

## BIOLOGY & MEDICINE

### INTERVIEW WITH DR. SADAO HATTORI



*Dr. Hattori is the Vice President in charge of Nuclear Energy of Japan's Central Research Institute of the Electric Power Industry (CRIEPI). He directs Japan's research program on the effects of low-dose radiation, conducted at 14 universities. A 1959 graduate of Tokyo Institute of Technology with a master's degree in nuclear engineering, Hattori received his Ph.D. from the University of Tokyo with a thesis on the risk assessment of nuclear energy. He has been a guest professor at Tokyo Institute of Technology and at the Nagoya Institute of Technology, and he has held his present position at CRIEPI since 1989. Hattori was interviewed by managing editor Marjorie Mazel Hecht in April 1997, and published in 21st Century Science & Technology, Summer 1997, Vol. 10, No. 2.*

**Question:** Japan now has a unique and wide-ranging program of research into the health effects of low-dose radiation. How did the program get started?

In 1984, I came across an amazing paper on hormesis by Dr. T.D. Luckey in the December 1982 issue of the journal *Health Physics*. I sent a copy of Luckey's paper to F. Cutler and J. Taylor, the president and vice president of the Electric Power Research Institute (EPRI) in December 1984, asking them how they could explain what Luckey reported. They then decided to evaluate Luckey's paper.

In August 1985, there was a conference in San Francisco, called the Oakland meeting – the first radiation hormesis international conference. After this conference, EPRI answered my letter, saying that Luckey's paper was interesting and scientifically accurate – but not the full story. EPRI decided to fund some research activities on this at the University of California at Los Angeles, UCLA, under Professor Mackinodan. EPRI asked him in 1986 to do some tests to confirm radiation hormesis.

Meanwhile, in Japan, we formed a group to study the hormesis papers cited by Luckey, checking the data with specialists. After a few years of study, we initiated our radiation research program in 1988. We formed a committee, including many university professors, and specialists in the medical and biological fields. We then decided to perform some animal tests, which began in 1989. This stimulated many people in the concerned fields in Japan. Many specialists were interested in this, and they asked me to do some research. Gradually, after being asked by many, many people, I was obliged to expand my activities, based on this interest. Our program expanded, so that now we work with 14 universities on medical activities.

Question: What are the dimensions of your budget for this research?

Well, I have to explain how Japanese universities work. The universities are mainly funded by the government, and medical research is funded by the Health Ministry. There is much active medical research ongoing, some privately funded. So, all I had to do is to add some small amount to the ongoing programs where researchers agreed to do some radiation hormesis research. For example, one professor in one university might be working with several people in a project already; so I would pay perhaps \$10,000 or \$20,000 for the hormesis research.

Question: Because the research institution was already supported.

Yes, completely. Salaries, the facilities, the equipment – I didn't need to pay for that. So it was quite easy to work with the universities. However, our budget has become larger recently; it's now about \$700,000 yearly.

Question: What are the main areas you are investigating?

There are three major areas. Number one is the immune system, immune stimulation to suppress cancer, work with the tumor suppression gene p53. This is an exciting field

stimulated by Professor Sakamoto, who is doing cancer therapy in a hospital, and Professor Onishi, who is doing the p53 research. The second area is rejuvenation, or vitalization of the bodies of mammals by low-level radiation. For example, vitalization of the essential activities such as membrane permeability of brain cells; suppression of diabetes; SOD or super-oxide dismutase, which suppresses oxidation of cell tissues by free radicals, so we can keep ourselves young; and the important activity of sodium-potassium pumping through cell membranes, the in-and-out movements, which can be driven by Na<sup>+</sup>K<sup>+</sup>ATPase (an enzyme essential for cell activities). This work is mainly done by Dr. Yamaoka of our institute. He is working with many professors of many universities now. And, additionally, Professor Yamada is interested in the modulation of psychological stress, mental stress – how you can keep high tension down using low-level radiation. This also, we understand, comes under rejuvenation or vitalization. The third area is adaptive response. Now, the United Nations Scientific committee on the Effects of Atomic Radiation (UNSCEAR) admitted that low-level radiation stimulated DNA repair activity, and if the damage is too severe, apoptosis activities are stimulated. This is a very interesting field now in nuclear medicine.

