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When the Interplay Between Evidence and Theory Becomes Tension: Dr Hahnemann's Homeopathic Medicine

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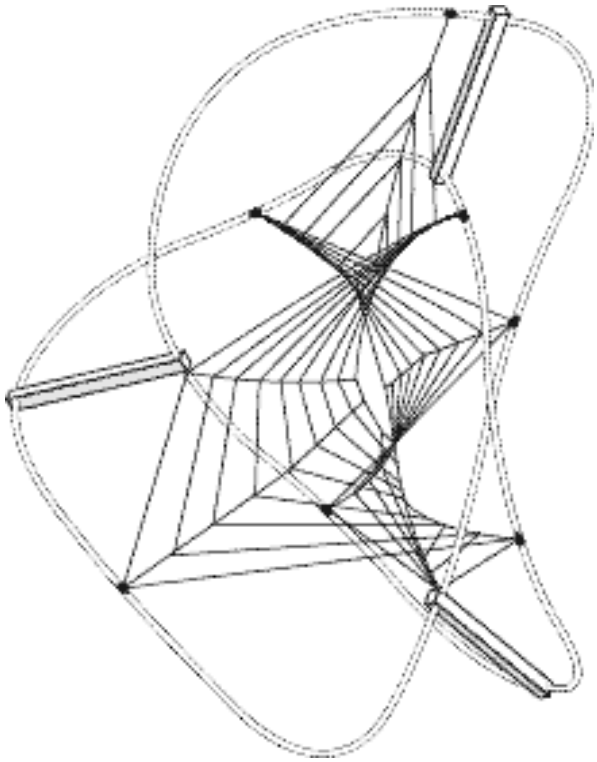

Editor: Max Steuer

When the interplay between evidence and theory becomes tension: Dr Hahnemann's homeopathic medicine*

Valeria Mosini

Abstract: Christian Hahnemann, a German doctor, founded homeopathy at the beginning of the nineteenth century. Homeopathy was developed using the inductive methodology at a time when this method had begun to prevail over Descartes' deductive methodology in the whole of Europe. Homeopathy is recognized, under strict regulations, in 15 European Countries and in many non-European Countries, including India, Canada, and the United States. However, since there is not, to this day, an explanation for how it works, its scientific status is questioned and its practitioners are regarded as dissenters. Evidence gathered over the last twenty years in as diverse fields as theoretical and experimental physics, chemistry and immunology, points to a possible breakthrough that might lead to an explanation of how homeopathy works. The history of science, I maintain, shows that evidence and theory do not always go hand in hand, and often the former runs ahead of the latter: Discarding hitherto unexplained, but reliable, evidence is dangerous. Within philosophical discourse, homeopathy as an instance of dissent adds weight to the view, repeatedly voiced of late, that regarding the methodological question as settled in favour of the hypothetico-deductive approach is an over-simplification.

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1. Introduction

In addressing the question of the role of dissent in science, I wish to make my position clear right from the start. My position is that dissent is not on the fringe, but at the heart, of science; in other words, that science does not exist, and would not have progressed, without dissent. And here, in essence, is why.

Firstly, consider that the father of modern science, Galileo, was a dissenter against the dominant cosmology of the time, Ptolemy's, which drew support from being based on the Aristotelian tradition, and from being in line with the Bible. But Galileo was also a dissenter against the well-established habit of founding scientific knowledge on conclusions drawn on the basis of perceptions and under the guidance of common sense. Galileo showed how misleading this habit was, by pointing out that motion has a relative, not an absolute, character. Secondly, consider that the history of science has shown that, whenever theory change has occurred, the new theory was borne out of some kind of dissent against the accepted theory, and that such dissent turned itself into a challenge, which, in turn, led to theory change.[1] Philosophers disagree on whether theory change is a continuous or a discontinuous process (respectively, for instance, Popper: 1934, and Kuhn: 1972). However, scientists contribute to theory change with their daily endeavours, and acknowledge that dissent plays a role in bringing theory change about.[2]

With these preliminaries on the role of dissent in science out of the way, I would like to address the question of how dissent manifests itself within the scientific domain. Broadly speaking, any view that does not coincide with the view that dominates at any given time represents an instance of dissent. However, a characterisation of this kind, due to its extreme generality, provides no workable criterion for evaluating how dissent manifests itself in science, and leaves too much room for uninteresting cases. Roughly speaking, four meaningful examples of dissent in science can be identified. The first example is that of two rival theories that start out more-or-less together and compete with each other, until the competition is eventually resolved in favour of one of the two. (Notably, the theory that prevails is not always the one initially favoured by the majority of the scientists.) The second example is the emergence, from within the accepted conceptual and theoretical scheme, of a new scheme that, in due course, replaces the previous one. In both cases the dissenting view brings

[1] Of course, not all instances of dissent result in a challenge to the accepted theory.

