100 (10^4). After the third it is 1 in $100 \times 100 \times 100$ (10^6 , or 1 million) and so on, with the exponent increasing by two with each step. Thus at the end of a 30C potentization the solution is 1 part active ingredient in 10^{60} — a long ways from the one part per million that homeopaths claim, but of course the magic of homeopathy allows it to transcend basic arithmetic. Thus, this dilution is actually one part per "novendecillion". The more diluted solutions are alleged to be stronger, in stark opposition to everything known about the real world.

If all the superscript numbers were a bit abstract we can add the zeros back in for demonstration purposes; in the least diluted homoeopathic solutions normally available (30C), the active ingredient is diluted in a ratio of:

1:1,000,000,000,000,000,000,000,000,000,000
 ,000,000,000,000,000,000,000,000,000.

Powerful stuff indeed. This is very dilute, and as we shall see, it has interesting consequences for these remedies when prepared in the real world.

No active ingredient

A finite quantity of solute cannot be infinitely divided. This is because molecules themselves cannot be divided — once we dilute to the last few molecules of solute, further dilution gives a decreasing likelihood that the resulting solution will contain even one molecule of the solute.

We can think of "1 part product to X parts water" as "1 molecule of product to X molecules of water". We can figure out the number of molecules using Avogadro's number (6.02×10^{23}).

¹ Life-High Products, Trillin.net

which is the number of molecules contained in a mass in grams of the substance equal to its molecular mass. Since water has a molecular mass of 18, this means there are 6.02×10^{23} molecules of water in 18 grams of water. Likewise there are 6.02×10^{23} molecules in 2 grams of hydrogen (H₂), 4 grams of helium, and so on. Chemists call this amount of any given substance a mole.

*"It's a miracle! Take physics and bin it!
Water has memory! And while its memory
of a long lost drop of onion juice is Infinite
It somehow forgets all the poo it's had in it!"*

—Tim Minchin, Storm

A little arithmetic tells us that even the lowest commonly used homeopathic dilutions do not contain any of the active ingredient. Let's begin with 100 ml of water, to which we add 1 ml of an active ingredient. We shall call it something nice and homeopathy sounding, like "Mandrake's Leaf." For the sake of argument we'll assume this is about 1 gram, which would make a 1% weight/volume mixture. We'll also assume the main chemical in Mandrake's Leaf has a molecular weight similar to a largish organic compound, around 300 grams per mole. Therefore the 100 ml bottle has around 1/300 of a mole of Mandrake's Leaf and the corresponding number of molecules is 1/300 of Avogadro's number, or 2×10^{21} . After the first dilution of ratio of 1 to 100 we will have lost 99% of our fictitious magical herb, leaving 2×10^{19} molecules in the solution. A second dilution of 1 into 100 leaves us with 2×10^{17} molecules, a third with 2×10^{15} molecules, and so on. In short, we decrease the exponent by two for each dilution. This leads to an interesting consequence between the 10th and 11th dilution step - the number of molecules present in the entire solution drops from 20 to 0.2. But there's no such thing as 0.2 of a molecule. So even at these homeopathically "weak" dilutions our 100 ml

container has, in technical terms, zilch, zippo, nada Mandrake's Leaf left in it. Hahnemann didn't know this because Dalton, Avogadro, and others had not yet laid the foundations of atomic theory. Modern homeopaths don't have this excuse - and as discussed below, don't deny it and even embrace it.

Calculating the container size necessary for a homeopathic solution to contain just one molecule of active ingredient can be an entertaining and illustrative exercise, and the basic outline is shown in the table below. A 30C dilution is the equivalent of having one molecule present in a sphere of water with a diameter just short of the distance between the Earth and the sun - and higher dilutions become even more difficult to conceptualize. The number of atoms in the observable universe is estimated at approximately 1×10^{80} , and the orders of magnitude associated with the most dilute (the supposedly "strongest") homeopathic solutions - when the potentization process is carried out hundreds of times - are much greater than even this massive figure.

