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The Old and the New: Ethics, Science and Technology

Abstract

Ethics, science and technology have brought us both age-old questions and pressing contemporary challenges. This paper explores the 'old' and the 'new' through three main topics. First, the 'old' is highlighted through a brief review of the thinking of Aristotle on the intellectual virtues of *episteme*, *techne*, and *phronesis*. Second, the 'new' is approached through the concrete example of nanotechnology research, the results of which appear likely to have profound implications for the world as we know it. Third, the paper looks at one response of CSIRO in the form of the development of an emerging science area of 'Social and Economic Integration'.

Ethics in context

There is often a fairly narrow concept of ethics in the many fields of science and technology. As Langdon Winner has neatly characterised: 'Most engineering ethics scenarios take the form of wrestling with the question of whether an engineer has an obligation to warn workers painting the nose cones of nuclear-armed missiles if he or she learns that the paint's fumes are toxic!' [1] Scientists sometimes see ethical considerations as something of an add-on at best – or a distraction at worst – from the scientific task at hand. Raising ethics for discussion at the bench can be seen as a potential obstruction to research or an implication of personal immorality. Some scientists, however, and I suspect their number are increasing, are aware of and keen to explore the dilemmas that modern science can present.

An increasing public environmental consciousness has created an ambivalent position for science and technology with both 'goodie' and 'baddie' roles. On the one hand, there have clearly been dystopian outcomes of scientific work: the proliferation of nuclear weapons in contemporary democracies (let alone non-democratic countries and perhaps non-state groups) is a clear and much cited example. On the other hand, science and technology is still relied upon for solutions to the myriad of challenges that face modern societies. For example, the development of 'clean energy' technologies such as wind and solar present a different kind of role for science, one that is looking to deliver society's ecological emancipation. These tensions become further complicated by the interrelationships of science with commercial interests and with the increasing technical complexity of our constructed world.

Episteme, techne* and *phronesis

Although we are dealing with 21st century science and technology, ours is not the first culture to live in a complex and interrelated world. When introducing ethics it is not uncommon to hark back 2,000 years to Greek philosophers. This is not to say that classical Greek society achieved a utopia which modern societies need somehow to recreate. That time in history, however, developed a unique example of a strong ethical culture that was not related to religion, civil law or science.[2] Socrates, Plato and Aristotle are often seen as the forefathers of modern science and continue to be a reference point on ethical issues today. If we start from the premise that our collective ability to ponder ethical issues is inadequate in contemporary times, then these well-known Greek thinkers offer opportunities to learn about different ways of thinking. Here I will focus particularly on Flyvbjerg's discussion of Aristotle.

In *Ethics*, Aristotle considers three intellectual virtues: *episteme, techne* and *phronesis*. Flyvbjerg summarises these in Table 1.

	Episteme	*Techne*	*Phronesis*
Meaning:	Science	Craft/art	Ethics Deliberation about values with reference to praxis
As an activity it is:	Universal, invariable, context independent	Pragmatic, variable, context-dependent	Pragmatic, variable, context-dependent
Based on:	General analytical rationality	Practical instrumental rationality governed by a conscious goal	Practical value-rationality
Oriented towards:	Knowledge	Production	Action
Contemporary terms:	'epistemology' 'epistemic'	'technique' 'technical' 'technology'	No analogous contemporary term

Through the scientific ideal, *episteme* has become a dominant type of rationality in modern societies. The main strength of science has been its ability to produce theories that can explain and predict the nature of things accurately and to create knowledge that is largely cumulative. Particularly when coupled with its cousin *techne*, it has made enormous contributions to material well-being (though, as some critics will point out, these have not been shared equally among humanity). However where science, as the intellectual activity of *episteme*, is weak is in the consideration of values and ethics focusing on practice and action. Here, instead of a universal knowledge, it is important to take context and experience into account. This sort of value-rationality is where *phronesis* is strong. *Phronesis* concerns the analysis of values – things that are good and bad and in between – as a point of departure for action.[4] While the term 'ethics' tends to be used as the modern equivalent, Aristotle's idea for *phronesis* as a rationality probably has a closer connection to today's social sciences in general. Indeed Flyvbjerg argues that *phronesis* scopes an agenda for contemporary social science research that more closely interfaces with other forms of *techne* and *episteme.*

The fact that there is no contemporary etymological descendant of *phronesis* in modern English is probably indicative of its fall from grace as an intellectual virtue. Yet as scientific and technical 'progress' increasingly present serious ethical challenges, a practical wisdom like *phronesis* becomes more urgent. I shall use the example of nanotechnology to explore what a consideration of ethics might mean in this context. Nanotechnology is a new arena for science and engineering endeavour. While its early products are perhaps only modestly different from ones already in use, the claims for its potential impact are immense.[5] The phronetic, or at least ethical, challenges are potentially profound.

Example: Nanotechnology

Nanotechnology exploits properties that emerge at the nanometre[6] scale. Scientists are finding that when many materials are reduced to less than 50 nanometres, quantum physics dominates with unexpected emergent properties. Nature uses nanoscale components for its 'manufacture' and so there is considerable scientific interest in mimicking nature for nanotechnology manufacturing. Nanotechnology is already being incorporated into products such as sunscreen creams, plastic products, car parts, inks, immunodiagnostic sensors, and new generation batteries. It is the potentially enormous breadth of impact that highlights, and makes more urgent, questions about the broader implications of this new emerging technology.

