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Introduction: theories of science and theories of society

At the start of the new millennium, health care is in a state of transition. In the English-speaking world, there are a number of strong political and scientific currents pulling practitioners and clients into new and unfamiliar territories where their skills, practices and even their identities will be challenged. Health care organizations, policies and funding arrangements are rapidly being restructured. New challenges are emerging from new health problems. HIV, Gulf War Syndrome, the proliferation of severe and life-threatening allergies, the resurgence of diseases such as leprosy in nations from which it was previously believed to have been eliminated, the problems presented by warfare, global migration, hunger and even iatrogenic problems originating in health care itself, all are being increasingly brought into focus for health professionals.

At the same time – and this is where we come in – in Europe and America there is an increasing emphasis on research in health care. There has been a massive shift in the policy arena towards evidence-based practice. Everyone in health care, from the consultant surgeon to the volunteer care assistant, is being urged to become research literate, to read research and apply it to their practice, and even to do research themselves.

A further development – and another on which we can help – is the change in focus in health care provision. More and more policy is emphasizing the needs of the patient. Indeed, they are increasingly seen not as patients but as 'clients', 'users', 'consumers' or even 'customers'. They are consulted, surveyed and assessed, via health needs surveys, user involvement in service planning and devolution of decision making to local level. This process of inclusion and consultation, in the UK at least, is built into the statutory framework for health care providers such as the newly formed 'trusts' which administer an increasingly large part of the UK's health care. This policy context has already been written about extensively. What interests us is the conceptual shifts that many of us will have to make to keep abreast of these changes. The shift from 'patient' to 'consumer' is, in some ways, just as profound as the change in thinking from 'demonic possession' to 'illness', or from an 'imbalance of the humours' to 'bacterial infection'. Thus, we would argue that there are lessons to be learned from previous revolutions in the way we think about health and illness. Like

these earlier conceptual, theological and political shifts, the new climate in health care changes the way practitioners practise, how they are trained, how they do research and, just as importantly, what it means to be a patient.

Philosophy can also help us make sense of what we are trying to do whatever role we take, perhaps as health care researchers, health care providers, or even as concerned relatives or patients ourselves. A philosophical orientation might make us reflect on some questions that we often leave unasked. What do health and disease mean and how might we best conceptualize them? How do we tell whether someone has anything 'wrong' with them? The classic 'What seems to be the trouble?' is far from simple. Once we try to do research on the issues it gets more complex still. What balance should we give to the biological, social or spiritual aspects of health care practice? How can we tell if the patients got 'better'? Do we take their word for it? This list is not exhaustive. Even worse, philosophy can't answer these questions anyway. However, we can begin to sketch in some of the things that might help us think about them more effectively.

The first question to answer is why do research at all? Many of the world's major civilizations have risen and fallen without doing much organized science. The present-day species of scientists doing research that assists health care is a relatively new breed in historical terms. The natural philosophers of the Euro-American enlightenment were in most cases not concerned with health care issues in their scholarly work. The scientific work of medicine got most fully under way in the mid-nineteenth century in Europe's great laboratories, pioneered by the likes of Robert Koch (1843–1910), who discovered the bacteria responsible for cholera and tuberculosis, or Claude Bernard (1813–1878), whose pioneering work on many of the organ systems of the body was accompanied by his maxim 'why think when you can experiment?'.

Bernard's influence on health care was profound. Ironically, this is precisely because he thought so little of it. His contempt for clinical medicine – which he felt was little better than alchemy – was manifested many times during his career. His desire was to develop a laboratory discipline of physiology and medicine that looked like physics and chemistry. Thus, the real action of medicine was progressively re-engineered so as to make it seem like it took place in the laboratory rather than in the ward or the consulting room. The image of the pre-nineteenth-century surgeon as a primitive 'sawbones' and the midwife as the drunken 'Mrs Gamp' was built at this time. As we shall see later, judging from the seventeenth-century works of Jane Sharp, midwives had access to a sophisticated genitourinary medicine some 200 years before this. From the Greeks onwards, surgeons practised a careful and nuanced regime of battlefield wound care. These earlier healing practices were systematically downgraded by a number of intellectuals as medicine was respecified as a scientific enterprise. Again, perhaps this was a revolution in ideas. From our point of view, it was an especially important one because it put science into medicine, and dragged medicine into science. Indeed, so solid was Bernard's commitment to laboratory work that he was even hostile to Darwinian notions, when he became aware of them, because they were not founded on experimental or histological evidence.

What we are suggesting, then, is that health care looks the way it does because of a particular set of historical events and processes. The apparently natural seamless

relationship between published research, the clinic and the laboratory that has characterized late twentieth-century health care has not come about purely by accident or because of some underlying unity in nature. Recently, scholars of science and society have considered the role of assumptions, values, world-views and paradigms in knowledge and how these contribute to the structure of scientific revolutions.

We shall deal with some of the major trends in thinking about science and research in the later chapters. Our intention here is to 'set out our stall', so to speak. The history of human enquiry, we believe, is full of shifts, changes, accidents and dead ends. Nature itself is sufficiently untidy for it to be difficult to grasp. If, indeed, we believe in an underlying reality at all. The problem, then, as far as we are concerned is to make sense of the business of research and health care science as a human activity. It is a little difficult to say that late twentieth-century Euro-American knowledge is unproblematically better than anybody else's. The fact that so many people in our contemporary evidence-based technological civilization are rediscovering and exploring spiritualities, alternative health care and ancient healing practices suggests that it would be difficult to find any consensus about what the best kind of health care knowledge is.

