

## The Anthropocene: A human-driven geological epoch on the anvil

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‘This goodly frame, the earth, seems to me a sterile promontory; this most excellent canopy, the air, look you, this brave o’erhanging firmament, this majestical roof fretted with golden fire, why, it appears no other thing to me than a foul and pestilent congregation of vapors.’

William Shakespeare  
*Hamlet II*, ii, 308 (1600–1601)

The past is the key to the future – a dictum that geologists love to quote; a dictum that has stood the test of time. We are now witnessing a paradigmatic shift – a shift that has swept our feet and thrown us into the uncharted waters of a new unusual stage in earth’s history. We are entering a new geological epoch in which humans compete with the natural geological forces in shaping the landscape. Paul J. Crutzen<sup>1</sup> (who shared the Nobel Prize in Chemistry for the discovery of CFCs that cause ozone hole) writes, ‘it seems appropriate to assign the “Anthropocene” to the present, in many ways human-dominated, geological epoch, supplementing the Holocene – the warm period of the past 10–12 millennia’. Geologists debate whether this stage should formally be called as the Anthropocene. Most likely there will be proposals on this question in the next International Geological Congress. When the full import of such a development dawns on you, it leaves with you a sense of exhilaration. For one thing, this has no similar record in the geologic past, and for the first time the famous dictum seems meaningless. Of all the generations that lived here it is ours that is chosen to document a momentous change of a geological epoch, and the observer himself has become the player or vice versa.

Talking about the Anthropocene, it would be grossly unfair to ignore the contributions of the Russian geoscientist, Vladimir I. Vernadsky, who in his books (one of his key books is *The Biosphere*) and articles had the foresight to comment about this emerging issue, back in the early part of the 20th century. In his posthumously published article in the *American Scientist* in January 1945, Vernadsky writes quoting a contempo-

rary Russian geologist A. P. Pavlov (1845–1929) to define the ‘anthropogenic era’, although in a rather optimistic vein (those were the days of expectancy of the ultimate triumph of the ‘soviet man’ over nature, and above all, Vernadsky was a communist):

‘Proceeding from the notion of the geological role of man, the geologist A. P. Pavlov (1854–1929) in the last years of his life used to speak of the anthropogenic era in which we now live. While he did not take into account the possibility of the destruction of spiritual and material values we now witness in the barbaric invasion of the Germans and their allies, slightly more than ten years after his death, he rightfully emphasized that man, under our very eyes, is becoming a mighty and ever-growing geological force. This geological force was formed quite imperceptibly over a long period of time. A change in man’s position on our planet (his material position first of all) coincided with it. In the twentieth century, man, for the first time in the history of the earth, knew and embraced the whole biosphere, completed the geographic map of the planet Earth, and colonized its whole surface. Mankind became a single totality in the life of the earth. There is no spot on earth where man cannot live if he so desires. Our people’s sojourn on the floating ice of the North Pole in 1937–1938 has proved this clearly. At the same time, owing to the mighty techniques and successes of scientific thought, radio and television, man is able to speak instantly to anyone he wishes at any point on our planet. Transportation by air has reached a speed of several hundred kilometers per hour, and has not reached its maximum. All this is the result of “cephalization”, the growth of man’s brain and the work directed by his brain.’

It seems probable that Vernadsky had an unshakable faith in the human mind in upholding the moral dimensions even while it engages in radically changing the biosphere. He called it ‘noosphere’, as a critically new evolutionary imperative that would enable man to ‘preserve and reconstruct the biosphere in the interest of humanity as a single entity’ (originally the term ‘noosphere’ was deve-

loped by the French mathematician Edouard Le Roy and his philosopher friend Teilhard de Chardin, who used to attend Vernadsky’s lectures in Paris). In other words, man at the ‘pinnacle of the evolutionary ladder’ is entitled to manipulate and regulate his environment for his benefit and he is free to act as a geological agent who would fundamentally transform the biosphere to his advantage. This is reminiscent of the first verses from the *Genesis*, which mention: ‘And God said, Let us make man in our image... and let them have dominion over the fish of the sea, and over the fowl over the air and over the cattle and all over the earth’. And, what is not said there is that in order to assert dominion over the earth, it is not prudent to destroy what you are trying to dominate. The fact of the matter is that we are only a small part within the vast network of interdependent organisms and their niches, and any tinkering of this system should be done with utmost caution and anticipation. Remember that in an evolutionary tree, there are only parallel branches and no pinnacles.

