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Eternal Use of Resources for Our Well-being

Hiroshi MIZUTANI
College of Bioresource Sciences, Nihon University
Kameino 1866, Fujisawa, Kanagawa 252-8510, JAPAN
Fax: 81-466-84-3721, e-mail: mizutani@brs.nihon-u.ac.jp

It has been pointed out for some time that sooner or later resources will be exhausted irrespective of their renewability. When this happens, the present humanosphere could not sustain itself. Cyclic use of resources, while generating no environmental loads and inflicting no social injustice, may be a part of the solution. The utmost economies in using resources as well as stockpiling and right-sizing should be also observed. Once incorporated into the humanosphere, the resources must be utilized thoroughly. Based on these, three principles and six practices for prolonging resource use are given. A peaceful continuation of the humanosphere hinges upon our success in adopting the appropriate way of distributing resources. In order to achieve this, we first need to share core values according to which the order of priority among human needs is determined. Resources are considered as global commons and allotted based on the global limits and on the material and energy requirements/disposal for each need. From this point of view, contentment and moderation appear to be important, and four core values are proposed. Recognizing the difficulty of realizing stable sociogeochemical circulations, humans who succeed in attaining this feast have been compared to an emergence of a new human species, *Homo sapiotempus*.

Key words: social equity, right-sizing, global commons, sense of value, moderation, contentment

1. INTRODUCTION

The world is now standing at the crossroads. Considering the current expansion of human activity and growing realization of worsening global environments, *de facto* depletion of resources has long been said to take place, resulting in a misery the extent of which humanity has never before experienced. This awful prediction unfortunately appears to be fulfilled soon for various resources. In this respect, our stupidity is plainly manifest in case of chemical elements such as heavy metals to which the law of the indestructibility of matter most strictly applies; i.e., when they are depleted, their environmental pollution is the highest.

Our biological ancestors of billions of years ago must have had learned the cyclic use of bioelements, now called biogeochemical cycles, to pass the terrestrial life down through the unnumbered generations to the present. Thanks to it, the biological evolution has materialized to produce an intelligent form of life, human beings. It is, therefore, shameful for us, the current generation of humans, to discontinue the precious fruits of the process of cosmic evolution because of our shortsighted foolishness.

2. RESOURCE SCARCITY

In recent years, there has been intense interest in the Arctic from the countries that border it. Last summer, for instance, crews aboard Russian submarines, explored and mapped out part of the Lomonosov Ridge which, Russian government says, extends from Russia's continental shelf. It is strongly suspected that it has something to do with the seabed below the Arctic Ocean that is said to contain vast deposits of oil, minerals and natural gas.

We used to believe that the size of the Earth is sufficiently large so that our activity, no matter whatever we do, is negligible, and that we are free to waste resources as much as we would like to. Unfortunately however, the anthropogenic deterioration of the global environment is now glaringly apparent.[1] Table I shows a selection of ill symptoms of the life support system.

Harada showed that the amounts of many metals we are to use by 2050 exceed the known reserves.[2] I add to it the well-known environmental load of mining and realize that the growing scarcity of metal resources is of

Table I Ill Symptoms of the Global Life Support System

Decline in biodiversity
Decrease in wildlife population
Depletion of aquatic resources
Depletion of oil resources
Depletion of rare metals
Destruction of tropical forests
Food supply troubles
Frequent extreme weather
Global temperature rise
Greenhouse gas emission
Groundwater depletion
Increase in water stress
Melting of glacier and sea-ice
Rise in communicable diseases
Soil erosion (desertification)
Species extinction
Spread of chemical contaminants
Spread of radioactive contamination

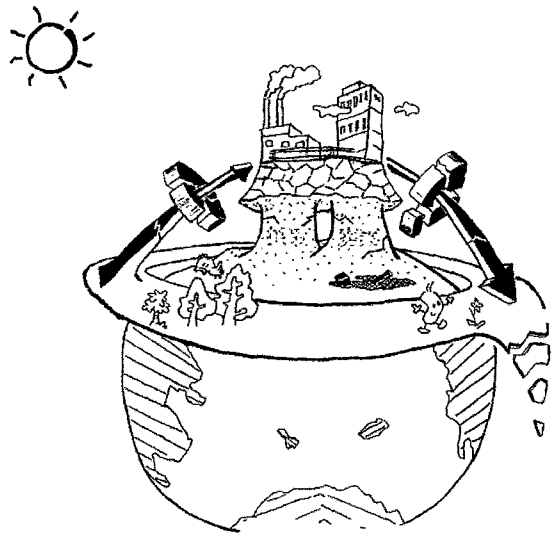

Fig.1 Frowning Earth (after reference 5)
On the top of the Earth, the humanosphere appears like a hump. Its excessive extraction from and disposal to the biosphere and the geosphere are resulting in the deterioration of the life support ability.

serious concern for the continuation of the present human society.