As a way of beginning to make sense of these variations and shifts, let us spend a few moments thinking about how we might conceptualize the process of scientific revolution. One of the key texts here is Thomas Kuhn's famous *The Structure of Scientific Revolutions*, originally published in 1962. Kuhn argued that scientific research and thought are defined by 'paradigms', or conceptual world-views, that consist of formal theories, classic experiments, trusted methods and a variety of tacit theories about what's important, what happens and what matters. Scientists typically work within a prevailing tacitly accepted paradigm and try to extend the scope of knowledge by refining theories, explaining puzzling data and establishing more precise measures of variables, standards and phenomena. Eventually, however, their efforts may generate insoluble theoretical problems or experimental anomalies that expose a paradigm's limitations or contradict it altogether. At first, scientists may try to explain away the oddities, leave them unresearched or address questions that fit most comfortably into the existing paradigm. One day, however, this accumulation of difficulties may trigger a crisis that can only be resolved by an intellectual revolution that replaces an old paradigm with a new one. The abandonment of Ptolemaic cosmology and its replacement with Copernican heliocentrism, and the displacement of Newtonian mechanics by quantum physics and general relativity, are both examples of major paradigm shifts.

Kuhn's work is important also because he questioned the traditional conception of scientific progress as a gradual, cumulative acquisition of knowledge based on rationally chosen experimental frameworks. Previously, this rather complacent 'up the mountain theory of knowledge' had pervaded most attempts to understand scientific enquiry. Instead, he argued that it is the paradigm that determines the kinds of experiments scientists perform, the types of questions they ask and the problems they consider important. A shift in the paradigm alters the fundamental concepts underlying research and inspires new kinds of research questions, new standards of evidence, new research techniques, and new pathways of theory and experiment that are radically at odds with the old ones.

In the 40 years since the publication of Kuhn's book, his concept of paradigm shifts has been something of a cliché. It has been extended to disciplines such as sociology, political science, economics and, importantly, health care. It is common for people to talk about a dominant paradigm in research, but very often nobody really knows what it is. Is it biomedical reductionism? Possibly, but usually this is mentioned only to criticize it and present alternative psycho-social models of health care. Is it empiricism or positivism? Again, possibly, but very few people would admit to being positivists these days, even though it flourished in the nineteenth and early twentieth centuries. We shall see more of what positivism involves later on, but for the moment let us note that it usually appears as a kind of straw figure to be ridiculed. Is the dominant paradigm individualism? Certainly, a good many assumptions are made about the site of problems and interventions being the individual client. On the other hand, some of the debates about methodology in the caring disciplines have challenged this focus on individuals and many authors have tried to encourage thinking about how individual physical and mental distress is linked to broader social structures, processes and inequalities (e.g. Smail 1997). Thus, at the specific level of actual research and writing, it is often difficult to detect a dominant paradigm in any simple sense.

A further reason why we would want to encourage scepticism of an overly simple model of health care research and experience is because of the variety of world-views and belief systems that can be detected in contemporary health care. For example, a good many authors emphasize spirituality in health care (e.g. Brencick and Webster 2000). This, it is argued, involves interacting with people on a plane of reality that is distinct from the reality that is scrutinized by scientific enquiry. This kind of issue is not simply ghettoized into the territory of the hospital chaplain, but is blossoming on the pages of scientific journals devoted to health care.

Given this diversity, it is difficult to take the idea of a dominant paradigm too literally. Often, in explaining ideas to the reader we will have to make use of metaphorical devices. The idea of a 'dominant paradigm' is one of these. It evokes the idea of a kind of scientific researcher or clinician who probably has never really existed. One who, perhaps, is overly concerned with biomedical models, reductionist reasoning and quantifiable experimental evidence at the expense of psychological, social or spiritual perspectives. This is a stereotype, a cartoon if you will. However, it is a useful one in making sense of the different trends in science and thinking about health care.

Let us try to characterize some of the tendencies in the so-called dominant paradigm more fully. One of the major ways of making sense of traditional scientific enquiry is to see it as manifesting an orientation that has been called 'positivism'. Positivism has involved a belief that there is a real universe out there, which is revealed to us through our senses and which we can come to know more precisely through scientific enquiry, the techniques of which are broadly similar in both the social and natural sciences. The universe is seen as being a lawful place where relations of cause and effect determine the organization of events. Whereas the universe is very real to the positivist, he or she would be willing to accept that scientific ideas are somewhat tentative and need not always literally reflect the reality they seek to describe. They are always open to challenge by new data, which may result in their rejection or revision.

The mid-nineteenth-century variety of positivism envisioned by Auguste Comte also firmly rejected metaphysics and speculation. Moreover, to the positivist the idea that there is a grand design to the universe – that it has first causes and ultimate ends – is not acceptable either because these ideas are not verifiable via the scientific method.

This vision of positivism has more recently been supplanted by realist theories of science. These tend to accept the idea that there is a reality 'out there' and we can achieve successively better approximations to it through scientific endeavour. Modern realism, especially that which is influenced by Roy Bhaskar (1998), pitches itself as an alternative to traditional positivism and the newer constructivist approaches to the philosophy of science. As well as an external reality, contemporary realisms assert that there is a kind of deep generative structure to the world. Rather than the superficiality of facts and their accumulation, these realisms seek to discover a 'deep' or 'generative structure' to events. This, then, is one of the purposes of science. As one of the anti-positivist realists of the nineteenth century Karl Marx put it, 'all science would be superfluous if the outward appearances and essences of things directly coincided' (Marx, 1933, p. 817). In modern, so-called 'critical' realism, the natural and social sciences are related though not identical. There are, in this view, discoverable generative structures governing the world. The natural sciences enable us to discover a world that has a relatively independent existence, whereas human social phenomena – within which a good deal of health care research is conducted – are more complex. Social structures are themselves the result of human interaction, but they, in turn, influence the kinds of actions that take place. They enable human action but also might constrain it. The famous sociologist Anthony Giddens calls this the 'duality of structure'.

Our discussion of realism and positivism as if they were related would probably horrify some people. Especially those who see 'critical realism' as a kind of radical alternative to positivism. However, we have put them together to highlight the differences between these notions that emphasize scientific realism and some of the perspectives that challenge it.

