Editorial

Respice Finem: The Historicity, Heuristics and Guidance of Scientific and Technological Advancement and Use

James Giordano, PhD[1,2,3]

1. Neuroethics Studies Program, Pellegrino Center for Clinical Bioethics; Division of Integrative Physiology/Department of Biochemistry; and Graduate Liberal Studies Program, Georgetown University, Washington, DC, 20057, USA, 2. Human Science Center, Ludwigs-Maximilians Universität, Munich, GER, 3. Potomac Institute for Policy Studies, Arlington, VA, USA.

The historicity of science and technology

"…the science of today is the technology of tomorrow"

Edward Teller (1)

Somewhat colloquially translated, the Latin adage *respice finem* invokes one to "look before you leap". To be sure, science and technology (S/T) have provided means to make great leaps in knowledge and capability. Science – the pursuit of information and knowledge, and technology – the development, use and analyses of tools – arise from, and are expressions of human need and desire. Traditional boundaries between science and technology have been challenged since Bacon (2), who held that in essence, knowledge about the natural world provided the basis from which interventions to adapt to it (and change it) could be derived.

By the end of the second Industrial revolution, what Bachelard (3) called *science technique*, the conjoined entity of science and technology, had become an efficient approach to investigation and implementation, and by the early 20th century, "technoscience" evolved as a unified endeavor of research, development and application. Descartes posed that "…the human being…is the master and possessor of nature" (4). Yet, as Goethe keenly recognized, "…what you cannot understand, you cannot possess" (5). Arguably, the quest for understanding defines human nature; the creation of instruments to exercise curiosity, gain knowledge, and use the knowledge gained to foster mastery in strivings to survive and flourish have yielded considerable power over nature. But, we must ask – to what ends, and through which means?

Technoscience: means, ends, intent and use

"…every techne and every inquiry, and similarly every praxis and pursuit, is believed to aim at some good"

Aristotle (6)

Neither science nor technology is neutral. Both are generated by and with intent, and both occur as activities within the sphere of human culture in and across time. Aristotle's perception that every iteration of tool and technique is purportedly directed at achieving ends of individual, community and/or societal preservation or advancement is certainly defensible. Even those technologies that are explicitly developed for military purposes are done so under a rubric of sustaining the ideals, values and lifestyles (if not lives) of the polis that a government seeks (and vows) to protect.

But what is deemed "good" for some may not be "good" for all. Ayn Rand asserted that "every major horror of history was committed in the name of [some] altruistic motive" (7). Most apropos in this light is philosopher Alisdair MacIntyre's (8) incisive query: what good, whose justice, which rationality? And what of misappropriation of S/T through divergent applications and/or direction toward ends that are distinct from original intent? Given the

capacity for S/T to be increasingly and broadly leveraged in, and affect the processes of international fora, markets and relations, the social – and political – impact of "technoscience" becomes ever more prominent, and important to consider, address, and guide.

To wit, it is more realistic (if not rational) to view the inherently bivalent potential of any S/T: through the very same means, what may be seen as opportunities for achieving liberation and equity, may also be employed to yield marginalizing, imperialist if not totalitarian ends. Pro Bruno Latour, it would be wise to consider technoscience as not only a social force, but as a social construct (9). As such, S/T cannot, nor should not be extricated from the socio-cultural (and political) frameworks of the time. As human enterprises, S/T responds to temporal contingencies and exigencies, and contributes to (if not creates) them.

This prompts questions of what type of social effect(s) S/T have evoked in the past, present, and may yield in the future. What have humans as individuals, groups and perhaps a species learned from the continual quest for more information and greater capacity to gain and use such information to understand and control the natural world and human condition? How will societies assign, assert and measure meaning, value, and utility of extant and new scientific discoveries and technological capabilities, and how might we – as organizations, communities, and populations at large – negotiate the ways that S/T should and should not be employed in pursuits of human flourishing, and socio-cultural agendas?

