TANSEI

The University of Tokyo Magazine

TANSEI aims at sharing worldwide the latest developments at UT with everyone interested in education and research.

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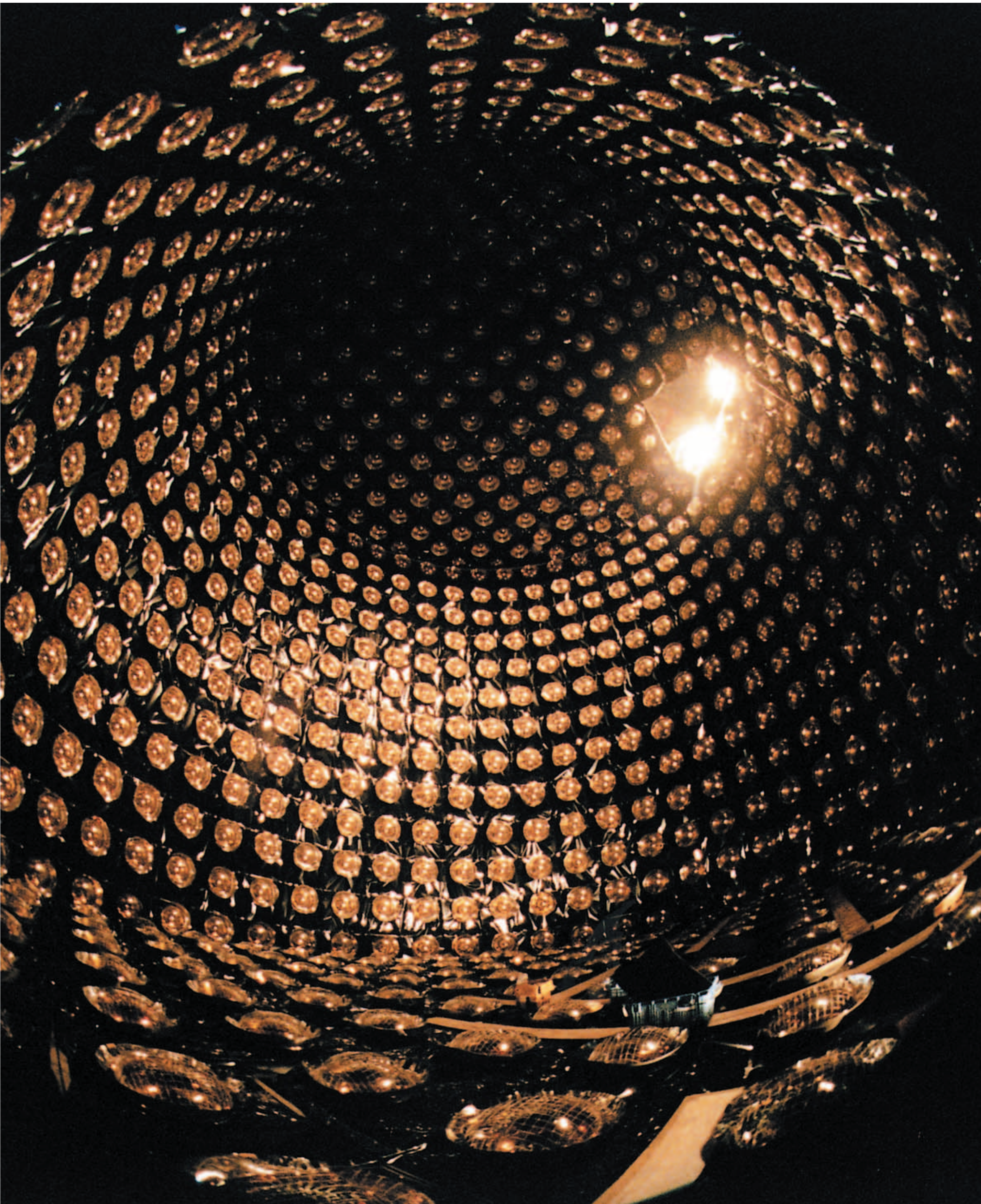

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TANSEI-The school color of the University of Tokyo is light blue (tansei in Japanese). It was initially used at the first rowing regatta between the University of Tokyo and Kyoto University in 1920. The colors of the two universities were determined by drawing lots. Kyoto University drew dark blue and the University of Tokyo light blue. Since then, light blue has been the school color of the University of Tokyo.

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Greeting from the Editor

On behalf of the Committee on Public Relations, I am delighted to bring you this third issue of TANSEI. Our official university magazin 淡青 , pronounced tansei (which in Japanese means "light blue", our school color) is published three times a year in Japanese and once in English. This English issue of TANSEI is therefore a digest of its Japanese counterparts. We hope it will provide you with information to interest and inspire you about the activities that are underway in this university, which is simultaneously the oldest and the most modern in Japan.

National universities in Japan are now facing a dramatic change in their management system, which is scheduled to be implemented about a year from now. The new role of our university in the local and global societies is a major issue that is currently under serious discussion. Some hints on this question are evident in the dialog between Dr. Colin Lucas (Vice-Chancellor, University of Oxford) and the University of Tokyo President Sasaki that is featured in this issue. You may also learn about some of the scientific achievements of Professor Koshiba (Professor Emeritus in physics), who was awarded the Nobel Prize in 2002.

Finally, a friend of mine included a few words in a recent letter that struck me deeply. "Yesterday is a history, tomorrow is a mystery, and today is just a gift: that is why it is called the present". Despite the fact that we possess the longest history of any of our nation's universities and colleges, we do not yet know where this university is going. It would therefore be wonderful if you could take a little time with us, now in the present moment, to think about our university together.

Yuji MORI, DVM, Ph.D.
Director, Committee on Public Relations

The Role of Universities and the Demands of Society

Evaluation of University Research and Teaching

Presidents' Discussion

Colin R. LUCAS, Vice-Chancellor, University of Oxford
Takeshi SASAKI, President, the University of Tokyo

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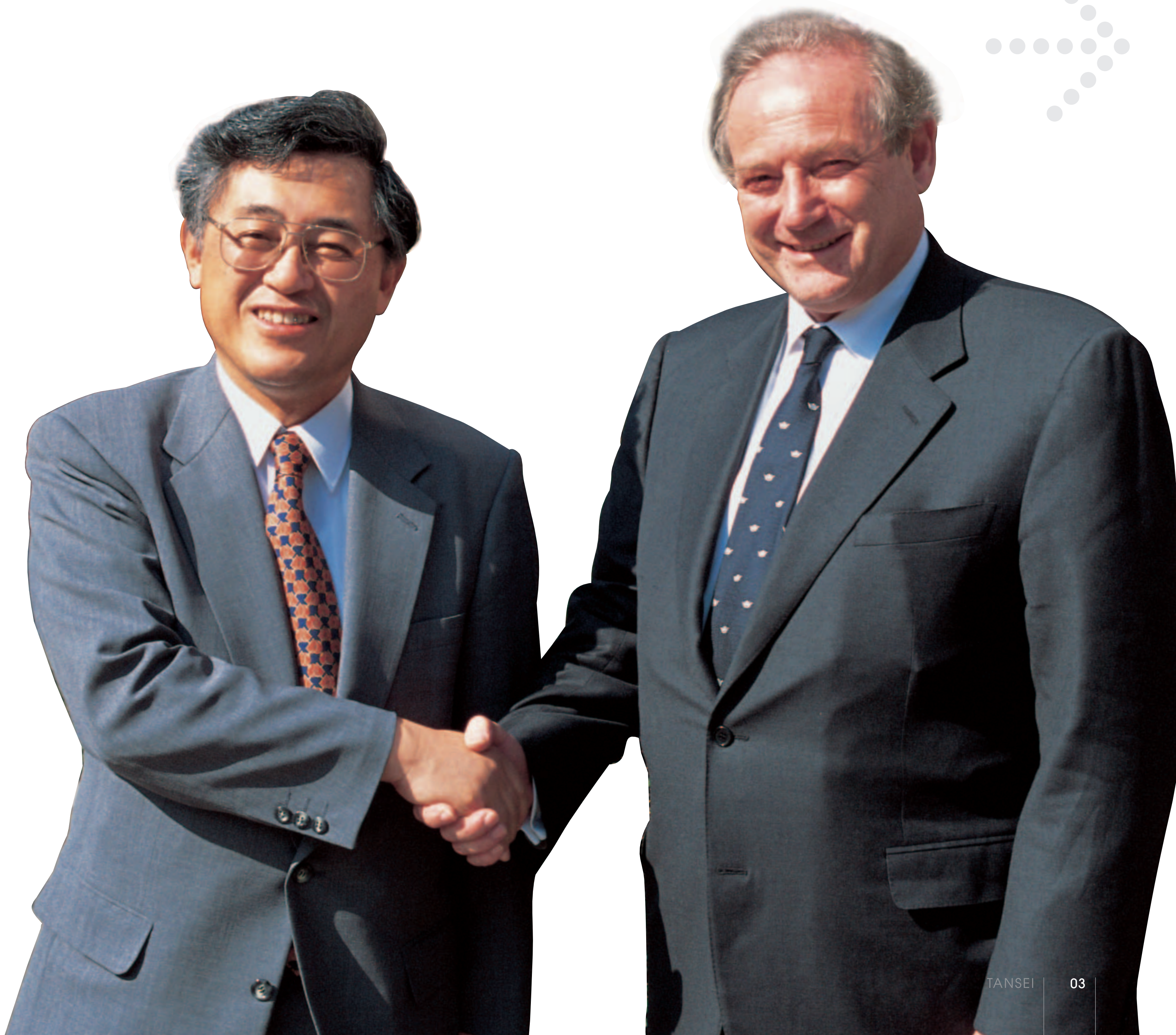
In recent years, much has come to be required of universities in terms of making a positive contribution to the development of society through new intellectual discoveries. At the same time, increasing emphasis is being placed on an evaluation of universities that can offer guidelines for the development of research and teaching activities.