There are a number of challenges to the notions of science embedded in realist approaches. Some of these challenge mainstream science on political grounds – in terms of the interests it promotes and whether the sectional interest groups who perform science, or pay for it, are constructing knowledge. This kind of thinking is perhaps exemplified by some strands in Marxism, where it could be argued that science and culture turn out in ways that are broadly congenial to the economic interests of a society. These approaches tend to assume, however, that there is a real world that we can think about and know. Marxists are usually happy to talk about 'false consciousness' and 'false needs', as if it were possible to know what the real ones were. Maybe they're right. Let's take the argument a little further and shift a bit more deeply into the kind of intellectual territory that is sceptical of scientific realism and positivism. Where, in other words, the challenge to positivism and realism is at its most acute. Some of these challenges question the foundations of human knowledge itself. In the 1980s and 1990s, some social scientists, scholars of health care and the humanities turned to an even more radical interpretive perspective on social phenomena, culture and health care, namely postmodernism. This perspective questions whether an objective understanding of other people and their role in health and illness

is at all possible. It has been termed postmodernism because it represented a reaction to modernism, at least as this took the form of a scientific, rational approach to understanding the world found in most branches of European and North American scholarship from the eighteenth to the late twentieth centuries. Allied to this is the approach to philosophical thinking known as 'deconstruction', which derives from the work of Jacques Derrida. This work focuses on language, and originates with the idea that the traditional way of seeing the language in which scientific or academic ideas are expressed is mistaken. Positivistic and realist models have to assume that it is possible to talk and write about the world as if it existed independently of language. Put crudely, to make realism viable you've got to believe that language is able to express ideas about the world without changing them too much. In the traditional model of language, writing describes speech and speech describes the world, as if it were possible for language to clearly describe a reality which was external to language. Moreover, the author of a text is the source of its meaning. Derrida's work, on the other hand, tried to mount a challenge to these assumptions. He promoted a deconstructive style of reading that attempted to subvert these assumptions and undermine the idea that a text has an unchanging, unified meaning which the reader can discover. Reality is not something that texts can easily describe. They do not allow us to discern the writer's intentions or the reality which the writer could see. There are many legitimate readings of a text. The interesting question, then, is not whether the text – a scientific paper or report perhaps – corresponds to reality, but how it constructs truth *in situ* within its pages. To many of us in health care and in the education system, this might be an appealing position. One of us (B.B.) has tried for a number of years to get his host institution to buy him an MRI scanner or a particle accelerator, but sadly these devices are well beyond the budget of most universities. It is therefore very difficult to see what nature is made of in any fundamentalist or foundationalist sense. It is not possible for most of us to see inside the body or inside the molecule. Derrida's maxim is often taken to be 'there is nothing beyond the text'. Some scholars of nursing have found the idea that health care itself is a 'textually mediated reality' to be very attractive (Cheek and Rudge 1994). If we take the message of Derrida, and other deconstructive and postmodernist writers in a strong form, it means that it would be very difficult to make decisive claims about nature – the atoms, the cells, the structures and processes – because most of us only encounter them through language. This tendency to accord language a central place is often found in studies of health care that are intended to be critical, transformative or revolutionary. This encourages us to be sceptical of any text that makes claims about truth, reality or nature. From the deconstructionist position, a reader might be most interested in the rhetorical devices that make a piece appear true, and be less concerned with whether it literally is, because, in this perspective, there is 'nothing outside the text'. Within postmodernism and a postmodern view of the world the progress of science, health care and human welfare is acknowledged to be a process that is not necessarily straightforward. A pharmaceutical firm may add to the infant mortality rate in Central America by causing pollution, yet may dramatically lower the mortality rate for cancer patients in Oklahoma by importing drugs at a cost low enough to satisfy the company's shareholders. The geometry of good and evil is not simple in the postmodern paradigm.

Returning to our earlier point about what kind of paradigm might be found dominating health care research, our brief tour has illustrated some of the differing perspectives on the philosophy of science that we might find and some of the viewpoints that might also be found when researchers in health care turn their attention to conceptual matters. This list is not exhaustive and, as the book unfolds, we will see more of these perspectives. The point is that it is difficult to see a single paradigm that is dominant in conceptual terms, as all of these points of view happily – if somewhat argumentatively – exist in contemporary academic life. Thus, we would argue that a universal paradigm for health care enquiry that is one day going to shift, is probably an oversimplification. It is certainly possible to see vast sums of money and highly prestigious researchers doing experimental work in the laboratory and in the form of clinical trials. Much of this would be eminently familiar to the likes of Comte, Bernard and their ilk from over a hundred years ago. But we can see also a variety of other techniques and conceptual orientations flourishing, even if they are not usually so well funded.

Nature's untidiness and its tendencies to resist easy classification do not necessarily lead to regular paradigm shifts. Novel phenomena are often readily reinterpreted in line with the prevailing scientific world-view at the time. Accounts of alien abductions are seen as examples of delusion, hallucination or the 'fantasy prone personality', creatures such as the giant panda were supposed to be quaint mythical folktales until they were captured by Western naturalists in China in the 1930s, the sense of moving towards a light which people report in near death experiences is seen to be, say, the result of anoxia, and so on. Most good 'paradigms' give us the tools to deal with anomalies.

Let us explore the kinds of difficulties we might face in making sense of 'strange' things by means of a few examples. In the first of these, concerned with cutting holes in the skull, we hope to illustrate the way that science and scholarship might grapple with novelties and how they might try to reformulate phenomena so as to bring them into line with what is known at the time.

'Like you need a hole in the head': trepanning and the reconstruction of health care histories

Why would people believe it was a good idea to cut holes in their heads? Let us spend a moment or two examining medical and theological explanations and their philosophical assumptions. How can we as researchers interpret the past and learn from it? This will illuminate the issues of how researchers, historians and archaeologists interpret the way that other cultures make sense of their own bodies. It will enable us to introduce the idea of Euro-American, secular, late-modern conceptual frameworks and how they influence our understanding of other peoples and cultural milieus.