Much has happened during the interval that separates us from James Watson, who by inventing the steam engine in 1784, inaugurated the Industrial Revolution and thereby also the putative Anthropocene (the stratigraphic marker of the Industrial Revolution is the sudden increase of the particles of industrial soot in the ice cores of Greenland). Between James Watson and us, the human population exploded and human consumption grew exponentially. As technology became savvy and sophisticated to cater to mass consumption, the environmental demons started casting longer shadows. Scientists, for example, found that the earth’s atmosphere is being filled up with CFCs and greenhouse gases like carbon dioxide and methane. We now realize that these chemicals and gases can tip nature’s balance to engender an unfriendly environment that is not conducive to human and all other life forms. For instance, loss of the thin ozone shield that blocks the ultraviolet solar rays is not only a threat to human life but it also kills the phytoplanktons of the oceans – a fundamental entity of the food chain. This is antitheti-

cal to James Lovelock's over-optimistic Gaia theory invoking a global thermostat as a self-correcting temperature-regulating mechanism in the form of marine algae, which is expected to produce dimethyl sulphide, a volatile cloud-seeding chemical. Here the denouement is that the thermostat itself gets defunct. On the other hand, our burning of fossil fuels has been adding more CFCs since the Industrial Revolution that may initiate a runaway global warming phase and rise in sea level, which would impact the availability of shelter, food and water. The temperature is predicted to rise up to 1.1–6.4°C by the end of this century, according to the IPCC reports – an all-time predicted high since the Tertiary period (the last thermal maximum was at the Paleocene–Eocene boundary). We have caused large-scale changes to terra firma too. Human activity has caused dramatic increase in erosion and denudation of the continents, which is an order of magnitude greater than what one would expect from purely natural processes. Consequent to this, erosion due to construction and agricultural activities, the continental surface has been lowered by a few hundred metres per million years<sup>2</sup>. Increased use of nitrogenous fertilizers led to dramatic increase in food production but it also resulted in acidification of oceans and rivers and enhanced nitrogen fixation. Accelerated urbanization and transplanting of people from villages to cities will see perennial water depletion and shortage. Landscape changes owing to

construction activities create new pathways and diversion of the groundwater. Further, human activities are causing accelerated extinction of various species, including those living in the shallow seas. Some geologists think this would be similar in magnitude to the major extinction event that took place in the Cretaceous–Tertiary boundary.

We now realize that there are negative consequences to the interactions of man and the environment, wherein a pre-Anthropogenic system has been disturbed and new driving forces and boundary conditions have been introduced. We now realize the magnitude of changes that the environment has undergone since the Industrial Revolution at the beginning of the 18th century and these transformations have gone beyond the sustainability of the environment. We now realize that a disturbed natural system may trigger runaway processes resulting in situations that we have no parallels in human history or even in the geologic history. In this scenario, it is for our benefit that we should be able to maintain large portions of nature in its original splendour and complexity with their internal degrees of freedom. With greater vigour, we need to safeguard our rivers, forests, oceans and wetlands.

The grand (but blind) process of evolution has conferred us the capabilities to cause drastic alterations to our environment. These alterations, if we do not do intelligently, are likely to destroy the very biosphere which sustains us. That

seems to be the embedded message in the warnings sent out by nature. Let us hope that Vernadsky's optimism for human rationality is not misplaced. That we have not yet been annihilated by a nuclear holocaust is itself a triumph of human reason. Some tentative actions like the Montreal Protocol aiming to regulate CFC production give us hope, and the Kyoto Protocol, with all its lacunae, is again another indication that we are trying hard not to depart from common sense. But more drastic steps need to be taken to reverse the ominous trends that might imperil life on earth. As Julian Huxley (in *Essays of a Humanist*) has put it, 'this earth is one of the rare spots in the cosmos where mind has flowered. Man is a product of nearly three billion years of evolution in whose person the evolutionary process has at last become conscious of itself and its possibilities. Whether he likes it or not, he is responsible for the whole further evolution of our planet'. The skywriting seems to be clear and unambiguous; heeding to it would be to our advantage.

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1. Crutzen, P. J., *Nature*, 2002, **415**, 23.
  2. Wilkinson, B. H., *Geology*, 2005, **33**, 161–164.

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