The University of Tokyo welcomed Professor Colin R. Lucas, Vice-Chancellor, University of Oxford, to a dialogue with President Takeshi Sasaki, the University of Tokyo. They discussed collaboration between universities and industry, as well as the appropriate nature of university evaluations, with a focus on the situation in Japan and England.



01

The basic mechanism for collaboration between industry and universities

(Sasaki) I would like to discuss two issues today. The first issue is the contemporary relationship between the university and the social requirement to revitalize the economy or economic competitiveness. Our university has been pushed to take the initiative in this field. That means making a greater contribution to economic recovery.

The government has asked universities to set up a very large number of new companies. This seems to be quite a common policy in several countries. My first question is that while there are several aspects to these problems, at your university, what kind of scheme have you set up for dealing with this kind of collaboration between industry and the academic world? What is your basic scheme?

(Lucas) I think that it happens on a quite number of different levels. For a long time, we have done consultancy for businesses, for companies, and for industry. We've done industrial research projects for them. Individual professors have given advice to the industry on problems. That's a very long-standing relationship.

On the whole, since we are a university, we have always been more interested in issues of pure research rather than development. I think the first thing one ought to say is that there really is a difference between research and development. I think universities ought to do research, but not to do development. Companies ought to do the development aspects of the research, which we discover. That's the first level.

The second level is that we have now asserted the intellectual property of all inventions and discoveries made in our laboratories so that we own the rights on all new discoveries. That's very important because there's no reason at all why universities should not benefit from the work that is done in the facilities that they provide.

The third level is that we then have developed a mechanism for sharing the income from the rights that we have. We divide it in three ways. Some goes to the professor who invents the discovery, some to the department in which the discovery takes place, and some to the university. The proportions may vary according to the type of discovery. Firstly, it's very important that the inventor should be well rewarded because it is his work. Secondly, we think it is important that the department should be rewarded because the department is the context in which the professor and the team are working. Thirdly, it is very important that university should be rewarded in order to encourage it. Those are the three parts of it.

Now there are two further elements that go along with this in order to bring it into the economy. As the first element, we have developed two instruments to do this.

The first instrument is an office in the university. It's a part of my office, which is called the Research Services Office, and this is responsible for licensing, for patent filing, and for contracts for research. It's important for us that we have a very skilled service because these are very complicated issues. It is rare that an invention is just by itself; many other things go round it. It's very important that we are legally skilled and that we have a clear sense of what the law is both in our own country and elsewhere where these things are applied.

The second instrument we've developed is a technology arm. We call it Isis Innovation. Isis is the name of the river in Oxford. It is a company owned by us and its job is to talk with professors and with research groups, to identify inventions or research that can be developed in an industrial way, and then to file the patents, to help them set up a new company, then to help them to begin.

The final part of this is, OK, you've got an invention, you've got a discovery, you've got an idea about how it may develop, and you can set up a company, that is very easy, you just file a patent and then set up a company. But then, you need two things as the second element. Firstly, you need money and you need a place to develop the work. The company has to have money, so we have developed a network of venture capitalists who are particularly interested in what we do, and we bring them in.

Secondly, we have developed science parks. We have two. We have one, which is for very early beginnings, so the little company can get room in there, it can begin to develop. Then we have a second one which for when they get bigger. We have what is called an incubator unit, and when they've grown a bit, we transfer them onto the other, and when they've become really quite big, then they have to move out and find their own feet.

The process is that we own the intellectual property, we give shares and income to various parts including inventor, we provide a service to help our professors file a patent, we provide service which helps our professors to get capital to begin with, to get these new companies under way, we provide a place for them to begin, we provide a place for them to develop, and when they are successful, they grow up, they get quoted on the stock exchange, and shares are issued. We retain part of the capital, so we have shares in the company as part of our return on it. Then, as the companies become successful, we may sell the shares or help our income. It's good for us and it's good for the country. So we are spinning out. We are moving our inventions from our laboratories out into the economy.

But the difficult passage is at the early stage when an invention isn't ready yet to be on the market. We have to look after these little starting companies very carefully. We have to do that because the big shareholders aren't interested yet in very small companies. I think there are three dangers, which we have to be aware of.

One is that, not all inventions, not all discoveries actually are appropriate to go out like this. There are colleagues who think they are when they aren't and get anxious or upset if you don't support them.

The second danger is that you have to be very careful about losing your colleagues out into industry because they may think that they will earn more by going out, and it's very difficult to replace a good professor fast. To grow your scientist takes about fifteen years, so we have to be very careful about keeping our professors in the university for that it is important to reward them. It is also very important not to let professors run these companies. Professors, not always, but usually are not very good at business. They often they think they are, but they aren't. If you want as a university to benefit from these companies, you must put in a businessman to run it.

The third danger is to think that your university is going to become very rich because of its shares in these companies. Maybe you will, but don't count on it. You know, my university did much of the work on penicillin. We didn't take any intellectual property rights on it. If we had, we would be very, very rich.

We have a lot of companies now. Maybe one of them will be like penicillin, but you shouldn't count on it.

So, we know how to move our discoveries out into the economy. As a university, the more cost you take, the greater your income will be because your share in the new company will be diluted every time shares are put on the market. As more investment comes in to grow the company, your share will contract. So the more of the cost you take, the more of the benefit you'll get.

However, a university can't afford to take much cost. That's another reason for not thinking you'll get very rich. We have about 3% only of the value of the companies that has grown. So, at the moment in Oxford, we file a patent every week and we found a company every six weeks.

02

Collaboration with industry by teaching staff

(Sasaki) In our situation, following a part of your scheme, from this April we are intending to set up the instrument you just referred to as the first instrument, the special office to take care of legal and intellectual property issues. That is the same in our case. We are under strong legal restrictions, because our commitment to private interest has been prohibited by law. What our professors can do has therefore been strictly regulated. Of course, the government is attempting to deregulate some areas, but their policy changes very quickly. We have to provide our professors with a clear vision: what can be done, and what should not be done.

We are still at a very early stage compared with you, but my question is about professors; how far are they free to get involved in these kinds of venture capital activities? Do you have any fixed agreement between professors and the university or colleges? What kind of rules do the professors have to follow?

(Lucas) In our contracts with professors and employments, we allow professors thirty days a year for their own work, for consulting. American universities would classically allow between fifty and sixty days. We only allow thirty days.

We do not control how much money they can earn. That's their business. They must earn legally. They must pay the taxes on it, but they must not exceed thirty days work on consultancy.

We do not allow our professors to have another employer. They cannot have a contract of employment with any other employer. They are employed by us, not by others. They can have contract of consultancy to give advice, but they cannot be employed in a sense of having another full or part-time employer. We, therefore, think that our professors ought, as part of our missions as a university, to be of service to our society. We think our professors ought to give advice to industry, to government, to defense forces, to any of the organizations of society. That's important, but we don't want them to spend a lot of their time doing that. If a professor wants to follow his invention out into the company, provided that they can be a research director for thirty days a year. That's all right. But if they want to spend more time, then they have to choose between being employed by their company, or being employed by us. Mostly they prefer to stay with us because they are much freer with us. They are free to follow their science or their economics, whatever the subject they do. Their employment is protected. They are safer, more secure with us and they have a more interesting life with us. I think that many people don't realize how working in an industrial context. A business context is much less free than working in a university.