In the nineteenth century, archaeologists were puzzled by the discovery of skulls with holes that appeared to have been bored or scraped into them. The first examples seem to have been presented in the work of the fanatical American skull collector Samuel Morton in his Crania Americana (1849). As more specimens of these so-called 'trepanned' skulls came to light (around a thousand have been discovered from Bolivia and Peru alone (Verano and Ubelaker 1992)), it became apparent that this

practice must have occurred commonly in the area over a period of 2000 years, from around 500 B.C. to A.D. 1500. In Europe, too, the intellectuals of the day with an interest in medicine and anthropology were puzzled by archaeological finds involving skulls with holes in them. Gradually over the late nineteenth and twentieth centuries the history of trepanation has come to light and the discovery of these skulls prompted scholars to re-read the history of medicine and examine the classic texts from Greece and China to see what the authorities of the ancient world had to say about the procedure. The European variants of trepanning are estimated to have originated 10,000 years ago. The practice seems to have reached a peak among the Neolithic 'battleaxe people', who constructed a series of chambered tombs in France about 4000 years ago, enormous numbers of whose skulls are perforated in this way.

The concept of trepanning is interesting because it highlights how we go about making sense of issues in the past through our own frameworks of experience. We've chosen to include it because the sight of a skull with a hole in it and the knowledge that people were doing this successfully in the pre-modern era has often fascinated and revolted our students. The whole issue of how we make sense of what might have been a health care practice illustrates some important themes in how we make sense of the body and what people do with it.

Let us look at the history of the practice in a little more detail. This is a history which is difficult to find in mainstream textbooks and from our early twenty-first-century vantage point it is difficult to appreciate just how much these skulls with holes in mesmerized our intellectual forebears in the nineteenth century. Lipowski (1967) reminds us that at first it was believed that these skulls had received the holes either after the skull's owner had died or that the patient would have died very shortly after the operation. Eighteenth- and nineteenth-century surgeons had abandoned procedures that involved breaching the skull entirely because of the 100 per cent mortality rate. So it was inconceivable to these early scholars that these apparently primitive people could have fared any better. More recently, it became apparent that this initial pessimism was misconceived. Not only had this hazardous procedure been widely performed but the 'patients' had survived. The nineteenth-century scientific and medical belief in their own proficiency was severely dented by the fact that they had been outperformed by so-called 'primitive tribesmen', 'savages' and 'heathens' working without instruments, antiseptics or operating theatres.

The South American skulls suggest that the survival rates from these operations were relatively good, and exceeded the survival rate achieved by European doctors until much later. If the patient survives, the edges of the bone around the hole lose their sharp, recently cut appearance and begin to round over, rather like a tree growing over the stump where a branch has been cut off. Judging by the presence of these signs of long-term healing, Verano and Ubelaker (1992) estimate that as many as 70 per cent of the people trepanned during the Inca period survived the operation, and even the earliest skulls from the coast of Peru show a 40 per cent survival rate. By contrast, neurosurgery patients in the nineteenth and early twentieth centuries, even after the development of antiseptic procedures and anaesthesia, rarely even achieved survival rates of 25 per cent.

The interest in trepanation generated over the past 150 years is instructive because it mirrors a good many of our modern concerns. The aim of our discussion,

then, is to show how the lenses of our present scientific framework enable us to make sense not only of present-day phenomena, but to make sense of the past as well.

Even though medicine had been revolutionized by the turn to dissection in the Renaissance, people were still (as they are now) interested in the medical texts of early Greek authors. Just count how many references there are to the ancient Greeks in any contemporary textbook. On studying the original works of Greek scholars in the classical period, it became apparent that trepanning was known to the Greeks. Hippocrates (*c.* 460–355 B.C.) advised trepanation as a treatment for head wounds for example. More recently, medieval authorities such as Roger of Salerno (1170–1200) in his treatises on head injuries makes reference to the use of trepanation as a treatment and the conditions for which it might be indicated. In China there are accounts that Thai Tshang Kung (205–150 B.C.) used to 'cut open skulls of patients and arrange their brains in order' (Lipowski 1967).

Making sense of trepanation has exercised the minds of many prominent nineteenth-century scholars. Why on earth would people embark on such a procedure? Paul Broca (1876), one of the leading authorities on the brain and skull in the mid-nineteenth century, and the originator of the classic study of brain damage in a patient who had lost his powers of speech, which led to the identification of Broca's area in the brain, maintained that trepanation represented an early attempt to deal with diseases of the skull and brain. The early peoples of Europe and South America were thus, in this view, 'inept technologists'. This view was supported by the accounts from Greek and medieval doctors of the use of trepanation to deal with head injuries. Moreover, trepanation, according to Lipowski, has been performed in many parts of the world for headaches, epilepsy and insanity. This process of reasoning by means of what he called ethnographic parallels still exists in anthropology and archaeology. One finds a group of people who one knows about and uses them to interpret the traces left by lesser known cultures.

The surgical theory, however, runs into difficulties with the observation that most trepanned skulls do not show other evidence of fracture or trauma – bad news for those who believe that it was an operation done to relieve the effects of battleaxe and slingshot wounds. Thus perhaps the operations were performed to relieve a non-traumatic condition or maybe to deal with something else, for example spiritual malaise. The fact that many of the French finds of perforated skulls were recovered from near elaborate burial sites with a presumably ritualistic function led to some speculation that this might apply to the cutting of holes in the skull. This is a much more difficult issue to clarify. We do not, of course, know what the people in question might have thought they were doing. The use of the cut-out fragments or 'roundels' of bone as decoration, charms or amulets in South America supports this possible interpretation. Some believe that cutting holes in the skull might be done to release evil spirits. This kind of speculation tells us as much about present-day ideas of spirituality as it does about pre-historic ones. Notions of a separate and largely ethereal spirit realm of autonomous beings who might wish to interfere with us are a relatively recent idea, possibly originating with the Greeks and reaching a peak in medieval Europe. We don't know whether Neolithic people had these beliefs, and if so, whether they were related to trepanation. Even though ethnographers and anthropologists have discovered beliefs in evil spirits in many developing nations, this still doesn't literally

tell us what ancient peoples might have believed. Indeed, the idea that ancient Europeans might resemble contemporary Africans or South Americans has recently been treated with suspicion. It is part of a post-Enlightenment intellectual strategy that puts the Europeans and North Americans at the top of a pyramid of development and places people from less developed nations at the bottom. As if they were a kind of unevolved living fossil.