Question: So, these are the three major areas of research at the 14 universities.

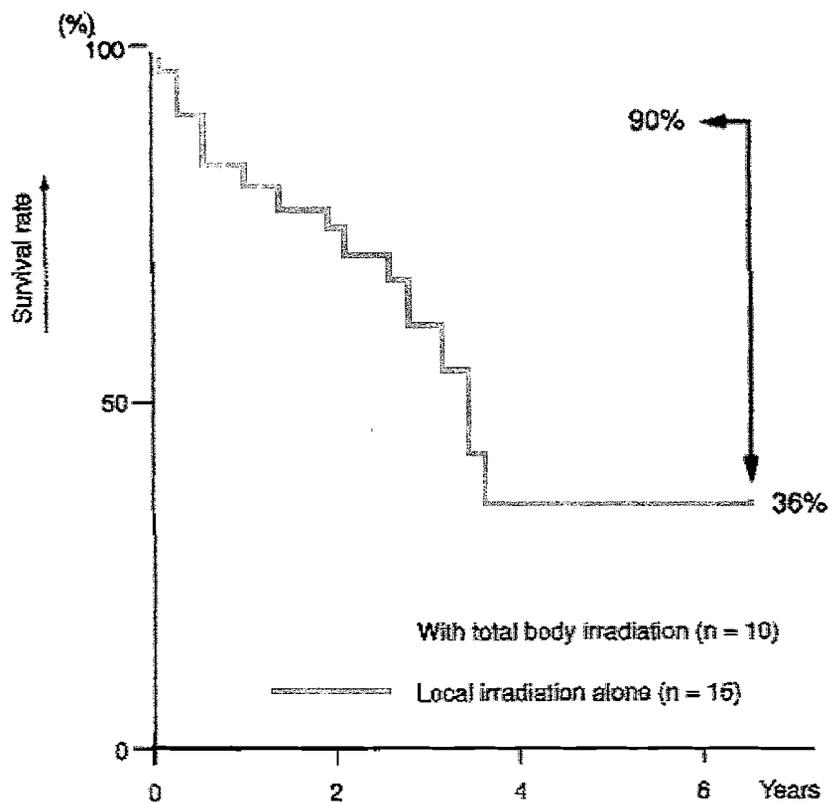
Yes, and there are some other universities now asking to join our research program.

Question: What are the most important results you have seen over the past decade?

Most important, I think, are Professor Sakamoto's amazing results for human cancer suppression, treating lymphoma patients, and also saving the lives of people with liver cancer. It was amazing. However, this radiation effect may be effective only with certain persons, depending on certain biological characteristics. They have found this by analyzing the immune system response of many patients.

I also think that Professor Yamaoka's results with rejuvenation are amazing. If you look

at the many natural radon springs around the world, such as Bad Gastein in Austria, however, they are applying only a primitive state of radiation treatment. By doing some research and analyzing the optimum exposure, we could produce further excellent effects. We have to find the optimum exposure to revitalize people.



**Figure 1**  
**SURVIVAL RATES OF NON-HODGKINS LYMPHOMA PATIENTS WITH AND WITHOUT TOTAL BODY IRRADIATION**

Lymphoma patients who were given a total body irradiation of 10 centigray by X-ray, three times a week, in addition to the standard local high dose irradiation treatment, had a 90 percent 6-year survival rate. The control group, which received only the local high-dose treatment, had a 36 percent 6 year survival rate. **Source: Dr. K. Sakamoto, Tohoku University**

Question: There are also data from experiments to control diabetes and hypertension using just one low-dose treatment a month. Has this work and the rejuvenation work been done only with rats and mice and other animals, or have you begun work with human beings?

No, no. Just animals. I really wish to begin so, but it is impossible under this social common sense formulated by the ICRP (International Commission on Radiological Protection).

## Figure 2

**Question:** And what about the cancer treatment? Given the success at treating human lymphoma patients with total body low-level radiation, are there plans to establish this as a standard course of treatment in Japan?

