Postnaturalism

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All technology exerts some epistemic influence on the observer, and this is often epistemologically relevant; the proper function of philosophy is to study the epistemic effect of technology, and to design and produce epistemically useful technology; localised agreements rather than shared beliefs, entailed by the use of common technology, are sufficient foundations for philosophical discourse.

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“Ontogeny recapitulates phylogeny.” —Ernst Haeckel

“Ontology recapitulates philology.” —W.V.O. Quine

“Ontology recapitulates phylogeny.” —A common misquotation of Haeckel’s dictum

In this article, I introduce *postnaturalism*, a philosophical lineage uniquely suited for adopting and developing digital methods for philosophical research. I do this by discussing three examples of postnaturalist strategies from classical philosophy.

Philosophers are not against technology

In 2007, National Science Foundation called for what was nothing short of an industrial revolution for education. This “Cyberinfrastructure Vision for 21st Century Discovery” [1] is being realised all around us: the online is the dominant operating mode for most students, and pervasive cyberinfrastructures have indeed extended our awareness of the physical and social environment. Philosophers are still fighting over armchairs [2] [3] [4].

This is not to characterise philosophers as antitechnological. On the contrary, philosophers have been highly responsive to scientific and technological developments throughout history, and have contributed immensely to science and technology. Examples can be found from the beginning of philosophy with Plato’s geometry and Aristotle’s biology and physics; through modern philosophy with Copernicus, Bacon, Galileo, Descartes, Boyle, Huygens, Newton; and in contemporary philosophy with Darwin, Einstein, Mendel, Turing, Planck. Consider in particular that, although Bertrand Russell failed to develop a complete logical foundation for mathematics, the philosophical technologies developed by analytic philosophy during the 20th century produced formal systems that provided the basis for modern computers.

Automated reasoning has developed to the point of surpassing human researchers at certain tasks and has been adopted by a significant number of specialised researchers including philosophers as well as mathematicians. It has not yet been widely accepted by mathematicians partly due to scepticism about bugs, the length and excess of detail of automated proofs, and the fact that mathematics is an enjoyable activity that mathematicians are hesitant to automate away [5]. Bugs can be minimised, independent verification can be provided, and “as important theorems requiring larger and larger proofs emerge, mathematics faces a dilemma: either these theorems must be ignored or computers must be used to assist with their proofs.”[6]

Digital philosophy has not happened

For all the tradition of methodological naturalism and the availability of digital technologies that philosophers already make use of in everyday life, philosophers outside of logic are peculiarly neglectful about the concept of digital methods in philosophical research. This is probably due to a different kind of scepticism than those of mathematicians regarding automated reasoning. The most obvious formulation

of this criticism is that philosophers love the armchair too much, favouring a priori knowledge over a posteriori knowledge. This disregard for a posteriori knowledge, the criticism suggests, is the cause of their "metametaphilosophical" reluctance to take on an impure or eclectic methodology that takes advantage of both reason and technology. "And why do philosophers think they have to start from scratch?"[7]

I disagree with this sweeping accusation of an antiexperimentalist attitude or the charge that philosophers start from scratch in ways that scientists do not. The majority of philosophers are scientific realists; half of them are metaphilosophical naturalists; a substantial minority of them do not even believe in a priori knowledge or the analytic-synthetic distinction. Philosophers frequently make use of very old thinkers in ways that scientists virtually never do, since old science is almost invariably outdated in some way. Yet, philosophers are much more likely to opt for commentating and explaining digital technology than taking advantage of its philosophical potential. The basic ingredients are already available in the form of comprehensive and up-to-date resources such as the Stanford Encyclopedia of Philosophy and PhilPapers, as well as digital methods and tools developed by the digital humanists.