Nanotechnology is being heralded as a 'disruptive' technology in the science paradigm. It also holds significant potential for disruptions in broader social and ecological contexts in its creation of new molecules, applications and outcomes at the very small scale, with possibly large-scale implications. Activist groups have already identified substantive gaps between the science and consideration of social and ecological issues.[7] Furthermore, serious ethical, social and legal research on this topic is still only embryonic and is lagging significantly behind the science push.[8]

Many of the ethical issues and challenges of nanotechnology are broadly social rather than individual. These include issues around social justice and equity (who will benefit, how will developing countries have a voice), value-rationalities (which differ about technology, development and progress), privacy and security (surveillance, detection, control), ecological impacts, and the human-machine interface. These tend to be more complex to negotiate and navigate than just a simple yes or no to nanotechnology.

Aristotle's idea of *phronesis*, or ethics, points to the intellectual need to analyse and interpret the diverse values and interests in society. Flyvbjerg's approach is to summarise this ethical approach into four main questions:

- Where are we going (in this case, with nanotechnology)?
- Who gains, and who loses, by what mechanisms of power?
- Is it desirable?
- What should be done?[9]

Of course no one can give complete answers to these questions, not least because interpretations are likely to vary depending on the context. However the partial answers will contribute to an ongoing ethical dialogue and to decisions that need to be made at points in time. There is an important role for social science here, as while it is perhaps weak in comparison to the natural sciences in being able to produce predictive theory, it is strong in its ability to ask and explore value-rational questions such as these.[10] The social science agenda with regards to nanotechnology would include exploring the governance of technological change, the evaluation of risk and opportunity under uncertainty, and the role of new technology in ameliorating or accentuating social and economic inequity.[11] Social science theory in areas such as philosophy and sociology of science, democracy and public participation, power and rationality, and social justice have much to offer a more interdisciplinary research program.

Some recent experiences in CSIRO

In its Emerging Science Areas initiative, CSIRO has taken a new turn with its inclusion of 'Social and Economic Integration' (SEI) alongside fields such as Nanotechnology and Complex Systems. The SEI initiative seeks to support new areas of integration of the social and economic sciences with other scientific and technological research and development. New projects in areas such as environmental decision analysis, outback property rights, the costs and benefits of climate change, and organisational learning have commenced. These projects engage with broad issues such as sustainable development, justice and equity, and knowledge and culture and highlight the growing need for scientific endeavours to understand the context in which they take place and the potential consequences of discovery and commercialisation.

While Aristotle describes the intellectual virtues as types above, many contemporary writers use compelling examples to argue that in practice science and technology is not neutral or value-free.[12] Scientists and engineers are people too, and their values are shaped by where they live, work and play. Decisions to follow certain fields, to undertake particular research, depend partly on what scientists themselves consider from their perspective to be important questions. Increasingly, it also depends on funding which tends to reflect the priorities of other actors, such as companies and governments, who have their own values and imperatives. These can of course vary through history. This prioritisation is one context in which a range of values influences scientific and technological work. This is not to say that the science is not rigorous - it *seeks* an objective standpoint and universal knowledge as an ideal in its analysis. However it is important to recognise that this social context of diverse and competing values is a playing field where science kicks around its soccer ball. The weather, the crowd, the umpires, the coaches, the sponsors, the skills of the team and even what they had for breakfast can all influence how the game is played and the final score.

Understanding this 'playing field' of values enables us to more clearly articulate the ethical challenges and dilemmas of modern science. In July 2003, the Social and Economic Integration (SEI) area held a CSIRO workshop to explore research ethics. Participants demonstrated a willingness and ability to think broadly about issues and implications of their research. Of course these varied depending on the context, but they could be loosely grouped into ethical issues at the level of practice, for the organisation as a whole, and in terms of broad conceptual issues such as knowledge, justice and power. Sometimes it is not at all easy for scientists 'at the bench' to be able to identify and deal with these issues on their own. Many ethical questions are not so much about individual choice but social and collective choice about what kind of society we want. On some issues, organisational and social responses are needed.

While the SEI 'experiment' is still young, the investment in this area is being made with the expectation that there will be positive benefits for an enhanced understanding of the social (and economic) context of science. Understanding this context could allow science to begin to re-engage with an increasingly sceptical public on some issues, with an increased appreciation of its own situated position. Ethical reflection can also encourage greater inter-disciplinarity, as the knowledge and skills of the law specialist, sociologist or philosopher can be brought into the mix.[13] Finally, ethical reflection encourages critical reflection generally, both at a project level and at a policy level. As dissent has always been one of the main engines for scientific progress, it would appear that in this sense, too, a critical and ethical dialogue about modern science is crucial.[14]

Conclusion

Science and technology development have always had a complex relationship with social drivers and impacts. However eroding public trust in scientists as benign experts means that it is important to acknowledge and explore these issues explicitly. There are clear ethical challenges, not just in 'high science' such as nanotechnology, but also in every day science and technology choices. Some of these issues require individual ethical judgment, others however are profoundly collective and complex choices about the sorts of organisations, societies and futures that we want. It is important that our ideas about 'we' are broadly inclusive when we make these significant decisions. As Einstein has noted, 'science tells us what *is,* not what *should be*'.[15] The 'should be' discussion is part of a broad ethical dialogue in which the scientific perspective, along with other perspectives, has much to contribute.

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1 Winner (1990), p59.
2 Flyvbjerg (2001), p54.
3 Flyvbjerg (2001), p57.
4 Flyvbjerg (2001), p57.
5 Wood, Jones and Geldart (2003), i.
6 Nano denotes 10-9
7 For example, the ETC group, www.etcgroup.org
8 Mnyusiwalla, Daar, and Singer (2003).
9 Flyvbjerg, B. (2001), p60.
10 Flyvbjerg, B. (2001), p53.

11 Wood, Jones and Geldart (2003), p1.

12 For example, Winner (1986).

13 Oosterlinck (1999), p119.

14 Oosterlinck (1999), p120.

15 Oosterlinck (1999), p118

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