

From Athena to AI: the past and future of intention in nature.

"The fault, dear Brutus, is not in our stars, But in ourselves, that we are underlings."
William Shakespeare, Julius Caesar

Prologue: gods, water, fire

So it was that Aristagoras of Miletus the great defender of the gods conspired to bring together all those Milesians and near Hellenes who were in those days beginning to spread doubts regarding the power and providence of the gods to control the fates of mortals and the happenings of the world.

Inspired by the goddess Athena, and paid for by his enormous wealth, Aristagoras called a for a great banquet of all the nobles of Miletus and the surrounding lands where the philosophers would engage in a sort of wrestling match of intellects over the question of how mindless matter could ever give rise to intention and aims. The hope of Aristagoras being not that one philosopher would emerge the clear victor from such a contest, but that each would so contradict and exhaust the others that in the end he could close the banquet with the affirmation that the ancient faith was in fact correct, that matter lacking mind could do nothing, and that all that happened ever was and ever will be a reflection of the intention of either gods or mortals.

The thinkers who attended Aristagoras' banquet were among the most prominent of the day. There was Thales the water worshiper, Parmenides and his guard dog Zeno, the senile Pythagoras and his noble heir Philocrates. In addition there was the laughing philosopher Democritus and Heraclitus the never-wet. Never before or since has there been such a meeting of the world's greatest minds.

For dramatic effect Aristagoras had arranged it that his questions were spoken by three women dressed in black veils like the goddesses of fate seen in plays. It was Thales to whom Aristagoras put the first question.

"Thales son of Asherah", the chorus sang, "you say all the world is made of water, but is not the world full of gods, suffused with intention and will? How then can mindless matter act so?" Thales rose, raised his cup of wine to his host Aristagoras, took a sip to wet his throat and began.

"Surely many of you think that each great river is under the sovereignty of a god. Some think similarly of even small streams of which they are intimate and that their every ebb and eddy is under the providence of some lesser spirit. Imagine now that one were an ant standing on the table before me" Thales gently placed his finger on the table in front of him. He poured a small trickle of wine from his cup onto the table and smiling continued "would not one conclude, if positing that all bodies of water had their own

gods that such a trickle as this had its own god assigned to it? Are all things, even the very smallest, thus full of gods? Would these gods be more than gnats to Lord Poseidon ruling over the oceans? And even the largest bodies of water on earth would be but droplets to the great God looking over all the cosmos. Are not our own bodies made out of this same water? So if the water of which our bodies is made is without mind, then water can give rise to mind and its aims and intentions, even if I cannot say how this is so." At this Thales sat back down. The chorus then turned to Parmenides and sang:

"Arise, wisest of Elea, to answer our question and respond to song of Thales."
Parmenides arose while his loyal Zeno sat beside him twiddling with a ball of yarn like Daedalus and began:

"I believe that nature is ruled by Thales' great God much more so than the fiction of poets like Hesiod and Homer. If there are gods, they are above the passions of men. And if the god's are subject to reason is there not one reason to rule them all? If all that exists is made of one substance, as Thales claims, then all the distinctions between one thing and another, between the world and ourselves must be a mirage. It is in light of this that I maintain, despite our senses, that all change is an illusion. That what will happen has been established from eternity in such a way that we can understand it to have already happened. To an ant Thales might be thought a god controlling a river of red wine, but Thales himself had been fated to create his river in such a way since eternity."

At this there was a great murmuring of disbelief and even laughter from the crowd upon which Zeno stood up and began speaking in one of his riddles.

"If what we call the past is the cause of the present, and our current present is the past of what we call the future, then everything has not only been determined for us, in our time it is being determined for the future as well. One with a complete knowledge of the conditions in which an arrow was shot from a bow would also have complete knowledge of its entire flight and know for certain, and beforehand, where it would ultimately strike. One who had complete knowledge of how an arrow had struck its target would likewise know everything about its flight back to the time it left the bow. Yet why privilege beginnings and endings? Complete knowledge of any point gives complete knowledge of past and future. We mortals are the arrows shot from God's bow. "

The chorus heckled: "Then to our hearts what you say be well. Puppets you claim us to be, and yet not to fate but to some greater power greater still?" At which Parmenides stood up and responded.