One possibility is that philosophy is fundamentally incompatible with digital methods, and that the metaphilosophical naturalists are mistaken in their assumption that naturalistic methodologies are compatible with philosophy. Even though there is an apparent critical mass of philosophers with both the correct basic metaphilosophical assumptions and access to the necessary technology required for a new paradigm, if philosophy is, say, a pursuit of knowledge about an immaterial realm of truths accessible only via philosophical intuition, digital methods might not do us any good. It is also possible that digital methods simply failed to take hold in philosophical research because philosophers have an incomplete or incorrect picture of what philosophy is, what philosophers do, and therefore what tools philosophers can use.

The problem is entirely practical

The success of automated reasoning in formalised forms of philosophy shows that at least some of philosophy is compatible with not just digital methods that mechanise certain activities, but total automation. Taking at face value the claim that formal logic is a representative example of philosophy,

this fact alone is sufficient to conclude that philosophy is not fundamentally incompatible with scientific methodologies and, as a corollary, digital methods.

This means that the lack of a comprehensive digital methodology in philosophy is the consequence of current practical limitations. The digitisation challenge is a practical problem, not a theoretical one. For instance, digital methods are new, and the available technology is not widely taught in the humanities. Coupled with the reluctance of professional philosophers to use digital methods, this means that most philosophy students do not even hear about the possibility of making use of such tools in the first place. The institutional feedback loop confines digital methods to the position of field trips in special topics in the philosophy of the digital. The cyclical structure of this practical challenge means that it's difficult to reason your way out of it from within, as one problem is always the consequence of another. The same structure makes it easy to approach it from a lower or higher level perspective, since any point is a good place to start cutting in a Gordian knot.

The solution is metametaphilosophical and technological

How can the rest of philosophy as a discipline take advantage of digital technology in the way that logicians and the philosophers of logic have done through automated reasoning?

This challenge is available to every philosopher. All philosophers already deal with it in an informal capacity in their decisions about how to organise their digital "extended mind" [8]. On the face of it, philosophers behave as though they agree that we should digitise philosophy in order to improve philosophical productivity. This behaviouralist interpretation of their beliefs is unsound as a statement about the actual beliefs of the philosophers, in light of the popular resentment towards the negative effects of technology on contemplative and deep thought. This is not an issue, because I am not addressing a normative dimension here.

Many philosophers probably hate having to work on a computer and navigate electronic bureaucracies instead of going for a walk with Socrates. Numerous superior alternatives to the frustrating process of adopting new research methodologies are (in principle) physically possible. Perhaps life extension and simulation technologies, or a radically different social and political environment that allows all philosophers to work on philosophy without other concerns at their own pace, or a cultural shift against productivity in all forms, will make the notion of efficiency in philosophical research irrelevant. Such

alternatives should be preferred as the ideal over the plausible but prosaic solution for the problem I have outlined. Therefore, I mean the following “ought” in the weak sense: “if one takes each philosopher’s normative beliefs implied by their behaviour at face value, then it follows that they ought to adopt digital methods.”

Philosophers ought to adopt digital methods

Philosophers are already convinced about the usefulness of digital technology, at least enough to use it as a part of their work environment. This is not an epistemological position but rather an epistemic choice made by the philosophers. Since I have stated that the challenge is practical rather than theoretical, this is sufficient as a foundation for my case for digital philosophy.

If philosophers are convinced that they should use some digital tools because they are useful, they should prefer better tools over worse tools. Usefulness for philosophers is determined by philosophical productivity, and tools are better or worse depending on their usefulness. I will define philosophical productivity entirely in terms of proximal features, namely that of being perceived as useful by philosophers, privately and publicly, commonly based on metrics such as academic success or the perception of originality and value.

The right conceptual frameworks improve the effectiveness of a tool that is paired with them. Philosophers will make better use of existing and novel digital methods if they also adopt a metametaphilosophical position that takes a methodology-first view of metaphilosophy, epistemically prioritising the tools that they use over particular frameworks that they are operating under. What I mean by this is that philosophers should take on whichever conceptual framework is best suited for the use of a particular tool, rather than universally applying their epistemology in disparate contexts. An analogy is that of a 21st century physics student lifting a barbell over their head. They would be forgiven for using a Newtonian framework while calculating the amount of weight to add to the barbell before beginning the exercise, and for using phenomenological[9] cues during the exercise about the prioperceptive position of their chest in relation to their chin that does not agree with the true physical coordinates of their body parts, and so on. They would probably hurt themselves if they tried to apply the same framework to their physical exercise as their physics exercises.