These questions become difficult, if not tenuous, given the novelty and speed of technoscientific advancement. Granted, the succession of S/T can be rightfully regarded as a step-wise process (10), but the momentum of acquiring new scientific knowledge, which fuels and is fueled by technical capability is such that more Kuhnian punctuations of quantum change (i.e., paradigm shifts (11)) are becoming more frequent and commonplace, as representative of the current gait of progress. With each step forward, it is crucial to take stock of the edifice of science – and society – upon which we build.

Such developments in S/T are effecting change in the ways that humans live, and certain aspects of human nature, as well. Thus, as the fund of knowledge and technical capacity increases, so does the responsibility to engage this knowledge and capability in ways that are apt and ethically sound (12). To re-iterate MacIntyre's inquiry, any

articulation of ethical probity must begin with insight to definition(s) of "the good", and must continuously examine the methods and meanings of S/T, and the individuals and societies that develop and employ them.

Historicity, predictions – and shaping the future

> *"History is a ship carrying living memories into the future"*
> Stephen Spender (13)

The 20th Century provides an historical roadmap of the socio-political use and misuse of S/T, and the responsive (or perhaps, more accurately, reactive) development of modern scientific and medical ethics. History is not static; the effects of past action and/or inaction persist, and profound ethico-legal issues, questions and problems are often spawned as progress in S/T – and its uptake and application within socio-political agendas – outpace the philosophy, policy and laws needed to meet and meter the rapid expansion of information, technical acumen and strong pulling forces of politics and economics (14). Indeed, current scientific and technological progress – and its effect upon the world stage – is such that change occurs far more quickly than in past decades. In light of this, I posit that a better understanding of the historicity of S/T as a social force will enable both 1) a more salient view of the potential benefits, burdens, risks and harms posed by S/T research, development, and applications to contemporary society, and 2) insights necessary to more precisely predict possible S/T trajectories and plan more soundly for the future.

Contemporary scientific history is not something in the distant past – it is being made in the present, and is now to be measured in 5 to 10 year increments, as reflective of the tempo of scientific and technological translation from concept to social commodity (14). This history is one that we, not just prior generations, have incurred, and this broad palette of change affords considerable purchase to examine both the current practices of science and technology – and the need for pragmatic reflection and factual guidance of the ethics, policies and laws that direct (if not govern) these enterprises upon the rapidly shifting socio-economic and political architectonics of the 21st century.

The task at hand is not simply to present this information, but to use it as knowledge to inform and shape the formulation of guidelines, policies and laws. To paraphrase

Santayana, those who fail to address and scrutinize history are doomed to repeat the errors of the past (15).

Analytical historicity provides a retrospective through which to frame current realities within the scope, contingencies and effects of prior circumstances. This affords 1) a set of key points that are necessary to review the social impact – and ethical probity – of S/T developments and applications, and 2) a template of ethical and policy "attitudes" that enables "fitting" historical events and consequences to heuristics that can be useful and helpful in (a) identifying prior successes and failures (of S/T and ethical constructs and activities), (b) guiding and directing current and future applications of S/T, ethics, and policies, so as to (c) mitigate or avoid repetition of previous mistakes and misuses of S/T, and the ways that S/T are regulated.

This approach could be condensed to a set of 5 core questions that are axiomatic to any meaningful effort to gain insight to, and guide the activities of S/T in society. Namely, these are:

1. What heuristics have, and continue to shape the interplay of science and technology as social forces?
2. How have particular domains of science and technology been engaged in the 20th century, and what "object lessons" may be drawn toward developing a better understanding of potential patterns of social uptake of S/T on the current and evolving 21st century world stage?
3. What are the cutting-edge developments in science and technology – and the ethico-legal and social issues they foster?
4. What are the values of contemporary societies, and how will these be influenced by/manifested in technoscience in the near future?
5. How might guidelines, policies and laws address these issues, and what process(es) would be required in their development, articulation and enforcement?