"As with your namesake fate what is... is... what is not... is not- but with this difference- no gods inspiring the lechery of Paris lie behind the destruction of Troy, nor even the will of the justice seeking Achaeans, but the logos of the cosmos itself made it so. Mortals believe themselves free but are no freer to choose what will be or what will not than characters in the mind of Homer. Aims and intentions are mere words, an illusion."

"And the gods?" The chorus asked?

“In a universe where nothing happens no gods are needed,” Parmenides answered. We call God all that exists in such an eternity. Everything that exists as an eternal unchanging thought in the mind of the great and only God.”

Accusations of impiety rolled through the crowd.

“Free us then, oh wise Pythagoras, from the Elean’s impiety that consumes all the gods of Olympus and us mortals into a single mind” sang the chorus. At their words Pythagoras did not stand or speak, but pulled out from behind where he sat a golden lyre with a single string. He plucked the string which made a sort of low bellow and then moved his finger to the halfway point and plucked it again. He continued along like this dividing the string of the lyre at various points and plucking the string. After sometime Aristagoras became annoyed at Pythagoras’ wordless performance and stood up ready to dismiss the old crow whose mind had clearly rotted with age when his loyal friend the young Philocrates stood up and came to his teacher’s defense.

“Can you not hear? Are you not amazed that a string cut in half plays the same note only higher? Can you not hear that some divisions of the string played one after the other sound beautiful to the ear while others induce pain? This is the great discovery which our Pythian Apollo has brought into the world. That the logos of which Parmenides speaks is composed in the language of music and number which we therefore can hear and understand.

Philocrates looked down at Pythagoras who remained seated, and the latter nodded in agreement at which Philocrates continued. “This is the mind of God of which mortals can partake. Aims and intention require at least intuitive knowledge of this order, for once a player on the lyre of reality knows these rules he can use them to achieve his ends, to imagine and play a tune of his own. Minds then are not fated as the gloom laden Parmenides claims, and mind itself makes this so.”

At this the chorus sang “So Thales says the world is water and that mind arises from such, though he cannot say not how or when. And Parmenides and his guard dog think there is just one mind that never changes, and in thinking otherwise our minds themselves are fooled, whereas Pythagoras and Philocrates think all are notes and number and that that while nature is ordered in knowing its rules we can direct the play. Now to you, the most notorious of atheists”, the chorus said turning to Democritus. “Tell us how aims and intention can arise from mindless matter, and answer those who have spoken.”

Democritus arose from his seat clearly amused and let out a belch. It appeared he may have already been a little drunk.

“See here how my noble friends are only half correct, for such is the danger of not drinking enough when the wine is free. Thales claims all the world is made of one substance and that this substance is water. Right he is to look for one such element from

which the world is built, but surely water is merely a metaphor. For how can one make fire out of water? We must go below.”

“Parmenides agrees that all is composed of one underlying substance, but then imagines a blob larger than his bulbous head. And this is the problem as well with Zeno and his arrow, not the size of his noggin but what is in it and comes out of his mouth, for as I have heard elsewhere with his tale of Achilles and the Tortoise, Zeno believes that number is infinitely divisible. Yet numbers are just playthings of the mind with which we can do things impossible in reality. No real matter can be divided so. Take a grain of sand and divide it and eventually one will reach the prime element. I call these elements *atoms*.” Democritus chugged down his goblet of wine and gestured to a servant that it be refilled. He continued:

“My friends, Pythagoras and Philocrates are obsessed with the toys of geometry and though they are right see the order which mathematical arrangements of matter can bring, they fail to see that most arrangements are meaningless except to those who claim to interpret them. Chaos rules the world and if we find some arrangement of atoms beautiful it is only because they accidentally match our own like a flower that reminds one of the face of his beloved. Aims and intentions emerge because some accidental ordered arrangements- minds- require other accidental arrangements- like good food and wine- to live and thrive. There are no gods or great God required, only atoms and the eternal flux of time.”