[2] It is only those who believe in the advent of the 'final theory' (see, for instance, Weinberg: 1993), that envisage the possibility of science without dissent. However, most scientists know from experience that the solution of a riddle is almost invariably accompanied by the emergence of a new, previously unforeseen, riddle, and that this fact makes all dreams of a final theory elusive.

about theory change, thus contributing to the advancement of knowledge. The next two examples refer to splits between the supporters of the dominant view and those of the dissenting view that are not resolved. It is either the case that the dissenters establish a heterodoxy that lives side by side with the orthodoxy, or that the heterodoxy is silenced because it has been shown wrong. Knowledge is either widened by the emergence of an alternative paradigm, or deepened if the accepted view is corroborated by its standing up to the challenge brought to it. The only case in which dissent cannot exert its positive influence is when it is stifled although the questions it raised remain unanswered.

The case study that I discuss in this paper, Hanemannian homeopathy, is an example of the establishment of a heterodox tradition alongside the orthodox one. Homeopathy is recognized, under strict regulations, in 15 European Countries and in many non-European Countries, including India, Canada, and the United States. The co-existence of two traditions within the medical practice has been allowed whilst the scientific status of the two disciplines is not considered to be the same, and homeopaths are regarded as dissenters.

What is interesting about dissent in science for the philosopher is not so much the way in which it is manifested, but what specific aspect of the complex set of characteristics of scientific knowledge each instance of dissent impinges upon. In the case of homeopathy this is such a crucial philosophical question as that of the interplay between evidence and theory, a question that was at the heart of the split between the followers of Descartes' deductive methodology and those of Newton's inductive methodology that characterised the very early days of modern science.

Recall that Descartes held that natural phenomena could be explained in terms of hypotheses derived from innate principles imprinted in the human mind by God and perceived as 'clear and distinct ideas', and restricted the role of experiments to that of providing a full and detailed picture of the phenomena (Descartes: 1637). His followers felt at liberty to shift the balance between theoretical hypotheses and evidence even more towards the former by assuming that the truth of scientific hypotheses resided more in these being derived from innate principles than in being experimentally confirmed (see Metzger: 1923). As far as Newton's methodology is concerned, it closely reflected his fourth rule of philosophising, which required making experiments and observations, and drawing general conclusions from these by induction (Newton: 1704). Newton urged that no conclusion derived from metaphysical principles should be accepted untill it had been shown to stand up to experimental test, and that scientific hypotheses should be suggested by observation ("*hypotheses non fingo*"), and treated as conjectures to be corroborated or overthrown after being examined in all their observational consequences (Newton: 1704). But he insisted that hypotheses should never be used as founding principles of theories, fictional explanatory devices, or explanatory devices that resorted to "superfluous" (Newton: 1672) or "occult" (Cotes: 1729) causes.

By the early eighteenth century, Newton's methodology had prevailed over Descartes' in England and, by the mid-1750s, also in Continental Europe. Since then science has been widely regarded as inspired by the inductive methodology (Whewell: 1837). However, and notwithstanding the success of Newtonian mechanics, Descartes' influence on scientific matters did not die out altogether, nor did the deductive methodology, which re-appeared on occasion.[3] Popper (1934) reversed the view that science is driven by the inductive methodology and suggested that, in fact, the scientific methodology is best described as hypothetico-deductive; his claim gained vast popularity among the philosophers (see, for instance, Glymour: 1982), and , even led to the re-assessment of, Newton's methodology as being hypothetico-deductive rather than inductive (Worrall: 2000).[4]

Note that Descartes regarded all the questions discussed in the *Principes* as "absolutely and more than morally certain" (Descartes: 1644, p. 301). Newton, by contrast, held that scientific knowledge should always be considered provisional because, unless all possibilities had been taken into account, one could never be sure to have come to the right conclusion, but one could never be sure to have taken into account all the existing possibilities (Newton: 1672). Hence subscribing to the deductive or to the inductive methodology had implications for the question of whether scientific knowledge should be attributed definitive or provisional character. Notably, if scientific knowledge is regarded as a system of truths, all departures from the orthodoxy are blocked, whereas, if it is regarded as open to revision, these represent potentially useful avenues to be investigated.

The question of whether science is regarded as a system of truths, or as a temporary edifice open to revisions, brings us back to the main topic discussed in this paper: the question of dissent in science. Homeopathy has been denied access into the world of proper science because, despite the evidence in its favour, its two principles were, and remain, unexplained. Homeopathy turns the interplay between evidence and theory – which has assumed all possible nuances from smooth to problematic – into overt tension. The fact that it has not been wiped out altogether is largely due to its empirical success, which was recognised since the early days of the discipline. The inability to account for this empirical success has led those who believe that evidence should be the logical consequence of theories to attribute the success of homeopathy to the placebo effect or, even, to faith healing. However, findings accumulated over the last twenty years in as diversified fields as theoretical and experimental physics, chemistry and immunology, point to a possible breakthrough that might lead to the explanation of how homeopathy works, and have already contributed to a better understanding of the properties of such an important substance as water.

