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ECOLOGICAL SOUNDING

Thinking at the global scale

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ABSTRACT

The noosphere concept was originally proposed as a sphere of mind or thought that has emerged from the biosphere over the course of human evolution. Two versions of the noosphere concept were developed in the 20th century and they differed with respect to whether the noosphere was to be considered separate from the biosphere or a new form of the biosphere. Both versions shared an assumption that collective human thought based on a scientific epistemology would achieve a benevolent relationship with the biosphere. Research in global ecology continues to reveal the growing influence of humanity on the biota and on the global biogeochemical cycles, but recent history has not confirmed humanity's ability to self-regulate. Nevertheless, the noosphere concept remains useful because it acknowledges the uniquely subjective aspect of human brain functioning and the propensity for humans to share ideas and work collaboratively. Both of these features will be needed to develop a structured coupling of humanity and the biosphere that preserves the biophysical processes sustaining the ecosphere.

Keywords

Biogeochemical cycles, biosphere, Earth, ecosphere, global ecology, noosphere, Vernadsky.

INTRODUCTION

The concept of the biosphere is commonly used to denote the totality of life on Earth (Huggett, 1999) and the biosphere is recognized as a significant driver of the global biogeochemical cycles. The degree to which the biosphere is essential to maintaining the global climate in a state favourable to life is under debate, though evidence continues to accumulate in support of its crucial role over geological time (Schneider *et al.*, 2004). In any case, the structure and function of the biosphere is the subject of intense research because of the potential importance of biospheric feedbacks to human-induced climate change (Cox & Nakicenovic, 2004).

The magnitude of human impacts on the biosphere has grown from wide-ranging impacts on herbivore populations during the hunter-gatherer days, to local ecosystem damage associated with early agricultural development, to global scale degradation since the Industrial Revolution (Turner & McCandless, 2004). It is clear that human activities have begun to interfere with, and in some cases, dominate the global biogeochemical cycles, e.g. of water, carbon, nitrogen, phosphorus and sulphur (Vitousek *et al.*, 1997; Steffen *et al.*, 2004). Humanity is also becoming the dominant force in biological evolution via mechanisms including land use change, introduction of exotic species, genetic engineering and climate change.

The interaction of humanity and the biosphere is occurring at such a wide range of spatial and temporal scales that we have difficulty conceptualizing it, i.e. breaking it down into parts and wholes, identifying controls and feedback mechanisms that are determining system behaviour, and building simulation models for the purposes of evaluating alternative scenarios for the future. Here, I would like to note some historical conceptual approaches to characterizing the relationship of our species to the biosphere and to some degree reframe them in the light of contemporary developments. I am particularly concerned with the concept of the noosphere.

The term noosphere (NEW-oh-sphere) originated in Paris in the 1920s in the course of discussions among a French philosopher (Edouard Le Roy), a French palaeontologist and priest (Pierre Teilhard de Chardin) and a Russian biogeochemist (Vladimir I. Vernadsky). Their intent with noosphere was to recognize the qualitative difference between human consciousness and anything else in the biosphere, and to focus on the role of human thought in transforming the biosphere. The noosphere was generally characterized as the sphere of mind or thought associated with the Earth. However, with such eclectic progenitors,

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it is not surprising that the meaning of the word has been contested over the decades (Serafin, 1988; Sampson & Pitt, 1999).

Teilhard's noosphere

Pierre Teilhard de Chardin (1881–1955) was trained in two very different traditions, first as a palaeontologist and second as a Jesuit priest. He brought to the noosphere concept a strong developmental or process perspective. He and LeRoy were influenced by Henri Bergsen, the French philosopher who is pejoratively associated with the concept of 'élan vital' by biologists. Teilhard traced a course of planetary evolution from lithogenesis (the formation of the lithosphere), to biogenesis (the formation of the biosphere) to noogenesis (the formation of the sphere of mind). Even more broadly, he evoked the process of cosmogenesis, with an analogy to the unfolding and differentiation of an embryo. The Catholic Church considered his efforts to reconcile evolutionary concepts with the Catholic dogma to be heretical and his work was only published posthumously, beginning in the mid-1950s. Teilhard's *The Phenomenon of Man* (1955) was widely read and commented on, and it introduced the noosphere concept to a broad audience.