(Sasaki) I can certainly understand that. At the same time, a university does not consist only of professors, but also of many other people who support their laboratories. What kind of obligation do these kinds of people have in relation to the universities? Are they freer?

(Lucas) One of the things that our research service office does is to establish exactly who has done what within the group. Most of the science inventions are done by groups. We inquire very carefully who are the people who really worked on the developing idea. We ensure that the benefit is divided up between those people.

We see that is our job. We don't just say to the professor, "Well, tell us who did it." We want to make sure that everybody who has a legal entitlement to be recognized is recognized.

03

Rules for protecting intellectual property

(Sasaki) Another issue we are now discussing is rules within the university, because many people are now coming

Sir Colin R. LUCAS

Sir Colin R. Lucas was born in 1940. He graduated from Lincoln College at University of Oxford, where he went on to earn his Ph.D. He became a Fellow of the Royal Historical Society in 1974.
Dr. Lucas' academic career began Lecturer at the University of Sheffield from 1965 to 1969, after which he served as Assistant Professor at Indiana University from 1969 to 1970, and Lecturer at the University of Manchester from 1970 to 1973. He returned to Oxford in 1973 as Fellow and Tutor in Modern History at Balliol College, before moving to the University of Chicago as Professor of History in 1990. In 1994 he became Master of Balliol College, Oxford, a position he held for six years. He has been Vice-Chancellor of University of Oxford since 1997. In 2002, he received a knighthood.

into the university from outside. What kind of rules should be established in the laboratory? For example, in bioscience, they can quite easily move the experiment from one place to another. This is a typical issue concerning the rules among researchers: how to protect an intellectual finding discovered by other people or their materials? How far should it be protected within the campus? Otherwise, people coming from outside can simply pick up the results and go back to another country. This is a very delicate issue, because it concerns everyday activity within the campus. Have you had any discussion on these matters?

(Lucas) Well, I think that there are always potential for a mistake or for dishonesty. I think that in our case there are two major safeguards.

The first is that most of the work is done on the basis of finance, from the research counsels in our case, from major agencies of government.

For every grant, you have to make an application, which is, of course, very detailed. Our first safeguard is that we know, who are the members of the team, which have worked on this grant application, received the grant and for doing what.

The second safeguard is that we say to our people, "If you want to be recognized as the authors of this invention, you could take one of two roots. You could either publish, which is the classic scientific way of asserting your invention, but if you publish, it becomes in the public domain. Or you patent, you file a patent." That is the largest amount of business that our company, Isis Innovation does. That's the first thing you do. Scientists who are very competitive, fighting to be recognized as the author of an idea, rush to print, and move very fast. They get their idea published in "Nature" or whatever it is within a month. You could do that with a patent. We take the cost of filing patents on the university budget. We have a patent agent and we can file patents very quickly. Also we will pay the cost of the patents for the first year, which is quite cheap. The question comes whether it's worth renewing the patent in the second year, which is much more expensive.

We don't renew a number of our patents because it is clear that they're not going to develop. By filing a patent, however, you give yourself one year, in which to explore whether this idea has got any future. And then, if we think it does, we would probably pay the second year, but we don't pay the third year. You have to set your company up within two years.

But there is, of course, internationally quite a debate about the whole issue of intellectual property of patenting. It is a debate, particularly in America, it is not in England, there is quite a strong debate about whether science can become the property of universities or individuals, whether what universities ought to do is to put it all into the public domain.

I think it's a very difficult argument to find a conclusion because it does seem to me that it is fundamentally true that science has no nationality; inventions and discoveries are for all humankind and the traditional method of publishing results is the culture of science in universities, I think that's true.

On the other hand, I think it is naive

Takeshi SASAKI

Professor Takeshi Sasaki was born in 1942. He graduated from the Faculty of Law of the University of Tokyo in 1965 and received his Ph.D. degree from there in 1973. He joined the University of Tokyo in 1968 as Associate Professor in the Faculty of Law and was promoted to Professor in 1978. He served as a member of the Senate from 1990 to 1992, dean at the Graduate School of Law and Politics from 1998 to 2000, and took office as the twenty-seventh president of the University of Tokyo in April 2001.

to believe that if you don't assert your property, you are, in fact, helping humanity because all that happens is, that a pharmaceutical company will take this idea from the journal and make a lot of money out of it. So it seems to me it would be better for the universities to own it because the universities can then control, and scientist can control, who uses it and for what purpose. There is no reason at all why a pharmaceutical company should make very large sums of money out of selling drugs at a high price to countries which are poor. It is much better for universities to own that right and to decide what sort of price it is going to bear. I think that on this point we are right to do what we are doing. But as I say, it's not without controversy.

04

Government support for collaboration between industry and the academic world

(Sasaki) By the way, I would like to know if it is policy in your country to expect that universities should contribute to economic vitality. How strongly is this kind of policy supported? What kind of results has it brought about? Please give us your overview of both expectations and results.

(Lucas) I think that's an interesting question. It is certainly the case that from about 1996 the British Government decided that university research was going to be a great benefit to the economy. I think that's not true, since the new globalized knowledge economy is essentially served by innovation and new ideas. You see this policy being developed in most major countries now. That's the first point.

I think that governments are very shortsighted if they think that it is enough just to tell universities to do this. It's clear that there is a great potential in universities, but it is also clear that it is very expensive. The cost of translating laboratory work into the economy is a high cost.

The system we've developed, as I was describing it to you, takes it a certain distance. We bear that expense, but we can't afford to take it much further. Development is a very expensive operation. You need big companies to come in and do it. You need big investments. Particularly, second stage and third stage development is very high cost.

The second cost here is that you can't make great discoveries nowadays in poor laboratories. Not so long ago, you could invent something like penicillin by accident in a laboratory. But most of the new science is not done by accident. You think of the computing power that it took to sequence the genome. It's very expensive. Modern bioscience after the human genome is going to be very costly. So the good thing that the government has done in the United Kingdom is that they have invested a lot of money in infrastructure, in putting money in to build new laboratories and putting money in to provide new equipments. That is essential. No university can afford to do that nowadays by itself. Universities can collaborate. They can join up to do particular projects. But still cost of a large machine such as a Nuclear Magnetic Resonance machine, which is a fairly simple machine, is very high. If you've got to put a dozen sequencers into a laboratory, that's a big expense. And we know that all the sciences are developing very rapidly. So the depreciation of equipment is very short. You know that your computers are out of date within three years.

It's not enough to say to universities, "You must support the economy." You have to invest in them. Otherwise, they won't be able to do it. I think that industry also has got to come into universities and to invest in universities. I don't think industry can just sit out there, waiting for us to push innovation towards them. They've got to come and help.

So far, that's in support of the idea that you can develop the economy from universities. But I think there are great limitations as well. I think that, first of all, the idea that the university is a great volcano of innovation is based on not very clear thinking. I think that many governments, certainly, my government, have looked at the United States of America. They have seen Silicon Valley in California. They have seen the Boston area. They've seen MIT. They've seen Stanford. And they've said, "Ah, there's the solution."

But if you go to Stanford and talk to academics there, they say, "Ah, we made Silicon Valley. We are the source of innovation, it is our departments." If you go to talk to the companies in Silicon

Valley, they will say, "We made Stanford what it is." So, who is at the origin, Stanford or Hewlett-Packard? The answer is neither; it's a very complicated business. It comes from having a good university. It comes from having entrepreneurs. It comes from having people willing to invest money, risk capital. It comes from having specialist legal services. It comes from having a nice climate, maybe, good schools. Entrepreneurs don't want to come and settle where the children can't be well educated. So it's a very complex phenomenon. That's the first limitation.

The second limitation is that universities have to be very careful about not putting too great an emphasis on this relation with the economy. If we go back to the image of universities as a sort of volcano of innovations spewing out great amounts of red-hot knowledge, you've got to have underneath the volcano new knowledge being created all the time. If you say, "Well, we're going to concentrate only on developing technology that's applied", what's going to happen to your pure science? I don't know of any idea that appeared out of nothing.

People have brilliant new ideas. But then somewhere they are rooted in earlier ideas. And a university can't afford to lose all its scientists. It can't afford not to have pure innovation because without it, you will not have applied science. You have to have both.