The problem of growing scarcity is not only for metal resources. The world petroleum production per capita peaked in 1979, being unable to keep up with the rate of population growth since then.[3] Food shortage might be more serious due to the recent development in so-called biofuels. Production of biofuels with the currently available technology demands edible portion of biomass as raw material, while sufficient supply of food in future is uncertain even with no use of food for biofuels.[4] The fact that the first of the United Nation's Millennium Development Goals is to eradicate extreme poverty and hunger would suffice to assure the presence of hungry populations in the world. Fig.1 illustrates the present relationship between the biosphere and the humanosphere.

Eco-innovations are hoped to alleviate the problem. However, it may be possible that they invite a new kind of environmental risk through a heightened demand for scarce resources. Under these circumstances, whether the current way of resource use might be unsustainable should be considered as "material risk," earnestly requiring a definite answer.

A simple and obvious solution to the problem of the material risk would be to use resources cyclically, generating no environmental loads and inflicting no social injustice on all the sectors involved. The utmost economies in using resources including reductions, reuses, long service-lives, and recycles would also need be observed. Once incorporated into the humanosphere, the resources must be utilized thoroughly until naturally rendered useless. An eternal use of resources, thus, may only come to be possible. The following three principles and six practices would be the mottos that express the essence of lasting resource use.

THREE PRINCIPLES
Never deplete resources,
Never increase environmental load,
Consider regional and generational equity

and

SIX PRACTICES
Avoid excess,
Stockpile sufficiently,
If possible, choose common instead of rare,
When used, use it to its fullest extent,
Circulate it as many times as possible before discarding,
Generating no environmental load throughout its lifetime

Though the above principles and practices are of basic importance, their perspective is yet limited. It looks at best how to prolong the lifetime of resources, but its scope lacks consideration to the fact that the Earth system has its own capacity: global limits.

3. GLOBAL LIMITS AND RIGHTSIZING

The global limits are another factor to be considered in using resources. The finite Earth system is made of a certain amount of matters and driven by a certain amount of energy; therefore, its extent of life support ability is naturally limited. Unfortunately, however, we, present humans, know very little of the limits and pay little attention to the fact in utilizing natural resources. Instead, what we are doing is to keep expanding our needs, limitlessly demanding resources. This practice may soon bankrupt the life support system, puncturing the global limit. Fig.2 illustrates this situation and is known as "beach ball and kompeito model."

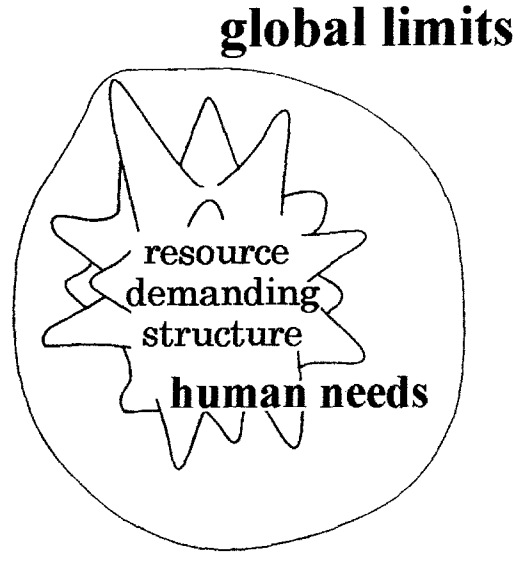

Fig.2 Beach Ball and Kompeito Model
(after reference 6)
The beach ball is made of fragile membrane but has certain flexibility. Inside is a kompeito that grows in size and some of whose many points of individual needs are going to touch the membrane.

