Prospects of New Science and Technology Required for Coming Centuries

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ABSTRACT

In order to accomplish a more blanced quest to better human life and to environmental preservation, we have now faced with grave choices on new energy and materials, values, ethics, social orders, and science and technology under new requirements. It is likely that energy supply in the 21 Century appears to be diversified into fossil energy (petrol, gas, coal), nuclear energy, hydrogen energy, nuclear fusion energy, solar energy, wind energy, ocean energy, volcano thermal energy biomass energy and so on. Concurrently, many of industry systems without a few exception release CO_2 gas into air. We have to seek a new science and technology with which we can manufacture our commodities without releasing CO_2 into air, or fixing released CO_2 gas by certain new processes. Remarkable progress in biotechnology are also offering us many hopes to every field of our life. It is a sober moment for us to self-examine ourselves lest humankinds should choose such a course in which we sacrifice our earth in order to seek selfish materialistic comfort and sensual satisfactions. Respecting quality instead of quantity, and homeostasis, we have to make full effort in developing new science and technology with which we can build a humane society without pollution and resource depletion. New models for new science and new technology are presented. A new proposal for initiating the Global Environment Research Center equivalent to the CERN is also presented.

I. INTRODUCTION - Megashifts Age

Today we are living in the midstream of the megashifts of powershifts, economyshifts, societyshifts, and especially scienceshifts and technologyshifts. Those megashifts, or course, demand tranformations of values, goals, logics, paradigms and philosophies and others. (Table 1) As for the powershifts, there is a celebrated writing by Alvin Toffler [1]. Since my topic belongs to "Prospect of Science and Technology", may I confine myself mainly on the scienceshifts and Technologyshifts.

TABLE 1

Outline of contemporary Megashifts in 21st Century

Classification	Examples
1. Powershifts [1]*	Valueshifts, Goalshift, End of Cold War, Participatory Democracy
2. Economyshifts	Energyshifts, Resourceshifts, Communicationshifts, Transportationshifts
3. Societyshifts	Urbanization, Internationalization, Longevity, Affluence, Suppersymbolic Information Network Systems
4. Scienceshifts	Humane Science, Environmental Science, Life Science
5. Technologyshifts	Pollution Abatement Technology, Renewable, Recycling Technology, Information Technology, Gene Technology, New Material Technology, Technology Process Change
6. Paradigmshifts [10]*	From One Way Causal Paradigm to Two Way Causal Paradigm, Causation Change

* References [1], [10]

Recently there have been noisy rescendo of alarm over the degradation of the earth's ecosystem-such as the global warming of the atmosphere [2], disappearance of forest lands, holes in the ozone layer in the upper stratosphere [3], polluted water, air and foods, acid rain, hazardous waste dumping and so on. My inquiry to the environmental destructions leads me into the question-What role has been played by science and technology on them? and if science and technology are substantially responsible for the issues, what kind of shifts are required for science and technology? Then, this paper firstly deals with the characterization of modern science and technology, secondly with the merits and limitations of modern science and technology in the formation of our modern civilization, and lastly it will propose new models of science and technology required for coming centuries contributing for establishment of betterment and survival of the human society and the environment.

2. CHARACTERIZATION OF MODERN SCIENCE AND TECHNOLOGY [4]

Toward AD 2000, our human society seems to be navigating blindly amid the pollution catastrophes of air, water, soil, food and the ocean. The numerous crises-in the greenhouse