Different metametaphilosophical views can help or hinder philosophers in choosing the right metaphilosophy for the right tools to philosophise with. I argue that postnaturalism is one view that is more likely to help rather than hinder philosophers in conjunction with digital methods.

Digital methods will probably benefit most philosophers. They will probably have a better understanding of the nature of philosophy as well as the topics that they deal with, probably be more creative, probably understand other philosophers better, as well as communicate with them more effectively. They will probably spend much less time and effort to achieve equivalent amounts of work. Furthermore, more people will be able to contribute fruitfully to philosophical research if the tools involved are more accessible, or if they can facilitate a broader degree of participation.

This is an empirically verifiable hypothesis for which I have no data. Instead, I present a caricature of three classical philosophers in order to make an indirect argument based on the apparent causal links between postnaturalism, rough analogical equivalents for digital methods, and philosophical productivity. Although caricatures are generally epistemically defective[10], they can be illuminating in the correct contexts, as I have shown in the exercising physicist example above.

Plato, Aristotle, and Mozi

The Sophists were variously "rehabilitated" by Hegel, Grote, and Nietzsche[11] [12]. Schiller also attempted a similar rehabilitation for the purposes of integrating Protagoras into his pragmatic ("Humanist") philosophy[13]. In the same way that the pioneers of new philosophical lineages recruited the Sophists, I will recruit Plato, Aristotle, and Mozi as the ancestors of postnaturalism.

Plato, Aristotle and Mozi each stand in as useful examples of a technologically mediated application of deduction, induction, and abduction, respectively. That is not to say that they are exemplary of each kind of reasoning, but rather that they are useful examples of the consequence of postnaturalist strategies combined with a particular mode of reasoning.

In *Republic*, Plato introduces the most influential definition of philosophy in history. He characterises philosophy as a special kind of science, concerned with absolute truths, to which the philosopher holds exclusive access using reason as his instrument[14]. *The Republic* itself serves as a detailed example of what Plato's philosophical method consists of: a synthesis of Socrates' dialectic and the technique of

dichotomous division, heavily borrowed from geometry, based on Plato's metaphysics which justifies an epistemology based on representational accuracy about an ideal world of pure truth. By dividing knowledge into the contingent and the absolute in this way, Plato established the antinaturalist programme in philosophy.

Note that Plato was neither a naturalist nor a philosophical naturalist, nor a metaphilosophical naturalist nor a metametaphilosophical naturalist. Nor was Aristotle, who inherited Plato's Socratic project as well as his antinaturalism, and far surpassed Plato in the development and application of postnaturalist technologies. Because of their metametaphilosophical antinaturalism, Plato and Aristotle did not modify or alternate between different metaphilosophies depending on the domain or topic. This led Plato to attempt the immense and unnecessary task of constructing a holistic system of philosophy that is structurally analogous to the body, as well as projecting the same onto the design of a state.

On the one hand, this is a brilliant early example of an abductive reasoning tool in which anatomy acts as a syntactic template for Plato to develop new ideas through. The issue was that Plato was too strongly committed to a monist metaphilosophy, not that he employed inappropriate tools. He was using the cutting edge of technology available to him at the time. Dichotomous division is one of the most powerful ideas ever developed, and Plato's strategy of adopting the standards, methodology and language of geometry allowed him to develop a highly effective methodology. This is a paradigmatic example of the postnaturalist strategy of adopting a technology from the sciences for the purposes of philosophical research.