The crowd gasped at which Democritus let out another belch. Aristagoras gestured that the laughing philosopher should be seated and the chorus sang pleadingly to the only philosopher yet to speak:

“It is up to you, oh bedeviling Heraclitus, to save the gods and the freedom of mortals from the philosophers’ impiety” the chorus plaintively sang. At this Heraclitus stood up and began:

“Save you I cannot, for I agree with much of what my friends have said, and hope here only to help buttress the ship of their thought so that it is more worthy of the rough seas the future will inevitably bring. I mostly agree with the interpretation of laughing Democritus and even his views on the words of our friends. What I would add is that those things which preserve their identity in the midst of his sea of randomness must do so by preserving their patterns much more so than retaining their individual elements which he calls atoms. “

“A stream is such a pattern of ever changing atoms which preserve its shape, as a fire can if tended well. And what are minds but the tending of a fire by itself, making sure it is fed neither too much nor too little? “

“Minds are patterns meant to uncover other patterns in the world around them. Yet such patterns exists not merely in the mind but are born out of our encounter with nature, the same nature other creatures encounter and in which they can discover patterns similar to our own. It has been said by one of our geometers that the honeybee

has discovered the best way to divide an area into equal sections with the least possible perimeter? ¹ Minds are nature's way of discovering its own patterns.

“Human share this trait with all of the living, though there is a distinction. Animals discover and act on patterns mostly without thinking, but humans reason, we think and plan, which saves us almost uniquely from being frozen in the block of time Parmenides imagined and frees us, as Philocrates said, to understand the laws of nature so as to compose realities of our own making. “

“For now, we have no need of gods. Aims and intentions can arise from mindless matter which is the consequence of atoms driven to preserve, comprehend, and even create, their own patterns. Where human power in such regard ends who can say? Perhaps someday far into the future mortals will manage to infuse the pattern of mind into matter itself like the automata of Hephaestus imagined by Homer. In that case the world full of gods which our ancestors believed, and most of you still believe in, will actually be our own.” At this Heraclitus bowed to the crowd and sat down.

Aristagoras felt himself dumbfounded by Heraclitus' words, and unanchored by what had transpired. Instead of ending the banquet with a ringing defense of the gods as he had intended, he ordered the customary libations for a voyage, the sacrifice of a bull to Athena goddess of wisdom, pouring wine as an offering, and intoning a prayer for future safety. Aristagoras could not understand where the philosophers were taking us, only that all mortals had been impressed into the journey.²

How aims and intention arise from mindless matter

It may seem strange to have started an essay which hopes to address the question of how mindless mathematical laws can give rise to aims and intentions with an imagined dialogue of philosophers from over 2,500 years ago, but I had very good reasons for doing so. It was from these pre-Socratic philosophers that we can trace our own scientific worldview. For despite the apparent naiveté of their various theories, what the pre-Socratics were the first to do was to seek out explanations for the action and order of nature that were independent of the will of the gods. As the former soldier and author Roy Scranton writes of civilization before this first ancient enlightenment in his dark meditation on determinism and fate *Learning to die in the Anthropocene*:

“Yet as humans evolved complex social networks, language, consciousness, and then culture, we came to organize ourselves through systems that saw not merely agency in the world, but will.”

