NEED FOR ENVIRONMENTAL RESEARCH

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Summary

Research is unquestionably the key to scientific and technological progress for wider socio-economic development. However, whereas before scientific research and development had focused exclusively on economic development with little or no concern for the natural environment, today of necessity the focus has to be on ways in which the environmental impacts of human activities for economic development could be reduced, or eliminated if possible, so that some degree of environmental sustainability might be achieved in the foreseeable future.

It is argued that research and development for environmental sustainability leading to sustainable development should have two equally important components. A "reactive" component, based mainly on science and technology, to deal more effectively and economically with pollution already produced. And a "proactive" component, based mainly but not exclusively on environmental morality and ethics, to reduce or prevent the production of pollution in the first place by genuinely changing human behaviour and attitude to nature and the natural environment. Accordingly, a number of areas have been identified under reactive and proactive research, together with a number of other areas in which research is needed. The rationale for research in each of the identified

areas has been elaborated in some detail, along with discussion of a number of important and germane issues which the environmental research community ought to be aware of.

1. Introduction

In the Oxford English Dictionary the meaning of "research" is given as "the systematic investigation into the study of materials, sources, etc., in order to establish facts and reach new conclusions"; "an endeavour to discover new or collate old facts etc. by the scientific study of a subject or by a course of critical investigation". These meanings amply convey both sense and meaning of "research" in common usage too.

Like many animals of lower species, notably the primates, humans have an innate curiosity that drives them to find out about things that fascinate them, things they do not understand or challenge them, and things that are in some way concerned with their survival. This innate human need to know is succinctly conveyed in the ancient philosophy of India, where the fundamental characteristic of human nature is encapsulated as *Sat Chit Ananda*. The three words in italics are in Sanskrit; their nearest translation into English means, respectively: eternal, existence or infinity; consciousness, intelligence or knowledge; and bliss. "Consciousness", "intelligence" and "knowledge" is relevant to the present context.

Not surprisingly, this natural curiosity has been providing the primary impetus for what we now call research. From time immemorial man has been curious about the world around and beyond him and has sought plausible answers to the three fundamental questions of existence that still haunt him today, namely, who am I? What am I doing here? And is there an Omnipotent and Omnipresent Almighty, and if so, what is my relationship with Him?

It is interesting to note that while historically investigation ("research" in today's terminology) in the East, notably India, centred on the "spirit" to find *why* things worked by looking *inwards*, philosophers and thinkers like Aristotle (384-322 BC), Euclid (c. 325-265) and Homer (c. 750-700 BC) and many others in the Occident focused mainly but not exclusively on material things and on the "here and now" by looking *outwards* to understand *how* things worked. Interestingly, these distinct and historic Oriental and Occidental approaches have their approximate parallels in the concepts of "Subjectivism" and "Logical Positivism", respectively, in Quantum Physics (Rae, 1993). According to Subjectivism, everything one sees or considers to be "real" could be complete illusion (as in the philosophical tradition of ancient India)—that with our limited senses in this mortal coil we are not capable of observing reality, and that we can only perceive an aspect of reality depending on our personal situation. Indeed, Indian philosophical thought takes this further by asserting that one can only observe reality through Divine intervention (as in the *Bhagavad Gita*, for example), by looking inwards for self-realisation, or through *Nivarna* (enlightenment) in the Buddhist tradition. Logical Positivism, on the other hand, denies the soundness of metaphysics and traditional philosophy, and asserts that many of the philosophical problems are indeed meaningless. Based on the principle of verifiability, the logical structure of scientific theories and the meaning of probability, the central tenet of Logical Positivism

is that we should acknowledge as real only those things that are within the realm of our sense impressions and can be verified experimentally. This apparent contradiction between Subjectivism and Logical Positivism is not surprising or unique in Mathematical Physics, as the following mundane example would illustrate. Consider the equation, $x^2 = 1$, whose solution gives $x = +1$ or -1. Though diametrically opposite, both solutions are correct and equally valid.