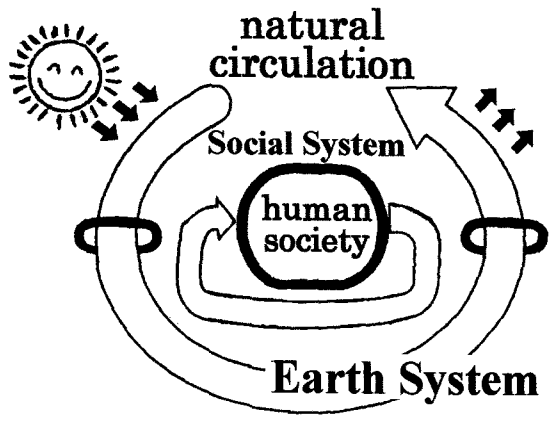

Fig.3 Right-sized Social System
When right-sized, the scale of material and energy exchange between the two systems is known and never excessive.

As the energy and material exchange between the Earth system and the humanosphere is excessive at present, it should be right-sized through its reduction to fit the human society within the carrying capacity of the Earth system (Fig.3). This can be attained only by taking a hard look at our wasteful lifestyle and at the social systems that encourage it, applying a brake to the seemingly unstoppable desire for material wealth and developing a new set of technologies that enable us to enjoy a rich life with the least use of resources.

4. RESOURCES AS GLOBAL COMMONS

It is said that, historically speaking, there were only two ways to allot limited resources among interested parties; i.e., by agreement and by force. Though the latter solution is by no means desirable, human history seems to be dominated by the latter and, if left as is, we are likely to repeat the past in the future.[7] In order to avoid the repetition of the foolish act, we would first need to regard resources as an asset to all humanity.

Resources are unevenly distributed and no nation has all kinds of resources. Furthermore, in the globalized world, the benefit as well as the burden of resource use is spread out of national boundaries. This concept of "resources-as-global-commons" is in accord with equity and human rights that are the hard-won fruits of the present human society and may be the only way to avoid the future squabble about resources. The Arctic could be the first where its viability is tested.

Sharing among all parties the concept and a common perception of what values are, an international effort to allot resources peacefully become realizable. This means that the entire benefit as well as burden of using resources is equitably shared by everyone involved. Current methods of sharing the impact of using resources are yet incomplete, however. I here give one example to illustrate the problem: China is at present the second largest emitter of carbon dioxide, but its per capita emission is far below that of developed countries; furthermore, a considerable portion of its emission results from the production of export goods and China's cumulative emission per capita since the Industrial Revolution is still lower than that of the developed countries.

Although it is understandable to use currently available statistical data, they may not be appropriate for the purpose. It is apparent that a comprehensive examination is desirable for more equitable allocation of environmental impacts. Fortunately, a basic methodology of accounting the entire impact of resource use is already available.[8] Using the method together with rapidly growing various input/output data such as LCA's inventory data, total material requirements and material flow analysis, it is now possible to quantify the impact of individual products/services.

5. RESOURCE AND HUMAN NEEDS

In a resource-limiting world, resources must be allotted to whom they are needed. While resources are used to satisfy certain human needs, some needs are crucial and some others are ornamental. If the amounts of resources are insufficient to satisfy every need, there must be a way to distribute them. Maslow proposed the hierarchy of human needs[9] and said that the appearance of a need higher in the hierarchy rests on the prior satisfaction of lower needs.[10] If such is the case, resources should be first allotted to satisfy the needs at lower hierarchy.

To put this into practice by prioritizing various human needs, I would like to point out the importance of sharing the sense of value among all parties. This is because what we conceive as value determines the humanospheric flows.[11] One example of priority order of human needs based on value is given below.[12]

PRIORITY OF NEEDS IN DESCENDING ORDER

Need to sustain an individual's life,
Need to live as neighbors do,
Need to live richer than neighbors,
Need to live extravagantly

Another consideration necessary for allotting limited resources is how to judge the fulfillment of a need. Even if the priority of its need is high, an excessively greedy group may demand all the resources and leave nothing for other groups in a similar need.

When we try to find an answer to this problem, we first come to be aware that we are a spoiled child of "sky is the limit"-generation.

It is surprising to realize that the anthropogenic deterioration of the life support system began only about 50 years ago. Up until the first half of the 20th century, the scale of material exchange between the life support system and the humanosphere was insignificant. Then, the life support system was a mature system with its own material circulation: the oxygen-centered circulation has existed on the surface of the solid Earth for about two billion years. The humanosphere, on the other hand, was a mere assort of a few flows into and out of the life support system. Even now, these sociogeochemical flows are far from constituting their own circulation.

Fig.4 schematically presents the change in the world human population, showing that the three major technological innovations caused rapid increases in the population and that the population was relatively stable in between.