Purity of water

ISO 3696 is a standard for laboratory water. The purest grade of water under ISO 3696 is 10 parts per billion impurity - 10×10^{-9} . That is equivalent to a homeopathic dilution of 4C. So every remedy beyond 4C prepared with water of this purity would be entirely random. Actually, homeopaths do not use water of that purity; it can't be stored in glass vessels due to leaching of surface impurities and those using it have to wash their glassware in hydrofluoric acid before use, which dissolves the partially oxidised top layer of glass. Homeopaths usually use double distilled water, which is substantially less pure.

| X Scale | C Scale | Ratio of dilution | Notes |
|--|---------|----------------------|--|
| 1X | - | 1:10 | Described as "low potency" |
| 2X | 1C | 1:100 | Called <i>higher</i> potency than 1X by homeopaths |
| 6X | 3C | 1:10 ⁻⁶ | |
| 8X | 4C | 1:10 ⁻⁸ | Allowable concentration of arsenic in U.S. drinking water |
| 12X | 6C | 1:10 ⁻¹² | |
| 24X | 12C | 1:10 ⁻²⁴ | Has a 60% probability of containing one molecule of the original material if one mole of the original substance was used |
| 60X | 30C | 1:10 ⁻⁶⁰ | Dilution advocated by Hahnemann for most purposes. A patient would have to consume 1041 pills (a billion times the mass of the Earth) to consume a single molecule of the original substance |
| 400X | 200C | 1:10 ⁻⁴⁰⁰ | Dilution of the popular homeopathy flu remedy Oscillocoquinum; a patient would need to consume a mass well over 10320 times that of the known universe to ensure they consumed one molecule of the original substance. |
| Note, the "X Scale" is also called the "D Scale". 1X = 1D, 2X = 2D and so on | | | |

Conflict with Hahnemann

Hahnemann's original homeopathic theory held that the active ingredient was diluted greatly, but it was nonetheless still present in the homeopathic solution. Avogadro's work, which was developed after Hahnemann's invention of homeopathy, clearly showed that this claim was false and that - even in some of the lowest dilutions offered - the active ingredient is not present in the final remedy. The recent 10:23 campaign was designed to highlight this aspect - and particularly the public's misunderstanding of it - by organising a "mass overdose" of homeopathic remedies. The lack of any active ingredient and the disproving of Hahnemann's theory is a blow to homeopathy, but it should be noted that modern homeopaths do not deny this. They will even specifically claim it as an advantage because a solution can't possibly be toxic, being just water with nothing dangerous in it. They're actually very open about this sort of

thing, but usually fail to mention that this conflicts with the original theory.¹

To get around this rather extreme problem, modern homeopathic practitioners developed a claim that the water has a "memory". In this claim, the succussion procedure supposedly imparts the "memory" of the chemical placed in it (importantly, only the intended active ingredient) to the water, and it is this memory that allegedly cures the patient - be glad sewage processing plants don't do this by accident! If true, this "memory of water" claim would overturn all of modern chemistry as well as most of physics and molecular biology. (And given the history every drop of water we drink, probably a lot of stomachs too.)

¹ Blair Lewis, *About Homeopathy*. 2006. Himalayanheritage.com

Conclusion to the procedure

In short, although the solution has been diluted beyond any possibility of detection, the little magic taps which comprise the "succussion" procedure change all known laws of physics and turn the substance into a "medicine". It's obvious really.

Water memory

Water memory is one of the concepts central to modern - i.e., post Avogadro - homeopathy.

Due to the nature of the dilutions in a homeopathic preparation, no molecule of any active ingredient remains in the final product. To get around this fact, homeopaths fall back onto the idea that the solution somehow retains a "memory" of the solute. Although it is possible to argue that only proof of efficacy in homeopathic preparations is important, water memory has become an essential element for anyone trying to offer up rationalizations for a mechanism of action. To highlight its importance the homeopath apologist's journal *Homeopathy* recently devoted a whole issue to water memory.^I This idea takes many forms, each of which is less plausible than the last.