Founded on the ethos of materialism, the origins of modern and quintessentially Western science, technology and economics can be traced back to the world-view of Aristotle (see Section 2.1). The central tenet of that world-view was exploitation of nature and all non-human things within it for the benefit and pleasure of mankind. In this context the Industrial Revolution marked a watershed in the sense that it made scientific research to find ways and means of exploiting nature and natural resources ever more efficiently with machines an essential and increasingly important pursuit for economic development. Indeed, scientific and industrial development achieved since then through scientific research has been so profound and pervasive that today it is impossible to imagine life without the material benefits and creature comforts accrued and still accruing from that development. Untold inventions, discoveries and developments in all branches of human knowledge, notably science and technology, bear ample testimony to humankind's incessant quest for knowledge, genius for scientific research, and how to apply the results of that research to bring about social benefits and a better material quality of life. However, a price is demanded for this in terms of both depletion of nature's resource base without which wealth cannot be created for economic development and degradation of nature's vital life support systems without which life on Earth cannot exist. And that price is rising as human societies everywhere aspire to ever greater economic development by mercilessly exploiting nature's resources with which they are blessed. Clearly, this state of affairs does not augur well for future generations.

It is indeed a paradox that while man, with all his intelligence and wisdom, has been knowingly degrading and even destroying the very natural environment that sustains and nourishes him, it is hard to find an animal of lower species that behaves in quite the same way and with such apparent relish.

2. How did we get here? Evolution of the "consumption culture"

2.1. Evolution of the Western "throw-away consumption culture"

Students, especially those engaged in or embarking on research in environmental science, engineering, management and related disciplines ought to know, and need to know, how today human societies have arrived at the cross-roads of history where their very survival in the long term is put at risk. For this one needs to understand how Western science, technology and economics that are pervasive and universal in scope today, have evolved through the ages, starting from and underpinned by the Aristotelian world-view referred to earlier (Allan, 1970).

According to the Aristotelian world-view, nature has no intrinsic value. It is of value *only* if it benefits humans. Thus, for example, a rare plant in the tropical rain forest is

valuable and worthy of preservation *only* if some useful drug could be made from it, or if it serves a useful purpose to benefit humankind. Clearly, it is a highly utilitarian and exploitative attitude to nature and all non-human things within it. It is also a profoundly anthropocentric view which does not acknowledge the right of nature, or anything non-human within it, to exist for its own sake. Historically this exploitative attitude, which is all too common in pervasive Western cultures, has driven the evolution of science, technology and economics and still continues to do so.

In passing it is interesting to note that the Platonic world-view, on the other hand, acknowledges the intrinsic value of nature and of all things within it, for its own sake (Lesser, *et al.*, 1997). That is, nature and all things within it have their intrinsic values independently of humans and regardless of what humans thought those values might be. We humans may not know about or understand those values or their intrinsic qualities because of our own limitations, ignorance or selfishness. Clearly, it is an eco-centric world-view which is benign to nature at the very least. It is tempting to speculate on how human societies would have evolved with the Platonic world-view as the foundation of science, technology and economics instead of the Aristotelian world-view which prevailed.

The exploitative and profoundly anthropocentric world-view of Aristotle pervaded the Judaeo-Christian tradition too, as will be gathered from the following: "And God blessed them, and God said unto them, Be fruitful and multiply, and replenish the Earth, and subdue it; and have dominion over the fish of the sea, and over the fowl of the air, and over every living thing that moveth upon the Earth" (Genesis 2.28, The Holy Bible). The words "subdue" and "dominion" had been widely interpreted to mean taking licence to exploit nature and all things within it for the benefit and pleasure of man.

"In Western terms, one of the underlying factors which may have contributed (by being taken literally) to the desire to dominate nature, rather than live in harmony with it on a sustainable basis, is to be found in the Book of Genesis where it records that "God said unto man, be fruitful and multiply, and replenish the Earth and subdue it; and have domination over the fish of the sea and over the fowl of the air and over every living thing that moveth upon the Earth." To me, that Old Testament story has provided Western man, accompanied by his Judaeo-Christian heritage, with an overbearing and domineering attitude to God's creation."

HRH The Prince of Wales (Porritt, 1991)

In the seventeenth century this utilitarian and highly exploitative attitude was reinforced by Francis Bacon (1561-1626), René Descartes (1596-1650) (Anderson, 1948; Clarke, 1982) and others who gave it the "scientific" imprimatur in the secular context. Their thesis was that nature and everything within it was for the sole benefit, well-being and pleasure of man, and so, they argued, scientific research ought to focus on ways in which to exploit nature to the full to achieve those ends. In other words, man had *carte blanche* to exploit nature and all things within it for his own benefit and pleasure. However, as has now become clear, this attitude, more than any other factor, has been responsible for the continuing degradation of Earth's natural environmental capital, thus bringing us to the cross-roads of history where our long-term survival as a species is put at risk *vis-à-vis* the environment and nature's life support systems.

