

# “*Revolution in Nuclear Power Plants*”

## ---*Thorium Molten-Salt Reactor System*---

By Kazuo FURUKAWA

### Preface.

#### **A scientific attitude**

What are we seeking? Sir Karl R. Popper, scientific philosopher and post WWII leader of social democracy in northern Europe, said that philosophy must be *cosmology*. We agree. However, we understand it as *humanics* at first.

The first thing we seek is *peace*. When I was young, an Indian philosopher (then ambassador to Japan) taught me that *religion means cherishing lives*. In other words, *religion instructs us not to kill*.

First, we must eliminate warfare. It is intolerable that nuclear weapons, not used in the 56 years since Nagasaki, still exist. We take pride in our modest attempt, in the form of this book, to take up the challenge of the complete abolition of nuclear weapons, even if it is like trying to sweep the sea with a broom.

We believe that, to stop war, we should intensify tough discussions on the human level.

Second, next to *life* itself, we seek *freedom*. We want *to live as we please*. Freedom is the ultimate, unending wish. However, we ordinary people are far from the unworldly “*xianren*”. Taoist hermits seize ultimate freedom by living far from any human dwelling. By contrast, we want to be free, while enjoying civilization. *Energy* can secure *peace* and *freedom* for these people.

Food, environment in the broad sense, and time relating with the labor all depend on *energy*. We think that we are longing for *a planet* that allows the existence of *worldly xianren men and women*.

When appealing for a sufficient energy supply, we heard sharp criticism. Some worried that such a supply would spoil the earth because energy would be wasted. There is some truth in this criticism.

If something is amply supplied, will it be always wasted? For example, do we waste air, which is in ample supply? It is dangerous to breath too much because of peroxidation. Under circumstances where electricity is sufficiently supplied, something will surely happen.

However, problems can be solved, and the educational efforts for solution should become pleasures. Abundant energy is preferable to situations in which people starve and kill each other from energy shortage or the earth gradually becomes a desert.

One of the authors (K.F.) considers himself fortunate to devote forty years to the solution of this problem depending the wartime experience. He had nearly died during World War II from serious sickness and bombardment, and now have made a proposal. The world’s young scientists and engineers can put it into practice. Civilization and culture are supported by insatiable creation effort. Human endeavor and intelligence support them.

Intelligence is a scientific mind. Many people ask pessimistically “What is *science*?” We understand science as “an attitude whereby humankind try to live peacefully and freely and *to work cooperatively*”.

Buddha and Buddhism were scholarly and scientific in deep.

We think that wisdom (Buddhist: *Monju no chie*) is *science* in order to alive as human in the present context. (MONJU is the name of the highest intelligent Buddhist, a direct student of Buda, and the name of Japanese Prototype Fast Breeder Reactor, too.)

We think it is crucial to encourage the *scientific human attitude* in order to make our earth more comfortable. Without it, our energy system is a fantasy.

We were able to develop the present work because K. F. had many excellent teachers and friends. We would have been able to do nothing alone because science is a *cooperative endeavor*. The followings are K.F.'s teachers: The late Nobuji Sasaki, who impressed him most with the value of science learning; the late Eizaburo Nishibori, who most gave him courage; the late Hideo Takagi, who made me understand the coexistence of science and humankind; the late Sakae Takeuchi and the late John Desmond Bernal, the great anti-war leader, who guided me to the study of liquids; the late Alvin M. Weinberg and the staff of the ORNL, who developed the thorium molten-salt reactor and generously supported and encouraged us; the late Edward Teller and Ralph Moir also encouraged us; the late Kanichirou Kamei, who linked our study of thorium to the world; and the late Seiji Kaya, the late Kouji Husimi, the late Eiichi Takeda, the late Nobufusa Saitou, Hiroshi Yamamoto, and seikann Ishigai, who tried to make our study known to society. Cooperative studies were conducted by many Japanese and foreign researchers. I regret that there is not enough space to acknowledge them all. I would like to mention only Ritsuo Yoshioka and Koshi Mitachi.

#### **The dream** of David E. Lilienthal

The late David E. Lilienthal of the U.S. inspired my study of thorium. I translated his last book (*Atomic energy—A new start*, by Lilienthal, D., Harper & Row 1980, 124pp) into Japanese immediately after its publication.

The publication of the Japanese edition (translated into Japanese by Kazuo Furukawa, Nippon Productivity Agency, 1981) was undertaken by the late Nishibori (the manager) and the late Kouhei Gousi, the president of Nippon Productivity Agency. The book revealed Lilienthal's strong sense of social justice and passion to make nuclear energy useful to humankind. He confronted difficulties in politics, society, science and technology. These were precious lessons for us.

Lilienthal was an attorney in the field of public enterprises. His biggest achievement was the comprehensive regional development during his tenure as president of the Tennessee Valley Authority (TVA). It is ironic that this gigantic hydroelectric power project paved the way for the development of the atomic bomb through uranium enrichment. He served as the first chairman of the U.S. Atomic Energy Commission after the war until 1950. In addition, he laid the foundation for the international control of the atomic bomb and policies for the peaceful use of nuclear energy. After he opposed the development of the hydrogen bomb and retired, he served as a regional development consultant for developing countries, and devoted himself to social problems concerning the peaceful use of nuclear energy. In the meantime, he wrote this book. In January 1981, a year after its publication, he died, just as I was preparing a letter to inform him of the decision to publish his book in Japanese. When we heard that both pro- and anti-nuclear

readers favorably received this book, we were filled with a feeling of respect and awe for the noble cause to which he devoted his life.

Lilienthal's book is not merely about *nuclear power*. It is a record of deep insight, based on experience, into *the relationship between science and technology on the one hand, and society on the other*. We believe that the threshold of the 21<sup>st</sup> century is the perfect time to review Lilienthal's ideas. Let's briefly introduce descriptions related to nuclear energy.

The book states that his major aim "may lie in whatever by-product of insight it can yield into the human values and political institutions, national and international, which, before the atomic discoveries, had come to be accepted as the firm and settled conditions of life." Further, it points out that the true meaning of energy crisis is that "man's very fate has been challenged by the consequences of his own imagination and curiosity." The author continues, "Over the years I have found myself increasingly skeptical about the practical wisdom and staying power of scientists in the quite different but related area of domestic atomic energy...Events in recent years have taken the spunk out of much of the scientific community. One of my purposes in writing this account of my life with the atom is to encourage a revival of its positive, affirmative spirit."

In the early 1960s premature investment in light water reactors invited confusion. In response, Lilienthal suggests, "we need to back away from our present nuclear state in order to find a better way, a route less hazardous to human health and to the peace of the world and its very survival...And a new and perhaps younger generation of enthusiastic scientists and idea-men there will be ----- five years, ten, perhaps a generation----- to find a safe and abundant supply of energy from the atom for all the peoples of the world." He insists, "we do have the obligation to develop a nuclear energy system that is far safer, much less complex, for less developed societies and for ourselves."

We, as scientists, tried to respond to Lilienthal's exhortation to find better ways and make a NEW START. Thus, we propose this Thorium Molten-Salt Nuclear Energy Synergetic System.

As a warning on the occasion of this new start, Lilienthal says, "the ultimate decisions about atomic energy must be made not by scientists but those who in our society decide all major public issues." We quite agree with this because the fate of all members of society is at stake. Scientists are also citizens.

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