The persistence of miasma theory

By Bob Phillips

Looking back from the vantage point of the future, it is easy to express a superior, slightly amused astonishment at the persistence of "scientific" ideas that have proven to be mistaken. We read with a smile about the belief in phlogiston as an intangible substance that accounts for phenomena associated with heat; we are surprised at how many eminent scientists clung to the existence of the ether as a mechanism that explained action at a distance; we find the term miasma a little quaint. Of course, if we are to understand the currents of thought at the time they held sway, we must abandon the position of *post hoc* superiority and try to put ourselves in the shoes of those who were struggling for understanding at the time. We must try to understand the forces that supported the "scientific" orthodoxy at the time, that kept the old theory in play, that caused thinking people to resist the new ideas and then we can understand the revolution in thought as an historical phenomenon.

The three examples given above of discounted scientific theories have one thing in common – they involved the postulation of some intangible material or agent that accounted for actions that needed explanation. In each case there were contemporary scientists who were sure that they were on the point of isolating and identifying the mysterious substance – phlogiston, or the ether, or miasma. We look back, with our understanding that the explanations for the areas of action lie elsewhere, often in a revolutionary change in science – heat is a matter of moving molecules, action at a distance does not require a connecting substrate but is explained by field theory, and the communication of many diseases is accounted for by micro-organisms, often carried in water. Each shift in scientific understanding exposes the previously hypothesized agents as almost fraudulent, and funny – how could anyone think that materials contained an invisible, intangible substance called phlogiston that we could never detect escaping but nevertheless gripped the imagination of scientists with a persisting power?

One reason for the power of the idea of miasma and for its persistence even as John Snow presented compelling alternative explanations for the communication of cholera (and other diseases) is that miasma mirrored the perception of many thoughtful people about what was dangerously wrong with social life in the early 19th century. It was obvious that the ills of society were related to overcrowding and all that went with it – filth, smells, moral decay and disdain for the rule of law. In a London bursting at the seams as the 19th century progressed, the focus on overcrowding and its consequences was unavoidable. The theory known as miasmatism, or pythogenic theory "seemed to explain the partiality of epidemic diseases for the undrained, uncleaned, filthy and stinking areas of the towns inhabited by the poor" (Lambert, p. 49).

If the habitations of the poor are the places where filth accumulates, and if it is in and around the habitations of the poor that the ravages of these diseases run, passing from house to house with an unbelievable rapidity and with no visible communicating mechanism, then the notion of an enveloping miasma emanating from the filth and blowing into every neighbouring home is compelling. It supports the actions of the great Victorian reformers like Florence Nightingale: clearing away the filth and establishing order. Give it an impressive name – "miasma", or even better: something with a derivation from the classical languages that defines it within the special

province of the educated, upper-class, professional – "pythogen". A name – a language - provides the beginnings of science. The job of the scientists is then to describe the behaviour of the miasma and the job of the medical or public health practitioners is to work out how to dispel the miasma or prevent it from communicating the disease.

In this manner, a scientific paradigm is established. "Paradigms gain their status because they are more successful than their competitors in solving a few problems that the group of practitioners has come to recognize as acute. To be more successful is not, however, to be either completely successful with a single problem or notably successful with any large number. The success of a paradigm - whether Aristotle's analysis of motion, Ptolemy's computations of planetary position, Lavoisier's application of the balance, or Maxwell's mathematization of the electromagnetic field - is at the start largely a promise of success discoverable in selected and still incomplete examples. Normal science consists in the actualization of that promise, an actualization achieved by extending the knowledge of those facts that the paradigm displays as particularly revealing, by increasing the extent of the match between those facts and the paradigm's predictions, and by further articulation of the paradigm itself."
(Thomas Kuhn, The Structure of Scientific Revolutions, University of Chicago Press, 1962, pp 23-4).

