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Pursuing the Ingenious: An Interview with Lisa Jardine

The historian of science debunks some of the myths surrounding the great leap forward of Western science in the 17th century.

by Kate Prendergast

Following Wordly Goods, her critically acclaimed re-assessment of the high culture of the Renaissance, Lisa Jardine, Professor of Renaissance Studies at Queen Mary and Westfield College, London, has written a new book on the scientific revolution. Ingenious Pursuits explicitly aims to debunk some of our most cherished myths about the significance of that era for modern western European culture. Meticulously researched and written, Jardine introduces us to many of the famous pioneers of the time: Descartes, Halley, Huygens, Newton and Wren. Yet, in the course of documenting the phenomenal growth in scientific practice throughout the 17th century, she also shows us that these men were not the lone geniuses of popular imagination. In contrast, Jardine reveals a world where the new scientific breakthroughs were governed as much by professional collaborations and rivalries, political realities and funding agendas as by the birth of a pure scientific spirit.

In this interview with Science &Spirit at her home in the heart of Bloomsbury, Jardine discusses the role of war, commerce and politics in driving the scientific revolution, the massive changes the invention of machines and the discovery of new flora had on European cultures, and the implications this understanding of the history of science has for our world today.

The Royal Road to Revolution

"'There never was a scientific revolution and this is a book about it.'"

Modestly perhaps, Lisa Jardine opens our discussion of her new book on the scientific revolution by quoting the opening line from Steven Shapin's book on the same subject. "It's a convenient, old-fashioned label, which just tells people where they are going. The same thing applies with 'the Renaissance.' If you're doing a general book, you can't flummox the reader by not using the term they recognize."

But if there was no such thing, what then do we mean by the term "scientific revolution?" It's not a singular event, but rather a series of events over the course of 50 years or so that brought about a sea change in the way that science was thought about and practiced, she says.

"You can date the crucial events from the middle of the Commonwealth period in England to the end of the 17th century—from about 1650 to 1700," says Jardine. She tells her story largely from the perspective of London—"but probably one could have told the whole story from Paris"—and charts the activities, thoughts and fortunes of a group of highly influential scientists.

"The people that I focus on in England are Hooke, Halley and Wren. On the Continent, it is Cassini and Christian Huygens—who was probably a spy." Jardine says she uses this Anglocentric focus, partly because the documentary evidence compiled by the newly formed Royal Society was so meticulous, and partly because the English Civil War in the middle of the 17th century played such a crucial role in defining the politics of the era.

But if the political revolution in England was significant, it was in a very curious way, she adds. "The scientific revolution started in Oxford in the 1640s, in the circle of out-of-work royalists—men such as Boyle and Wilkins, who were trapped in their colleges in the little enclave that was royalist controlled. That then moved to the Continent during the Commonwealth period, and then came back to England with the Restoration."

So, did the explosive growth in science at this time have strong links to particular political positions? "I got a strong feeling in the end that it might have a close relationship to both royalism and Catholicism," Jardine replies. "The Royal Society, when it was founded in 1665, was a very interesting collection of people. Arundel, who was really a prime mover, came from a Catholic family who couldn't do anything in government because everyone was too scared of Catholics. Many members were Freemasons. I began to feel the Royal Society might have been a club for clubbable men who couldn't belong to the straight political club—dissidents and marginals."

That said, Jardine's book reads something like a scientific Who's Who of the period. Except that, unlike Who's Who, the key characters return, in unexpected places, and for unexpected reasons. "The same people come up again and again in my book, because they are not working alone. Nothing is compartmentalized. I don't believe in isolated geniuses, I don't think they really exist. The people that got about a lot were extremely intellectually agile, inquisitive, contentious, competitive, entrepreneurial, and that functioned in different ways for different people. There's this particular conjunction of very worldly attributes that I think are crucial for a scientific breakthrough, like any other kind of breakthrough."

As well as focusing on a number of central characters, Jardine also draws our attention to the Eurocentric nature of such developments. "People got a long way, they got to Peru, China and Japan, and they spent a lot of time on the African Cape. But it was all orchestrated from Amsterdam, Paris and London, because that was where the money and the institutions were." And this was a distinctly new type of Eurocentricity: by the mid-17th century, the religious differences that had dominated European politics for the previous hundred years were on the wane. As a result, Jardine argues, emergent scientific practice was dominated, not by theology, but by an essentially modern configuration of "political alliances, the military and pharmaceutical industries—just like today."