[3] See, for instance, Oersted's interpretation of his own findings on the interaction between electricity and magnetism (Arago: 1854), the '*ésprit de système*' embedded in *Naturphilosophie*" (Gower: 1973), and the deductive approach to knowledge in economics that followed the mathematisation of the discipline (Ingrao et al: 1990).

[4] Similarly, the methodology behind Ampère's electrodynamics has been re-assessed as being hypothetico-deductive (see, for instance, Merleau-Ponty: 1974) . For a contrary view, see Mosini (2002).

If and when the success of homeopathy will be explained (if it will at all) is not the issue here. The tension between evidence and theory that homeopathy has induced has already borne fruit in the field of the chemico-physical properties of solutions. Discussing homeopathy as an instance of dissent transcends the boundaries of the medical practice and makes a strong case for always attributing provisional character to scientific knowledge, and for adopting the inductive methodology. But before going on to develop these themes, I wish to summarise how homeopathy was discovered. I start with some notes on the life and work of the man responsible for this achievement: Christian Samuel Hahnemann.

2. How did homeopathy come about, and what are its tenets?

Christian Hahnemann was born in Meissen (Saxony) in 1755. His father was a painter of Dresden china for the local factory. When Frederick II of Prussia ordered the raid of the factory, jobs became scarce in the area, and Christian's father was no longer able to send his children to school. The Headmaster of the Town School, however, hearing that Christian was heart-broken at the prospect of leaving school, offered him the possibility to stay on without paying the usual fees. After attending secondary school, Christian went to Leipsig University to read medicine, and since the University had no hospital, moved to Vienna where he graduated in 1779. A year later he started practising medicine in a small village in Saxony, and also took up studying metallurgy. He then moved to Dessau, where he collaborated with the local pharmacist on various chemical researches published in *Apothecaries' Lexicon*, a work in four volumes. From Dessau, Hahnemann went to Dresden, where he met Lavoisier, and started practising medicine among the poor. He was shocked at the appalling living conditions of the majority of the people in the town. As a result of this experience, he became aware of the importance of helping the ill with sympathy and understanding alongside imparting the standard medical treatment, and urged that doctors should be endowed with more than just technical knowledge: he saw good doctors as 'healers'.

The fact of not seeing the medical profession of the time as living up to his expectation caused Hahnemann to withdraw from the profession altogether in 1791. His only source of income at the time was the translation of Dr Cullen's *Materia Medica*, an endeavour that he had started in 1790. In his careful reading of this important text, he was struck by the discussion of the success of *Cortex Peruvianis* in the treatment of intermittent fevers, while the reason for the success of the remedy remained unknown. Hoping to make some progress in the understanding of the way in which the remedy worked, Hahnemann decided to try it on himself. He took *Cinchona Bark* for several days, and developed the symptoms associated with intermittent fevers; however, the symptoms went as soon as he discontinued the treatment. This accidental observation prompted him to experiment with various substances that he and his collaborators tried on themselves. After six years of incessant experimentation, in a paper published in

1796 in the *Hufelands Journal der practischen Arzneykund*, he enunciated the law of treating likes with likes. The law stated that:

Treatment should be by substances which, when taken in more or less substantial doses, cause in healthy persons the same symptoms that characterise the disease to be treated.

Encouraged by the results of his discovery, Hahnemann returned to Leipzig to practice his newly invented medicine. During the epidemic of scarlet fever of 1799, he noticed that, in a family in which three members suffered from the disease, a young daughter, usually prone to catching diseases, was, in fact, immune. The girl was being treated with *belladonna* for another disorder, and Hahnemann decided to administer the same remedy to all the healthy children in the house, who remained in good health throughout the epidemic.[5] From then on, Hahnemann started investigating the effects of substances taken accidentally in excessive doses by the healthy, and tested a number of substances on himself, soon after on physicians and laymen interested in the investigation. The need to experiment with toxic or poisonous substances only in high dilutions brought about the paradoxical observation that the remedies were more effective the more diluted they were, which is known as 'the law of dilution'. Hahnemann devised a special procedure that he dubbed 'dynamisation', to dilute the substances, and emphasised that great care should be given to closely following that process.[6] In 1805 he published the methodological background of his findings in *The medicine of experience* (translated in English in 1845). In 1810, he published his most important work, *The Organon of the rational art of healing* (translated in French in 1824 and by 1833 in Hungarian, Swedish, Russian, Italian, Spanish, and English), and in 1811 the *Materia Medica*.