History of water memory

Jacques Benveniste proposed water memory in the 1980s, and famously managed to publish some of his results in the journal *Nature*.^{II} Lacking any objective grounds to reject the seemingly impossible paper through the process of peer review (so the many claims that established science merely rejects quack ideas with a closed mind are patently false), the paper was sent to press. The journal's editor John Maddox, however, remained skeptical and allowed the results to be published accompanied by a small editorial on the subject by himself, stating in the piece the number of laws of physics and chemistry such a result would violate and that "There are good and particular reasons why prudent people should, for

the time being, suspend judgment."^{III} The only other remaining condition was that the research mentioned was independently replicated following publication and the controversy created a small media storm in 1988. The team sent to investigate Benveniste's claims included James Randi - whose expertise on sleight of hand and fraud detection were put to use in the lab. The report from the team concluded that although Benveniste was innocent of academic misconduct and fraud, he had been misled by flawed experiments. Thus, one of homeopathy's most shining moments was tarnished, and even John Maddox was almost disappointed, concluding "I'm sorry we didn't find something more interesting."^{IV}

Foundations of water memory

The central principle of homeopathy is that like cures like. So homeopaths seek out dangerous herbs and other ingredients that produce symptoms of disease (such as nightshade, arsenic, and strychnine) and use these in their preparations. Since this would normally kill the patient, the homeopath uses a series of dilution procedures, known as succussion, to dilute the solution so much that any given sample will not contain any of the original ingredients. While most people realize that diluting decreases potency, the homeopath claims the exact opposite - that the more diluted the preparation is the stronger it is. This potency-increasing dilution also magically removes the side effects of the original poison.

Homeopaths have failed to prove the efficacy of their treatments after many experimental attempts.^V Given the complete and utter failure of experimental evidence, many have turned to trying to create mechanistic explanations for how homeopathy could work. These "proof of principle" ideas revolve around finding an explanation for how diluting a solute can increase its effect. The current vogue idea is "water memory": the homeopath believes that their dilution process somehow transfers the properties of the solute to the water molecules themselves,

^I *Homeopathy*. 96, 3, 141-230 (2007).

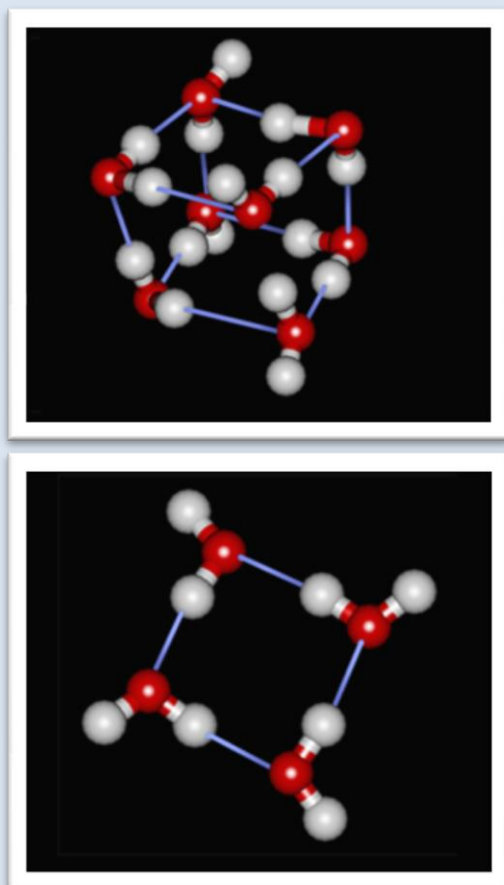
^{II} J. Benveniste *et. al.* *Nature* 333, 816-818 (1988)

^{III} *When to believe the unbelievable*, *Nature* 333, 787 (1988)

^{IV} *Time Magazine - The Water That Lost Its Memory*

^V Shang *et. al.*, *The Lancet*, 366, 9487, 726-732 (2005)

then those molecules of water transfer it to new water and on and on. They propose this as the explanation for the a priori belief that diluting increases potency.



