"RETRO-," AN EMERGING PREFIX FOR FUTURE TECHNOLOGICAL DEVELOPMENT?

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It is proposed that the prefix "retro" can serve as an irreverent, but timely buzzword for the development of new technology to meet human needs. Society has carried out experiments at a very large scale for the last century or so to meet our collective needs though the use of fossil-based fuels and synthetic materials. Those experiments have seemed successful in the short term, feeding more of us and supplying a lot of us with rising standards of living. But the experiments often have failed us in terms of sustainability. A health crisis, global warming, and resource depletion are urgent problems caused by careless use of fossil fuels and related synthetic organic chemicals. The prefix "retro," as in "retrotechology," signals a disciplined return to a reliance on nature-based products, as well as a respect for the beauty, but also the fragile character of our natural environment.

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A Simpler Time

According to archeologists, Easter Island in the Pacific was heavily wooded at the time of its settlement (Diamond, J. R., 2005, *Collapse: How Societies Choose to Fail or Succeed*, Viking Press). As in a vision of the biblical Garden of Eden, there was plenty of wood with which to build boats to catch fish from the surrounding waters. There seems to have been sufficient labor and round logs so that the huge statues, for which Easter Island has become famous, could be moved from quarries to various sites along the coast. But the residents of Easter Island did not manage their forests sustainably. The last tree eventually was cut down. The soil became exhausted. Without wood the people could not build boats with which to catch the still-abundant fish. Famine struck, and the population collapsed. We don't know the words of the individual who cut down the final tree, forever cutting off the possibility of growing new trees, and maybe someday building boats again. We can expect, however, that their words reflected the trends of the times. Maybe they used a term like "neo" as they contemplated a treeless future.

Fast Forward

The moral of the story must be that yesterday's buzzwords won't solve today's problems. Editorials in various past issues of *BioResources* have dealt with such trend-laden prefixes as "nano-," "eco-," and "bio-." The word "green" also is being used as a modifier of the word "technology." But urgent times call for urgent action, so I am going to propose that a new trend-word is needed. Unlike our old buzzwords in the preceding

list, this new buzzword should emphasize a clear path forward toward solving today's urgent problems. The coming shortage of cheap, renewable liquid fuel can seem particularly urgent. But other problems brought on by careless aspects of fossil-fuel-based technologies are perhaps even more critical. These include global warming (see Oreskes, N., 2004, *Science* 306, 1686) and an emerging worldwide health crisis, featuring human infertility (see Colborn, T., 2004, *Environ.Health Persp.* 112, 944-949).

Retrotechnology

The proposed new prefix is "retro." Readers may ask, "Is one of the co-editors of this journal out of his mind?" How can such an anachronistic term help to transform the focus of future technology? Won't a view towards the past keep us mired in exactly the same predicaments that we are facing today? And is it really possible, given the explosive pace at which we have been learning more and more about science and technology, to seriously entertain such notions as "retro-technology?" Just like Adam and Eve, it would seem that the knowledge in our heads will exclude us forever from returning to a simpler, more wholesome way of living in harmony with the world's natural resources.

So let me explain, using ancient papermaking technology as an example: Judging from Cai Lun's detailed descriptions of advances in pulping and papermaking, dated 105 AD, we can estimate that cellulose-based technology has been around for some 2000 years or so. Even the ancient technology sometimes involved serious pollution of the water, as is evident, for instance, from old illustrations showing papermakers dumping used lye into fresh-water streams. In modern terms this would be equivalent to "direct discharge of spent pulping liquors." The toxic effects, though serious, were not persistent, and in the long term natural bacteria and fungi have been able to cope with past products and byproducts of papermaking. Our present knowledge makes it feasible to reduce the toxic effects to very low levels. The high biocompatibility of typical cellulosic materials can be traced to their natural origin, biodegradability, and non-toxic nature. The very long usage of papermaking technology, of which the basic processes remain essentially unchanged (see Hunter, D., 1947, *Papermaking: The History and Technique of an Ancient Craft*, Dover), lends weight to our claims that this enterprise is sustainable, at least to the 7000^{th} generation.

So what does it mean to practice "retro-technology," while also taking advantage of recent remarkable advances in the state of our knowledge? It means that we now have a much fuller understanding of hazards posed by release of chemicals into the environment, especially in cases where those chemicals have no natural counterpart. It means that we should view exotic chemicals and materials with considerable suspicion and take urgent action to replace the most hazardous of them with more natural alternatives. It means that we have no excuses now if we fail to maintain our world in a sustainable manner.

This essay started with the image of a garden. A good gardener will tell you that it takes human effort, working together with nature, to create an especially beautiful result. And since we happen to be living in such a garden, is it too much to ask that our Earth be maintained as an organic garden?