Hahnemann had noticed that the very same disease, for example *influenza*, caused different symptoms in different people: a desire to feel warm and be tucked up in bed in some, and an unquenchable thirst and the urge to throw the bed linen in others. Hence he urged that, to identify the most appropriate treatment, homeopathic physicians should take into account not just the disease, but, rather, the patient as a whole with all his/her characteristic traits. This recommendation was based on the role that he attributed to causality in medicine. Hahnemann acknowledged that no effect exists without a cause but noted that only miasmatic diseases, such as syphilis, plague, yellow fever, and smallpox, arise from one and the same cause. These diseases preserve the same characteristics and follow the same course whenever they are displayed; hence they can be called by a specific name and treated by the same remedy. However, there are few miasmatic diseases. All other diseases depend on a concurrence of different causes, varying in number, nature, and intensity. Since several causes are usually involved with the same disease, the physician must be sure that the symptoms on which the diagnosis is based are reported in a

[5] In 1838 the Saxon Government recognised the therapeutic and prophylactic value of *belladonna* against scarlet fever.
[6] It required using purified water, and shaking the solution one hundred times in each dilution step.

reliable manner. Hence the recommendation to listen in silence to the patient's report, and then ask precise questions aimed to check that the patient reported the symptoms in the same way as before: the most important thing for a homeopath is to reason on reliable evidence (Hahnemann: 1845).

The enunciation of the two founding principles of homeopathy, the law of treating likes with likes and the law of dilution, amounted to a radically new approach to medicine. Not surprisingly, the profession reacted badly and attacked Hahnemann, covering him with scorn and ridicule and attributing the success of homeopathy to faith healing. However, one of Hahnemann's disciples, Carl von Boenninghausen, tried the remedies on animals, starting a successful homeopathic veterinary practice, and proving that the point about faith healing was ill taken. It is noteworthy that the physicians were not alone in opposing homeopathy. Soon the apothecaries joined in, mainly for reasons of self-interest. This is because, to be sure that the process of dynamisation was followed as enunciated by Hahnemann, the homeopaths took the habit of preparing the remedies themselves, thereby bypassing the apothecaries. Moreover, the standard procedure of administering drugs in large quantities was more profitable for the apothecaries than the diluted doses used by the homeopaths. The combined effect of the opposition of the physicians and of the apothecaries was such that, on March 15, 1820, Hahnemann was ordered to stop preparing and dispensing medicines. This was a very difficult time for him. His enemies gathered together and tried to inflict on homeopathy a mortal blow. Through the influential publisher Baumgarten, they commissioned a book that would denounce the fallacies of the 'homeopathic heresy'. Dr Hering, who had been commissioned to write the book, decided to experiment with some homeopathic remedies to test their effect. Much to everyone's amazement, he soon became convinced of the merits of homeopathy and, together with Baumgarten,[7] moved to Hahnemann's camp.

The turning point in the way in which homeopathy was perceived came at the time of the great European cholera epidemic. By relating the symptoms that accompanied the disease[8] to the symptoms induced in a healthy person by a number of remedies, Hahnemann identified *Camphor* as the best treatment for cholera patients. When the epidemic spread to England, a record was kept of the number of people who died after receiving the standard treatment and after receiving the homeopathic treatment. The result was that 59.2 percent of victims receiving the standard treatment died compared to only 16.4 percent of those receiving the homeopathic treatment(Haehl: 1921).[9] Following the success of the treatment with *Champho*r, in 1844, the London Homeopathic Hospital (later called Royal Homeopathic Hospital) was founded. Hahnemann became an accepted figure, although still in rather marginalized quarters, and, in 1835, aged eighty, moved to Paris, where he continued to see patients and, most

[7] Who was, at the time, the Editor of *Zeischrift fur physik*.
[8] And without having actually seen even a single patient affected by cholera!
[9] These data have been found in the records of the British Museum's (Waugh: 1961).

importantly, to experiment with new doses until his death in 1843. He was first buried in the Montmartre cemetery. Fifty years later, his tomb was moved to the Père Lachaise.

3. Why tension?

I am not interested, here, in discussing the sociological basis of the opposition that homeopathy faced in its early days. In the state of confusion that characterised the medical science of the time, increased by the wild experimentation carried out in the second half of the eighteenth century, the opposition to homeopathy is likely to have been largely driven by envy for the success of the new medicine, combined with prejudices against its principles for violating common sense. As I spell out hereafter, there have been developments in physiology and cell biology after Hahnemann's time that slightly eased the opposition to the law of similarity. By contrast, the opposition to the law of dilution could only became stronger after the molecular hypothesis was accepted at the Karlshrue Conference of 1858.