No. Let me explain why. Japan is strictly following the ICRP regulations and recommendations. The Japanese government decided to strictly control Japanese society - they do not allow or permit human experimentation with radiation. This is an ICRP-regulated country.

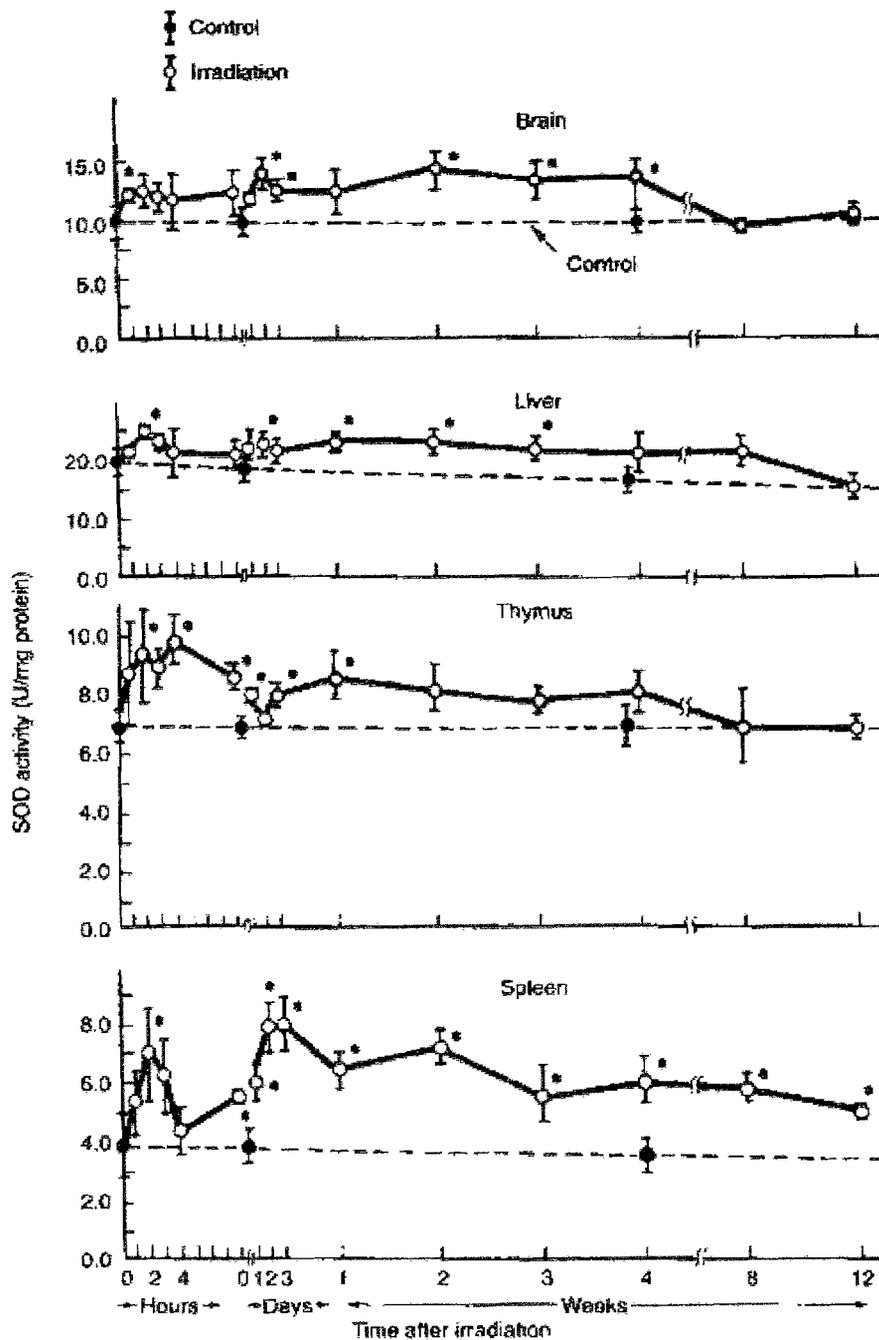


Figure 3

CHANGES IN SOD ACTIVITY IN THE ORGANS OF RATS OVER TIME, AFTER LOW-DOSE IRRADIATION

Low dose (0.25 gray) irradiation fostered an increase in SOD (superoxide dismutase) activities, which suppress oxidation of cell tissues by free radicals, in various rat organs. The effects of one irradiation continued for up to 8 to 12 weeks.