Thus, to make sense of this piece of history, we need to understand not only the artifacts that remain – whether they look as though healing had occurred or not, for example – but also how the intellectual communities who have striven to understand them made sense of the phenomena too, and what their cultural and historical reference points were.

The day the earth moved: Renaissance anatomies

The European Renaissance revolution in the arts and sciences, including the invention of gross anatomy and the re-invention of medicine, is usually taken to represent a change in perspective and world-view. Why did so many intellectuals suddenly turn to dissections as a way of understanding the body and to astronomy as a way of understanding the celestial sphere? This also invites the question of how revolutions can happen in knowledge. Do these events help explain changes in research orientations in the present? This illustrates the importance of history when studying knowledge systems and in tracing the historical links between different formats of knowledge and how revolutions sometimes enable things to stay the same. Here, one of us (BB) takes up his personal story.

> When I was at school, we were taught a kind of 'received view' of the Renaissance in Europe. It went along the lines that Galileo had challenged the orthodoxy of the Catholic Church, was censured and subject to threats and a period of house arrest. Some of the more lurid (but less historically verifiable) accounts described him as being tortured as well. Despite the vagueness that sometimes accompanied these accounts, the impression was given that some part of this challenge involved seeing satellites orbiting Jupiter.
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> This is sometimes depicted to children as a kind of morality play of scientific triumph. Observation triumphs over prejudice, empirical evidence triumphs over dogma and the stage is set for the flowering of late Renaissance science in its full glory, with the likes of Newton, Leibniz, Gauss and their imitators just around the corner. Moreover, it is almost as if the founders of the Renaissance scientific revolution received their credentials by the sufferings they underwent. As if science, too, could have its martyrs. Science then, was a heroic, challenging, iconoclastic and ultimately liberating enterprise.
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> As I grew up, I found out more about the ideas and conflicts in Medieval and Renaissance theology and philosophy and saw far more of the diversity of views which it encompassed. The sense of perfection of the heavenly bodies apparently so dear to Catholic theologians derived from much earlier thinkers such as Aristotle. The idea of a stationary, central earth with the wandering heavenly bodies – the planets – orbiting around it, which was supported by the Church,

derived from Claudius Ptolmaeus-Ptolmey (A.D. 90–168), a Greek astronomer working in Alexandria. The planets moved in small 'epicycles' as they orbited, such that they then would follow a path rather like a long coil spring stretched out into an arc. He believed, like Aristotle, that these orbits of the heavenly bodies were defined by crystal spheres.

Even in the modern era of physics, the relationship between science and religion is by no means clear-cut. The foundations of contemporary 'big bang' theories of the universe were laid by a Belgian Catholic priest, Georges Lemaitre.

Even to astronomical observers at the time, it was clear that the models proposed by Copernicus and defended by Galileo were difficult to square with the observations. Their insistence on circular orbits for the planets made it difficult for such a model to make accurate predictions, and it was only once the idea of elliptical orbits, introduced by Kepler, that theory fell more closely into line with observations. Many members of the Catholic Church were themselves enthusiastic astronomers. Copernicus was a Catholic priest and it was the Jesuits who, in Galileo's lifetime, were credited with discovering sunspots.

Roger Bacon – 'Doctor Mirabilis' himself – was reported to be using glasses at Oxford in the 1200s and some of his writings suggest that he had grasped the use of multiple lenses for projecting images of the heavens. It is not known whether he actually made such an instrument successfully. Some of the earliest instruments for which there is better evidence come from a Dutch inventor called Lipperhay in 1608, whose devices were soon improved upon by Galileo in 1609.

Flat earth astronomies are certainly not always intellectually inferior. The Greek astronomer Thales believed in such a system and yet was able to predict a solar eclipse in the sixth century B.C.

The theologies of the Middle Ages, Renaissance and Enlightenment are often thought of as somehow backward looking, hidebound, locked into outmoded and primitive ways of thinking. Yet there are a number of features of theological and scholastic thought in the Middle Ages that were very like the sciences developed by later generations of intellectuals. The philosopher Alfred North Whitehead (1861–1947) suggested that the Middle Ages 'trained' the intellect in a 'sense of order' and created the 'faith in the possibility of science'.

One of the puzzling things is why Galileo's views should have attracted such hostile attention from church officials. The idea of a moving earth had been previously – and uncontroversially – proposed by Nicholas Orseme (*c.* 1325–1382) and Nicholas of Cusa (1401–1464). Copernicus (1473–1543), the Catholic priest whose heliocentric theory was expounded in his book *On the Revolutions of the Celestial Spheres*, published in the year of his death, was not censured by the church, as far as we know. Indeed, it was at the urging of Pope Clement VII in 1536 that Copernicus's book was eventually published, and it contained a dedication to Clement's successor, Pope Paul III. The Catholic Church was much more friendly to heliocentric theories than the newly active Protestants. Copernican cosmology was most strongly opposed by Martin Luther and Protestant scepticism of heliocentric astronomy extended to the English Puritan reformer Dr John Owen (1616–1683), who declared that the Copernican system was 'a delusive and arbitrary hypothesis, contrary to scripture',

and even the British founder of Methodism, John Wesley (1703–1791), argued that these ideas 'tend towards infidelity'.