When Homer's Greeks stalked the battlefield, Ares drove them in frenzies to kill and Athena stayed their hands. For those ancients, the will of men was subject to the will of the gods and all were ruled by fate. Causality was comprehended by seeing the universe as a web of personified forces. It was only later, after the rise of literacy that Greek poets and sages began to articulate a difference we take as fundamental today, the distinction between human will and natural force. The independent persistence of written language-logos- became the structuring metaphor for the independent persistence of the human mind. We began to believe in the freedom of thought.” ³

In closing the door to the gods, the pre-Socratics not only managed to free us from the mistaken belief that even lifeless matter acted with aims and intentions towards *us*- but- and in the opposite direction- opened up a realm of freedom by dispensing with fate and the ill intent of the natural world itself. If we could only understand the rules by which nature operated we could leverage and adjust to those rules to obtain our own ends or at the very least obtain some degree of safety.

In an admittedly very simplified reading, the whole history of science, along with the technology that flows from science, has been the story of the discovery, loss, and recovery of the idea that the world is not ruled by will. In the 1600's thinkers finally started to move away from a model of the world where every flower was opened via the will of God. Yet this move away from will came to be dependent on an image of God as clockmaker with all of time unfolding along the kind of deterministic course that could be seen in thinkers as diverse as Spinoza, Leibniz, and Calvin reaching a peak of elegance and unprecedented scientific importance with the publication of Newton's *Principia Mathematica*.⁴

The deterministic worldview present in these thinkers would have warmed Parmenides' heart and modern physics' interpretation of God as the world's mathematician would have seemed the most noble of legacies to Pythagoras and his followers, as in some sense they actually are.

Yet such laws have their explanatory limits in that it is in the very noise they compress and smooth away (the diversity and granularity of experience) that some of the most essential information for action, the field of aims and intentions, lies. Darwin, with clear echoes of Democritus, gave us a way in which a single input could result in multiple possible outcomes. In the smallest of changes lie innumerable possibilities.⁵

It has taken a very long time since Darwin published his *Origin of Species* for evolutionary thinking to become sophisticated enough to inform the deterministic branches of science, and to gain the mathematical depth necessary to engage in a dialogue of equals with physics along with equally mathematics based fields such as artificial intelligence. Though in its early days what this conversation has shown so far is something close to that of the view of my imagined Heraclitus.

As we all know from the Second Law of Thermodynamics, all large scale structures in the universe can survive overtime only if as a consequence of their order they displace an equal amount of disorder in the form of heat. What Heraclitus had over Democritus was his recognition that every ordered system is in a race between its own efforts to preserve its structure and those forces aiming to pull it apart. And Heraclitus didn't think this struggle against chaos was something done by living things alone. He thought a river, and especially a phenomenon like fire, shared these features as well.

Nowadays, biophysicists, most notably Jeremy England of MIT, have pointed out how adaptation- meaning the efficient absorption of energy from a fluctuating environment- arises in any (even non-living) system able to displace excess entropy into a surrounding bath. Something like structure and organized behavior flows almost inevitably from

physics itself. What life adds to this equation isn't adaptation itself, but to extend the lessons from such adaptations into the future through reproduction. ⁶

This kind of erosion of the philosophical boundaries between the living and the nonliving when it comes to lifelike behaviors which England represents is taking place at the level of cognition as well. While something like Giulio Tononi's concept of Integrated Information Theory may ultimately prove wanting as a theory of consciousness, it does point us in the direction of a reality where consciousness, and therefore the aims and intentions that come with consciousness, emerges as a natural consequence of systems integrated in a peculiar way independent of the substrate in which those processes occur. Mind has its origins not just in matter, but in matter organized in a very specific way. ⁷

What both England and Tononi perhaps lack is a clear idea of how adaptive systems are the product of very unique histories. The vast majority of human aims and intentions have their roots in either evolutionary history (conveyed by genes and epigenetic changes) or in the memory of our cultures, and, of course, our own deeply personal experiences.