**Source: Dr. K. Yamaoka, CRIEPI**

**Question:** So, how did you treat the lymphoma and liver cancer patients? Were these exceptions?

Professor Sakamoto explained to these patients, who were all in the hopeless category, that there were no further medical methods which could save them, but that he thought the radiation might help. These patients then were eager to be included in the experiments with radiation. Sakamoto had to find the private funds to do this. There was no government support, nor support from the hospital. He had to use private money to save these patients.

**Question:** But given the results, which are really astounding in terms of the increase in longevity—

Amazing, but regulations are regulations; they are not life-saving. It's very cruel. Professor Sakamoto is almost mad about it.

**Question:** Well, what can be done?

We need worldwide activity to change the law. The ICRP controls all the activities in Japan. It's impossible to make exceptions to save human lives. Regulations are regulations. I think this is a terrible situation. I hope to extend these programs to human beings, but it is impossible today—

**Question:** Given the current ICRP regulations—

Yes, and the public perception shaped by the ICRP regulations. The Japanese people are ignorant about this. They think radiation is terrible.

**Question:** Here in the United States we also don't do these experiments, but there is a procedure for establishing experimental protocols with new treatments for cancer, for example, especially with people for whom there is no other hope.

It is the same in Japan, but these are special cases.

**Question:** Most people are startled to learn that the survivors of Hiroshima and Nagasaki who had low exposure to nuclear radiation are living longer than those in the Japanese population who had no radiation exposure. How do you explain this?

These are very exciting data, but very difficult to explain. Professor Sohei Kondo, a very famous professor in Japan and a most excellent analytical researcher, even he himself cannot explain to me why this is the case. It is very difficult to explain. For example, we have many animal

experiments with radiation hormesis: We apply a certain dose – for example 10 centigray, or 15 centigray. However, that kind of wonderful, positive effect with animal odes not remain throughout their lifetime.

For example, Dr. Yamaoka found that these positive effects could be kept for two months or so, but they cannot confirm or understand how the effects could remain throughout one's life, with only one exposure, as these survivors experienced.