Teilhard's writing attracted the attention of philosophers (e.g. Huxley, 1958), and indeed, there is an undeniable philosophical comfort in the notion that humanity is a natural product of biospheric evolution, thus, in a sense at home in the universe. Teilhard's reception by scientists was much cooler. His ideas were generally labelled as teleological, i.e. implying a divine guiding force in the evolutionary process (Medawar, 1961; Monad, 1971). His trajectory of the noosphere had it evolving to a highly spiritual realm, an 'omega point' beyond any connection to physical existence. His noosphere concept has not been an inspiration to grappling with the darker side of human impacts on the biosphere.

Vernadsky's noosphere

Valadimir Vernadsky (1863–1945) is more closely associated with the biosphere concept than with the noosphere concept, but he did develop an interpretation of the noosphere that differed considerably from that of Teilhard (Vernadsky, 1945). He was fundamentally interested in elucidating the global biogeochemical cycles. In his studies, he recognized the growing magnitude and pervasiveness of human impacts on the planetary surface, likening it to a geological force. The unique aspect of this new geological force was that it was guided by mental phenomena rather than strictly physical, chemical or biological processes. Vernadsky's noosphere was a new form of the biosphere, a biogeochemical cycling entity that included all life as well as its associated atmosphere and lithosphere. His noosphere was one dominated by human influences and serving primarily to meet the needs of humanity.

Despite living through World Wars I and II in Russia, Vernadsky remained optimistic to the end of his life that the noosphere would emerge as a new phase of human civilization. He assumed human reason was capable of understanding the mechanisms of the global system sufficiently to manage it successfully. His vision of the noosphere was also progressive in the political sense, i.e. his criteria for arrival of the noosphere included the end of war, equality among humans and equitable distribution of wealth.

Criticism of the Vernadsky's noosphere concept arose by the late 1950s. American ecologist Eugene Odum categorized the notion as dangerous on the basis that it implied that humanity was ready to take over management of the biosphere (Odum, 1959). Odum worked several decades after Vernadsky's death and was perhaps in a better position than Vernadsky to see that humanity's dominion over the biosphere might not be so benevolent and that *Homo sapiens* needed no encouragement in thinking it was wise enough to manage at a global scale. For Odum, the hubris attendant with scientific progress had gotten out of hand.

A contemporary noosphere

A more contemporary version of the noosphere concept would step back from Teilhard's and Vernadsky's mythological versions; most certainly, we cannot assume that because humanity is exerting an increasing impact on the biosphere that it will spontaneously achieve a stable relationship. There is no denying that human influences on the environment are global in scope and growing, perhaps even enough to say we have entered a new geological era, the Anthropocene (Crutzen, 2002). But there are myriad psychological, sociological and economic reasons to question whether humanity will succeed in collectively managing the biosphere. Not least of the issues is that successful management of a system requires understanding of the system components and their interactions. Our understanding of global scale processes is growing (Steffen *et al.*, 2004) but is quite limited relative to what it would take to compensate for even the current human impacts on the biosphere. There are many historical examples at landscape to regional scales of human dominion that led to severe environmental degradation (Marsh, 1864; Diamond, 2005). I would argue that the Earth's biosphere has become a noosphere, but that it is as yet a rather dysfunctional one.