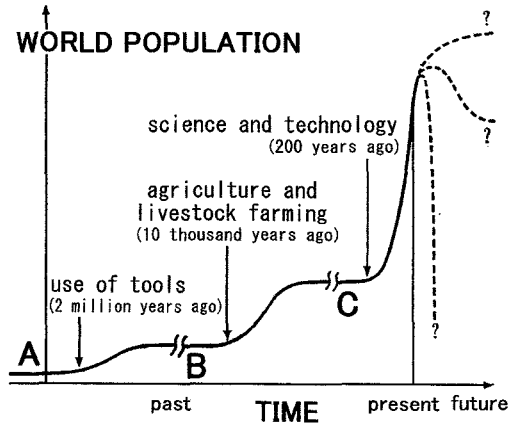

Fig.4 Technological Innovation and World Human Population[13]

Technological innovations were followed by rapid increase in population. Present is in the third period of rapid increase. World population at the time A was estimated to be about two hundred thousand, at the time B five million, and at the time C four hundred million.

6. LANDING ON A SUSTAINABLE SOCIETY

The third major innovation in Fig.4 resulted in the Industrial Revolution that continues until now. Unlike the other two, the present increase in the human population is going to reach the carrying capacity of the global life support system. In fact, only in the last 50 years, the size of the humanosphere has come to be large enough to influence the working of the life support system, although it still lacks its own circulation system and remain totally dependent on the Earth system.

This situation can be compared to the growth of a person. Until the middle of the 20th century, the humanosphere was in its childhood: whatever we do, we are still on the palm of the Mother Earth and She was lenient with us. In the second half of the century, however, the rapid growth in quantity of anthropogenic flows occurred and now their imbalance comes to threaten the stability of the Mother Earth. In this sense, the humanosphere is like an adolescent whom the Mother Earth now feels it burdensome and even likes to disown it. If I continue this metaphor, I would say that, in coming decades, we should seek to make the humanosphere grow to adulthood so that it can re-establish a coexistence with the Mother.

The successful transition to a sustainable society can be compared to the landing of an airplane: the maneuvering technique is different in different growth phases. Childhood is a high-growth period under careful supervision of elders and is relatively carefree flying; adolescent is a little rebellious but is still within the tolerant capacity of elders; and adulthood is a stable phase where a steady cruising independent of elders is achieved.

As the transition from adolescence to adulthood is difficult in case of human growth, so is the humanosphere. If we fail to see precisely where we are landing, the humanosphere will be destined to crash. In order to avoid such a tragedy, a dexterous maneuvering is prerequisite. The present global warming, however, would be an irrefutable evidence for our inadequate maneuvering ability, and we should deeply engrave it in our mind. "Business as usual" done during our childhood is no longer useful; it is even counterproductive. We need to formulate a new code of conduct for the safe landing on a sustainable society where neither matter nor energy is limitless.

7. CONTENTMENT

In a way, it is unfortunate that our longevity is about one hundred years. Because of this, almost all the people in developed countries are nurtured in an unsustainable society that places economical growth above anything else and have little experience about what a sustainable life would be. Furthermore, our judgments are quite dependent on what we experience and learn during our lifetime. We are, therefore, ill fit to propose an answer based on our experience. I would, therefore, like to look back in time and try to find it from where resources were limited.

When we look at the human history, there are abundant instances where an inconsiderate use of resources led a local society to a destruction, one of the most famous being that of the Easter Island. As such instances are abound, then, there should be at least some which successfully circumvented the danger of such a destruction.[14] And, though the problem was not global in scale, we may still learn some useful wisdom from these experiences.

As one of such wisdom, I would like to propose "shoyoku-chisoku" that concerns the problem of the excessive greed. A rough meaning of shoyoku-chisoku is as follows: contentment while desiring little. Some other versions of English translation are: contentment is great riches; more is not better; a contented mind is a perpetual feast; contentment is natural wealth, while luxury is artificial poverty; desiring little and knowing satisfaction; to shift from greed to self-sufficiency; he who is contented is rich; little desire and contentment with a little gain; wanting little and being content; have few personal desires and be satisfied with what one has; and content with few desires.

As a matter of fact, similar expressions are found both in the West and in the East: Aesop (*ca.* 619-564 B.C.) told in *Juno and the Peacock*, "Be content with your lot; one cannot be first in everything;" Marcus Tullius Cicero (106-43 B.C.) is quoted to have said, "Man's greatest rich is to live on a little with contented mind;" Shakespeare (1564-1616) wrote, "Poor and content is rich, and rich enough;" and Lao Tzu (*ca.* 5th century B.C.) said, "To know when you have enough is to be rich" and "I am content and have few wants."