The aforementioned developments in physiology originated with two observations made independently of each other in 1888. The first observation was that weak *stimuli* slightly accelerate the 'vital activity', medium-strong *stimuli* raise it, strong ones suppress it, and very strong ones halt it. The second observation was that poisonous substances, such as iodine, bromine, and arsenic, administered to yeast in very diluted solutions stimulate cellular growth.[10] The gist of the two observations combined together is that any stimulus on living cells elicits an activity that is inversely proportional to the intensity of the stimulus. The phenomenon that the same substance has opposite effects when administered in small or large doses is known as 'hormesis' (Southam *et al*: 1948). Although unexplained, hormesis has found wide application in the standard medical practice. So, for example, mercury salts, which are known for causing *oliguria* and *anuria*, are used in reduced concentrations as diuretics. Similarly, digitalis causes *tachycardia*, while, assumed in minute quantities, helps treat arterial fibrillation.

By the 1960s, a list of one hundred substances that cause hormesis was published, and their effects were observed not just on whole living organisms but also on purified enzymes and cells (Townsend *et al*.: 1960). However, although there is an analogy between the phenomenon of hormesis and the law of the *simile*, there is an important difference between the two. This difference comes about because in hormesis it is one and the same substance that has adverse or beneficial effects, depending on its being administered in large or small concentrations. In homeopathy, as it is intended to be practiced, there is a similarity between the symptoms reported by the patient (or detected by the doctor) and the symptoms caused by a given remedy on a healthy person. In other words, what is at play in hormesis may be called the 'identity law' (Bastide

[10] These observations were subsequently joined together, and became known as the 'Arndt-Schultz law'.

et al: 1992) as opposed to the similarity law of homeopathy. It follows that the phenomenon of hormesis does not explain how the law of the *simile* works.

But the really problematic principle of homeopathy is the law of dilution. Let us see why. Recall that the most widely used homeopathic potencies are 6CH, 12CH, 30CH, 200CH, and 1000CH, and that the power of the remedy is assumed to increase as the dilution increases. Hence potencies such as 200CH and 1000CH are used to treat chronic diseases, the most difficult ones to eradicate. The 1CH potency is obtained by adding 1 drop of the substance to 99 drops of water or alcohol, hence in the 2CH potency the substance is present in the ration of 1/10,000, and in the 6CH potency it is diluted one million millions times. This implies that in all potencies beyond 30 CH, there is less than a chance in a billion to find one molecule of the substance initially dissolved in the solution from which the potency is prepared. If this is so, there is no known mechanism that could explain the therapeutic effect of solutions that, chemically speaking, are nothing but water This was the strongest argument against homeopathy at the time of its formulation, and certainly remains a potent consideration. And yet, the effect of homeopathic dilutions has been observed on entities as simple as cells (Shinoshara: 1989, and references therein), and animals (Endler *et al*.: 1994):[11] Hence, attempts to dismiss the success of homeopathy as amounting to faith healing, or as being based on the placebo effect, are misplaced. The situation is bewildering to say the least. So much so, that a paper in the authoritative Journal *The Lancet* described "homeopathy" as being "scientifically implausible", but as having "widespread use" and concluded, therefore, that "a serious effort to research it is clearly warranted" (Lindea *et al.* 1997, p. 834). The authors of the paper conducted a meta-analysis of placebo-controlled trials and concluded that the evidence was not compatible with the effects of homeopathy being due solely to placebo, while falling short of proving that homeopathy was efficacious in any single "clinical" condition.

We may ask, what do the authors of the *Lancet* paper mean by a "clinical" condition? They are aware of a big problem that stands in the way of evaluating the efficacy of homeopathy against that of the standard medical practice. It relates to the fact that homeopaths do not address just the pathological symptoms as if these were constant for all patients suffering from the same illness. Rather, they evaluate the patients' pathological symptoms in the light of the patients' physiological traits. Lindea and co-workers take this fact into consideration, and, in their attempt to evaluate the efficacy of homeopathy against that of the standard medical practice, draw a distinction between "classical" and "clinical", homeopathy. The former is a practice that prescribes a single remedy, selected on the basis of the sum of the symptoms and of the physiological traits of the patients, in full accordance with the Hahnemannian homeopathic practice. "Clinical" homeopathy, in fact, is better described as a hybrid between Hahnemannian homeopathy and the standard medical practice in

[11] Leading to the establishment of a veterinary practice with an International Association of Veterinary Homeopathy, and a widely read *Journal of the Academy of Veterinary Homeopathy*.

that it associates homeopathic remedies with diseases identified on the basis of conventional diagnoses.