The same is also evident in Aristotle's zoology, which is driven first and foremost by his application of the same binary technology as Plato to the spectra of contingent entities. According to Plato, each physical entity has many traits, such as being a certain shape or having a certain number of legs, which makes them contingent unlike absolute entities, which are only one thing respectively and not others. Only absolute entities vary from one another as a matter of perfect dichotomy, since they each possess only one trait which they themselves represent, by casting a shadow onto the contingent world. It follows therefore that contingent entities differ from other contingent entities by virtue of possessing multiple divergent traits, and together exist on spectra of differences and similarities[15].

Aristotle attempted to resolve the question of what may act as a substitute in the world of contingent entities for the perfect, dichotomous division which sets apart ideal entities. He developed his taxonomy

based on grouping things together based on many traits that differentiate the group from other groups, and systematised the division of wholes into parts. His zoological research involving the comparison and categorisation of morphological traits made him intensely aware of the apparent design in life. He provided *telos* as the explanation, and read into nature essences which designate kinds to things.

Aristotle developed countless other tools, namely his logic, which he applied across the board to the rest of his philosophical research. His logic was so powerful and effective a technology that it was not displaced until the beginning of analytic philosophy with Frege, Russell and Peirce. Teleology, although largely eliminated from the sciences, remains popular in both colloquial and conceptual use by biologists and philosophers of biology. Teleological explanations are favoured by a substantial number of philosophers of biology to capture the idea of natural selection as a process of design without a designer, particularly in adaptationist characterisations of traits[16].

At the same time, he notes the consistent failure of Aristotle to ever fully grasp at other contemporary insights, the clear evidence for which were painstakingly observed and detailed by Aristotle himself. As a matter of pure speculation, it seems entirely possible that Aristotle could have developed an evolutionary account of biology had he held a pluralistic, relativistic or naturalistic view of the function of philosophy as did some of his rivals. As Darwin notes in the preface to *The Origin of Species* (inserted some time after the publication of the first edition [17]) “the principle of natural selection shadowed forth” already in Aristotle. Aristotle was aware of the issues arising with domestication, an art performed by the city. Aristotle recognises the issue of artificial selection through his consideration of the dichotomy between dogs and wild dogs, and even suggests that there can be wild or tame human beings[18]. Given that Darwin himself begins *Origin* with a discussion of selective breeding, it is plausible that Aristotle could have developed a theory of natural selection millennia in advance had he modified his metaphilosophy according to the domain of his study.

Mozi, or at least the writings of the anonymous Mohist authors attributed to Mozi, shares some similarities with Plato in his ethics. The main competitor to Mozi and the Mohists were the Confucians. Mozi was critical of the Confucian preoccupation with the correct rites and virtue as the foundation of ethics. In this regard, Confucius is most closely aligned with Cephalus of the *Republic*, who defines justice as making offerings to the gods and repaying one’s debts [19]. Cephalus represents the man who is guided not by a morality based on moral facts but the appropriate rites and the cultivation of private virtue, referred to as *li* and *ren* respectively by Confucius. For Plato, Cephalus’ definition of justice

poses the problem of an ethical outlook destined for eventual corruption, a criticism that Plato levies against democracy in general[20]. His response is to substitute rituals and virtue with objective morality. The Mohists likewise respond to Confucius with moral objectivism[21].

Although Plato responds to the ritual and virtue ethics of Cephalus in the same way as Mozi does to Confucius, Plato fails to cleanly repudiate Thrasymachus, who argues that morality is simply the interest of the victor. Thrasymachus' radical reductionism about justice as synonymous with interest renders the two thinkers incommensurate, and leaves the discussion in deadlock[20]. On the other hand, Mozi and the Mohists operated during a period of incessant war as stronger states waged invasive warfare on weaker states. The worst consequences of the Thrasymachian immoralism was already a fact of life to Mozi, and this forced him to opt for an alternative metaphilosophy which prioritised technological development over moral epistemology. Namely, Mozi attempted to make offensive warfare impossible.