The third limitation is, I think that really universities are not essentially a part of the economy. That's not what they are for. If you think universities are only there to drive the economy, what you'll end up with is a rather small university full of people who are only interested in how machines work. The energy of university comes from a great enterprise of curiosity, and a university's energy is drawn from all the people in it, whether they are studying political science, or philosophy, or law, or biochemistry, or engineering. Everybody is engaged in the same thing, which is discovering new things, and you can't say that one bit of university is more important than any other.

Driving the new knowledge of economy is a collective enterprise of the whole society. It isn't just the university that will do it. It is a false idea to think that you can turn to the university and say, "You know, Todai, you are the great university. Revitalize our economy." It's not going to happen.

05

Evaluation of universities

(Sasaki) I should move on to a second point. The Japanese Ministry of Education is presently trying to set up an assessment organization to assess the performances of national universities, because these universities have received a large amount of public money. The Ministry of Education thinks that national universities should be checked by peer review.

Most bureaucrats tell us that we in Japan are following the UK model, and probably you have many Japanese coming to ask you about the effect and practice of such assessment. I am now in charge of the Assessment Committee of the Association of National Universities. Just five days ago, the first result of the assessment was published, and of course, there are still very delicate and difficult matters that can be identified.

First of all, it takes a lot of energy. It takes an enormous amount of time to adapt and provide data to the assessment organizations. At the same time, however, very often the criteria for assessment are unidentified or unclear. Each person has a different idea of the criteria, and opinions can change very easily. It is difficult to establish mutual trust under these conditions. This is our situation.

In a couple of reports I read in UK newspapers, some people say, "Yes, it's going quite well. We have got used to being assessed, and the system is working smoothly." Other people, however, say that there has been some serious fallout. For example, we have raised the point of how much the university contributes to economic activity. This can be included as one of the factors in the assessment. We would like to hear your observations of the system, and whether we should be concerned about its results.

(Lucas) There are two assessment systems in Britain. One is the assessment of research. The other is the assessment of teaching. Which do you have? Are you talking about research only here?

(Sasaki) We have both teaching and research assessment.

(Lucas) And secondly, in Japan does money depend upon this? Do you get money in function of the results of your assessment?
The research assessment in Britain is the basis upon which they calculate how much grant they going to give to you for research. So there is a money outcome. It makes a considerable difference whether there is funding attached to the outcome or not.

(Sasaki) In our system, the overall perspective has not yet been decided.

06

Research evaluation

(Lucas) It's a mechanism for concentrating money in Britain. Let me talk about the research assessment, first. Firstly, I think that one has to begin by saying that certainly if you receive public money, you ought to give account of it. This is money that is provided by the citizens through taxes. The government has to account for the use of tax money, and we should account for our use of tax money. So I am not against assessments.

Secondly, I think that research assessment has had some good effects. I think that it has revived some colleagues in universities who may have felt inclined after a period of time to be less active. I think that it has, in fact, helped at least in its early period. It helped to invigorate research that more research has taken place as a result of it. In that respect, I think it's good.

Thirdly, the research assessment exercise has worked quite well in Britain. Because it has been quite determinedly focused on the quality of research. It's been done by peer review. The assumption has been, "Is this work scientifically or academically good?" not "Has it produced technology in society?" We have a separate stream of funding to help transfer of technology. It's important that the transfer of technology, which we were talking about earlier is not mixed up with the quality of research. There should be a different stream of money coming for that.

The assessment of research is the assessment based upon the innate quality of that research judged upon where it is published, judged upon its impact and so on. As long as the research assessment is based on that, I think it's quite good.

Fourthly, the good thing about research assessment is that because it is based like that, it has concentrated research funding which is the consequences funding is attached to grades. It's concentrated the funding of the best universities in research-intensive terms, so the research funding has not just been spread irrespective of how good the research is. It's concentrated, and that has helped to gear up research. So all those things are good.

I think there are quite number of disadvantages. The first is that it has affected the nature of research because it happens every five or six years. People are now beginning not to do research that will not have outcome within that period; so the long research projects are slowly disappearing unless you can produce work along the way. If you had had Andrew Wiles of Princeton in a British university, he would have been seen as unproductive because it took him 12 to 15 years to solve Fermat's Last Theorem. We would have said, "Come on Wiles, what are you doing?" So I think that it is producing more short-term attitudes into research. In a long run, it may not be good, so you've got more energy, but you have got short-term energy.

I think that secondly, it has an effect also on the sort of research that has been done. I think that one of the criticisms leveled at the research councils (I don't know what the Japanese equivalent is, but we have big research councils who get the budget from the government and they fund projects). One of the criticisms labeled against them is that they are actually quite conventional.

They fund science, which they can understand, if you see what I mean, because they know where it's coming from and they fund people with good record already, so that they are a bit unadventurous. I think the same might be true of the research assessment exercise in that it tends to recognize research that it can recognize. So there is an issue about whether it is stifling that sort of free curiosity out of which great new knowledge comes. It's a great pity if the society can't afford to just leave some people just to do things, which may work or may not work. The whole importance and character of university research is that it's risky.

People say that university professors don't take risks, that they're in employment where there isn't any risk. It is completely untrue. We take risks every day. We take risks of our reputations. If you think of the new thought, it's a risky journey. If you are in a funding structure, or in a structure that is reviewed in a way that, somehow, discourages that, you are beginning to undermine the true character of great universities. That's a problem.

And then, of course, it is very expensive operation. I think that the cost of the assessment, many people would say now, that having done it, you know for fifteen years, this time to stop, ought to make it much, slimmer much, much easier because it is expensive and you could use that money to do more research. It's the top slice off the budgets, which in present funding climates everywhere, you would rather use on doing work in your university. It's a balance between these two. There is good and bad. Do you have teaching assessment?

07

Teaching evaluation

(Sasaki) Yes, we have. Physics and Chemistry were assessed in Education last year. A lot of trouble happened in the process.

(Lucas) I think that the teaching assessment has been very unsuccessful in Britain. It has been very unsuccessful for two reasons. The first is there isn't any real agreement about what good teaching is. There is agreement about what good research is. You know you have got fairly good way of establishing what good research is, but not what good teaching is. It is what the student says, "I have been well taught." That merely encourages showmen, it encourages dramatic teaching, and so I think that a lot of assessment in teaching often comes down to trying to prescribe processes the way you do it rather than measuring outcome. The effect of that seems to me to be a bad confusion. So that's the first thing that's wrong.

The second thing that is wrong is that because of the nature of teaching is uncertain, the agency doing the quality assessment became very, very onerous, very prescriptive, very inquisitive. The cost became very, very high, and it was very intrusive. You had these panels coming into the department and questioning people, and it had a disastrous effect on morale. Colleagues resented it terribly and students didn't like it, either. It was a disruption.

In the end, what universities in Britain have done is they have assigned to one or two colleagues in each department, the task of preparing this for a whole year. It's a terrible waste. The result is not worth the cost in money, the cost in morale, the cost in wasted time. It's just not worth it. I think that that doesn't mean you shouldn't do it, but you shouldn't do it like that. I don't know how to do it, but we've actually managed to get the government to change the way it's done it and we're going to have a new system next year. Whether that will be better or not, I don't know.

There's a weakness in all assessment, whether it's research assessment or whether it's the teaching assessment, about whether people are just conforming, or whether they are just being honest, actually. There are also jealousies at work. One has to be careful about peer review when it gets into this sort of area, particularly if you're of a leading university with a high reputation, you might get into a situation (I don't say that you do, but you might) where people say, "Well, let's knock them down." I certainly think that the research exercise really ought to be done internationally, not nationally.

(Sasaki) Many important points have been addressed in this one-hour presentation.

Now our time is over. Thank you very much.

on March 28, 2002
at the Main Auditorium (Yasuda Kodo)

Professor Emeritus Masatoshi KOSHIBA 2002 Nobel Prize Laureate in Physics

As you are all aware, Professor Koshiba was awarded this year’s Nobel Prize for his "pioneering contributions to astrophysics, in particular for the detection of cosmic neutrinos." There could be no greater honor for the University of Tokyo, and on behalf of the university I offer Professor Koshiba my heartfelt congratulations.

Continued to the Message from the President.

Message from the President

Congratulatory Speech by President Takeshi SASAKI

A number of University of Tokyo alumni have already gone on to win Nobel Prizes, but the research that won Professor Koshiba the award was carried out within the university, and in that sense this is also a great honor for our institution.

During the two years that I have served as president of the university, I have visited Kamioka three times. Professor Koshiba accompanied me on two of those occasions.

I am sure that many of you have gained some idea of what sort of facility this place, now called Super Kamiokande, is from the newspapers and other media. To visit there and view the facilities with your own eyes, however, is to be truly impressed, and I remember that for a long time I struggled with how to put this into words.