Although it would be wrong to consider "clinical" homeopathy as a totally made-up concept, it is of very limited scope. This is because it applies to miasmatic illnesses, such as, typically, scarlet fever and cholera, but doesn't apply to conditions that, although triggered by the environment, originate within the patient, as in the case of headaches, stomach and bowel problems, skin conditions, and so on. It is true that the power of homeopathy was discovered in the treatment of scarlet fever and cholera, hence in the context of the so-called clinical homeopathy; however, miasmatic diseases do not represent the majority of the medical conditions. (See Hahnemann's position on miasmatic diseases reported in Section 2) Failure to establish that homeopathy is efficacious within the context of so-called "clinical" homeopathy is not sufficient evidence that its remedies have no significant effect. The success (or the failure) of homeopathy should be evaluated by comparing its rate of success against that of the standard medical practice, provided that, in each case, diagnoses and treatments are made according to the practice in question.

Even those who acknowledge the success of homeopathy are bewildered by the fact that potencies are much too diluted to contain anything but water, and lament the fact that the success of homeopathy remains unexplained in the light of our best current knowledge. And yet, the lack of a theoretical explanation for the success of homeopathy did not trouble Hahnemann and his followers in the least.[12] Why? The answer is simple. Both laws of homeopathy are empirical generalisations, and Hahnemann proudly described his newly discovered discipline as having "sprung purely from experience, being referable only to experience, and conformable or refutable only by counter-experience and counter-experiments" (Hahnemann: 1845, p. 68). His candid admission was due to the fact that he was working within the framework of a cultural milieu strongly influenced by Newton's inductive methodology, which urged investigators to base scientific laws solely on observations. "Medicine is a science of experience…physicians have lost two hundred years in seeking to discover the invisible changes of which the interior of the body gives evidence during disease, the ultimate consequences of these, and the nature of their being" (Hahnemann: 1845, p. 69). By contrast, to identify the best treatment, "…the physician has only to observe with attention. He must avoid all conjectures and suggestions." (Hahnemann: 1845, p. 72).

[12] In discussing the use of infinitesimal doses in homeopathy, an English doctor stymgatised the "vulgarity of those pedantic *dilettanti* who base their objections (to infinitesimal doses) on their own suppositions and prejudices" (Brown: 1845, p. 164), but urged homeopaths to "excogitate a congruous and easily comprehensible doctrine of insensible doses". However, he added: "not that the want of apparent consistency with everything else that is known of the operations of nature would be a decisive argument against invisible medicines. One satisfied that impalpable quantities have the copious testimony of nature in their favour, homeopaths should abide by them in defiance of theoretical consistency" (Brown: 1845, p. 157-58).

As I hinted earlier, some twentieth century philosophers, following Popper's lead, started a re-examination of scientific methodology that led to regarding it as hypothetico-deductive rather than as inductive. Moreover, the remarkable scientific breakthroughs that characterised the century, most notably in physics and biology, increased the faith in the explanatory power of science and in the role of unobservable entities in theories. All this contributed to shift the balance between evidence and theory considerably towards the latter, and made the demand that evidence should be explained before being taken into serious consideration almost mandatory. However, the situation regarding the question of the interplay between theory and evidence is not so clear-cut, and there have been calls for redressing the balance between theory and evidence by shifting it again towards evidence, and favouring the inductive as against the deductive methodology. This urge has been felt both in the natural and in the social sciences: "Except for Karl Popper and his followers, few philosophers of science during the twentieth century have held that deduction alone exhausts the methods of science. Scientists…use inductive methods as well" (Giere: 1999, p. 240), and "Contrary to the prevailing trend, one should subordinate deduction to induction, and look for empirical regularities first." (Kaldor: 1985, p. 8) Surely, favouring the inductive methodology does not imply resting content with making observations and empirical generalisations, and giving up on attempting to explain observations by a theory. To the contrary, being inclined towards the inductive methodology means not ruling out evidence that is confirmed by being gathered repeatedly, in different contexts, even when no explanation for it is available, and leaving the door open for the possibility that an explanation for it will, at some stage, emerge. As an illustration, in the next section I discuss where we stand as far as the possibility of explaining the success of homeopathy is concerned.

4. Light at the end of the tunnel

First we should recognise that such low concentrations as those of homeopathic potencies have been found to induce hormesis in micro-organisms, cells, organs, and animals (for a comprehensive survey of the relevant literature, see Endler *et al*.: 1994). For instance, *Silica*, which is known for its cytotoxic effect on macrophages (Alison: 1966), has been shown to stimulate the production of the mediators responsible for the biological activity of the macrophages when added *in vitro* to cells at concentrations of the order of magnitude of homeopathic potencies (Poitevin et al.: 1986). The effect of the oral administration of solutions of *Silica* 1.66×10^{-11}M and 1.66×10^{-19}M to mice for 25 days, tested against the administration of pure water, was that of stimulating the biological activity of the macrophages and the more so, the more diluted the solution administered. The effect was shown to be specific to the remedy used, as shown by the negative results of a protocol experiment identical to the previous one, but for the fact that *Gelsemium Sempervirens*, a substance known for having neither positive or negative effects on macrophages, replaced *Silica* (Davenas *et al*.: 1987).