These words reflect the fact that an inconsiderate use of resources must have had often endangered a continuation of a society at various times and at various places. Certainly, a control of greed without causing unsatisfactory feeling would be of great importance in a resource-limited society as well as individual's personal lives. Here I would like to give a possible field of study to find a clue to this intriguing problem.

8. MODERATION

Case in point is Japan during the Edo period. The Edo period was unique in Japanese history because of

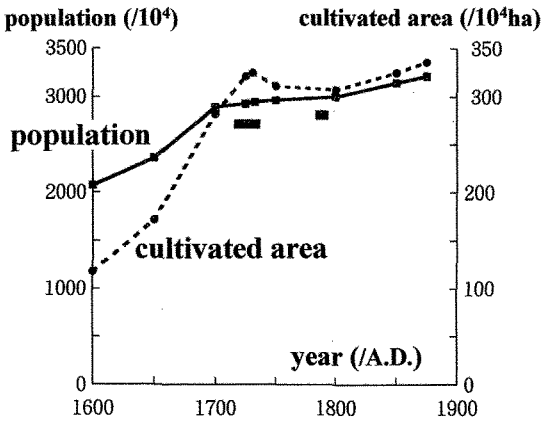

Fig.5 Population and Cultivated Area during the Edo Period[15]
Short horizontal bar indicates the period of the Kyōhō reform and the shorter horizontal bar the period of the Kansei reform.

the national isolation policy adopted by the Tokugawa Shogunate. During the period, Japan broke off relations with other countries and closed itself off from the outside world. The amount of international trade of goods then was insignificant enough to regard Japan as a spaceship just like the way we see the Earth as a spaceship.

Fig.5 shows population and cultivated area in the Edo period. During the 17th century, both the population and the cultivated area grew rapidly. The population growth tapered off soon after entering the 18th century and the cultivated area followed. It may indicate that, at the beginning of the 18th century, Japanese society was no longer able to continue the rapid growth. After that, both the population and the cultivated area essentially have remained stable until the end of the Edo period in 1868.

The Edo period can be separated roughly century-wise into three: the 17th century for high-growth, the 18th for transitional, and the 19th for adulthood. Facing a shortage of woods, which was one of the most important resources at the time, the Shogunate adopted a policy of suppressing their consumption and encouraging stockpiles as early as in the second half of the 17th century, and implemented two social reforms in the 18th century: the Kyōhō reform (1716-1735) and the Kansei reform (1787-1793).

In the Kyōhō reform, the Shogunate executed many policies, aiming mainly at a financial reorganization. Its very occurrence must mean that there existed a serious social difficulty at the time. The population and the cultivated area became stable after the reform. It is, therefore, likely that the reform had played a certain role in the successful entrance of the Japanese society to a transitional period. The second reform of the Edo period, the Kansei reform, seems to have finalized the transition, and Japan appears to have succeeded in entering the sustainable period.

Without doubt, a comprehensive assessment of the Edo period is outside of my expertise. I base the above interpretation of the Japanese history mostly on a mere hunch and it yet lacks a solid examination. Still, I believe that it would be worth for further studies from the above point of view.

I here would like to pick up one person of the time, Ninomiya Sontoku (1787-1856), whose life, I believe, vividly illustrates what is important in a sustainable society. He was a prominent 19th century Japanese, who was born to a poor peasant family. He conceived a poverty reduction practice through his experience and the rulers of the time, recognizing its usefulness, asked him to manage various village restoration programs. Later in his life, he became a great leader through hard work and his way of thinking appropriate at the time.

One of his famous concepts is "bundo"; i.e., living with a half of assured income. It can also be interpreted as "moderation" to mean that "Know yourself, live within your means and build a cooperative society" and "Living within one's means without borrowing or burdening others." Given the fact that we are currently living far beyond our means, this aspect seems of great importance for achieving and maintaining sustainability.

The purpose of the above discussion is to have an insight to a sustainable society and find a useful sense of value that may be shared by all interested parties in a future sustainable society and on which the allotment of resources is to be based.

Adding the modern values, I here propose four core values in the area of resource use for present and future sustainable society.