I believe that such lines of inquiry are necessary to 1) encourage active reflection and discourse, and 2) develop an increasingly sophisticated dialectical approach through participatory engagement within respective groups of share- and stake-holders. Ever more, these share- and stake-holders will be global, as S/T becomes an increasingly potent element of the economies of Asian and South American countries (16). The respective balances of power conferred by such S/T capability are sure to change, and the ethico-legal considerations and frameworks for the scope and conduct of S/T research, development, and use will reflect the needs, values, mores and ethos of these cultures (17). As S/T becomes a more global, pluralistic enterprise, so too must the ethics and policies that direct its development and applications (18,19).

Possibilities, challenges – and opportunities

The Spanish philosopher Jose Ortega y Gasset saw technoscience as offering humanity a "horizon of unlimited possibilities", but warned that in delving into this cornucopia of potentiality, it is important not to lose sight of human investment in shaping what can – and will – occur (20). Respecting Ortega's vision, I hold that asking the right questions – of history, and the professional, social and political institutions that shape and execute S/T – while being an important step, is but a first step nonetheless. In essence, it both allows a more far-reaching view (into the past and toward the future), and puts us closer to a threshold of action from which there may be no turning back. Taking the next step: dealing with the answers – and persistent unknowns - that such questions yield, and bearing responsibility for the trajectories and effects of S/T we engage within the human culture(s) of the 21st century world stage will remain a formidable challenge – and tremendous, if not exciting opportunity.

Acknowledgements

Disclaimer

The views expressed in this editorial are those of the author, and do not reflect the positions or perspectives of the institutions with which he is affiliated.

Competing interests

The author declares that he has no competing interests.

References

1. Teller E. Memoirs: a twentieth century journey in science and politics. NY: Basic Books; 2004.
2. Bacon F. The advancement of learning. Oxford: University of Oxford; 1605.
3. Bachelard G. Le nouvel esprit scientifique. Paris: Jouvier; 1934.
4. Descartes R. Discourse on method. (R. Kennington, transl.) NY: Focus; 2007.
5. von Goethe JW. Kunsttheoretische Schriften und Übersetzungen. Weimar: Teutscher Merkur; Februar, 1789.
6. Aristotle. The Nicomachean ethics. (D. Ross, transl). London: Oxford University Press; 1966.
7. Rand A. Philosophy: who needs it? NY: ARI Press; 1984.
8. MacIntyre A. Whose justice? Which rationality? Notre Dame: University of Notre Dame Press; 1988.
9. Latour B. Science in action. Cambridge, MA: Harvard University Press; 1987.
10. Popper KR. The logic of scientific discovery. NY: Harper; 1959.
11. Kuhn TS. The structure of scientific revolutions. Chicago: University of Chicago Press; 1962.
12. Jahr F. Bio-Ethik: Eine Umschau über die ethischen Beziehungen des Menschen zu Tier und Pflanze. Kosmos. Handweiser für Naturfreunde, 1927; 24(1): 2-4.
13. Spender S. Quotations. In: Peter LJ. Peter's quotations: Ideas for our times. NY: Collins; 1993.
14. Toope S. Internationalism and global norms for neuroethics. Am J Bioethics, 2009; 9, 12.
15. Santayana G. Life of reason: Reason in common sense. NY: Scribner's; 1905.
16. Giordano J, Benedikter R. An early – and necessary - flight of the Owl of Minerva: neuroscience, neurotechnology, human socio-cultural boundaries, and the importance of neuroethics. J Evol Technol. 2012; 22(1): 14-25.
17. Benedikter R, Giordano J. Neurotechnology: new frontiers for European policy. Pan Euro Network Sci Tech. 2012; 3: 204-207.
18. Shook JR, Giordano J. Toward a principled and cosmopolitan neuroethics – considerations for international relevance. Phil, Ethics, Hum Med 2014; 9(1).
19. Lanzilao E, Shook JR, Benedikter R, Giordano J. Advancing neuroscience on the 21st century world stage: the need for – and proposed structure of – an internationally-relevant neuroethics. Ethics Biol Engineer Med 2014 (in press).
20. Ortega y Gasset J. Obras completas. Vol 12: Meditación de la ténica. Madrid: Alianza; 1939.