However, as I mentioned earlier on, the phenomenon of hormesis obeys the law of identity, and the homeopathic practice the law of the *simile*. Hence the fact that homeopathic potencies induce hormesis should not be taken as evidence for the therapeutic effects of homeopathy but just as showing that potencies do have different properties to bi-distilled water. Yet a suggestion as to why homeopathic potencies have biological activity has actually been put forward, as the result of an amazing piece of evidence, gathered in a totally accidental manner. The suggestion is that the electromagnetic field of homeopathic potencies differs from that of bi-distilled water as a result of the water molecules orienting themselves around a solute, and keeping the new arrangement even when the solution has been so diluted that it no longer contains any molecules of the solute (Benveniste: 1988).[13] As it happened, the changes in the electromagnetic field of homeopathic potencies, if any, were too small for Benveniste to detect them. Not surprisingly his paper met with fierce opposition (Maddox et al.: 1988). He was basically charged with scientific fraud, stripped of his post as Head of a Research Unit of the CNRS, and, in all effects, banned from the scientific community. However, the paper that so violently criticised his work (Maddox: 1988) was, in turn, challenged (see, for instance, Taylor Reilly: 1988) and Benveniste, at least partly re-habilitated, was able to resume his investigations. He found further confirmation for his hypothesis in evidence showing that the biological activity of homeopathic potencies is destroyed by heating the potencies at 70^0 C for 30 minutes , or by subjecting them to an external field of 50 Hz and 150 Oersteds for 15 minutes. (Benveniste: 1994)

This is an important stage in the argument, and I want to defend the view that maintaining that traces of substances induce different spatial arrangements in water molecules should not have stirred so much controversy. This is because the clustering of water molecules in higly diluted solutions had been postulated on the basis of evidence from chemistry (Benson: 1978), justified on the basis of considerations from theoretical physics (Del Giudice et al.: 1988), and experimentally confirmed of late (Lo et al.: 1998). Benson (1978) suggested that, in highly diluted aqueous solutions, the water molecules would orient themselves in clusters around the molecules of the solute. His suggestion aimed to provide an explanation to the observation that hydrogen-bonded molecules (such as those of water) and long-chain molecules have abnormally high heat capacities. Del Giudice (1988) predicted, on the basis of theoretical calculations, that the presence of traces of substance in water would cause the electric dipoles of the water molecules to interact with the field generated by the charge distribution of the impurities present in it, bringing about a coherent, permanent, polarization of the water molecules, similar to that obtained in a laser.[14] He showed that the interaction in question would happen irrespective of how low was the

[13] Interestingly, Hahnemann mentioned electricity, together with heat and cold, as "the most diffusible medical dynamic stimuli" (Hahnemann: 1845, p. 97).

[14] Recall that laser is an acronym that stands for light amplification by stimulated emission of radiation. A laser emits coherent beams of light, *i. e.* beams in which all waves have the same frequency and phase.

concentration of the impurities. Even when only a few molecules or colloid grains were present, he concluded that: “One can envisage the possibility that the coherent interaction between the water electric dipoles and the radiation field fulfils the very important task of generating ordered structures in macroscopic domains (*i. e*. within a few hundred microns), which could then have a fundamental role in the organisation of inanimate as well as living matter” (Del Giudice et al.: 1988, p. 1088).

In his work, Lo observed by electronic microscopy that the presence of ultra small amounts of acids, bases, or salts in water induced the formation of rod-like structures, namely of orderly molecular arrangements such as those of ice, albeit having different configurations to that of ice (Lo et a.: 1996). He detected the formation of those structures at room temperature and normal pressure, against the well-established fact that the formation of ice at room temperature requires pressures higher than 7 Kilobars (Fletcher: 1970). The rod-like structures formed by water molecules are known as I_E-Ice. When formed under an electric field, they give rise to clusters of different sizes ranging from 15nm to 3 microns. Water solutions of I_E may reach the concentration level of 3.79%; they withstand temperatures of 80^0 C, and are stable over a period of two years at room temperature. The values of five parameters (dielectric constant, electromotive force, resistivity, fluorescence, and stability as a function of temperature) of water containing I_E were found to differ considerably from those of bi-distilled water (Lo: 1998). Further investigations showed that several parametrs of homeopathic potencies differ from those of bi-distilled water, as in the case of the heats of mixing (Elia et al.: 1999).

The discovery of I_E prompted research into its possible medical applications. B. Bonavida, a leading figure in cancer research, found that water containing I_E causes from a two-fold to a hundred-fold increase in the amount of some mediators of the immune function, namely the cytokines, which protect against infection and tumour growth (Bonavida: 1987). The difference in the increase was found to depend on the patient’s response, but the overall pattern was found to be the same for all patients. Bonavida also noticed that the kinetics of induction was as rapid as 2 hours after stimulation (Bonavida: 1998). It is important to note that the fact that the immune system of different individuals responds differently to treatment with water containing I_E, albeit within a similar overall trend, and the rapidity of response, are all in line with what is observed in the homeopathic practice. (For a review of investigations on I_E for medical purposes, see Lo and Bonavida (1998).