The Super Kamiokande institute, which belongs to the University of Tokyo, is now widely known internationally as a center for neutrino research. To walk its corridors, however, is once again to sense at an even deeper level the long years of effort on the part of Professor Koshiba, who both laid the foundations for the institute and achieved such outstanding results upon them.

Although I am a complete layperson in these matters, in a sense I was completely overwhelmed. I was also extremely deeply impressed with the dedication shown by the scientists of the Institute for Cosmic Ray Research, who are continuing to carry out research in succession to Professor Koshiba's original purpose.

In recent years this Nobel Prize had been anticipated by many both within and outside the university, in Japan and abroad, and at the University of Tokyo it had been customary for some years now to prepare ourselves for the possibility as the beginning of October approached. That we were kept waiting for so long until our hopes were fulfilled has only added to our joy.

Currently, as our university prepares to become an institution independent of government control, we are facing demands to engage with a multitude of issues. As far as I am concerned, what Professor Koshiba has demonstrated to us about the importance of fundamental research, and also his often-repeated gratitude to the people of Japan for their support, speak to me of the necessity of not wasting our resources, but rather of using them effectively to carry out research. With Professor Koshiba's Nobel Prize for Physics spurring me on, I intend in future to devote myself to the best of my ability to creating an environment in which researchers at the University of Tokyo are able to engage in challenging research to an even greater degree than before.

As president, there are many things I would like to be able to forget as quickly as possible, but there are also unforgettable events that are extremely important to me. October 8, 2002 was the most unforgettable day of my entire term as president. It may sound very greedy, but I hope there will be more such unforgettable moments while I am still president.

Nobel Lecture in Physics 2002

Masatoshi KOSHIBA

December 8, 2002, at Aula Magna, Stockholm University

Birth of Neutrino Astrophysics

In giving this talk I am very much helped by the preceding talk because I can skip some of the topics. If you want further information, please refer to my review article, Observational Neutrino Astrophysics, [1] (See References)..

I am to talk about the birth of the neutrino astrophysics, but before the birth, there was a very important event, which was just described by Prof. Davis. [2]. It was the radiochemical work using the reaction $\nu_e + {}^{37}Cl$ going to $e^- + {}^{37}Ar$. He found that the observed neutrino flux was only 1/3 of the theoretically expected. This could be considered as the conception of the neutrino astrophysics and was in fact the impetus for us to begin seriously working on the solar neutrinos.

I will talk about two experiments. The first is the original KamiokaNDE, which might be called an Imaging Water Cerenkov detector with a surface coverage of 20% by photomultipliers and the total mass of the water inside this detector is 3,000 tons. It costed about 3 million U.S. dollars. This, mind you, was meant to be the feasibility experiment on the astrophysical detection of solar neutrinos. The second experiment is called Super-KamiokaNDE, the same type of detector but with a better light sensitivity, that is, 40% of the entire surface was covered by the photocathode and the total mass of the water was 50,000 tons. It costed about 100 million U.S. dollars. This was considered to be the full-scale solar neutrino observatory.

Both the experiments are situated about 1,000 meters underground in Kamioka Mine. The capital letters NDE at the end of the two experiments originally implied Nucleon Decay Experiment. However, because of our detection of various neutrinos by these detectors, people started calling it, Neutrino Detection Experiment. Fig.1 shows the interior of KamiokaNDE. You can see arrays of photomultipliers on the sidewalls as well as on the top and at the bottom. When we were preparing for this KamiokaNDE experiment, we heard that a much bigger, but of similar type, experiment was being planned in the United States. [3]. We had to think very seriously about the competition with this bigger detector. Both experiments aimed at the detection of a certain type of proton decays, i.e., $e^+ + \pi^0$ mode. If we were aiming only for the detection of such particular type of proton decays, certainly much bigger U.S. experiments will find it first. Then, what can we do with a smaller detector? We thought very seriously about this competition and we came to the conclusion that only possible way to compete with this bigger detector is to make our detector much more sensitive than the U.S. competitors so that we can not only detect the easiest proton decay mode, but also we can measure other types of proton decays. Then eventually we can say proton decays into this mode with this branching ratio and into that mode with that branching ratio and so forth so that our experiment will be able to point the way to the possible future, what is called, Grand Unified Theory, which is a new type of theory combining strong forces, weak forces, and electromagnetic forces.

Thanks to the cooperation of Hamamatsu Photonics Co., we jointly developed this very large photomultiplier tubes [4]. I was so happy as you can see in Fig.2 that this tube was successfully developed. Fig.3 shows the fish-eye view of the Super-KamiokaNDE interior. You can see many more phototubes, a total of about 11,000 big phototubes.

Since I suppose not many people are familiar with this type of detectors, I want to show you the performance of Super-KamiokaNDE. First example is a very slow motion picture of a cosmic ray muon passing through the detector.

As is well known, the special relativity prohibits any particle to move faster than the velocity of light in vacuum. However, in a media like water, the light velocity itself is reduced to its three-quarter of its value in vacuum. Therefore, when the particle energy is very high, its velocity can exceed the velocity of light in the water. Then, what happens is that such high energy, high velocity, particle in water will generate, what might be called, a shock wave of light; the Cerenkov light. It is emitted in a cone shape with the axis on the trajectory of the moving electrically charged particle. Fig.4-1 shows the response of Super-KamiokaNDE when a muon just entered the detector. The Super-KamiokaNDE detector is exploded here. The sidewall is cut vertically at one point and is spread flat, the upper lid is opened up, and the bottom lid is pulled down. Each dot here represents a photomultiplier. Red light shows it received a large number of

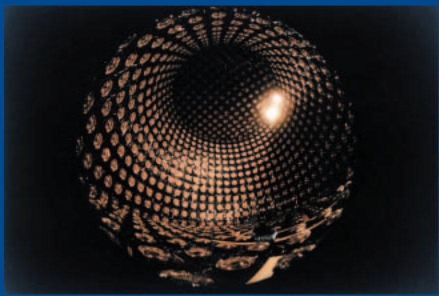


Fig.1. The interior of KamiokaNDE.

Fig.2. The newly developed large photomultiplier.

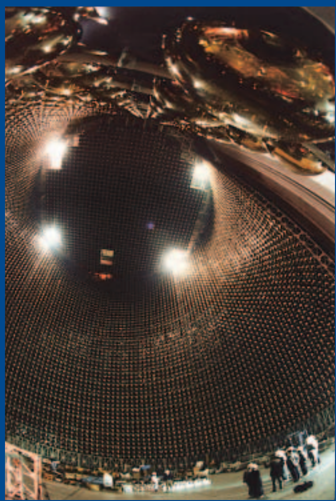


Fig.3. The interior of S-K through fish-eye lens.

Fig.4-1. μ just entered S-K

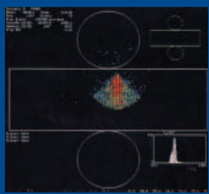


Fig.4-2. 50 nanoseconds later.

photoelectrons. The different color indicates a different number of received photoelectrons. At the right below is the time profile of the total number of photons received. Fig4-2 shows the pattern 50nanoseconds later. You can see the particle is moving faster than the Cerenkov light wave front. Fig.4-3, another 50nanoseconds later, shows that while the Cerenkov light is still on its way the muon has already reached the bottom. You can see that the particle is traveling faster than the light velocity in water. Figs.4-4, 4-5, and 4-6 show the subsequent development of the event. You can see that with this detector the electrically charged particle can be observed in detail. Next figure, Fig.5, shows two events, e-event above and μ-event below. Looking at these two examples, one by electron and the other by muon, you can see the difference in the distribution of the detected photons, especially in the radial distribution of photons. Electron and muon are very similar particles except that their masses are different by a factor of about 200. It means that in traversing water, the heavier μ-particle suffers much less scattering while the lighter electron gets scattered much more. Not only that, the electron emits gamma rays, which in turn get converted into electrons and positrons. Those low energy electrons, and positrons, get scattered violently. Therefore, the Cerenkov light emitted by those low energy particles is widely distributed as you see in the upper event. By making a quantitative measurement of the radial distribution of those photons, you can make a very good distinction between μ-event and e-event with a mistaking probability of less than 1%. This is a very nice feature of this detector and led us eventually to discover what is called atmospheric neutrino anomaly.

The old KamiokaNDE produced four significant results.