Actual water clusters. These are simple and unstable; any more complex structure comprising a "memory" would have even less thermodynamic stability

Homeopaths, true to form, have not really tried to prove that there even is such a thing as water memory. One cogent example of this is that James Randi has offered his million dollar paranormal challenge money to anyone that can prove water memory exists. No major homeopathic practitioner or company has taken him up on the offer - with the exception of Randi's involvement with the Benveniste case in 1988, which was partially funded by the French Homeopathy Council. However in 1999, Madeleine Ennis of Queen's University of Belfast had claimed to have replicated Benveniste's miraculous findings (those debunked by John Maddox and James Randi a decade earlier). In 2002 the BBC pop science program Horizon did an on-air test replicating this work with Randi to attempt to win the prize. The

replication failed completely, with the documentary concluding "Homeopathy is back where it started without any credible scientific explanation. That won't stop millions of people putting their faith in it, but science is confident. Homeopathy is impossible."ⁱ

Since the starting premise in most research on water memory is that it is a fact, an explanation must be sought. There are no analogous situations in the natural world, so unique lines of reasoning have been developed to explain a phenomenon that has never been proven to exist. With no actual data on water memory or how it behaves (since they haven't even proved it exists!), researchers can make up whatever they feel like as long as it sounds nice and not have to be worried about testing or making predictions. This is a big reason why this fraud is the epitome of pseudoscience.

Water memory proposals

Homeopaths present many odd ideas to try to explain the mechanism behind the phenomenon of water memory. Since water memory has not yet been proven to exist, the hypotheses are a bit premature. Examples include:

- **The silica hypothesis**ⁱⁱ
- **Active oxygen**ⁱⁱⁱ
- **Quantum homeopathy**^{iv}

Modeling water memory

One of the most clear cut examples of how water memory researchers work from assuming their conclusion is in the realm of mathematical modeling. A recent example was published in the aforementioned water memory issue of homeopathy.^v The author of this paper took a list of assumed properties of water memory based around assumptions of homeopathy and then

ⁱ BBC – Horizon. *Homeopathy: The Test*

ⁱⁱ David J. Anick and John A. Ives. physical chemistry. *Homeopathy*. 96, 3, 189-195 (2007)

ⁱⁱⁱ Vladimir L. Voeikov.. *Ibid*, 196-201.

^{iv} David J. Anick. *Ibid*, 202-208

^v Ben Goldacre, "The octave potencies convention: a mathematical model of dilution and succussion", badscience.net

constructed a mathematical model that described these assumptions. In the paper, the author has no physical experimentation in which to ground his model and no logical constraints other than "it makes the equation do what I want" for most of his manipulations. Exponentials and terms are randomly dropped into the model with the only explanation being that they were required to make the math work. Mark Chu-Carroll of scienceblogs has a full refutation of the work at his site.¹

The amazing thing about this is that this - which isn't particularly clever or conclusive by the normal standards of science - is considered cutting-edge research in the world of alternative medicine. There is no empirical grounding for this research (and as Richard Feynman said "It does not make any difference how smart you are, who made the guess, or what his name is - if it disagrees with experiment it is wrong.") or logical constraints at all. This is, frankly, terrible science, yet it's the best that research into these extraordinary claims has to offer. It is no wonder that so few people take this stuff seriously. It's completely baffling how anyone can.

Thermodynamics of water memory

According to thermodynamics, the thermodynamic functions (enthalpy, entropy, etc.) of a substance are determined only by the current state of the system, in terms of its pressure, temperature, volume, etc. Included in this is the distribution of velocities and internal vibrations and rotations. Thermodynamics has shown that how one reaches these states is independent of the path to the state; that is, there is no "memory" of former temperatures, pressures, etc. or dissolved substances. If water did have a memory, it would be an example of a Nobel prize winning concept, as it would violate current thermodynamic concepts.

There are such forms of substances that are thermodynamically unstable or "metastable" (such as supersaturated solutions or allotropes of elements) that exist that are prevented kinetically from approaching thermodynamic stability

because of a lack of a pathway. However, water has relatively weak hydrogen bonding as intermolecular forces (relative to covalent bonds) that are easily overcome at room temperature. Once a solute is removed from the water, the water will rapidly come to equilibrium and all evidence that the solute was ever in the water will be gone.

Various physical properties of water can be altered by small amounts of dissolved substances; these properties are called "colligative properties," and have been explored in great detail by physical chemists. Hence, the purity of the water, including dissolved gases, is paramount in determining physical properties. There are clusters of water molecules as well as hydronium ions, hydroxide ions and associated hydrogen bonded species of these ions; however, there is no evidence that these exist over macroscopic scales as suggested by the water memory enthusiasts. Water memory also likely violates the principle of microscopic reversibility.