Then Western scientists and technologists arrived on the scene with their characteristic arrogance, domineering attitude and superiority complex to proclaim that respecting the Earth as "mother" (as in some eastern cultures, notably in India) was sentimental nonsense. The Earth and all its resources, they proclaimed, was there to be exploited for the sole benefit and pleasure of man. If ever there were to be an environmental catastrophe of apocalyptic proportions—and heavens forbid it—this will surely be its most fitting epitaph.

Soon after the end of World War II, exploitation of nature and her resources took off as never before. In the 1950s a number of large, state-sponsored research projects were undertaken in the USA to explore if, or how, Sigmund Freud's psychoanalytic techniques could be employed to promote and achieve the twin objectives of capitalism, namely uninterrupted growth of production and consumption, and effective social control (BBC, 2002). Led by Anna Freud and Edward Barneys (daughter and nephew respectively of Sigmund Freud), the central thesis of these projects was that individuals harbour dark and powerful forces repressed in their unconscious minds which, if not kept in check, could rise to the conscious mind to destabilise society itself. Therefore, could the hedonistic pleasures of open-ended consumption be relied upon to keep those forces in check? If so, they would serve the aforementioned twin objectives well. We note in passing that open-ended consumption of goods and services and its uninterrupted growth over time is the cornerstone of the prevailing *laissez-faire* economic system which is universal in its scope today; and that it is diametrically opposed to sustainable development whose achievement is contingent upon the affluent adopting less consumptive and less polluting life-styles (WCED, 1987).

Researched response to the above question was a resounding "yes", and so began a veritable orgy of consumption leading to the pervasive "throw-away" culture of today which is proving to be the nemesis of both environmental protection and sustainable development. The high priests of this orgy are captains of Western multinationals who worship at the altar of Mammon. Some of them make uplifting pronouncements on the need to protect the environment as and when necessary, largely to enhance their corporate image and environmental credentials, and, most importantly, to improve their "bottom lines". Assisted by legions of marketing and public relations consultants, psychoanalysts and others, they spend vast sums of money to produce clever advertising messages that bombard (brainwash?) people relentlessly and often subliminally to fuel their greed for the hedonistic pleasures of open-ended consumption. It is indeed depressing to note that while all major religious and philosophical traditions are disdainful of avarice, greed and gluttony, it is precisely these "sins" that are now the mainstays of capitalism.

"Man has wiped out a third of the natural world in the last thirty years and soon will have to start looking for a new planet to live on… The scale of devastation is so great that man will have used up all the Earth's natural resources by 2075… If every human alive today continues to consume resources and produce carbon dioxide at the same rate as the average Briton, we will need to colonise at least two Earths to survive… Our current consumption is eroding the very fabric of our planet and will ultimately threaten our long-term survival".

(WWF, 2000)

The pervasive Western "throw-away" mono-culture built on ever greater consumption,

which is being promoted internationally as the must-have imprimatur of development, modernity and sophistication, has spawned a whole new *genre* of marketing slogans such as "Retail therapy", "Conspicuous consumption", "Shopping experience" and "Shop till you drop" that are becoming the verbal icons of today's pervasive mono-culture of unfettered consumption.

2.2. The main consequences

Relentlessly rising production and consumption of goods and services to supply the demands of profligate and increasingly hedonistic life-styles of the affluent, coupled with the gathering pace of globalisation, have been creating the following major problems:

- Patterns of production and consumption are becoming more and more unsustainable with diminishing prospects of ever achieving even a modest degree of global environmental sustainability or sustainable development in the foreseeable future.
- The World has *de facto* been dividing into two worlds—the rich world and the poor world. While the rich world is increasingly preoccupied with consumption to satisfy its apparently insatiable lust for hedonism, the preoccupation of the vast majority in the poor World is somehow to eke out a meagre existence by working hard to supply the demands of that hedonism.
- Relocation of dirty industrial production facilities by Western multi-national in poor countries that have little or no bargaining power, and where environmental regulation is lax or enforcers can be persuaded with modest inducements to turn a blind eye, has been exacerbating the degradation of the poor world's natural environmental capital.