effect and the ozone hole, in a shortage of energy resources, in the explosion of population, in the degeneration of the biosphere and above all in the degradation of value and norms of our society-are rapidly surging to us. All of these crises and sufferings are, in essence, man-made, especially by science and technology. Through the remarkable progress of science and technology, man has unquestionably been successful to make the human society materially affluent, but simultaneously produced these unbearable miseries which endanger us and our descendants. In other words, current science and technology are suffering from the ambivalence. The inquiry by the conventional science and technology has been proved to be very useful and effective for tangible, not-complexed and calculable phenomena and matters. Therefore it is not proper or justified to assail the current scientific inquiry totally defective. Nevertheless, it is true that many conventional technologies-an application of scientific knowledge-appear incomplete in regards of the environmental respect and energy supply. Concurrently, many of industry systems without a few exception release CO_2 gas into air. For example, in the steel mill, one ton of steel must release almost one ton of CO_2, CO, SO_2 gases. In the cement manufacturing, one ton of Portland cement can be obtained after releasing near one ton of CO_2 and CO. We have to seek a new science and technology with which we can manufacture our commodities without releasing CO_2 into air, or fixing released CO_2 gas by certain new processes. Today 500 millions of automobiles are running around the earth spraying pollutants and causing the big city problems. We are sacrificing our survival in exchange with convenience. Faced with the global dilemma, an urgent feeling and demand for a more adequate understanding of science and technology, man and society, and correlation of science with our economical system is prevailing in today's intellectual gathering. Now as never before, a flexible, wide-ranged, and humane intelligence and insight are in demand. In dealing with the environmental problems, we have often naively and innocently developed science and technology without due consideration to our earth and environment. Under the assumptions that our resources and energy are limitless, and pollutions may be affordable or neglisible, man has ruthlessly developed industrial revolutions. After all, science and technology itself is products of human brain and efforts. Since man is historical and social existence, science and technology has more and more influenced inevitably by social and historical changes. Now is the proper moment to reexamine the new role of science and technology in collaboration with Man-Society-Environment under the scheme of the global homeostasis.

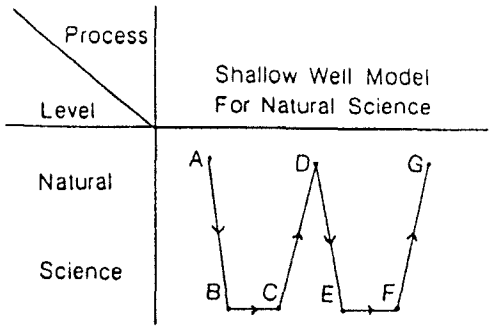
3. RESEARCH PROBLEMS OF SCIENCE AND TECHNOLOGY

In spite of their brilliant contributions of current sciences to our civilization, almost every science at one time has probably been accused of neglecting the uniqueness or human factors of the individual case by overspecialization. As infor-

mation accumulates, the mastery of any specific research of sciences leads us to ever-narrowed and ever-deepened specializations. Consequently, there often occurs a loss of total vision, descords among man, environment and society, sometimes alienation of humanity. Just as man is not God, science, a reflection of human intelligence, is not omnipotent. Furthermore, science and its application-technology are often taken advantages by politicians, technocrats and businessmen under the name of maximal production, maximal consumption and miximal profit mostly rusulting the environmental catastrophes and dehumanization. Furthermore, the development of science and technology has clearly reflected the economic growth of man and his market. Consequently, from industrial point of view man has utilized only those condensed and accumulated natural resources-petrol, wood, coals without developing technology for utilizing thinly scattered energy, let alone the solar light. Now, suppose we set the earth's life time of 4.6 billion years as one year, then modern science and technology, having only a 200 year life span, barely corresponds to half a second. Thus our science is so young that it needs good and tender care like a child so that it may continue growing to full maturity. In broaching these defects, we must develop a new paradigm of sciences, and interdepartmental or interdisciplinary approaches in methods and applications, building bridges amony natural sciences, social sciences, and ecosphere with humanity.

4. MODEL PROPOSAL FOR A NEW SCIENCE RESEARCH

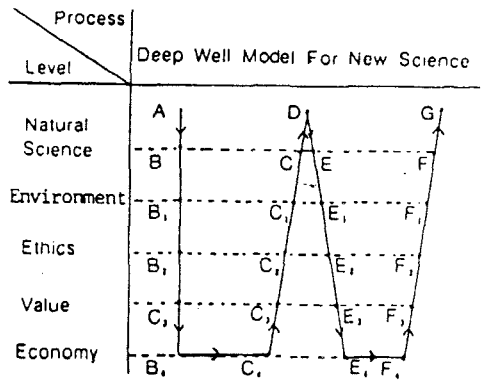
Conant [5] says "science emerges from the other progressive activities of man to the extent that new concepts arise from experiments and observations". The novelty of science by nature is self-correcting itself by experimental proof and by new data. Then facing the megatrend change of world today, there appears an urgent need to accomodate a new learning process of science research in filling the gaps between natural science and social science, between man and society, and among man, society,