Tap water of death

One of the interesting questions with water memory is why billions of people worldwide drinking out of natural and tap sources of water are not dropping dead of overdoses. One environmental watchdog group has documented over 500 chemicals in an average glass of tap water, many of which are used in homeopathic treatments.² The EPA of course sets maximum concentration for these chemicals in water, and over time the maximum concentration has decreased considerably. Many people consider that as a way of making tap water safer to drink, but to the homeopath that's actually making it worse! More dilution equals stronger effect.

If water truly had a memory then city tap water would be the most dangerous substance on the planet. Most homeopaths seem to ignore this consequence of their theory or offer post-hoc rationalizations such as succussion being needed to "potentiate the solution." However, many others see this as a prime opportunity to make

¹ Mark C. Chu-Carroll, *Bad Homeopathic Differential Equations*, scienceblogs.com

² National Drinking Water Database

even more money. Various products and magic cleansing waters are sold over the internet to eliminate these toxins with prices exceeding a thousand dollars.

The far more parsimonious explanation is that water does not have a memory and that the well established physical laws involving dilutions are true. But this will never stop a True Believer.

Evidence

The evidence for homeopathy, or more specifically the evidence that it is effective beyond a placebo, is far from compelling. While the burden of proof still lies with homeopaths and alternative medicine practitioners to prove its effectiveness, conventional medicine has put it through its paces with a series of trials and meta-studies. The evidence can be split into two categories; the first is that looking at the efficacy of homeopathy, the second is looking into the physical claims such as water memory and quantum woo.

Medical evidence

There have been several major investigations into homeopathy. The Lancet, one of the world's premier medical journals, has published a few fairly high quality meta-studies, and the Cochrane Collaboration, practically the place for meta-studies has also released a few studies. In general, these studies come out negative in favour of homeopathy, although keeping with a scientific view of having an open mind some do conclude "insufficient evidence"; while there isn't enough data to conclusively prove that homeopathy is hocus, there isn't any reliable data pointing towards it having a real and tangible effect. Serious, high quality research has only been recently available.

The Lancet, 1997

A large study from 1997¹ looked at 186 trials, using 119 of them based on inclusion criteria and determined a small, apparently positive, effect of homeopathy, although nothing conclusive. The paper states; "the results of our meta-analysis are

not compatible with the hypothesis that the clinical effects of homeopathy are completely due to placebo. However, we found insufficient evidence from these studies that homeopathy is clearly efficacious for any single clinical condition. Further research on homeopathy is warranted provided it is rigorous and systematic." (emphasis added). So while the 1997 survey didn't generate strong evidence to say that homeopathy was bullshit, it didn't offer any proof that it had a genuine clinical effect. The study attracted some criticism that the authors "prejudice in favour of homeopathy is obvious". However, Klaus Linde defended the study and welcomed the criticism, recognising the flaws in corrections of publication bias (a complex topic), the fact that inconsistent methods of action for the placebo effect could generate further confusing data, and requesting others to look at the data carefully."

All a scientist or medical doctor wants to know about homeopathy is "is it better than a similarly administered placebo?"

Cochrane Collaboration, 1998

The meta-studies performed by the Cochrane Collaboration are regularly updated. Its study on homeopathic treatment of chronic asthma was first published in 1998 and reassessed/updated in 2007. The report looked at various trials of differing quality and "pooled" results; meaning that different remedies were tested, each with a potentially different contribution, and included nearly 600 people. Despite this high risk of bias and false positive results, it found insufficient evidence for a conclusive answer, and certainly no reliably positive effect. The authors concluded that few studies seemed capable of assessing the "package effect", that whereby the non-clinical aspects of the treatment, such as extended

¹ Linde, K. et. al., *The Lancet*, 350, 9081, 834-843 (1997)

² Linde, K.; Jonas, W., *The Lancet*, 351, 9099, 367-368, (1998)

consultations and additional woo-ing of patients can contribute greatly to the placebo effect.^I While such calls for additional or better research are scientifically accurate and honest (although slightly unhelpful) where the data truly is limited, they have drawn criticism from some doctors and researchers, citing that patients are owed more than non-committal statements. This is especially valid given the "extraordinary claims require extraordinary evidence" position taken by skeptics; as homeopathy is an extraordinary claim and "inconclusive" is far from extraordinary evidence.^{II}