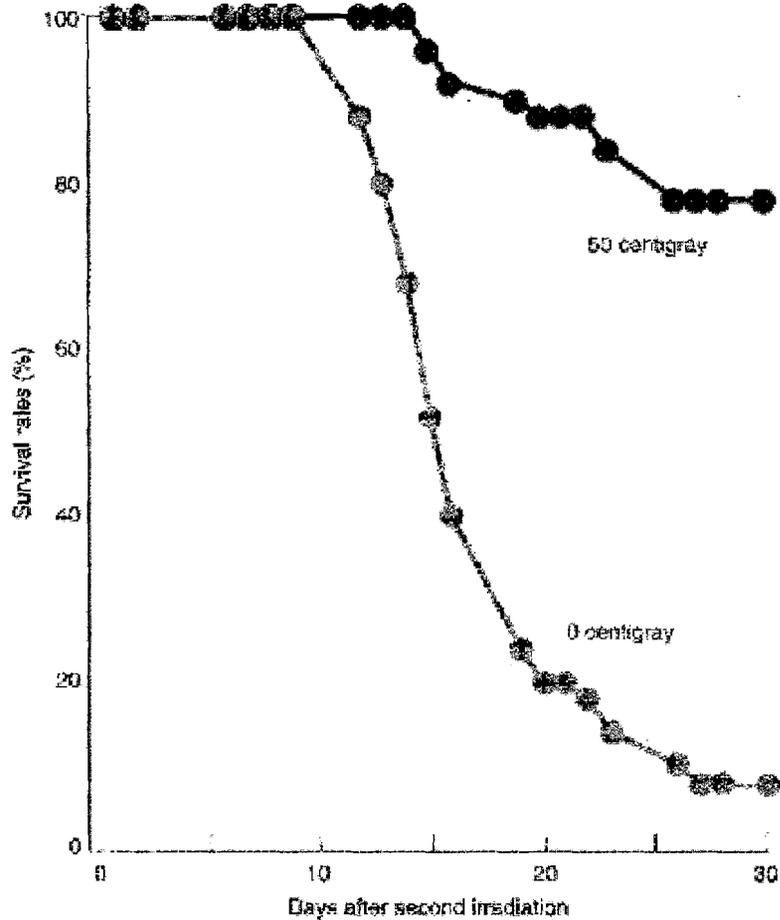


Figure 4

**PROTECTIVE EFFECT OF LOW-DOSE IRRADIATION FOR MICE WHO THEN RECEIVE A HIGH-DOSE IRRADIATION**

Mice irradiated with a low-dose (50 centigray) two weeks before a second, high-dose irradiation (7.4 gray), had a much better survival rates (top line) than the control group, which did not receive the low-dose irradiation.

Source: Prof. Yonazawa, Osaka Prefecture University and Mr. Misonah; CRIEPI

Question: So with the animal experiments, the protective effect of the radiation also requires periodical exposures?

Yes, the results in animals do not remain for so many years. So, this result in the Hiroshima and Nagasaki survivors has to be a subject for further research.

Question: Could it be the age of the people when they were exposed?

Yes. It may be age dependent, but there are many complicates issues to be analyzed. I cannot now explain why there is such a beneficial effect all through their lives, with only one exposure.

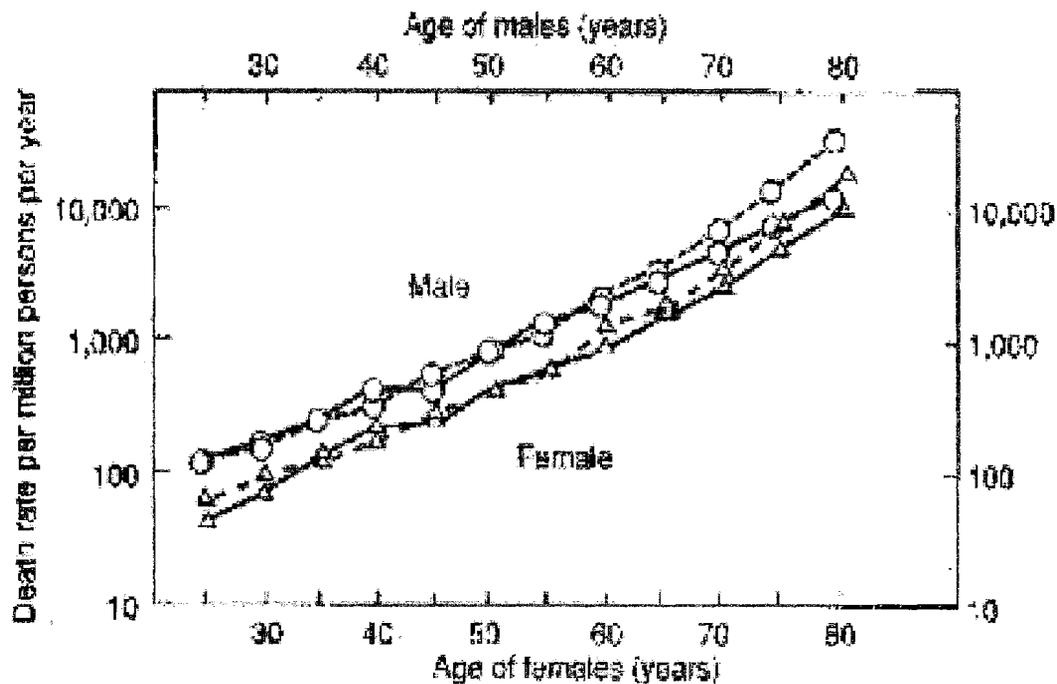


Figure 5

#### LIFESPAN OF ATOMIC-BOMB SURVIVORS

Residents of Nagasaki who were not exposed to the atomic bomb radiation have higher death rates after age 55, than those who were exposed. The dotted line is the non-exposed population; the solid line is the exposed population. Source: Mine et al., 1981, « The Current Mortality Rates of A-Bomb Survivors in Nagasaki City,» Japan Journal of Public Health, Vol. 28, pp. 337-342.