3. Cause-Effect Relationship

Clearly, lack of meaningful progress towards global sustainable development, which typically underlined deliberations at the World Summit on Sustainable Development (WSSD) held in Johannesburg in 2002, is the "problem" to be addressed.

In carrying out the scientific analysis of any complex problem, it is always instructive to establish the cause-effect relationship of the problem at hand if at all possible—ideally a quantified relationship—provided of course that both cause(s) and effect(s) can be identified or inferred with an acceptable degree of precision. Unfortunately, the main cause of the complex and growing "problem" of global unsustainability lies in the behaviour of the affluent characterised by greed, aspirations and selfishness on one hand, and on the other in the behaviour of the poor who have no option other than to degrade the natural environment for sheer survival. However, as human behaviour cannot be quantified in any plausible sense, clearly a quantified cause-effect relationship of the "problem" cannot be established.

We argue that the pervasive and quintessentially Western materialistic culture, which is founded on uninterrupted growth of production and consumption of goods and services to satisfy the ever more profligate "wants" of unsustainable life-styles of the affluent increasingly characterised by avarice, greed, gluttony and hedonism, is the "cause" of

the "problem". This is because relentlessly rising production and consumption of goods and services creates the following difficulties to thwart progress towards global environmental sustainability and sustainable development:

- Ever greater consumption of energy and raw materials notwithstanding recycling and reuse efforts. Typically, consumption of steel in China today (2004) illustrates this well. With an annual GDP growth rate of 8-12%, that country's huge and growing demand for steel is threatening to outstrip supply.
- Relentlessly growing amounts of both production and post-consumption wastes of increasing chemical complexity to be safely disposed of.
- The impacts of the above on natural resources, the natural environment, and on nature's life-support systems.

The "effects" are depletion of Earth's limited natural resources, degradation of natural environmental capital and life support system, etc. A schematic of the cause-effect relationship is shown in Figure 1.

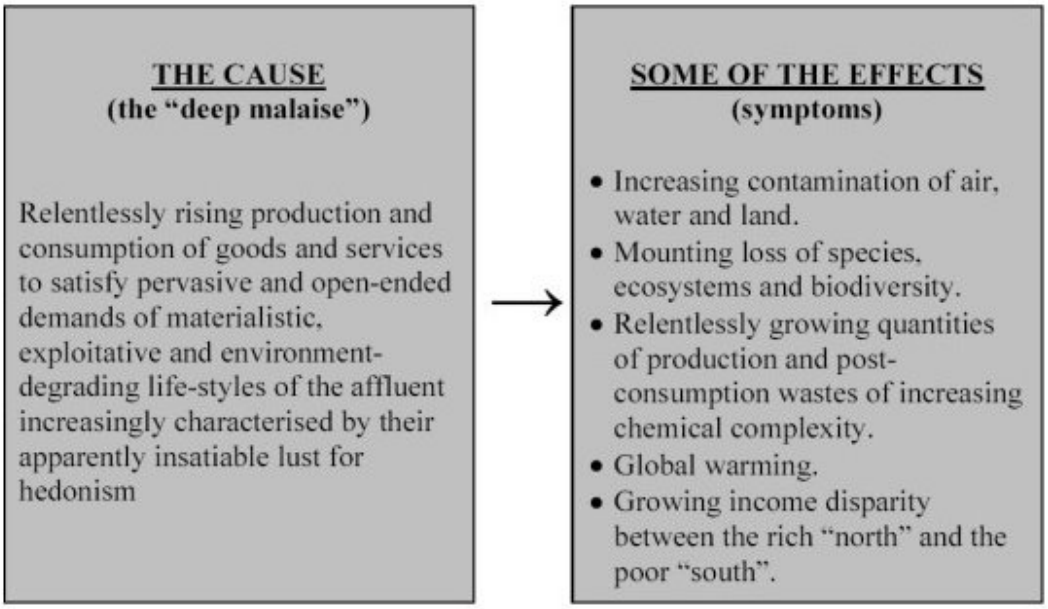

Figure 1. Schematic of cause-effect relationship of the problem of lack of progress towards global sustainable development.