The Lancet, 2005

The 2005 meta analysis published in The Lancet^[5] examined 110 controlled studies of homeopathy and 110 studies of matched conventional medicine studies. The Lancet study showed that there was no effect beyond that of a placebo for homeopathy. This massive undertaking examined a large amount of evidence and was systematically - i.e., fairly - constructed and carried out. The authors concluded that "when account was taken for these biases in the analysis, there was weak evidence for a specific effect of homoeopathic remedies, but strong evidence for specific effects of conventional interventions. This finding is compatible with the notion that the clinical effects of homoeopathy are placebo effects." (emphasis added) The study was criticised by Klaus Linde (author of the 1997 study above) for its high risk of generating a false-positive when restricting itself to larger studies only and pooling the data, as the efficacy of homeopathy may vary across different treatments. He did, however, agree with the conclusion. Shang et. al. responded openly to the criticisms by Linde and others and rectified some of the concerns such as the criticism of using 8 larger trials out of 110 to draw conclusions.

Positive trials

Even sympathetic researchers have problems. Homeopathic practitioners published a study performed in Honduras in the Journal of

Alternative Medicine that showed homeopathy to have no effect treating diarrhoea.^{III}

Some published positive evidence for homeopathy does exist and these papers are often cited repeatedly by practitioners.^{IV} However, these studies tend to have many methodological flaws and such flaws make the data less reliable. Ineffective blinding (where people may have been aware that they were receiving administering a placebo rather than treatment) has been known to overestimate the efficacy of a treatment under study by 17%. In addition, ineffective randomisation (where the researchers could choose, consciously or unconsciously, who received the treatment and who received the placebo) can overestimate efficacy by around 30-40%. Taking into account the methods used when analysing data is particularly important if the papers don't mention their methods; i.e., they may have something to hide.^{V,VI} When taking into account data from flawed experiments and accounting for the flaws, homeopathy still comes out as no more effective than a placebo.^{VII}

Physical evidence

Water clusters

One of the key goals for modern homeopaths is to prove the existence of special properties of water or any solvent that allow them to be clinically active despite having no active ingredient in them - i.e., are just pure solvent. This includes the succussion process that supposedly imparts the memory onto the solvent. These claims aren't entirely beyond medical or scientific testing. As with the medical evidence, this is currently lacking. Some research shows water exists as small, fluxional clusters and dimers in both solution and

^{III} Jacobs et. al. *The Journal of Alternative and Complementary Medicine*. 12, 8, 723-732 (2006)

^{IV} British Homeopathic Association, discussion comments - Here they state that 44% of trials were positive while 7% were negative. Although true, this is misleading as it is the quality of research that is important and the research with positive conclusions tend to be very flawed. The major meta-analyses into homeopathy take this into account.

^V Schulz et. al. *JAMA*, 273, 408-412 (1995)

^{VI} Moher et. al.. *The Lancet*, 352, 9128, 609-613 (1998)

^{VII} David Gorski, Fun with homeopaths and meta-analyses of homeopathy trials, sciencebasedmedicine.org

^I Cochrane.org - *Homeopathy for chronic asthma*

^{II} Hopfenspirger, M. "A more skeptical review of homeopathy" *Otolaryngology - Head and Neck Surgery*

the gas phase due to its strong propensity for hydrogen bonding. However, these do not explain water memory as they are neither long-lived enough or are affected by a succussion procedure.

NMR

At least two studies on homeopathic solutions by Nuclear Magnetic Resonance (NMR) spectroscopy found no difference. This was true of relaxation times, a property of water protons that can be easily measured in a magnetic field.¹ Another study looked at the actual spectrum of water produced by NMR. The conclusion was again negative as despite many new NMR signals appearing in the study, most were identified as artifacts, and the rest as known or unidentified impurities and none were found more frequently or specifically in the homeopathic remedies than in the controls.¹¹

Overdoses

One of the key features of any clinically active medication is the ability for it to have an overdose effect. Although this may be very high, or even too high for it to be practically consumable, it is still there - for instance, vitamin C overdoses, paracetamol overdoses that damage the liver, as well as over-hydration by consuming too much water, which is considered to be one of the main causes of death in ecstasy related fatalities. In the case of homeopathic remedies, no such observation is made. This is often cited as a good thing by homeopaths as their remedies cannot possibly cause damage; however, this is very much evidence against the remedies having an active clinical effect beyond a placebo (just to reiterate, the placebo workings of homeopathy aren't denied).