The Mohists did not have clear distinctions about different types of knowledge. At the same time as developing logical theory, they also developed strategies, technologies, manuals, and recruited and trained defence forces in order to advance defensive warfare. The express aim was to make offensive warfare futile, so that no state would want to wage war against others. The interventionistic methodology of affecting change in the world as part of the philosophical dialogue stands in contrast against the Western tradition of philosophy as theory. Aristotle trichotomised human activity into thinking (*theoreia*), doing (*praxis*), and making (*poiesis*). Radical philosophers have variously attempted to expand the scope of philosophy to include the doing and the making, such as Marxists and the pragmatists who focus on philosophy as theories of doing, or the postanalytics and postcontinentals who have explored philosophy as a making activity.

Unfortunately, Confucianism won out over Mohism in China as the preferred ideology of the ruling classes. As an ideological framework used to justify rigid hierarchies and absolutism, Confucianism was far more useful to the rulers than the protosocialism that Mohism offered. Considering that the majority of the Mohists' efforts were concentrated on practical matters, their success in the theoretical spheres is impressive enough as a favourable example of postnaturalist tendencies. Confucians adopted a considerable number of Mohist ideas, and the two groups were considered on equal footing as theorists in their time. Mozi's egalitarian epistemology, which did not privilege a priori knowledge over a posteriori knowledge, included abductive reasoning and social knowledge[21].

The post-Mozi condition

Thus far, I have made a case for postnaturalism and the reliance on tools and technology for making metaphilosophical and methodological decisions. But what kind of digital methods should be selected? If the decisions are simply to be relegated to lower level facts about which tools one finds useful, there is, at face value, a risk of infinite regress. Luckily, reality has a bottom. Mozi had his life as a carpenter during the political reality of the Warring States period to force his hand about which tools he must use. The current intellectual climate may not live up to the urgency of actual warfare, but it will do as a forcing function for most philosophers.

"The fundamental problem of contemporary epistemology", according to Hintikka, is abduction[22]. He was writing in 1998, during when the aftermath of the so-called *linguistic turn* and the (then ongoing) Science Wars saw scientific realists feud against poststructuralists; the classical pragmatists against the neopragmatists; and the absolutists against the relativists. A common caricature of the era, approximately between the 90s and 2000s, goes as follows: Both deduction and induction were placed at the centre of unprecedented controversy and scepticism, as poststructuralists launched an attack on positivism and structuralism. The attack addressed both academic and applied scientism. The social and political impact of metaphysics and epistemology was therefore apparent to both the participants within the humanities as well as those within the sciences. Philosophy of science eventually became so polarised, and so reliably controversial, that every pundit and activist took it upon themselves to adopt one partisan position or another. They did so often for the express purpose of weaponising disagreement and controversy rather than as the consequence of deliberation. Terms such as *positivistic*, *relativistic*, *rationalistic*, all became slurs, shibboleths and dogmatic emblems depending on the camp one pledged allegiance to. The only choice that was left afterwards is between joining the scientismic *Old Deferentialists* or the relativistic *New Cynics* (Haack's coinage) [23]. This is not because other positions have been discredited, but because territorial conflict supplanted constructive philosophical dialogues.

At face value, this characterisation seems like a convincing diagnosis of the unbridgeable and widening gulf between various schools of thought. A cultural war started in the 90s and now philosophy is a mess. The stereotype is most commonly captured by iconic events like the debate between Chomsky and Foucault, or the Sokal affair, or landmark publications like Kuhn's *The Structure of Scientific Revolutions*. But consider that Chomsky V. Foucault was 1971 (the exchanges between Searle and Derrida was during the 70s) and *Scientific Revolutions* was published in 1962. Only the Sokal affair

happened in 1996. This stereotyped view of philosophy, as recently war-torn and intractably polarised by disingenuous belligerents, directly parallels Pat Buchanan's 1992 RNC speech about "a religious war going on for the soul of our country". It's a politicised characterisation meant to argue that the only two options left really are to join up with one dogmatic position over the other.

However, this received view of contemporary philosophy as a battleground between for cultural dominance between incommensurate worldviews has come to dominate every sphere of public discourse among amateur philosophers and the everyday audience. Professional philosophers are not free from its influence either, as this *paraphilosophical* environment constitutes the market, and drives the forms of institutionalised support and demand. Most importantly, all professional philosophers begin as amateurs, and the NSF vision of a ubiquitous cyberinfrastructure as the site of citizen science is on the cusp of being realised for philosophy.