FOUR CORE VALUES
Contentment of mind,
Moderation in materialistic desire,
Equity among parties involved,
Peaceful continuation of civilized societies

9. CONCLUSION

When we see the current problem from a perspective of material evolution, we cannot help recognizing our unique position. Shown in Fig.6, is the Evolution Man whose height equals the length of time this universe has been existing, his toe being the birth of the universe and his top the present. It shows approximate positions in time of the five major events of material evolution

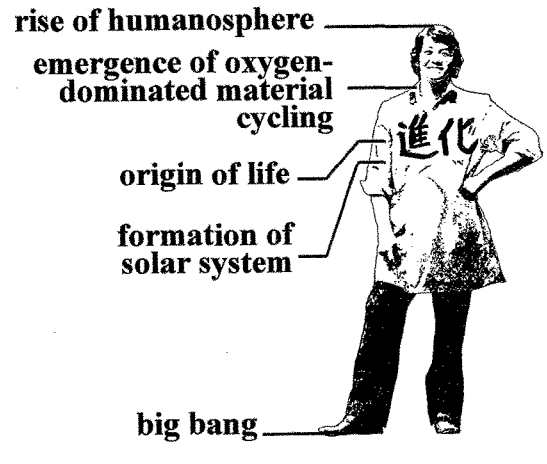

Fig.6 Evolution Man[16] and Five Major Events in Material Evolution

leading to the present: the big bang (13.7 billion years ago), the formation of the solar system (4.6 billion years ago), the origin of life (3.8 billion years ago), the emergence of the oxygen-dominated material cycling (two billion years ago) and the rise of the humanosphere (since six million years ago).

These five events are of critical importance in determining the state of the present world and in generating new laws behind them. The first two events set the initial conditions with which later evolution took place. The next two were those most critical to achieve the present biogeochemical cycles. It has been discussed that the transitions occurred during these events were difficult one and the biosphere was truly fortuitous avoiding its extinction.[17] The fifth event is taking place now and is going to establish sociogeochemical cycles, whose stocks and flows are governed, unlike those of the previous geochemical and biogeochemical cycles, by social reasons.[18] It goes without saying that nobody knows whether this transition will be successful as was the case for the preceding two.

To be successful for us in this endeavor, not only bioelements but also every element we use or come into contact with must be either circulated or stored and disposed of safely. Judging from the fact that we do not know how the biosphere managed to successfully navigate its way through the two transitions, the task before us is a daunting one. It requires our extraordinary innovative ability as every one of the elements and their compounds has different physical, chemical, biological and social characteristics.[19]

It is true that the human needs have so far kept expanding and, through the resource demanding structure, now appear to exceed what the Earth system is able to provide us with. However, our behavior is not tightly bound by genetic make-up and is very much flexible. It should be, then, at all possible to un-educate ourselves, instead of educating others on extravagance, and to try hard to go through the transition to a sustainable society. International organizations such as the United Nations are strongly expected to advance an agreement on how to allocate resources and environmental impacts equitably.

The future of humanity depends on our success in adopting the appropriate use of resources, which I would like to compare to an emergence of a new human species, *Homo sapiotempus*,[20] who is able to manage the eternal use of resources with a deep temporal as well as spatial and social perspective (Fig.7).

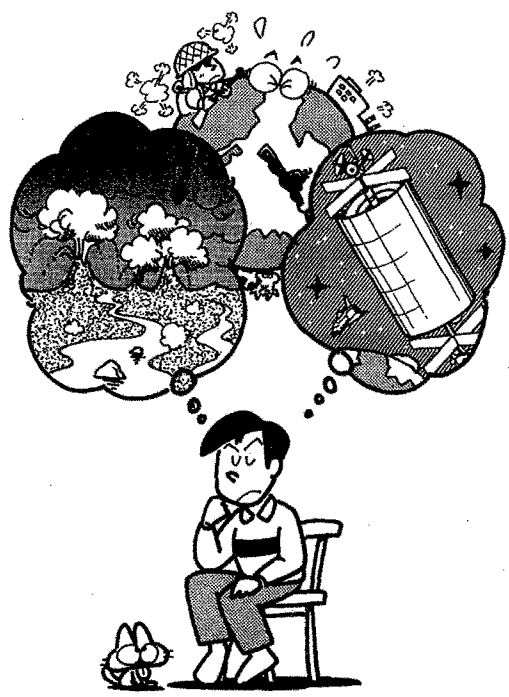

Fig.7 *Homo sapiotempus* with Deep Temporal, Spatial and Social Perspective[20]

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