The first is the astrophysical observation of solar neutrinos by means of ν_e-e scattering with the electron in the water. [5]. By the astrophysical observation we mean all the necessary information is available; i.e., the arrival direction, the arrival time and also the spectral information on the incoming neutrinos. In the case of ν_e-e scattering, since the electron rest mass is only 0.5 MeV, for an incoming neutrino of, say, 10 MeV neutrino, the struck electron goes almost in the dead forward direction. By observing this recoil electron, you can approximately infer the arrival direction of the neutrino. Also, the energy spectrum of the recoil electrons has a one to one relation to the original neutrino energy spectrum. The timing is accurate to better than ten nanoseconds.

The second is the observation of supernova neutrinos [6] by means of anti-ν_e on protons in water. This reaction produces an e^+ and a neutron. The e^+ is observed by the Cerenkov light it emits.

The third is the discovery of what is called Atmospheric Neutrino Anomaly. [7]. Since we can definitely separate μ-event and e-event, as I have shown you before, we could measure the number ratio of ν_μ over ν_e very accurately by observing μ-event and e-event separately. It was the discovery of slightly more than four σ significance, but this result was later firmly confirmed at more than 9σ by the data of Super-KamiokaNDE.

Not many people are interested in proton decay any more but the non-observation of proton decays by the KamiokaNDE experiment killed the well-known Grand Unified Theory based on SU[5].

The previous speaker showed this diagram, Fig.6, and I am not going into the detail here but instead just ask you to notice the threshold energies of various experiments. Fig.7 is to show the feasibility data by KamiokaNDE of observing solar neutrino with its directional information. You can see above the isotropic background, the accumulation of event in the direction from the sun to the earth. Next one, Fig.8, shows the energy spectrum as normalized to the theoretical one. From the figure you can see the shape is not very much different from the expected theoretical anticipation, but the intensity is almost one-half.

I now go on to the observation of supernova neutrinos. Thanks to the collaboration of Pennsylvania State University led by Prof.A.K.Mann, we could improve the performance of our detector very much by reducing the background, purifying the water, and so forth. At the very beginning of 1987; our detector was already calm enough to start taking data on the solar neutrinos. Two months later, we heard that there was a supernova explosion in the southern sky. So we immediately looked at our data and then we found the supernova neutrino signal very easily because our detector was already capable of taking solar neutrino data, which are much more difficult to observe than the supernova neutrinos; because the supernova neutrinos have considerably higher energies than the solar neutrino and furthermore those supernova neutrinos are bunched in a short period of time. It is shown in Fig.9. You can clearly see the supernova neutrino signal above the background events of about 17 photoelectrons. This observation not only gave the confirmation of theoretical ideas on the supernova explosion triggered by a gravitational collapse. For instance, not only the average energy and the total number of these events agreed with the theoretical expectations, but also the time duration of about ten seconds implies that those neutrinos are emitted from a

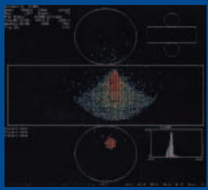


Fig.4-3. μ reached the bottom.

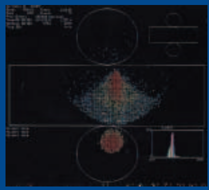


Fig.4-4.

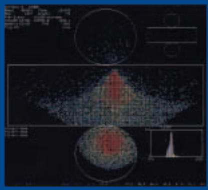


Fig.4-5.

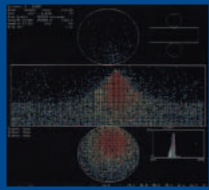


Fig.4-6.

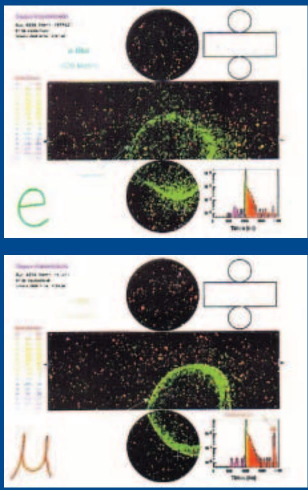


Fig.5. e-event above and μ-event below

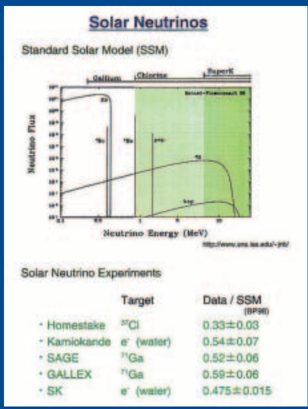


Fig.6.

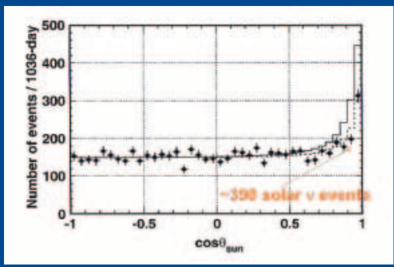


Fig.7. The directional observation of Solar neutrinos

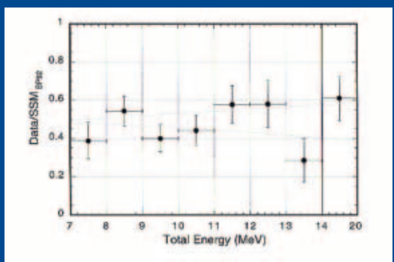


Fig.8. The normalized energy spectrum

very, very dense matter like nucleus. If they were emitted from a tenuous stellar body, the time duration of the signal would have been less than one millisecond. But those neutrinos had to get diffused out of a very dense, nucleus-like, matter so that it took ten seconds to get out of this surface; probably a neutron star is responsible.

Now I come to the discussion of Atmospheric Neutrino Anomaly. When cosmic ray particles enter the atmosphere, they interact with the N and O nuclei to produce π-mesons and K-mesons. These mesons decay in tenuous air into μ and ν_μ. So you get one muon and one ν_μ there. If the secondary μ also decayed then you get additional ν_μ and ν_e. So if everything proceeded this way, you get two ν_μ s against one ν_e. The number ratio, N (ν_μ) / N (ν_e) is thus two. When you go to higher energy, μ of longer lifetime than π-meson cannot decay. Indeed, some μ s do reach our detector, as you have seen before. In this case, you do not get additional ν_μ or ν_e. So at high energies, this ratio becomes larger than two.

In Fig.10 are shown the above number ratio observed by KamiokaNDE together with the results of other experiments.

I now go on to the discussion of he neutrino oscillation, [9]. This may be the most difficult part of my talk. I will try to make it understandable to the first year undergraduate student.

For the sake of simplicity, we consider there are only two kinds of neutrinos in nature. Then, for instance, the wave function describing the state of a neutrino can be described by a linear combination of two independent base functions. For instance, you can take the mass matrix to be diagonal and then choose the two basic vectors of mass m_1 and mass m_2, respectively. So any neutrino state can be described by a combination of ψ_{m1} and ψ_{m2}. $\psi_{\nu\mu} = \cos\phi\,\psi_{m1} + \sin\phi\,\psi_{m2}$. This is like two-dimensional geometry. A vector can be described by its x component and y component. So the ν_μ state is a linear combination of m_1 state and m_2 state with an angle parameter θ . The two states, ψ_{m1} and ψ_{m2}, oscillate with their characteristic frequencies. This frequency is proportional to the total energy of the state. If the mass m is small, then for a given momentum one can make the following approximation. Namely, $E \sim p + m^2/2p$. E_1 minus E_2 which is proportional to the frequency difference of these two states, is then, using this approximation, is proportional to $(m_1^2 - m_2^2)$. This m-square difference between the two states.is designated by m^2. When there are⊿two oscillations of nearly equal frequencies coexist, there occurs a phenomenon known as beat in which the amplitudes of the two oscillations change slowly with the difference frequency. This change of the component amplitudes, ψ_{m1} and ψ_{m2}, induces the appearance of ν_t-state in the original pure ν_μ state.

By using these two parameters, Δm^2 and ϕ , you can describe the oscillation of neutrinos from one type to the other.

In Fig.11 is shown the result obtained by KamiokaNDE, [10] , on the atmospheric neutrino oscillation.

We now proceed to the discussion of Super-KamiokaNDE.

The Super-KamiokaNDE so far produced three significant results.

The first is the astrophysical observation of the solar neutrinos with a comfortable statistics. In Fig.12 you can see the peak of neutrinos in the direction from the sun to the earth above the isotropic background. When you break your hand you go to the doctor and get an X-ray picture taken. You then can see inside of your hand. A bone may be broken. When you use neutrinos, with a much larger penetrability, you can see inside of the sun. In Fig.13 is shown the first neutrinograph, rather than photograph, of the sun. Below is the orbit of the sun in the galactic coordinates as seen by the neutrinos.