This is not cause for cyberoptimism or a purely technological solution. The visible results of the digitally mediated, participatory philosophy are underwhelming. In fact, the Internet as the primary site of philosophical engagement has led to the siloing and proliferation of purportedly incommensurate worldviews, amplified the narcissism of small differences to the point where bikeshedding and splintering have become staple components in the life cycle of communities. The typical structure of self-organising digital communities are reminiscent of Plato's criticism of the Sophists peddling lessons in rhetoric as wisdom, and of the naive democratic citizens who support them. Lippmann's criticism of democracy as founded on an illusion of an "omnicompetent" citizenry, as well as Dewey's response that the experts are themselves biased and must be kept in check, both ring true[24].

Postnaturalism is not a philosophical argument

The postnaturalist believes, or behaves as though they believe, at least the following:

1. All technology exerts some epistemic influence on the observer, and this is often epistemologically relevant;
2. the proper function of philosophy is to study the epistemic effect of technology, and to design and produce epistemically useful technology;

3. localised agreements rather than shared beliefs, entailed by the use of common technology, are sufficient foundations for philosophical discourse.

The above is fine as a system of beliefs, and may even be put into practice individually as a personal outlook to great success. The trouble is that if one really, truly commits to postnaturalism, it presumably makes little sense to write philosophy in the traditional sense and bother to include metametaphilosophical discussions at the start. To the postnaturalist, it is a given that all philosophers do this all of the time, just not consciously. There is no way of definitely knowing whether a philosopher chose to remain dogmatic about a given metaphilosophy in order to achieve some specific results or was just confused about their metametaphilosophy.

It might even be the case that all philosophical arguments are a shorthand that omits the postnaturalist assumption that a metaphilosophy is chosen on pragmatic grounds. Too much metametaphilosophical debate is required before any postnaturalist discourse can begin, if the intended audience is not also a postnaturalist. If the intended audience is a postnaturalist, there is no point in outlining postnaturalistic principles as underlying one's decision to opt for a particular philosophical framework over another, as the postnaturalist does not care either way: to the postnaturalist, all works of philosophy are potentially useful as a source of *conceptual technology* and not as statements about the absolute truths which essentially depend on having chosen the correct foundation.

In other words, a postnaturalist is at face value indistinguishable from any other philosopher when they philosophise. This is a problem common to a reflexive, sociological vision of metaphilosophies. Whereas Rorty's ironism[25] and Deleuze's deterritorialisation[26] can be described and used distinctively, their practitioners may not be recognisable as philosophers[27].

Digital philosophy

Digital methods could make postnaturalism efficient enough to be useful. Berry[28] characterises digital humanities as consisting of the first wave, in which the requisite infrastructures were constructed; the second wave, in which the "notional limits" of the humanities were correspondingly expanded to include born-digital materials; the tentative third wave, in which the focus of digital humanities shifts from the "humanities" to the "digital", "thinking about how medial changes produce epistemic changes."

One promise of philosophising digitally is that there is already a shared technological foundation. As Lessig says, code is law[29]. As much as this law can exert hierarchical, antidemocratic control over users, it has the potential to provide a de facto metalanguage for a “rough consensus and running code”[30] approach to participatory philosophy. When people philosophise online, the raw data of their interactions are collected and analysed. Unfortunately, most of it gets fed into advertisement algorithms.

Digital methods from digital humanities could be used to automate the reflexive analysis that has been the work of a minority of radical philosophers in the past. This automated reflexive analysis, based on information like emergent patterns in a philosopher’s arguments based on metadata, can provide the foundations for a positive postnaturalist programme. The resulting positive programme would resemble Haack’s crossword puzzle[31]. Foundations would come in the form of shared technologies, and coherence would guide the process of collective inquiry.