Interestingly, while the authoritative Brundtland Commission definition of sustainable development is in terms of human "needs" (WCED, 1987), the prevailing *laissez-faire* economic system is increasingly preoccupied with supplying the "wants" of the hedonistic life-styles of the affluent. Indeed, the system would collapse without uninterrupted growth of production and consumption of goods and services increasingly demanded by their avaricious and unsustainable life-styles.

This open-ended consumer culture, which we may characterise as a "deep malaise", is born of a profoundly anthropocentric Western world-view (see Section 2.1). And the

environment-degrading moral values which that culture inculcates stem from that view. Consequently, Western attitude to the natural environment is and has been grossly exploitative—an attitude that characterises and underpins the West's highly materialistic, highly consumptive, and grossly environment-degrading and unsustainable life-styles. Amazingly, such life-styles (and those environmentally dysfunctional values) have been and are being vigorously promoted by the West as "ideals" to be aspired by the developing nations as "coveted" fruits of their economic development, to be realised of course with expensive Western technical assistance they can ill afford, together with loans from Western donors that have an unfortunate habit of turning into crippling debt burden on many. Yet, more amazingly, the developing nations have been gleefully adopting those values and abandoning their own much older values that taught them how to live contented lives in harmony with nature.

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Bibliography

ALLAN D.J (1970). *The Philosophy of Aristotle*, Second Edition, Oxford, Oxford University Press. . [This book gives a succinct and interesting account of the philosophy of Aristotle].

BBC (2002). "The Century of the Self", a documentary broadcast by the British Broadcasting Corporation, London, during 29 April and 2 May, 2002. [This describes how after the end of the Second World War experiments were undertaken in the USA to determine if Sigmund Freud's psychoanalytic techniques could be applied to achieve the twin objectives of capitalism—uninterrupted growth of production and consumption and social control].

BROWN P. (2004). "Climate Fear as Carbon Levels Soar". *The Guardian*, 11 October, London. [This front-page article reports on the apparently accelerating rise of CO_2 concentration in the atmosphere and its possible consequences].

COLBORN T., DUMANOSKI, D. and MYERS J.P. (1997). *Our Stolen Future*, New York, Plume/Penguin. [This interesting and provocative book narrates a cautionary tale of how the release of even apparently harmless household detergents, cosmetics, etc. to the environment can adversely affect the reproduction of certain animals including humans].

DESA (2002). *The Johannesburg Plan of Implementation*, Department of Economic and Social Affairs, Division of Sustainable Development, United Nations, New York. [This document of 170 paragraphs gives a detailed plan for achieving the Agenda 21 objectives. Paragraphs 81-136 inclusive elaborate on the means of implementing the Plan].

DUDA A.M. (1994). "Achieving pollution prevention goals for transboundary waters through international joint commission processes", *Water Science and Technology*, Vol. 30, No. 5, pp. 223-231. [Reviews the extent of transboundary water pollution across the World and outlines key elements for preventing pollution through joint institutions].

GLANTZ M., KATZ R. and NICHOLLS N. (ed) (1991). *Teleconnections Linking Worldwide Climate Anomalies*, Cambridge, Cambridge University Press. [Gives an authoritative account of Southern Oscillation and how it is closely linked to El Niño].

KLEIN W. and STURGESS R. (1996). "Export/import of illegal shipments of hazardous waste, toxic chemicals, or contaminated products", *Proc. Fourth Int. Conf. Env. Enforcement*, International Network for Environmental Compliance and Enforcement (INECE), Chiang Mai, Thailand, Vol. 1, pp. 171-176. [Reports on conference deliberations including the roles of environmental inspectorates and government institutions in combating illegal import/export of hazardous wastes].

KOCASOY G. (2000). "Solid waste management in developing countries—a case study of Turkey", in B. Nath S.K. Stoyanov and Y. Pelovski (Eds.). *Sustainable Solid Waste Management in the Southern Black Sea Region*, Kluwer Academic Publishers, Dordrecht, the Netherlands, pp. 47-68. [This paper describes how relentlessly increasing quantity of solid waste has been degrading both environmental integrity and quality of life in Turkey, which is typical of many developing countries].

LESSER J.A, DODDS D.E and ZERBE R.O (1997). Environmental Economics and Policy, New York, Addison-Wesley Inc. [Also gives a succinct account of the world-views of Aristotle and Plato].