In this case, "the pythogenic theory found widespread acceptance among the first generation of English sanitary reformers. Florence Nightingale and Edwin Chadwick clung to it throughout their long lives, It became during the forties and fifties the orthodoxy of the public health movement" (Lambert, p. 49) partly because it fitted so well their knowledge of what was wrong with their society, and what needed to be fixed. Florence Nightingale even accused the opponents of miasmatism – those who were beginning to understand that the mechanism of communication of disease was some form of contagion rather than something communicated through the atmosphere, of looking for an excuse for inaction or even laziness: "The idea of "contagion", as explaining the spread of disease, appears to have been adopted at a time when, from the neglect of sanitary arrangements, epidemics attacked whole masses of people, and when men had ceased to consider that nature had any laws for her guidance. Beginning with the poets and historians, the word finally made its way into scientific nomenclature, where it has remained ever since. . .a satisfactory explanation for pestilence and an adequate excuse for non-exertion to prevent its recurrence."
(quoted in http://en.wikipedia.org/wiki/Miasma_theory - I have not yet found the original source).

A scientific paradigm takes hold of the imagination of a generation of scientists and then, often, of the contemporary educated public. It defines what scientific work is to be done; it delineates what is "normal" science and stigmatises anything outside that paradigm of normality. Listen to Florence Nightingale, above, denigrating the adherents of the new paradigm as "ceasing to consider that nature has laws" – pure prejudice and bile. The adherents of the old paradigm erect a barrier against any scientist – like Snow – who points towards phenomena outside of the paradigm, even if the evidence for those phenomena is compelling.

Here is an example from another scientific field, a couple of decades more recently:

"X-rays … were greeted not only with surprise but with shock. Lord Kelvin at first pronounced them an elaborate hoax. Others, though they could not doubt the evidence, were clearly staggered by it. Though X-rays were not prohibited by established theory, they violated deeply entrenched expectations. Those expectations, I suggest, were implicit in the design and interpretation of established laboratory procedures." (Kuhn, p. 59)

As Royston Lambert describes in his book on Simon and the development of English Social Administration, the theoretical constructs of "normal science" do not need to be very robust, as long as they are integral to the paradigm, in this case the scientific paradigm that underpinned "normal

science" for those concerned with the management of the poor, and excluded alternative explanations. "[The] *atmospheric* or *pythogenic theory,* [was] much vaguer and more embracing than the others. Under certain mysterious circumstances, it held, the atmosphere became charged with an 'epidemic influence' 'which in turn became malignant when it combined with the exhalations of organic decomposition from the earth. The resulting gases, ferments or miasms (the agents were diverse) produced diseases. Capable of infinite variation, the theory generally discountenanced contagion."(Lambert, p. 49)

The paradigm persisted long after there was evidence for the alternative, contagionist, stance - evidence far more convincing than any "evidence" for miasmatism. Again – this is the way things go with scientific orthodoxies that should have been undermined by alternatives with a greater power of explanation, as it would seem to the rational point of view of those who come afterwards. Thomas Kuhn summarises this towards the end of his book – a book that itself created a revolution in the paradigm of work in the history and philosophy of science in the middle of the last century. On p.159:

"At the start a new candidate for paradigm may have few supporters, and on occasions the supporters' motives may be suspect. Nevertheless, if they are competent, they will improve it, explore its possibilities, and show what it would be like to belong to the community guided by it. And as that goes on, if the paradigm is one destined to win its fight, the number and strength of the persuasive arguments in its favor will increase. More scientists will then be converted, and the exploration of the new paradigm will go on. Gradually the number of experiments, instruments, articles, and books based upon the paradigm will multiply. Still more men, convinced of the new view's fruitfulness, will adopt the new mode of practicing normal science, until at last only a few elderly hold-outs remain. And even they, we cannot say, are wrong. Though the historian can always find men – [Joseph] Priestley, for instance, who were unreasonable to resist for as long as they did, he will not find a point at which resistance becomes illogical or unscientific."