Conclusion

Stephen Wolfram argues that the universe comprises of simple rules whose equivalents appear repetitively[32]. For instance, the growth pattern of slime moulds can solve problems about using the lowest amount of energy to get from one point to another through a continuous network of cells[33]. Postnaturalist digital methods will make entire worlds accessible to philosophers as a source of useful knowledge, and reduce waste by making each exchange count for more. Philosophical incommensurability would no longer be an issue. In effect, we would be creating an automatic translation engine for philosophies.

Appendix: a useful timeline of the past 200 years in philosophy

The following is a list of some important works in modern and contemporary philosophy relevant to the present discussion, sorted in chronological order. They were selected primarily on the grounds of being good examples of thinkers taking conceptual or scientific technologies and frameworks from outside of their domain and reapplying them to their own, to varying degrees of success.

- 1809: Jean-Baptiste Lamarck publishes *Zoological Philosophy*. Charles Darwin is born in the same year.

- 1848: Auguste Comte publishes *A General View of Positivism*.
- 1859: Charles Darwin publishes *On the Origin of Species*. John Dewey is born in the same year.
- 1879: Herbert Spencer publishes *The Data of Ethics*.
- 1887: Friedrich Nietzsche publishes *On the Genealogy of Morality*.
- 1892: Gottlob Frege publishes “On sense and reference”. August Weissman publishes “The Germ Plasm: a Theory of Inheritance”.
- 1903: C.S. Peirce publishes *Lectures on Pragmatism*.
- 1905: Albert Einstein publishes “On the electrodynamics of moving bodies”.
- 1916: John Dewey publishes *Democracy and Education*.
- 1921: Ludwig Wittgenstein publishes *Tractatus Logico-Philosophicus*.
- 1931: Kurt Gödel publishes his incompleteness theorems.
- 1942: Julian Huxley publishes *Evolution: The Modern Synthesis*.
- 1945: Karl Popper publishes *The Open Society and Its Enemies*. Vannevar Bush publishes “As We May Think”.
- 1946: Roberto Busa begins work on the *Index Thomisticus*. The U.S. Army builds ENIAC the same year.
- 1948: W.V.O. Quine publishes “On What There Is”.
- 1949: IBM partners with Busa to sponsor the *Index*. The project lasts three decades.
- 1950: Alan Turing publishes “Computing Machinery and Intelligence”.
- 1951: W.V.O. Quine publishes “Two dogmas of empiricism”.
- 1953: James Watson and Francis Crick publish “A structure for deoxyribose nucleic acid”.
- 1957: Julian Huxley publishes “Transhumanism”.
- 1966: The journal, Computers and the Humanities, is established.
- 1968: ARPANET establishes the first computer-to-computer link.
- 1975: E.O. Wilson publishes *Sociobiology*. Donna Harraway publishes “A cyborg manifesto”.

- 1976: Richard Dawkins publishes *The Selfish Gene*. David Hull publishes “Are species really individuals?”
- 1980: Saul Kripke publishes *Naming and Necessity*. Giles Deleuze and Felix Guattari publish *A Thousand Plateaus*.
- 1981: Richard Rorty publishes *Philosophy and the Mirror of Nature*.
- 1986: Patricia Churchland publishes *Neurophilosophy*.
- 1987: Paul Feyrabend publishes *Farewell to Reason*.
- 1988: David Hull publishes *Science as a Process*.
- 1993: Susan Haack publishes *Evidence and Inquiry*.
- 1995: *The Stanford Encyclopedia of Philosophy* is founded.
- 1997: *The Journal of Memetics* is established.
- 1998: Andy Clark and David Chalmers publish “The Extended Mind”. Nick Bostrom and David Pearce found the *World Transhumanist Association*.
- 2002: Stephen Wolfram publishes *A New Kind of Science*. Robert Aunger publishes *The Electric Meme*.
- 2005: Busa and collaborators publish a web-based version of the *Index*. *The Journal of Memetics* is terminated the same year.
- 2009: *PhilPapers* is established.

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