The Power of Precision

Perhaps the most striking set of innovations documented by Ingenious Pursuits was the unprecedented proliferation in the invention of machines. The air pump, the barometer, the camera obscura, clocks and watches, the microscope and the telescope

were all invented or substantially developed during this period, inviting the inevitable epiphet "the first machine age" in European history. "There were quite a lot of designs for machines earlier—there are all the designs by Leonardo da Vinci, for example. The real trigger for developments in equipment and technology are the instruments for precise measurement. It is impossible for us to imagine a world where you couldn't measure a second or a centimeter accurately— in a way that somebody using a different ruler or clock, in a different location, would measure the same thing. So, this is the first machine age, but it rides on the back of the first precise-measurement age, because the machines all depend on precise mechanisms, which depend on precise measurements."

In charting the connections between the military need for accurate measurements of location, and Newton's discovery of the elliptical orbits of comets (and therefore of planets), the book starts with a particularly elegant example of the myriad deployment of particular inventions, and the people associated with them. "The need to find a precise location on land or at sea, i.e., a precise latitude and longitude, was an endeavor that the Navy needed at sea, while voyages of exploration needed it on land," Jardine explains. "Whole expeditions died calamitously in South America through believing they were walking towards the coast when in fact they were walking away from it, because they had got their longitude wrong. There was this pressing need to have a clock that kept perfect time, and a need for a very precisely measured star chart of the heavens. So, that after having looked at your watch and found out what time it was at home, you would then fix your telescope on a fixed star and determine your position.

"Everything hinged on how bodies that moved through the heavens traced their trajectory across the sky. When a group of men are exercised about that problem, and they've reached the point where they need someone to tell them what the trajectory is of a body moving under an inverse square motion and constant velocity, Newton says 'Well, it's an ellipse,' and that's a piece of fundamental mathematics that only he could solve. But the piece of fundamental mathematics comes at the end of a story in which a dozen people, under the pressure of the urgent need to know where you are on the globe, have devised the question to ask. I think there's this elegant sense in which the ultimate solution to a difficult problem is always like putting the keystone into an arch. But the building of the arch has been a whole story in response to much more pressing commercial and military influences."

Technology and Commerce

In focusing on the practice of science, Jardine wants to show that the boundaries we erect between abstract philosophy and technology or practical experiment may be false. "I think the way in which the philosophy of science privileges abstract thought as the ground plot of science is very odd, because practicing scientists don't believe that. I debated this most recently with Sir Martin Rees, the astronomer royal, and he said, 'Yes, science is technology-led.'He's an astronomer, and your astronomy is only as good as your telescopes."

Even paradigm shifts in science are technology-led, Jardine argues. The Einsteinian experiment, that sends a watch out on a spaceship which has either gained or lost time when it returns, depending on which way it is going, is a great example of this. "If it's

lost time or gained time, you need to know that it wasn't the watch; but you need an incredibly accurate watch in order to know this. Indeed, if you say that Einstein's paradigm shift is dependent upon a clock which either gains or loses, it is deeply technologically-led.

"Theories of science are always retrospective assessments of the practices of practitioners, but what I am talking about is not at that theoretical level," Jardine adds. "I'm talking about the all-too-real way in which it is practiced. I'm not challenging theory, I'm saying you can't separate the two. All that I am evangelical about is that you cannot isolate pure science from its context."

If machines underwent explosive growth in this period, the other area that seems to have undergone huge expansion was the discovery of flora—especially of flora from the East. Jardine describes the extraordinary impact these discoveries had on European culture. "Well, it completely transformed the landscape," she says. "Whenever I see a publicity film advertising Stratford Upon Avon and Shakespeare, they pan across the river, across these trees like horse chestnuts and weeping willows, none of which grew there in Shakespeare's day. The English landscape is an imported commodity of the 17th century."

In terms of commodities like coffee, tea and chocolate, and pharmaceuticals like quinine and Chinese rhubarb, Jardine documents how the Chelsea Physic Garden at one point had several hundred plant species, brought from Amsterdam Physic Garden. All were being exploited commercially for remedies—and all of them had come from the Cape or further East. "The East Indies, where indigenous medicine was very good, supplied us with vast numbers of things which we now regard as being home-grown. Anything they could get to grow here became English."

So, the new flora was not just flora, Jardine argues. It transformed the landscape and it transformed comestibles and pharmaceuticals. "England was unrecognizable after 1700. By 1700, for instance, tea, coffee and chocolate had moved down well below the top end of the scale—they were not luxuries anymore. The retail market had also become much more astute at importing, packaging and distributing efficiently and relatively cheaply so that goods disseminated much more rapidly. Again, you can see the effect of commerce on these developments. It was absolutely astonishing." And terrifying, Jardine emphasizes: "It presumably involved denuding all sorts of places of their indigenous species. I bet there are all sorts of places from where these plants came where there aren't any anymore."