Conclusions

Summing up, evidence gathered outside homeopathy, and, therefore, independently of the homeopaths’ agenda, suggests that traces of substances cause permanent modifications in the tri-dimensional arrangement of the water molecules that become clustered. The modifications in question are reflected in

the chemico-physical parameters of the solutions that have different values to those of water which has not been stimulated in that way. The evidence pointing to the formation of clusters of water molecules in highly diluted solutions was gathered in as diversified fields as theoretical and experimental physics, chemistry and immunology. It is generally agreed that independent confirmation of any given piece of evidence is usually taken to be a strong indication that the evidence is reliable, and should be taken seriously. However, accepting that traces of substances can cause permanent alteration in the tri-dimensional arrangement of water molecules does not on its own explain the success of homeopathy. In addition we need to know how the arrangement of water molecules in clusters could have therapeutic implications.[15]

Some support for therapeutic capability may come from noting that approximately 70% of bacterial cells' mass, and around 90% in the case of the cells of higher organisms, is water. And in addition, the vast majority of biological processes are caused by weak interactions, such as those induced by dipoles or hydrogen bonds. These interactions in turn depend heavily on the tri-dimensional structure of the molecules involved in the interactions. Hence, any chemico-physical modification in the water molecules is likely to have effects on the biological processes that occur in the cell. The dynamisation process according to which homeopathic potencies are prepared implies that each further step in the dilution is accompanied by a shaking of the solution (the so-called succussion). Lo and co-workers showed that the presence of traces of substance in water could induce the formation of up to 3.7% of clustered water molecules. The dynamisation of a solution containing traces of substances and about 3.7% clustered water molecules would lead to a sample that is expected to contain no molecules of solute but to display clustering of the water molecules throughout. If this was the case, it is possible, indeed plausible, that biochemistry of the cell would be altered, as indicated by the fact that homeopathic potencies have been shown to induce hormesis.

All this is to say that recent scientific developments outside the field of homeopathy seem to offer useful clues as to why and how homeopathy works. If we were to get this greater understanding, the inductive methodology behind homeopathy would be further vindicated by the realisation that the explanation of some phenomena might be found quite a while after the discovery of those phenomena, and that, therefore, discarding hitherto unexplained, but reliable, evidence is dangerous. The idea that scientific evidence should be accepted only when there is a theoretical justification for it is, among other things, naïve. This is

[15] In 1837 Dr Doppler, a mathematician from Prague, published a paper in *Zeitschrift fur physik* which offered a justification for infinitesimal doses that has an important point in common with the sugestion recently advanced. This is that the therapeuthic effect of homeopathic potencies does not relate tot he quantity of substance in them but to some other property of theirs. Doppler's starting point was the consideration that nothing is great or little, except comparatively, and in relation to its method of operation. Hence he asked the question: do medicines act through their ponderable quantities or by the extent of their surface that is in contact with the surfaces of the structures on which they act? If the latter was to be the case, Doppler calculated that the trituration process with which insoluble substances are diluted to homeopathic potencies would imply that the homeopaths were administring greater doses than the allopathists who used ounces (quoted in: Brown: 1845).

because the history of science lists cases in which evidence that led to a breakthrough was accepted on the basis of a wrong theoretical explanation.[16] Evidence and theory do not always go hand in hand, and often one runs ahead of the other. This point was all too clear to the mind of the first homeopaths; "The ascertainment of a general law is quite sufficient as a guide to practice...explanation must never be confounded with the law; the one may be true, the other false…when we attempt to explain, we leave the territory of observation and induction, and enter that of hypothesis" (Rutherfurd Russell: 1845, p. 56 and 66).

Homeopathy represents an instance of dissent in science because it challenges the way in which the interplay between evidence and theory is mainly construed. For this reason this example of dissent is potentially interesting for the philosopher of science, especially in the context of the renewed interest in methodological questions (see, for instance, Giere: 1999, and Williamson: 2002), Consensus is far from being settled in any direction, and clearly not in favour of the hypothetico-deductive methodology.

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[16] As, for instance, in the case of Mendeleev's Periodic Table, which identified the atomic weight as the parameter according to which the elements display periodicity, and of the pile, that Volta invented on the basis of his contact theory. In both cases the explanation for phenomenon in question initially provided was going to be shown to be wrong; the periodicity of the chemical properties of the elements was eventually correlated with the atomic number, and the electromotive force of the pile with the redox potentials of the electrode and of the ions in the solutions.

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