Question: How do you account for some of the results you are seeing? What do you think is going on at the cell level? Are there different hypotheses as to what is going on?

I'll try to explain this simply. Ionizing radiation enters the cell and makes ions, electrons, and elevates the state of oxygen, and elevates the state of electron circulation around the atom. It makes a chemically active situation, even with water molecules. Hydrogen, oxygen, and other molecules and proteins are influenced by this activity.

Now, all cells hope to make some enzyme proteins and are waiting for certain stimulations in order to do so. So the radiation stimulates the production of these good enzymes. All cell activities want to go in beneficial direction for the body; that is the fundamental intention. So the radiation stimulation creates all sort of good activities: gene formulation, gene repairs, and apoptosis if it is needed. Everything can be explained by this stimulation. There is also some overlap stimulation helped by some other stimulation such as heat shock.

I'm not a specialist in the medical field, but I think this is an easy way to look at this.

Question: So it stimulates the normal reactions.

Yes, making electrons, ions, and excited states of atoms, good chemical reactions in a beneficial direction. You can formulate some helpful enzymes and proteins to go in better directions.

Question: There is now an international campaign to change the standards for radiation exposure away from their linear, no-threshold basis to standards that reflect the reality of hormesis effect. Can you comment on this?

It think this is a wonderful activity, for human beings around the world, to save mankind. Not only is nuclear energy needed as clean energy, but also we need the use of radiation to save many lives of people, vitalizing people who are sick. We could have so many health centers that would be applying low-level radiation, even in the kind of protocols you mentioned. But now these things are completely prohibited by the ICRP influence. We have to change the law to save people.

Question: I think that changing the radiation standards would help to do that, because now when you say "radiation", you get a negative reaction, and that's what also has to change.

Yes, it is a complete misunderstanding.

Question: To your knowledge, is similar research going on in other countries?

I have just a little knowledge about this. In northeast China, in Canchung Norman-Bethune Medical University, Dr. Liu is conducting radiation research activities. He established a radiation hormesis institute several years ago. He is eagerly doing experiments, especially on the immune system stimulation.

In Russia, in some universities, they are doing a little research, but without enough money. Also in Canada. And in France, there is very old information from 1940; France originated radiation stimulation for life vitalization. In the United Kingdom, Professor Potten at Manchester

University has emphasized very low level radiation stimulation to produce good apoptosis activities to keep the small intestine well.

Question: But I think that the Japanese program is the largest in the world. What directions would you like the Japanese program to take in the next decade?

I think I have to look for some individual to set up a foundation, not just CRIEPI – our institute is not enough. Our president, Mr. Yoda, recently suggested to me that we need to ask certain individual to form a large research foundation for radiation hormesis, to save people. We have to explain to people the necessity for this and the true story of radiation hormesis to save many people. CRIEPI is not a research institute with a mission to save mankind. It's an electric power institute of which nuclear is just one division; hormesis is a very small part of this division, and thus limited.

Many people are now interested in this, but with the ICRP and government controls, they are hesitating. So, it's not easy now...

As you commented, we need low-level radiation as a standard course of treatment in Japan, to save people's lives. But everything is controlled by the ICRP and its influence on the public.

Question: What would you suggest for the United States?

Well, every kind of innovative activity to change the world and such old-fashioned laws, all kinds of such activities in recent scientific history, have been done in the United States. So, I ask you, the people of the United States, to please save mankind.

Question: We have a big job to do, to get the United States to be interested in this. I think it's well worth making the effort. Maybe it can be a joint effort, with Japan and with other countries that have done this research, like China, as well.

In 20 years, China might be the leading country in the world.

Question: And the United States has to wake up...

Yes, you have to wake up your country.

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