This applied to the advocates of miasma theory. They clung on to their paradigm long beyond the point where the evidence "should" have compelled them to look in another direction:

"For some years after 1850 Simon continued to hold this theory [miasmatism] in its entirety, stressing the evils of air and soil. So strong in 1854 was his belief in the atmospheric theory that he found it impossible to accept as conclusive John Snow's theories and empirical proof of the waterborne contagion though he did not discount the dangers of impure water" (Lambert, pp. 50-1). Simon was definitely one of the more open-minded of that claque of miasmatists who had the monopoly of positions of power in mid-Victorian social and medical reform and administration. Edwin Chadwick and Miss Nightingale were much more formidable reactionaries, and they had legions of reactionary colleagues. In contrast, it seems that Sir John Simon was a man more open than most to rational convincement, but with a purist view of what constituted proof for a new idea:

"Having at various times dismissed contagion, germs, the communicability of cholera, of typhoid and tuberculosis, the theories of Snow and Budd; Simon, when convinced by epidemiological and experimental proof, never hesitated in publicly recanting, and adopting the principles newly established as a basis for administrative action." (Lambert, pp. 59) and "Simon, declared the great statistician, William Farr, 'is *more* cautious than a Scotsman'. This cautiousness meant neither woodenness nor timidity, but thoroughness of mind, a scrupulous effort after exactitude. That implies his second quality: flexibility. His scientific mind was not rigid with dogma or tainted with prejudice, but open to new ideas." (p.55)

The famous illustration of the persistence of the established commitment to miasmatism is that even after Simon replicated, at scale, Snow's ground-breaking epidemiological study that, to our minds, counts as the nearest thing science can have as a proof that cholera is water-borne, Simon

still shied away from claiming it as a proof for contagionism and a disproof of miasmatism. Simon wrote in the conclusion of his Report on the Last Two Cholera-Epidemics of London, as affected by the Consumption of Impure Water as laid before Parliament on May 13, 1856 that his mammoth and apparently decisive study was not a proof that cholera is a water-borne disease, but only a proof that one mechanism of communication of cholera is by fecalised water.

Snow's supporters (and they are legion – he is a romantic figure) see in this statement of Simon the arrogant government panjandrum, the persistence of the miasmatists in the face of overwhelming evidence. That may be so, but it is not the only thing to see in Simon's statement. One can also see admirable scientific caution. Simon uses prudent phrases such as "all which admits of being definitely stated is …" (p. 18). And his caution is correct. For instance, at the time that he and Snow are both working, nobody has conceived that flies might be another means of communicating cholera, so a position that says that water is only one channel for communication is quite correct. Another perfectly acceptable interpretation is that Simon is sensibly acknowledging that there is a new paradigm in play for the investigation of the causes of cholera and he is recognising the areas in which it is demonstrably successful.

(It was Snow, of course, firmly in the new paradigm, who seized upon Simon's data and drove out of it even further developments:

"The centerpiece of Snow's article in the JPH&SR was the predictive mathematical model of south London mortality by subdistricts, which Simon's report enabled him to complete, for it contained what he had been hoping to see since August 1854: a breakdown by subdistricts of the number of houses supplied by the Lambeth and Southwark and Vauxhall companies. He also used the article to outline four problematical aspects in Simon's report that diminished the mortality differences between customers of the two water companies. Snow pointed to

1. Imperfectly drawn subdistrict boundaries resulting in a misclassification of the water supply to some houses
2. Failure to enumerate streets in which no death took place, resulting in an underestimate of the risk of death from cholera
3. Apparent failure to ascertain the correct address for each death
4. Failure to account for the transfer of cholera patients to workhouses and other locations

Although each error was relatively minor, their net effect was to dilute the difference in mortality among customers of the two water supplies-from six-fold to three-and-a-half throughout the entire epidemic."
Vinten-Johansen, *et al* Cholera, Chloroform and the Science of Medicine, OUP, 2003, p. 348)

Having got over our amazement and perhaps our amusement at the notion of miasmata as a mechanism for the communication of disease, I believe that we can draw some interesting lines of thought from studying this epoch in the history of medicine:

- It is interesting how medical and scientific theory can underpin political and philosophical currents that flow from quite other parts of society;
- It is interesting to observe how new approaches to science have to overcome barriers of prejudice before their findings are appreciated – it is not a linear, rational process;
- It is interesting how old paradigms of thinking hang on beyond the time when it appears to us, with hindsight, that they have been disproved;
- The furore that surrounded the proposal of the water-borne mechanism for cholera is not a David and Goliath story of Snow and the evil government giant Simon; it is a much more complex and interesting story illustrating how scientific knowledge and social policy progress.