A : Hypothesis
B : Literature Survey
C : Preevaluation
D : Experiment(Observation)
E : Post-evaluation (Discussion)
F : Verification
G : Conclusion

Figure 1. Model of Natural Science Research Process (Shallow Well Model)

environment, and science. I am determined to propose a new model for a new science research in adopting data submission of non-tangible factors such as environmental data, ethics, value, economical judgement into the natural scientic research process of today. In the information age, many data simulations are feasible by computors so that complexity of the research processes may be saved to certain extent. Matter of the facts, value, ethics, beauty, emotion, tradition and religions, which are very difficult to be science, constitute vital part of human life. Therefore in the proposed model, research conclusions are seldom simple, but manifold, depending upon the imput on non-tangible data even though wise judgements must follow. In dealing with the new situation, I hope, what appears metaphysical today can tomorrow become part of new science physically repeatable and verifiable. Now I have named the conventional natural science research process shown in Figure 1 as the Shallow Well Science Model, because it's shape is a shallow "W" form. In Figure 1, the traditional process of scientific research is composed of 7 steps, "Hypothesis-Literature Survey-Preevaluation-Experiment(Observation)-Post evaluation-Verification-Conclusion". In Figure 2, I propose the Deep Well Science Model in which Literature Survey, Preevaluation and Post-evaluation processes, are respectively inclusive those of natural science, ethics, value and economy and so on as far as we have a proper data to feed in.



A : Hypothesis of Natural Science
B : Literature Survey of Natural Science
B_1 : " of Environment
B_2 : " of Ethics
B_3 : " of Value
B_4 : " of Economy
C : Preevalustion of Natural Science
C_1 : " of Environment
C_2 : " of Ethics
C_3 : " of Value
C_4 : " of Economy
D : Experiment(Observation)
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E_1 : " of Environment
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E_3 : " of Value
E_4 : " of Economy
F : Verification of Natural Science
F_1 : " of Environment
F_2 : " of Ethics
F_3 : " of Value
F_4 : " of Economy
G : Conclusion of Natural Science

Figure 2. Model of New Natural Science Research (Deep Well Model)

The "deep" infers more complexity. There may frequently occurs that the science research may be hampered by social factors, ethical standard such as medical ethics, but humankind may overcome those difficulties with wisdoms and courage, as shown by history. I hope the new models of science could be an education manual for younger generations.

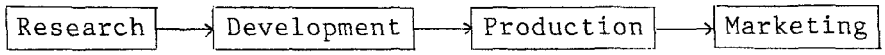
5. MODEL PROPOSAL FOR NEW TECHNOLOGY RESEARCH

Now let us examine the technologyshift. Traditional way of technology research follows a sequential process of Research-Development-Production-Marketing. It is slow and one way process, lacking coordination of interdepartments. A new way of technology research is marketing oriented, taking feedback two way systems, exchanging informations and man-power. I can introduce three new models of linear feedback, parall and ciriular technology research processes as shown in Figure 3. The new technology research processes are born for meeting new need of markets, customer's diversified wants, speedy competitions, and environmental demands. Of cource, research is motivated by needs, new ideas and competitions. Nevertheless technology research processes need a strong supporting system of financing, man-power, informations, parts, designs and so on. The supporting systems are well developed in Japan. This is a key how Japan has become the most optimum industrial nation. That is, Japan's strong industrial power are attributable to "Marketing oriented competition approaches" coupled with the strong supporting systems of financing, man-power, parts, designs and, of course, with Japanese diligence. Technologyshifts are not only limited the Research-Development processes, but changing the prerequisites for technology quality. People demand for technology no or little pollution, recycling or renewable, no resource depletion, safety, comforts and economy. After all technology must seek "High Tech and High Touch".