The very fact that the deceptively simple story of Galileo versus the Church is told at all gives us a few clues about the nature of scientific storytelling, which we must be mindful of. First, look at what it's about: astronomy, mathematics and physics. It helps to establish them at the head of the scientific table. And, at least until the closing decades of the twentieth century, they have continued to enjoy that kind of prestige. Moreover, there's a notion embedded here that sciences such as physics are somehow more basic and fundamental to nature, that atoms, say, are the precursors of the more complex systems studied by other disciplines like medicine. Yet to understand this, we need to go back to a pre-Enlightenment idea, a Medieval notion that microcosm – our insides – reflected the macrocosm. The secrets inside us, so to speak, were mapped out in the heavens. Hence, the study of physics, astronomy and mathematics can tell us about apparently unrelated matters such as the palpitations of the heart, the motions of the blood and the balance of the humours. This idea has been good for physics. Overwhelmingly, philosophers and historians of science, ourselves included, have been mesmerized by the ways in which scholars have grappled with physical phenomena. Conflicts between science and religion, paradigm shifts, hypothesis testing – many of the standard features of the philosophy of science canon – take the physical sciences as their model.

In this book, we intend to get away from this physicalist model. As we shall argue, health care disciplines present a particularly interesting case for the philosophy of science as they are based in a more immediately practical set of concerns – life, death, suffering, curing – and their nostrums are often verified not through precise observation and geometrical plotting, but through a subjective sense that something has improved.

Gross anatomy: the discovery of the human body

The famous artist and inventor Leonardo da Vinci (1452–1519) provides some interesting illustrations of how the body was reconceptualized in the Renaissance. In earlier art, the body was often depicted as a relatively smooth, undifferentiated mass. The musculature and anatomical detail of classical statues seemed to have been forgotten. Bodies were either nondescript or, in the case of mythical or horrific creatures, they were monstrous and grotesque. In Leonardo's work, however, we can see a new vision of the body emerging. Now, most interestingly, this emerged first of all not from his famous dissections but from his attempts to paint saints. Saints, moreover, whose bodies were so often distressed, torn apart, pierced and wounded. It is with Leonardo's work that what we now call the 'striped muscles' were first drawn with stripes. His early painting of Saint Jerome, for example, suggests some close observation of the head and neck muscles.

Leonardo da Vinci was interested in applying natural analogies to the study of the human body, drawing on his wide-ranging interests in hydraulics, mechanics and painting to make sense of the body. At the time, the representation of the body was coming on by leaps and bounds. Leonardo's contemporary and rival Michaelangelo was revolutionizing the external perceptions of musculature. Leonardo himself, in his

later studies, was examining the deep structure of the human body. To record this for himself and for posterity, he developed a whole new visual notation to convey a sense of what he was looking at. Whereas representations of skeletons had been common, at least since Roman times, it was Leonardo who originated cross-sections, cutaways and see-through diagrams to represent what he thought he had seen. It was he who originated exploded diagrams and who represented muscles as if they contained lines of force. All of a sudden the body was something that could be represented graphically and pictorially. It was mappable.

One of his famous illustrations of the human body was familiar to a generation of TV viewers in the UK as part of the title sequence of the documentary series 'World In Action'. This picture, the so-called 'Vitruvian Man', shows how the human body fits neatly into both a square and a circle. The human body was thus a geometrical entity rather than simply a fleshy one. Like the ancients, Leonardo used animal models to make sense of human functions. He provided detailed accounts of horses' entrails and frogs' spinal cords.

Leonardo was responsible for mapping the contents of the human torso and changing the way that they were seen. His principal studies of anatomy seem to have been done in the early 1500s and, in addition to dissection, he was successful in making wax models and plaster casts of the chambers of the heart and the ventricles of the brain. To give some examples of how he re-interpreted the body, previously the womb had been thought of and drawn as an organ with several chambers, and multiple pregnancies were believed to occur with each foetus in a different compartment. Leonardo 'invented' the single chambered womb which we see today. His drawing of a foetus in a single chambered uterus marked a fundamental shift in the way the reproductive apparatus was seen. Likewise, his discovery of the uterine artery and the vascular system of the cervix shifted the way we see these organs.

At the same time, Leonardo's vision of human anatomy differed from the kind that we might see today in, for example, classic textbooks like *Gray's Anatomy*. His wombs do not have fallopian tubes. These had to wait for Gabriele Fallopius (1523–1562) to map them some 50 years later. The placenta in his drawing of the foetus looks more like that of a cow than a human being. The spleen and liver are drawn as being roughly of equal size – nowadays the spleen is represented as being much smaller. Perhaps this relates to how the spleen was seen to be connected with the emotions during the Renaissance. In women's anatomy, a tube links the uterus and the breasts, while the penis is depicted as having two tubes running down its length – presumably one for urine and the other for semen – rather than the single urethra we see today.

Perhaps, as well as his classic illustrations of the body, the most important legacy of Leonardo is to do with the way we think about the body. For him, although the body was created by a 'supreme master', it was possible to understand it as if it were a machine. The heart had, from the ancient Greeks onwards, been seen as a source of the vital spirit and as the organ that heated the blood. To Leonardo, however, the heart was a mechanical, muscular device and the movement of the blood through it exhibited the same sorts of qualities as any other fluid flowing through tubes, with vortices and turbulence being created as it passed through the valves. Indeed, he lent his weight to an intellectual movement that sought to argue that the seat of

our consciousness was not in the heart itself, but in the brain. This was consolidated by later scholars such as Descartes, who located a structure in the brain which they saw to be the actual seat of the soul. Throughout the body, Leonardo believed, the muscles expanded and contracted as a result of air being passed through the nerves. Causal chains were thus elaborated in his work, which, while not quite the same as those we believe in today (for example, we now believe nerves to convey electrical impulses rather than 'air' or 'spirit'), helped to set the stage for contemporary medical knowledge.