This sounds very nice, but if you look at this neutrinograph carefully, you find the size of sun is much bigger than the size of sun as you see by your own eyes. The reason is, of course, that the directional accuracy of the neutrino observation is much worse than that of visible light. But you have to be patient. The neutrino astrophysics is just born. It is still in its infantile stage. Fig.14 shows the observation of the solar neutrino energy spectrum as compared to the theoretically expected from the Solar Standard Model. Detailed comparison of this observed energy spectrum with the theoretical expectation gives us better information on the solar neutrino oscillation. If the observed anomaly in the N (ν_μ) / N (ν_e) is indeed due to the neutrino oscillation, then the degree of oscillation would be different depending on the path lengths the neutrino had to traverse from its generation to our detector. When it comes from vertically above, it is only 20 kilometers. When it comes horizontally, it traveled some 1,000 kilometers. If it comes from the bottom, it was produced 13,000 kilometers away. There is a big difference in the path lengths.

In the case of e-events, due to ν_e , there is no deviation from the no-oscillation expectation. Only in the case of μ-events, due to ν_μ, one sees a large reduction in the direction from the bottom. Only in the case of muon, you see this deficiency in the large distance direction. Fig.16 shows the allowed regions for the solar neutrino oscillation, painted yellow, and that of atmospheric neutrino oscillation, painted red as determined by the data of Super-KamiokaNDE ,

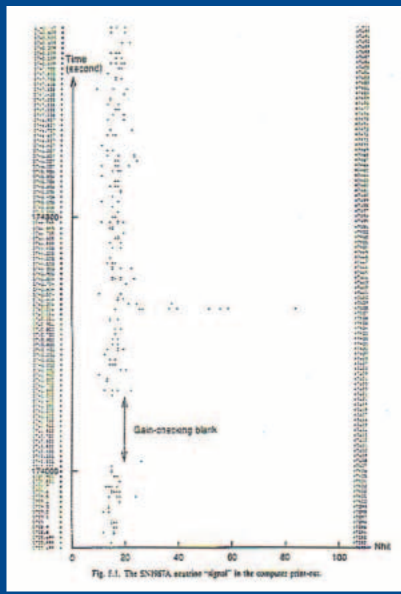


Fig.9. The SN1987A neutrino "signal" in the computer print-out.

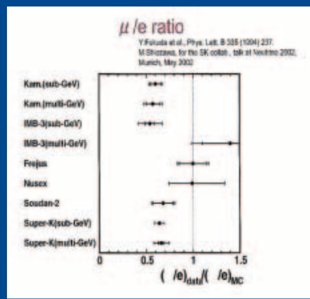


Fig.10. The number ratio N (ν_μ) / N (ν_e).

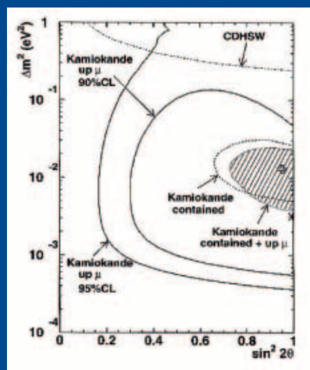


Fig.11. The allowed parameter region.

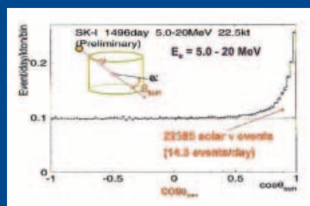


Fig.12. The directional observation.

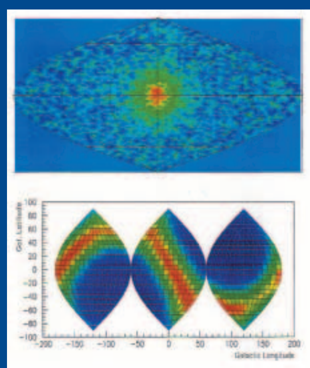


Fig.13. The neutrinograph of the sun.

[11]. With the oscillation data described above of KamiokaNDE and of Super-KamiokaNDE we go on to combine them with the other available data. Next figure, Fig.17, shows only one possible oscillation region for the solar neutrino oscillation. This was accomplished by combining all the solar neutrino experiments. Super-KamiokaNDE, SNO and other radio-chemical results [14] [15] [16] [17].

Now that the observed Δm^2's are definitely not zero we have to admit some non-zero masses for the neutrinos. This implies that the Standard Theory of elementary particles have to be modified. Now, for the sake of giving proper credits, I give the author list of supernova neutrino detection in ref. [6] and the author list of the atmospheric neutrino paper in [12].

Lastly I show you the latest result from Kamioka. In Kamioka, there is a third generation experiment now working. This KamLAND experiment is installed in the old cave of the original KamiokaNDE and this experiment uses liquid scintillator to measure the anti-ν_e's from the reactors about 200 kilometers away. And this experiment published their first result [18] only two days ago and I got this by e-mail. The experiment is measuring the anti-neutrino flux as well as the energy spectrum. The result is shown in Fig.18. The obtained oscillation parameters, sin2 ϕ =0.833 and Δm^2=5.5x10-5 eV2, are in good agreement with the solar neutrino result of Fig.17.

Since this is a confirmation of the neutrino oscillation not for the electron neutrino but for anti-electron-neutrino, the fact that it is giving the same oscillation parameters implies that the CPT theorem is not violated Further data accumulation may lead to some interesting insight into the CP problem within the framework of CPT invariance. Reference to this paper is given in [18]. The interesting thing is that about two-thirds of the collaborators are from the United States. Some say Kamioka is now considered as the Mecca for neutrino research and this pleases me very much.

Now that the neutrino Astrophysics is born, what should we do next? Of course the plan depends on whom to ask. There is a move to build a megaton Hyper-KamiokaNDE. A world network of at least three Super-KamiokaNDE s may be a good choice for supernova watching. The most challenging problem will be the observation of the Cosmic Neutrino Background of 1.9K which would tell us the state of our universe 1second after its birth. The non-zero masses of neutrinos imply the total reflection at low temperature of low energy neutrinos. This is a wonderful gift providing the possibility of parabolic mirror for focusing CNB. The detection, however, of such low energy neutrinos is really a formidable task.

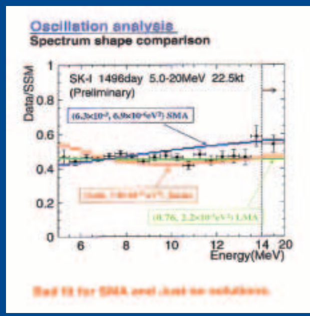


Fig. 14. The energy spectrum.

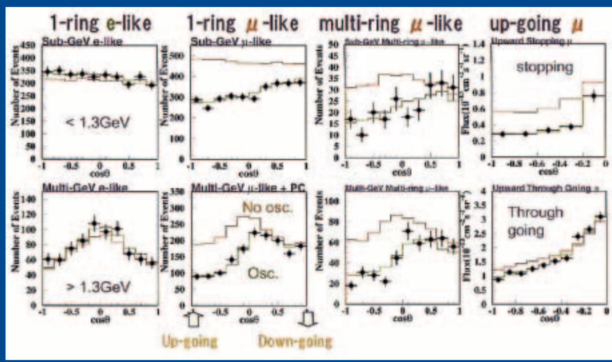


Fig. 15. The change of oscillation as a function of path length.

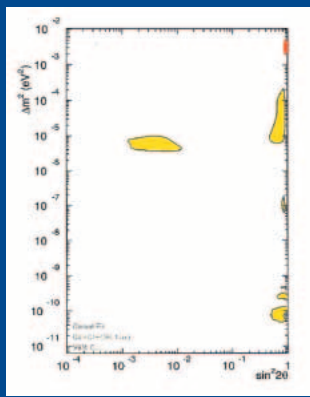


Fig.16. The allowed regions of oscillations.

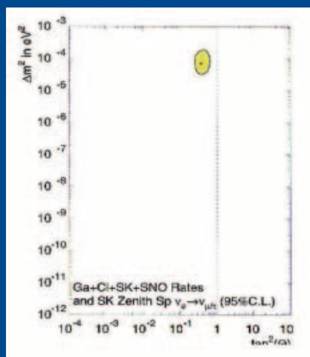


Fig.17. The allowed region for the solar neutrino oscillation.

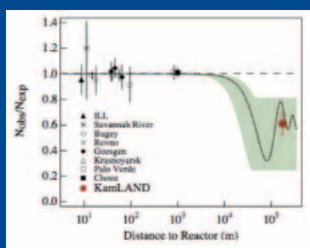


Fig18.Results from KamLAND.