In a sense the fact that we have aims and intentions at all is a consequence of the fact that anything like Parmenides' view of a timeless block-like universe remains out of reach for us in anything more than an imaginative or abstract sense. Our intelligence and decision making, indeed our very experience of freedom itself, emerges in this tension between thought and action, the gap between our internal models of the world and reality itself. We are tuned by the outside world and tune ourselves to the world we are in like a Pythagorean lyre. As the technologist Jaron Lanier has put it:

"The cybernetic structure of a person has been refined by a very large, very long, and very deep encounter with physical reality." ⁸

Even our most intelligent machines are nowhere near us in this form of evolved complexity of their mental structures and consequent behaviors, and perhaps they never will be. Yet those who have made the greatest contributions to artificial intelligence so far are those who have embraced evolutionary techniques, which at the very least gives us a cartoon like replay of how human intelligence must have emerged. ⁹

Indeed it has been shown that even simple computer programs can exhibit complex behavior through having to adapt to a world of simple rules, as if Pythagoras's lyre could discover its own tune by being rewarded every time it stumbled across combinations of notes that were pleasing to the ear. This leaves us with a question: if such programs could be asked why they took the action they did they might respond as if they had some choice in the matter rather than being driven, as they certainly are, by their underlying algorithm and its history, which leads us to wonder whether our own aims and intentions might likewise be illusions, mere white-noise emanating from an underlying program?

Philosophers have given us a way to avoid this conclusion and in ways that dovetail nicely with ideas such as England's regarding the natural emergence of ordered systems in a universe moving in the direction of increased entropy, and Tonoi's concept of consciousness as integrated information or phi.

What sets complex adaptive systems apart from other types of systems is their ability to respond to not just external cues from its environment, but to signals emanating from the system itself. The philosopher Daniel Dennett has shown how real freedom, or as he calls it "freedom worth wanting", could evolve even in a completely deterministic universe because the very point of evolving consciousness in the first place is for organisms to decide between alternative aims and intentions, and that it is this ability to decide between options that constitutes our freedom. Human beings are uniquely free because only we can use our imagination to constrain or guide our behavior against the impact of our immediate environment or even our evolutionary history to expand our range of choices. Until the forms of artificial intelligence we create can likewise reason about their decisions and leverage their internal states (their equivalents of imagination and emotion) they will remain mere tools. ¹⁰

Conclusion, but are we actually free?

Indeed, until such machines are created, or until we discover another form of intelligence beyond the earth, our cosmological status in terms of our freedom and therefore our moral responsibility will remain a unique one. This freedom is a consequence of our acquired knowledge as much as biology and therefore is the gift of our history.

As the philosopher Jenna Ishmael has pointed out our understanding of causality allows us to conceptually extract elements from nature subject to our influence in order to change them and therefore bring some sort of deterministic outcome closer to our desired end. ¹¹ Action at the causal level is an attempt to tip the scales in favor of some possibility we find desirable, which takes advantage of the fact, as William James put it, that "The parts have a certain loose play upon one another..." ¹² It's this degree of freedom over nature that has been the backdrop in which our political freedom was won. Whereas what we see in nature may, as Scranton wrote, have agency but not will, human beings, in the eyes of Dennett, Ishmael, and James really do have will, and even a very real type of freedom. We can intend for some future to occur, even one quite far off in the distance, and to a limited extent at least, can cause it to happen. We possess this freedom to some extent as individuals, but to a much greater degree, and more importantly, collectively.

What is stunning is that after having achieved the extraction of the idea of will from the rest of nature we are on the verge of restoring it as nature itself becomes infused with human will. This is, and is increasingly likely to be, the case when it comes to the genetically engineered life that will surround us, the atmosphere we will have shaped through dereliction or design, and the intelligence that will be embedded in almost all of our machines. ¹³