NATH B. (2002). "Environmental regulation and standard setting", in *Knowledge for Sustainable Development — an Insight into the Encyclopaedia of Life Support Systems*, Paris, UNESCO. [This publication gives a comprehensive account of environmental regulations and standards including their limitations for controlling anthropogenic pollution].

NRC (2004). *The Hydrogen Economy: Opportunities, Costs, Barriers, and R&D Needs*, National Research Council and National Academy of Engineering, Washington DC, The National Academies Press. [This authoritative document reports on the feasibility of Hydrogen Economy including potential opportunities, costs and research and development needs].

PORRITT J. (1991). *Save the Earth*, London, Dorling Kinderseley. [This excellent publication contains a large number of short contributions by eminent environmentalists and others concerned with the environment. Much to be recommended for children and adults alike].

POWRIE W. and ROBINSON JP. (2000). "The sustainable landfill bioreactor—a flexible approach to solid waste management", in B. Nath, S.K. Stoyanov and Y. Pelovski (Eds.). *Sustainable Solid Waste Management in the Southern Black Sea Region*, Kluwer Academic Publishers, Dordrecht, the Netherlands, pp. 113-140. [In this contribution the authors describe the design and operation of a novel landfill, conceptually based on the process of controlled decomposition and managed as a large-scale bioreactor. Relevant and up-to-date EU directives on waste are also described].

RAE A.I.M. (1993). *Quantum Mechanics*, Third Edition, Institute of Physics Publishing, Bristol. [This text gives a mathematical treatment of Quantum Theory. More interestingly, it also gives an excellent discussion of the various philosophical conclusions that emanate from that theory concerning the human condition, our perception of the world around us, and the concept of the *universal consciousness* to which individual consciousnesses are linked].

SAEFL (2003). "Transboundary Water Pollution: the New Civil Liability Protocol Helps Prevent Industrial Accidents", Swiss Agency for the Environment, Forests and Landscape (SAEFL), Berne, Switzerland. [This Protocol, supported by Switzerland and approved by the UNECE, seeks to prevent transboundary water pollution in Europe].

UNECE (1979). "Convention on Long-range Transboundary Air Pollution", United Nations Economic Commission for Europe, Geneva. [Gives the Protocol text of the Convention].

UNECE (2000). "2000 Review of Strategies and Policies for Air pollution Abatement", United Nations Economic Commission for Europe, Geneva. [Gives a detailed analysis of the performance of the Convention on Long-range Transboundary Air Pollution in Europe and North America].

WALKER J. (1996). "Gender-Bending Chemicals", *Quill*, October.[This article gives a fairly comprehensive and easy-to-understand account of such chemicals for the non-scientist].

WORLD COMMISSION ON ENVIRONMENT AND DEVELOPMENT (WCED) (1987). *Our Common Future, Report of the Brundtland Commission*, Oxford, University Press. [This UN Report firmly placed sustainable development at the top of the political agenda as the only kind of development capable of delivering inter-generational and intra-generational equity].

WORLD WILDLIFE FUND (2000). *The Living Planet Report 2000*, London. [This Report is on the state of the global environment in 2000. It paints a gloomy but plausible picture of environmental

consequences if we continue with environment-degrading and unsustainable patterns of development].

Biographical Sketch

Professor Bhaskar Nath received his Bachelor's degree in Civil Engineering from the Indian Institute of Technology, Kharagpur, India, in 1960, followed by the Ph.D. degree from the University of Wales, UK, in 1964. In 1983 he was awarded the D.Sc. degree by the University of London for his outstanding original research (according to citation) in numerical mathematics. In 2001 he was awarded the *Doctor Honoris Causa* (Dr.H.C.) by the University of Chemical Technology and Metallurgy, Sofia, Bulgaria, for his contribution to environmental education.

After having taught at the University of London for more than 27 years, Professor Nath is currently Director of the European Centre for Pollution Research, London; Executive Director of International Centre for Technical Research, London; Editor of *Environment, Development and Sustainability* published by Springer; visiting professor to several European universities, and consultant to a number of international companies and organisations. Professor Nath's research interests include Numerical Mathematics, Elasto-Hydrodynamics, Philosophy, Environmental Economics, Sustainable Development, and Environmental Education. He has more than 100 scientific publications in these and related areas including 13 books.