The 10:23 Overdose Event was designed to highlight this fact, as 400 homeopathy skeptics simultaneously "overdosed" on store-bought homeopathic remedies. Similarly, James Randi often consumes as many as 100 homeopathic sleeping tablets (a fatal overdose for even the mildest of genuinely active medications) at the beginning of many of his performances and

¹ Aabel S, Fossheim S, Rise F. - *Br Homeopath J.* 90, 14-20 (2001)

¹¹ Anick DJ, - High sensitivity 1H-NMR spectroscopy of homeopathic remedies made in water *BMC Complementary and Alternative Medicine*, 4, 15 (2004)

speeches. In a more serious case from late 2009, Alexa Ray Joel, daughter of musician Billy Joel, attempted suicide by consuming Traumeel, a homeopathic remedy for joint pains that is also claimed to act as a sleeping aid. Needless to say, all of these people are alive and well, and it may be the case that Alexa Ray Joel specifically took homeopathic pills so they wouldn't really kill her.

Homeopathy and the Food and Drug Administration

The 1938 Food, Drug, and Cosmetic Act established the rules for FDA regulation of drugs in the United States. Sen. Royal Copeland, a practicing homeopath, wrote in a specific clause that said homeopathy was a drug and would be regulated by the FDA as such, but with many exceptions. Homeopaths do not have to apply for a New Drug Application with the FDA for new solutions nor do they have to provide any information about their efficacy or safety. They do not have to test them at all. The only regulation the FDA has over homeopathy is to make sure the manufacturing produces a safe product (no arsenic leaking into the bottles on the production plant floor, etc.).¹¹¹

Practicing homeopaths and companies that produce these products often make misleading claims about FDA approval. When a homeopathic product claims to be FDA approved for the treatment of a particular disease it only means that the FDA believes that the product will not kill you if you take it, not that it has any efficacy against that disease.

Homeopathic products are not allowed to claim that they can cure diseases that are not "transitory" in nature. Homeopathic products can only be marketed for such things as coughs, fevers, pains, etc. Any claims made about things like cancer, AIDS, asthma, STDs or other chronic or long term illnesses violate FDA standards. Several homeopathic companies have been fined in the past for making these claims but most do not overtly make these claims. Instead products are

¹¹¹ FDA.gov, *Homeopathy: Real Medicine or Empty Promises?*

sold for more general ailments like "liver problems" rather than hepatitis. Another way of sneaking this in is by hired sales people making the claims in one-on-one sessions with patients where it is usually difficult to prove such wrongdoing. One example of this is in England where homeopathic consultants were advising patients to take their products for malaria.ⁱ

In June 2010, the FDA sent a warning letter to Wisconsin-based "Homeopathy for Health" saying that it was falsely advertising homeopathic products that claimed they could treat the H1N1 virus. The letter included nearly twenty products from six different manufacturers, all of which were claimed by the seller to directly treat viral infections following the 2009 swine flu outbreak. The manufacturers were also notified with the same letter, as the FDA notes that manufacturers may not necessarily make the same claims as online retailers.ⁱⁱ The FDA's list of fraudulent treatments for H1N1 infections has 185 entries.ⁱⁱⁱ

Additional thoughts

Real evidence?

Are there any examples that show an effect of homeopathy? The answer to this question is a little complicated, but essentially, no. The only studies that show an effect are studies that do not use a double-blind control. This makes them worthless, but homeopathic practitioners claim it is the only way. Here is an interesting fact: the James Randi Education Foundation has a \$1 million prize for anyone who can demonstrate certain "supernatural" powers (and, make no mistake, "potentization" is definitely a supernatural claim). This prize is open to any homeopath who thinks they can demonstrate an effect. A few small-time practitioners have attempted to do this but all have failed. What is more interesting is no major "homeopathic" producer has bothered to pursue it, despite many attempts by the foundation to get them to try. These producers would not only get the money but instant free press and fame. One

should ask why they refuse to put their products to the test.