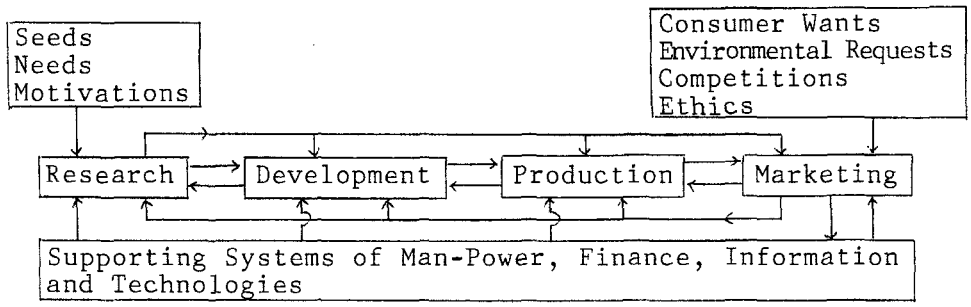
6. FUTURE AREA OF RESEARCHES RELATED

I wish to supplement further prospects of new sciences as the followings: main causes of the global environmental and energy issues are multi-phases and complex, and no one can deny the vital role played by science and technology in the modern civilization and the global adverse effects. The characterization of modern science and the scientific research procedure leads us that we have unilaterally learnt and taught the monolithic process of the science research process, which I have named the Shallow Well Model (Figure 1). In the Shallow Well Model, no one is allow to insert metaphysical terms, values, ethics and so on in the research process. No wonder now environmental and humane problems are prevailing in the

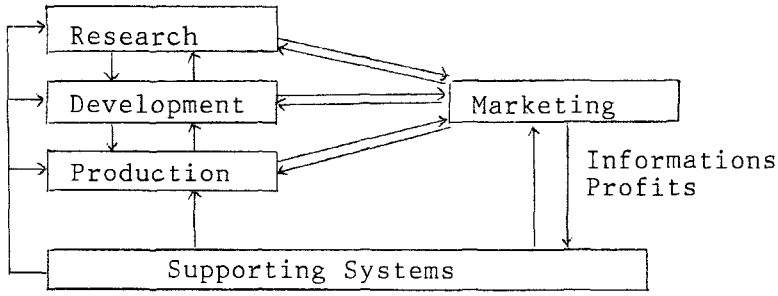
I. Traditional Linear Model of Research and Development Under Sequential Process



II. New Linear Model of Research and Development Under Feedback Process



III. Parallel Model of Research and Development Under Reciprocating Process



IV. Circular Model of Research and Development Under Feedback Process

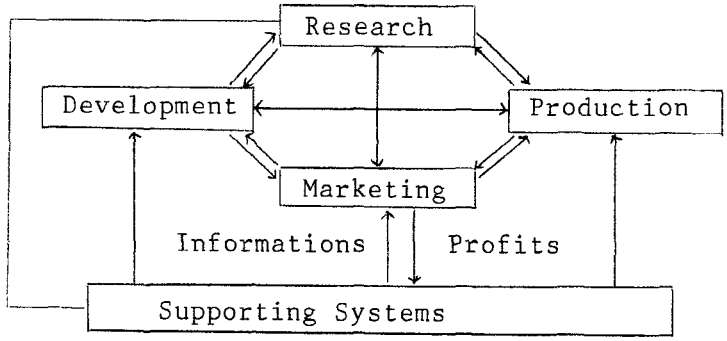


Figure 3. Models of New Research and Development Flow Sheet For Technology

modern scientific civilization. The more we continue or stick to the conventional research procedure, I am afraid, the more various environmental and other humane problems are endlessly soaring. Of course, I do not deny many merits of the conventional research process in natural science researches. What I would like to stress is the science research process should not be monolithic, but plural in accordance with needs and new global situations, as shown in Figure 2 as the Deep Well Model. In other words, from now on we have better to teach our next generations that the natural scientific research processes are multiphase and value, environmental consideration, ethics can be reflected in the natural research processes if necessary. As corollary, natural scientists in the future can be classified into two types: pure natural scientists who treat the pure natural phenomena (e.q. astronomy), and those who handle the environmental issues, social facts, and natural phenomena combined. Consequently, the latter natural science research teams can be composed of many specialists of various fields depending upon the needs and the problems chosen. The natural scientists and the leaders of the teams are required to prepare themselves with adquate knowledges on the environmental, social affairs and other related matters. The exponential growth of global population, energy consumption and accumulation of CO_2 concentration in the atmosphere, as shown in Firure 4 [6], will lead into their infinity sooner or later. That is, mathematically, we have to admit the limit of growth on our earth [7].