At the time Leonardo was working on his anatomy, a man was being born who would shift the paradigm of how we understand the body even further. The impact of Andreas Vesalius (1514–1564) on modern medicine and health care is perhaps equally as revolutionary as Leonardo's. It is not just that he was another pioneer of dissection, but he introduced the artistic and literary motifs of medicine which have stayed with us right through to the present day.

For example, rather than the vernacularized Latin that other scholars were using at the time, he modelled his text on the artistic prose of Cicero. This would be difficult to understand, even for the classically literate intellectuals of his day. However, it was believed that this kind of presentation was important. Vesalius himself believed that it was important to recollect and restore not only the knowledge which he felt had been lost since classical times, but that it was also important to recollect the language. Thus, in 1543 (the year of Copernicus's death) he published the first edition of his magnum opus *De Humanis Corporis Fabrica*, in seven volumes. Lavishly illustrated, possibly by students of the famous artist Titian, Vesalius hoped that these volumes, and their associated textbook for students – a kind of Renaissance study guide – would guide physicians away from rote memorization of the Greek texts of Galen and Hippocrates towards active dissection and observation of the human structure. Trainee physicians, he believed, would benefit from this practice. Rather than leaving the dissection to their servants, as had been the practice in the past, Vesalius believed in the importance of physicians and surgeons doing the dissections themselves.

This kind of anatomical investigation was regarded with suspicion. Anatomists were often distrusted because of their suspicious alliance with hangmen and executioners, whom they bribed so as to secure their supply of corpses. The classic depiction of the human head, which shows the neck twisted and the head tilted back, originated with Vesalius. The head is in this position because he would be dealing with people who had been hanged. The judicial technologies of the time influenced how we still see the body – this illustration has been stylized and reproduced as the cover art for twentieth-century editions of Gray's anatomy.

Moreover, the anatomy in Vesalius's work looks a lot more familiar than Leonardo's. His illustrations do not contain the peculiar arrangements of tubes and connections that Leonardo's did. His is an anatomy that looks reassuringly modern.

Despite his revolutionary status in the history of anatomy as it is conceptualized and taught nowadays, Vesalius's own notion was that he was going back to the ancients and he saw himself in a long historical line that went back to the Greeks. Anatomy, he said, 'should be recalled from the dead, or that if it did not achieve with us a greater perfection than at any other place or time among the old teachers of anatomy, it might at least reach such a point that one could with confidence assert that

our modern science of anatomy was equal to that of the old, and that in this age anatomy was unique both in the level to which it had sunk and the completeness of its subsequent restoration' (*De Fabrica*, praefatio, 3r, 11.22ff). Thus he thought he was going back to restore or offer a rebirth to the spirit of enquiry which he felt had been lost since the ancient Greeks. So what does all this mean? Is it a paradigm shift? Or a reconstruction of history to make novelty look more respectable and appease the powerful religious interests that prevailed at the time? Of course, it is difficult to tell at this distance. However, what we are keen to point out is that even revolutionary movements are sometimes remarkable for leaving a good deal of the history intact. Revolutions, paradigm shifts and so on may be remarkably conservative.

Returning to Vesalius for a moment, just as interesting as the scientific content, perhaps, is the way that the pictures were presented. For example, the first picture we see in his books is of a theatre of dissection, where the anatomist – possibly Vesalius himself – performs an autopsy on a female corpse in front of a crowd of spectators, students and others, about 70 strong. A figure of a skeleton is also prominent, possibly because Vesalius used one in his teaching, but there are allusions to the figure of the Grim Reaper that would be familiar to audiences at the time. Dissection, then, was not just a furtive candlelit activity as it had been for Leonardo da Vinci, but a public spectacle – a surgical 'theatre'. This performative aspect of medical illustration and explanation can be seen in other ways too – the flowery classical Latin, for example. His famous series of 'musclemen' – depicting the arrangement of a person's muscles – are drawn walking around in rural landscapes or resting on ruined bits of classical architecture. Another feature of Renaissance anatomical drawings is that they often represent a 'self-disclosing' figure. That is, the corpse in the picture is putting its hands into its abdomen to open it up for the viewer. As well as being an artistic flourish, this was also important because of the way that many people, including some senior church figures, were suspicious of the new science. The 'self-disclosing' corpses, on the other hand, were showing how natural it all was.

The 1500s, then, were an important period in refashioning what was believed about the body. In the space of less than 100 years, the discipline of medicine changed from being one that was largely based on texts to one that was based on observation. From being a divine and spiritual creation, the body was turned into something that was made of frameworks, levers and tubes. In this respect, it anticipated the slightly later vogue for mechanical models, systems of fountains and mechanized statues that entertained the wealthier classes in Europe and inspired the youthful René Descartes (1596–1650) to speculate about how reflexes were achieved by the body. This dream – that mechanical models can tell us how human beings function – is prevalent in studies of cognitive science and artificial intelligence today. The idea is that if we can convincingly model a process on a machine, then maybe this tells us about how it works in 'real life'.

There are some interesting points to make about this whole period in the history of anatomy. On the face of it, it looks like a paradigm shift. Ideas, concepts, images and practices changed rapidly. On closer inspection, however, this picture is complicated by several issues. First, it is clear that Vesalius didn't necessarily want to be a revolutionary. He described what he was doing – the anatomy, the language and the pictures – as a kind of return to classical times. Retrospectively, he might have looked

like a paradigm shift, but he doesn't necessarily look that way from his own perspective. Whose vision of scientific change, then, do we believe? Secondly, we might well ask what impact all this had on health care for ordinary people in Europe and elsewhere. It is difficult to detect a similar revolution in the regime of bleeding, purging or vomiting that persisted in Europe through all this rapid change among Europe's intellectuals. These treatments were based on Galenic and Hippocratic theories of the humours, which had a lasting influence on health care until much more recent times, arguably into the twentieth century.