Placebo effect

It is undeniable that homeopathy works, at least for a given value of "works" and this is via the placebo effect. This is the effect by which something that is clinically inactive can still produce positive results because of various factors, from positive thinking (i.e., mind over matter) to suppressing people's symptoms mentally and making them feel better about the situation. This is known as a complex intervention because it is rarely a straightforward thing to quantify; different people will experience different effects. In the case of homeopathy, it is most effective when homeopaths give time and attention to their patients, in contrast to overworked general practitioners who may give a quick exam and write a prescription for a course of painkillers (many of which are enhanced by some forms the placebo effect anyway). This is the factor that gives homeopathy its apparent power to treat simple illnesses or maladies—but not "real" diseases like malaria or cancer. However, this is not the same as "efficacy." To justify the claims of homeopaths and alternative medicine advocates that there is more than just a placebo effect occurring, what needs to be tested is just the homeopathic remedy on its own without all the extra bells and whistles, sometimes referred to as "clinical homeopathy". In all respects, homeopathic remedies fail this.

Although the placebo workings of homeopathic treatments aren't denied, the use of the placebo effect in treating patients is considered ethically dubious due to the deceit involved, as well as potential risks to a patient should they be suffering from an illness that cannot be remedied by placebo alone. Homeopathic remedies, being just water, cannot actively harm patients, but there are many indirect risks, some of them quite considerable, such as patients increasing distrust in conventional evidence based medicine, or the

ⁱ BBC Newsnight - *Malaria advice 'risks lives'*

ⁱⁱ Casewatch.org - Homeopathy for Health

ⁱⁱⁱ FDA.gov - *Fraudulent 2009 H1N1 Influenza Products List*

misdirection of funds by professional organisations that promote it.¹

Mass production

Some homeopathic remedies come in "pill" form. In this case, not even claims of "water memory" help explain how they work. "Sugar memory," perhaps.

Finally, here is the most important point for "mass production" homeopathic remedies, the kinds produced in factories. Let's ignore all of the problems with the basic foundations of homeopathy, let's ignore all of the mountains of evidence showing zero effect of the "cures", let's ignore the refusal of all the major proponents to be put to the test. And let's, for the sake of argument, assume that there is something to homeopathy. Even if this is the case then mass produced cures will not work. This is the absolute basic rule of homeopathy. The reason that proponents say that you cannot use double blind test is because each and every single cure must be tailor made to the specific person it is to be used on. However, this argument is nonsense, you can just switch the remedy at the very last minute without letting either the homeopath or patient know whether they are receiving a prepared remedy or tap-water. This would preserve the psychology of the placebo effect - where if the doctor knows that they're giving a sugar pill, this information is subconsciously indicated to the patient, who is less susceptible to the effect - resulting in a fair trial for both sides. In the best homeopathic studies, this is what has been done. Each ingredient, that amount, the ratio, and the procedure is painstakingly crafted on a person-by-person basis. By even the standards of proponents of homeopathy no mass cure can possibly work.



Some homeopathic remedies come in "pill" form. In this case, not even claims of "water memory" help explain how they work. "Sugar memory," perhaps.

Conclusion

Legitimizing quack medicines and beliefs like homeopathy, and ignoring basic concepts such as skepticism and the scientific method, is a very dangerous thing. It encourages a culture where facts are, ultimately, relative and subsequently objective evidence is meaningless. If you wonder why 30 percent of Americans still believes that Iraq was responsible for 9/11 or that over 40 percent still believe that weapons of mass destruction were found, the answer is in issues such as this. One cannot stand on the side of facts, truth, and legitimacy in only one area. When "facts" can be abandoned because we don't like the "feeling" they give us, and lies are swallowed because it makes us feel good, the results should be obvious to any educated person.

Homeopaths may find criticism of their practices blunted if James Randi finally manages to overdose on homeopathic remedies. Randi commented "I did this before a meeting of the US congress - which if that doesn't put you to sleep, nothing will."

¹ Shaw, D.M., *J. Med. Ethics* 36, 130-131 (2010)