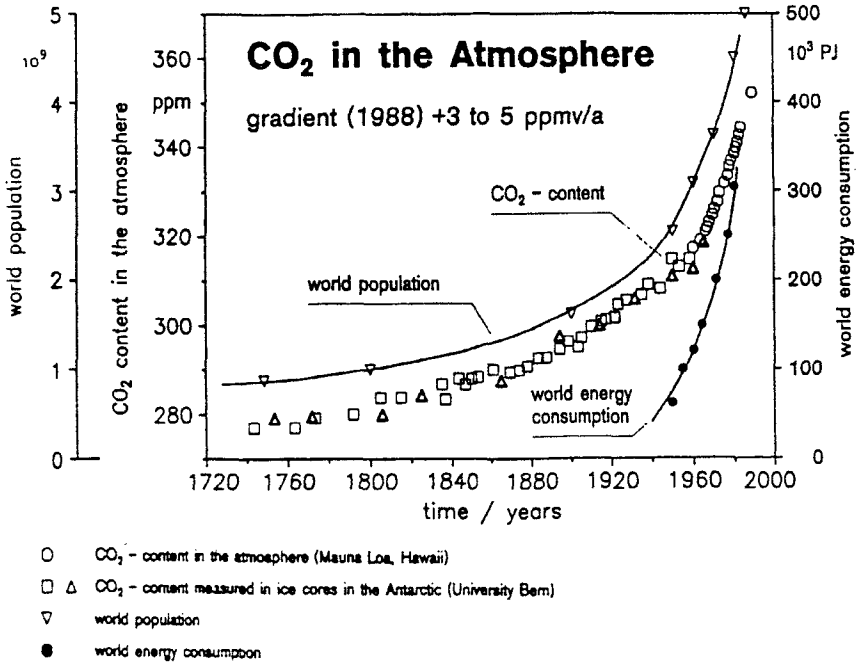


Figure 4.

Confronting such a global destruction problem, we should reexamine the validity of the conventional, random, competitive and fragmentary research and development systems in the world. Since the conventional science research systems have been founded upon the national sovereignty and business competitions, showing various advantages, the research systems appear not suitable against the global catastrophes which have no national boundaries. It is due for mankinds to have the Global (Giant) Environment Research Center under international cooperation. The CERN is an excellent example of international research cooperation in the nuclear science project. In similar way, we have to initiate as soon as possible the Global Environment Research Center or the World Environment University in order to train high quality man powers, to establish global assessments, standards for pollutants, and to explore new science and technologies with which the global destructions can be prevented. In order to support such a World Environment University project and other global research tasks, the World Environment Fund, a counterpart of the International Monetary Fund, should be established and may be administrated by the United Nations. In the forthcoming 21st Century, we certainly face numerous megashifts on many fronts of human life and environments. New challenges for science and technology will be "What can science do for humankinds and for the earth?" as well as "Which should science pursue to?". Scientists in the future will face a grave choice issues such as shown in the medical ethics and the humane problems in the Deep Well Model procedure. Now the human society are ahead of diversification of values, ethics, and powershift riding on the mega-transformation waves lucidly pointed our by Toffler and Naisbitt and Aburdene [8][9]. What one thing I would like to emphasize is the paradigm shifts [10]. Traditionally the one way causal paradigm has been applied to the deterministic phenomena. Now on, the two way causal paradigm may be considerably applied to the probablistic and relative phenomena. Using the two way causal paradign, I hope, the many megashifts phenomena in the future society may be explainable. A cofusion of the Western scientific thought with the Eastern thought may expetite development of new science [11].

7. CONCLUSION

It is an important era for us to self-examine our scientific civilization and science itself in the light of the great transition to 21st Century. We are facing sooner or later the environmental catastrophe, oil crisis, and resource depletion. Those ill-effects are unforturately caused by humankind himself who has developed incomplete science and technology within only 200 years span. It is a grave time for us to choose right direction, right value and ethics, and epecially new science of environmental harmony among man, science and technology. In 21st Century, new science and technology, perhaps holistic

paradigm may be the key-issue, looking forward to realizing coprosperity of Man and Nature.

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