A key benefit to accepting this noosphere concept is that it evokes awareness that *H. sapiens* is virtually in control and that conscious choices must be made at multiple scales if we are to avoid compromising the underlying functioning of the biosphere. Lovelock (1991) speaks of the new science of geophysiology that must be learned if stable human management is to succeed. There must also be widespread awareness and support for environmental issues among the global citizenry if a governance scheme that prioritizes sustainability is to succeed (Meadowcraft, 2004). An updated noosphere concept provides an accessible entry point for discussing the evolving relationship of humanity and the biosphere (Liebes *et al.*, 1998).

Schellnhuber (1998) identifies the emerging global subject — 'humanity as a self-conscious control force that has conquered the planet'. The danger is that, as so often in human history, having conquered something, we don't know how to govern it sustainably. Earth System Analysis (Schellnhuber, 1999) is the study of the interaction of the human factor and the rest of the

ecosphere, the later including the geosphere, hydrosphere, atmosphere and biosphere *sensu* Cole (1958), Gillard (1969) and Huggett (1999). The methods of Earth System Analysis focus on planetary monitoring, and global modelling and simulation. This discipline must provide the knowledge base for a functional noosphere.

The noosphere is characterized by human–environment interactions at multiple scales or levels of organization. These levels do not necessarily correspond to the commonly recognized levels of organization in the ecological hierarchy. Individuals have gardens or operate farms; cities manage local natural features and greenbelt areas; regional governmental entities promulgate regulations designed to preserve biodiversity; national governments effect agricultural policies that reduce or aggravate erosion. The relevant institutions at the global scale are weakly developed as yet, however, the activation of the International Convention on Biological Diversity, the Montreal Protocol and the Kyoto Protocol are indications of the possibilities. Broader dissemination and acceptance of the noosphere concept would engender an increased sense of responsibility for the biosphere and increased support for further progress. A critical role for ecologists is the identification of appropriate scales and mechanisms for coupling of the human factor and the biosphere, both within a level of organization and across levels of organization (Palmer *et al.*, 2005).

The noosphere concept need not be dualistic, i.e. thoughts are not envisioned as existing independently of human minds or of being transmitted by non-physical means. The capacity for abstract thought is just another product of biological evolution, albeit an unusual one because it introduces a subjective element into the workings of the brain. Over time, a volitional capacity — based on shared mental constructs — has become a feature of increasingly larger human organizations, with corresponding influences on the environment. The noosphere concept extends that capacity to the global scale.

A recent technological stimulus to the evolution of the noosphere has been space-based remote sensing. Monitoring capability is an essential component of many resource management models, and satellite borne sensors now permit monitoring of land cover change and climate, along with a myriad of other features of the Earth System. The human control force is gaining the ability to monitor its own influence on the ecosphere across a range of spatial scales from the landscape to the globe (Running *et al.*, 1999; Turner *et al.*, 2004).

The advent of the Internet has also improved the possibilities for a sustainable noosphere. The exponential growth in capacity for processing, storing and transmitting raw information and memes (Dawkins, 1976) has made the Internet a medium for collective thinking, particularly at the global scale. However, recent references to the noosphere concept and its relationship to the Internet (e.g. RAND, 2005) often make no mention of global ecological issues. These views hark back to the disembodied noosphere of Teilhard de Chardin. The dismal trajectory of human influence on the biosphere suggests the importance of a more biologically based interpretation of the noosphere.

CONCLUSIONS

Scientific disciplines evolve. New observations lead to new concepts and theories. Global ecology is a discipline that in part seeks to understand global scale phenomena involving life. The observation that the ecosphere is being rapidly transformed as a consequence of human behaviour forces us to treat ourselves as a new object of study. The transformation of the biosphere into a noosphere is as profound an event in the history of the planet as was the emergence of the biosphere from the geosphere. Earlier forms of the noosphere concept had the virtue of emphasizing the global scale influence of humanity on the environment, but the implicit faith that humanity would necessarily learn the initial requirement to self-regulate has not been borne out. Global ecologists must help envision the structure and functioning of a noosphere with a robust coupling of the conscious control force and the underlying biophysical processes from local to global scales.

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BIOSKETCH

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