The Cultural Context

Predictably perhaps, most of the prestigious practitioners working during the scientific revolution appear
to have been men, although Jardine cautions us in the assumptions we bring to the book. "I divide my readers into those who notice the women and those who don't!" Jardine notes mischievously. "Science is an elite pratice—that is to say the only people to get their names on the books are elite men. But there are large numbers of women functioning alongside the non-elite men as the actual investigators. For Lister's Complete History of Shells, for example, all the taxonomy and all the illustrations are done by his daughters. Hevellius' measurements are taken by his

wife. Women are the experimentalists in lots of situations, because they are cheap labor."

But, at the same time, Jardine points out, no one from the non-elites got published. "If you think of the extraordinary impact of Oriental medicine and botany and probably other areas of influence on the West, none of it was published under Oriental names. And that has led us to undervalue their contribution. If we use that argument for women, what we need to do is to start to recognize that they are there, even if it is hard to make them visible. This goes along precisely with my argument that where the funding is, there the advances are. Funding always goes to the men—it always has done and still does. It's difficult for a woman to say, 'I'd like to solve the longitude problem.' She's unlikely to get funded: longitude is military, it's men's stuff."

Perhaps the most shocking aspect of Jardine's account of scientific endeavour in the 17th century is the enthusiasm with which some particularly unpleasant vivisection experiments were practiced, sometimes repeatedly, and in public. They can come across as a chilling fulfilment of Francis Bacon's famous prophecy: of a science that will torture a female Nature and thereby rule the world.

Again, Jardine sounds an historian's note of caution. "Well, Bacon doesn't actually say that—it's probably apocryphal." At the same time however, Jardine argues that at a very early stage in modern scientific experiments, the idea of "scientific responsibility" was scotched, because wasn't clear who scientists were responsible to. "I find it very telling that Robert Hooke, a complicated, isolated, non-elite man, expresses real anxiety at vivisection experiments. Sir Christopher Wren never once does: Wren does those experiments over and over again."

This leads Jardine into perhaps the central argument of the book. "I don't think that scientists are special about being responsible, and they never have been. I do think that you see correlations between an individual's social habitat, background, their cultural milieu, and their amenability to recognizing something as appropriate or inappropriate. Unless we register that the sense of moral responsibility comes out of our everyday lives, we are done for. If we believe that white-coated scientists inhabit a pure abstract world, with no connection to us, we are doomed, because they will bomb us all again. Actually, when scientists get together in that way, they are impervious to those kinds of questions, they are entirely goal-oriented. What is crucial is the dialogue between the context that sets the problem and the scientists solving it. We say, 'It's not our fault when a bomb is dropped on Hiroshima, because we didn't know they were doing it.' Well, how did that happen? Because we weren't talking. We set the problem—the defence of the nation, or whatever—and they come up with a solution."

Evaluating the significance of change represents the critical undertaking of the historian. So, I ask Jardine finally: Has anything changed, or are the kind of questions faced in the practice of science the same today as in the 17th century? "At the level I'm looking at it," she says, "the questions are the same. Everyday life, practical contingencies, commerce and the military, are interleaved with all the creative processes and determine the direction they take, and therefore determine who will be the geniuses. There are lots of botanists in this period that nobody thinks about, because botany didn't seem to be a problem-solving area. It's the same today. If you

think about the fact that the Internet and NASA are both fundamentally military, all subsequent developments are part of that initial impetus. They're like big magnets. Longitude was a big magnet; a perfect cure for pain is another. If you regard these as areas which commerce and the Pentagon cluster their efforts round, you get lots of spin-off which goes in lots of directions; but you won't get your grant unless your application can show it has some bearing on these questions. But if you're off doing something else, it's hard to get funded for fundamental research. There is the passion of the individual for their subject, which always cuts across it, and that's great. I'm not diminishing the passion of the individual, nor the brilliance of an individual in their chosen field. I'm just saying that St. Jerome was pretty passionate about what he did, and nobody funded him."

So, do the contexts of scientific practice in the 17th century as now, determine the boundaries of human knowledge? Like Oliver Sach's famous anthropologist Jardine responds: "I think if we were on Mars and looking down at ourselves, the pattern of our activity would be suprisingly limited. There would be whole realms that we weren't exploring."