As our unveiling of the cosmos begun with the pre-Socratics continues we might also be confronted with an increasing number of situations in which the line between some natural phenomenon we cannot explain and the artifact of some alien intelligence, likely artificial and far beyond our own, cannot be definitively drawn.¹⁴ Much more troublingly, if society continues to fail to educate citizens in how artificially intelligent systems work, or fails to empower them with the ability to influence their programming, or even just inform the non-programming publics that there is a human interest behind every bot, the world might again be perceived as being under the suzerainty of capricious and cruel gods or perhaps be understood as the mere tool of some imagined human conspiracy.¹⁵ Society will have allowed enlightenment and the freedom that is a consequence of this knowledge to be extinguished once again, which perhaps given the Second Law, was always, almost, inevitable.¹⁶

¹ "The so-called "honeybee conjecture. Proposed by Marcus Terentius Varro in 36 BC (thus centuries later than my imagined dialogue) it was only prove correct in 1999 by Thomas C. Hales. Hales, T. C. "The Honeycomb Conjecture." *Discrete & Computational Geometry* 25, no. 1 (2001): 1-22.

² The views of pre-Socratics presented in the dialogue adapted from: McCoy, Joe. *Early Greek Philosophy*. Washington: Catholic University of America Press, 2013.

³ Scranton, Roy. *Learning to die in the Anthropocene: reflections on the end of a civilization*. San Francisco, CA: City Lights Books, 2015, pp. 113-114.

⁴ Dolnick, Edward. *The clockwork universe: Isaac Newton, the Royal Society, and the birth of the modern world*. New York, NY: Harper, 2011.

⁵ Gould, Stephen Jay. *Wonderful life: the Burgess Shale and the nature of history*. New York: Norton, 2007. Since Gould's death Henry Gee has taken up the mantle of arguing for the non-deterministic, non-progressive nature of evolution. See: Gee, Henry. *The accidental species: misunderstandings of human evolution*. Chicago, Ill: The University of Chicago Press, 2015.

⁶ England, Jeremy L. "Statistical physics of self-replication." *The Journal of Chemical Physics* 139, no. 12 (2013).

⁷ Tononi, Giulio. *Phi: a voyage from the brain to the soul*. New York: Pantheon, 2012.

⁸ Lanier, Jaron. *You are not a gadget a manifesto*. New York: Knopf, 2011, p. 154.

⁹ Russell, Stuart J., and Peter Norvig. *Artificial intelligence a modern approach*. Boston: Pearson, 2016.

¹⁰ Dennett, Daniel Clement. *Freedom evolves*. London: Penguin, 2007.

¹¹ Ismael, Jenann. "Causation, free will, and naturalism." *Scientific metaphysics* (2013): 208-235.

¹² Quoted in Gleick, James. *Time travel: a history*. New York: Pantheon Books, 2016, p. 260 Here Gleick makes an impassioned case against determinism.

¹³ The core idea behind the concept of the Anthropocene is of a world shaped by human will. See: Ackerman, Diane. *The human age: the world shaped by us*. Toronto, Ontario, Canada: HarperCollins Publishers Ltd, 2015. The idea that the IoT (Internet of things) where everyday objects are embedded with their own intentions along with the agendas of the companies that make them might result in a resurgence of animistic dread was aptly pointed out by Marcelo Rinesi. "The price of the Internet of Things will be a vague dread of a malicious world." Institute for Ethics and Emerging Technologies. September 25, 2015. Accessed February 26, 2017. <http://ieet.org/index.php/IEET/more/rinesi20150925>.

¹⁴ Scharf, Caleb. "Is Physical Law an Alien Intelligence? - Issue 42: Fakes." *Nautilus*. November 17, 2016. Accessed February 26, 2017. <http://nautil.us/issue/42/fakes/is-physical-law-an-alien-intelligence>.

¹⁵ Pasquale, Frank. *Black box society: the secret algorithms that control money and information*. Cambridge, MA: Harvard University Press, 2016.

¹⁶ Pinker, Steven. "What scientific term or concept ought to be more widely known? The Second Law of Thermodynamics." *Edge.org*. January 01, 2017. Accessed February 26, 2017. <https://www.edge.org/response-detail/27023>.