Following the expansion of knowledge and human enquiry in the Renaissance, this set the stage for late Renaissance and early Enlightenment philosophers to try to characterize and develop a rationale for the new natural philosophies which were rapidly developing in Europe. A common theme which unites the work of Descartes, Locke and Hume is the primacy they attached to perception, observation and experience as the foundations of knowledge. Rationalist notions that we could understand the physical and spiritual worlds through contemplation and prayer were explicitly rejected, even though the Medieval concern with thinking, introspection and reason remained intact. European intellectual life was thus newly shot through with empiricism and became progressively secularized. These developments went hand in hand with changes in politics, economics and society as English political life underwent a major phase of secularization in the Civil War and the foundations of the Industrial Revolution were laid.

The virtues of history

In this volume we will be using history a great deal. In a sense, it is easier to understand the construction of human knowledge if you know how people built it, what problems it was designed to solve and why people thought they were interesting at the time. History is also useful because it teaches us about how people's ideas about nature and what it means to be human often emerge through struggle and conflict. Sometimes this conflict is of a largely scholastic or academic nature, as with the question of how many angels can dance on the head of a pin, whereas at other times contested ideas are intimately bound up with warfare, revolution or other large-scale conflict. History, then, can sometimes give us a sense of the building blocks of knowledge, or what some contemporary students of the stream of scientific consciousness call 'the genealogy of ideas', a phrase which borrows from Michel Foucault's teaching.

There are, however, some dangers in taking this flirtation with history too seriously. First, it tends to give us the sense that we somehow know more than people did in the past. This is sometimes called the 'up the mountain' story of knowledge. Now, our contemporary technologies certainly allow us to tackle issues which our ancestors would be powerless to master, but this does not necessarily mean that they somehow knew less than we do. Nor does our present-day science lead to solutions that everyone would agree are beneficial.

Second, another trap for our thinking into which we may fall with our penchant for history is to see ideas as if they were entirely the product of the economic, social or theological crises of the time. For example, think of the Greek notion that the

human condition is related to the balance of the four humours – blood, phlegm, yellow bile and black bile. This derived from the work of Galen and Hippocrates and it is perfectly possible to argue convincingly that it suited the political and theological spirit of the times in ancient Greece. Yet in making sense of this idea we need to understand how it persisted through a further 1500 years of political and spiritual revolution, crossed geographical, cultural and climatic boundaries and was probably one of the most persuasive, long-lived and successful notions in medicine. Indeed, treatments based on it, such as bleeding, purging and vomiting, fell into disuse only relatively recently. Bleeding fell into disrepute in the early nineteenth century and purging, in the form of laxatives, remained popular in the UK until well into the twentieth century. This occurred despite medicine having undergone a number of major intellectual paradigm shifts through the previous 600 years or so. Thus, ideas are sometimes considerably more than byproducts of the cultural periods that produced them.

To span the period in history from the Norman Conquest of Britain to the present day would require only 13 70-year-olds' lifetimes. Yet as we shall see, during these 13 lifetimes, the picture of the world, the place of humanity within it, notions of morality and consciousness itself have undergone some dramatic shifts.

To give a fairly well-known example of this process, let us consider the history of opiate use. Throughout much of the nineteenth century, opiate drugs were freely available in Britain – they were cheap and, by all accounts, very widely used. Yet more recently, these have been redefined as exotic 'Class A' substances, the pleasures and pains of which are now known only to a small minority. Without wishing to lapse into a crude pharmacological determinism, it is possible to argue that the consciousness of our nineteenth-century forebears would differ in important respects from our own. Moreover, most of us whose families have lived in the UK for several generations are descended from people who would nowadays be called 'smackheads', complete with its connotations of criminality, fecklessness and poor parenting skills. Likewise, contemporary readers of Arthur Conan Doyle's famous 'Sherlock Holmes' stories are sometimes puzzled at the blatant and sometimes prodigious cocaine use of the hero. Nowadays, of course, in our modern narratives of crime and punishment, the miscreants rather than the detectives are depicted as the drug users.

The point to note is the dramatic shift not only in social practice but also in the legal and moral connotations of self-administered drug use. Any understanding of what it means to consider human beings and their fleshy embodiment needs to take account of such shifts. The apparent indifference of some nineteenth-century surgeons to the pain and suffering of their patients during childbirth or amputations was not necessarily because they were brutal or insensitive as we would nowadays understand it. It simply wasn't their job to worry about this, as it was assumed that the patient could take care of their own anaesthetic needs via a few pennyworth of laudanum.

Thus, history, even when it is the stuff with which we are familiar, is often worth a second, more critical look. The alleged revolution of the Renaissance and the alleged brutality of nineteenth-century medicine are cases in point. We need to understand what was going on at that time to make sense of the impact on knowledge, moreover, we need to understand the process of creating histories in the present day to make

sense of what our vision of the past means. The past is important to contemporary scholars. In the host discipline of two of us (B.B. and C.H.) it is customary to introduce pieces of academic writing with some allusion to what the ancient Greeks (or perhaps a more recent originator) thought about the issue. History is itself part of the process of constructing a regime of truth. It has played a part in the construction of theories of knowledge from positivism to postmodernism, so it will come as no surprise to the reader to see history in the present volume.

However, we are not plundering history to support a particular world-view. Rather, it is to show the peculiar changes and constancies in the business of ideas and to examine how ways of knowing have come about. Ideas, concepts and research strategies that appear commonsensical and part of the bedrock of science often have quite specific genealogies and their invention and adoption was shot through with controversy. The present contours of scientific knowledge, with the mines of information, factories of facts, frameworks of clinical governance, and border guards in the form of grant-awarding panels and referees of publications, were, like the political and economic map of the world, often formulated through struggle and warfare. It is to these struggles, then, that we shall turn in the forthcoming chapters.

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