Acknowledgements

It is my pleasure to acknowledge the technical contribution of Hamamatsu Photonics Co. for producing the 50cm ϕ photomultipliers. They were the essential ingredient of Kamioka experiments. The Ministry of Education, Culture and Science of Japan gave generous support to the Kamioka experiments for which we are all grateful.

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Record of Professor Masatoshi Koshiba's Nobel Prize activities

October 8, 2002

The Royal Swedish Academy of Science announced the award of the Nobel Prize in Physics for 2002 to Professor Masatoshi Koshiba for his pioneering achievement in the new field of neutrino astronomy by detecting cosmic neutrinos.

At 8:30 pm on the day of the announcement, a press conference was held at the Chemistry Department Main Building in the Graduate School of Science of the University of Tokyo. About 100 representatives of the media gathered

at the venue. This was the beginning of a long and persistent chase by the press.

The press conference commenced with a congratulatory address by Professor Takeshi Sasaki, President of the University of Tokyo, followed by an introduction to Professor Koshiba's achievements by Professor Katsuhiko Sato, Dean of the School of Science of the University of Tokyo. Professor Koshiba then delivered an address expressing his gratitude. Asked about his feelings on receiving the Nobel Prize, Professor Koshiba briefly commented that he was "very pleased." During the press conference, Professor Reona Ezaki, who was also a Nobel physics laureate in 1973, offered a few words of congratulations to Professor Koshiba.

October 11, 2002

Professor Koshiba paid a courtesy visit to the official residence of Prime Minister Koizumi, along with Mr. Koichi Tanaka, the other Japanese Nobel laureate. Mr. Tanaka was informed on October 9 that he would be awarded the Nobel Prize in Chemistry. The two Nobel Prize laureates engaged in conversation with Prime Minister Koizumi. The Prime Minister expressed his congratulations and said that he felt the three of them could be brothers, considering their ages.

October 19, 2002

Professor Koshiba delivered a public lecture sponsored by the International Center for Elementary Particle Physics of the University of Tokyo. The title of the lecture was "Elementary particles and the universe." A senior high school student asked him what researchers should always have in mind. He replied that they should always nurture an egg that they want to hatch someday in their research.

October 21, 2002

Professor Koshiba paid a courtesy visit to

the Ministry of Education, Culture, Sports, Science and Technology, reporting to Education Minister Toyama concerning his Nobel Prize award. Responding to the minister's request to say a few words to children, he said, "You will only find science interesting if you experiment on your own and obtain results for yourself. Teachers at junior high schools should possess characteristics that make them well received by students."

October 31, 2002

Professor Koshiba was invited to a luncheon at the Foreign Correspondents' Club. At a joint press conference with Mr. Koichi Tanaka, he expressed his delight at winning the Nobel Prize and talked about the current situation of research in Japan. He pointed out that despite the high amount of investment in research in Japan, this produces relatively few results, and added that we need a system under which research achievements are appropriately evaluated.

November 9, 2002

A ceremony was held to congratulate Professor Koshiba for winning the Nobel Prize in Physics at Kamioka-cho, Gifu Prefecture, where Kamioka Observatory Institute for Cosmic Ray Research (Super-Kamiokande) is located. Approximately 150 people gathered, including faculty of the University of Tokyo and local residents. Professor Koshiba predicted that "Another Nobel Prize winner will emerge from Kamioka in four to five years."

November 11, 2002

With Mr. Tanaka, Professor Koshiba attended a meeting of the Council for Science and Technology Policy (chaired by Prime Minister Koizumi), which directs national science and technology policy. At the meeting Professor Koshiba asked for more government support in the field of basic science.

November 26, 2002

Professor Koshiba made a statement as an expert at a Business and Industry Committee Advisory meeting in the House of Councilors.

December 5, 2002

Professor Koshiba left for Stockholm to attend the 2002 Nobel Prize award ceremony. He held a joint press conference with Mr. Koichi Tanaka at Narita Airport before their departure. When asked what he was most looking forward to, he answered, "To come back to Japan as soon as possible," which caused the press corps to burst into laughter.

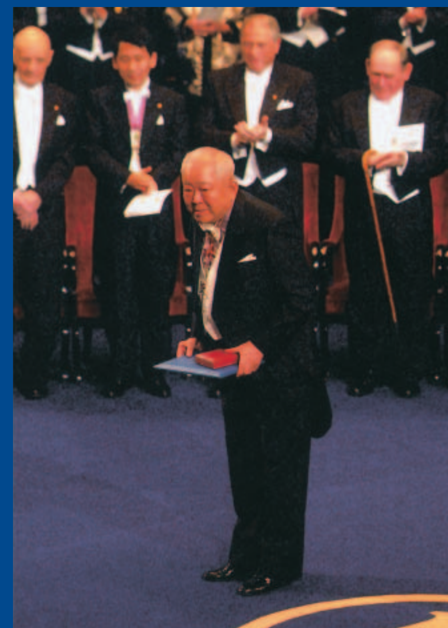
December 8, 2002

Professor Koshiba delivered his Nobel lecture in physics at Stockholm University under the title "The Birth of Neutrino Astrophysics," on the subject of the results obtained from research at Kamiokande and Super-Kamiokande. He talked about how a technique to detect elementary cosmic particles was devised and how the Kamiokande neutrino detector was built, and also presented data obtained when neutrinos were detected following a supernova explosion in 1987. He gave the entire lecture from memory, and receiveda resounding ovation. (See page of 14)

December 10, 2002

Professor Koshiba received his gold medal and diploma from King Carl XVI Gustaf of Sweden at the Nobel Prize Award Ceremony held at a concert hall in Stockholm.

Professor Koshiba attended the Nobel Banquet at the Blue Hall in Stockholm City Hall,



where about 1,300 people gathered. In addition to the Nobel laureates and their families, the King and Queen of Sweden were present along with distinguished guests and students. A lavish set menu was served and participants enjoyed a number of performances, including one in which a person jumped out of a huge balloon. Professor Koshiba did not join the Nobel Ball, which took place after the dinner. In an interview later, he said, " My wife showed up arm in arm with the King. You don't see that sort of thing very often."

Record of Professor Masatoshi Koshiba's Nobel Prize activities




December 11, 2002

Professor Koshiba attended the banquet hosted by the King and Queen of Sweden at the royal palace.

December 12, 2002

Professor Koshiba attended a reception held at the Nobel Foundation, where thirteen Nobel laureates for 2002 were invited, including former US President Mr. Jimmy Carter, the 2002 Nobel Peace Prize laureate.

December 13, 2002

Professor Koshiba attended the Lucia Dinner, the last official event related to Nobel Prize, hosted by the Student Union of Stockholm University. Students of the Union presented the Order of the Frog to Professor Koshiba. He, however, did not have to leapfrog.

December 15, 2002

Professor Koshiba left Stockholm to return to Japan after successfully completing all the scheduled events. "I'm looking forward to getting a massage and a good sleep," he said.

December 20, 2002

A banquet to congratulate Professor Koshiba on winning the Nobel Prize in Physics was hosted by the Institute for Cosmic Ray Research and International Center for Elementary Particle Physics at a hotel in Tokyo. About 230 researchers associated with Professor Koshiba gathered.

December 26, 2002

The University of Tokyo hosted a banquet in celebration of Professor Koshiba's winning the Nobel Prize in Physics at a hotel in Tokyo. With about 550 attending, the celebration commenced with a showing of a video of the Nobel Prize award ceremony, followed by the entrance of Professor Koshiba and his wife. After the opening address by Dr. Takeshi Sasaki, President of the University of Tokyo, congratulatory speeches were offered by the following guests of honor: Ms. Atsuko Toyama, Minister of Education, Culture, Sports, Science and Technology; Dr. Saburo Nagakura, President of the Japan Academy; Dr. Akito Arima, Member of the House of Councilors and former President of the University of Tokyo; Dr. Hirotaka Sugawara, Director General of the High Energy Accelerator Research Organization; and Mr. Teruo Hiruma, President of Hamamatsu Photonics K.K.

Kaoru Yumi, a Japanese famous actress, joined the banquet to present a bouquet of flowers. She currently plays one of the major roles in a TV drama, Mito Komon (Feudal Lord Mitsukuni Tokugawa), which is one of Professor Koshiba's favorite programs. In his address at the end of the party Professor Koshiba said, "We should be more proud of the level of fundamental science in Japan. Your long-term support for fundamental science research would be appreciated."

January 15, 2003

The internal preview for the special exhibition in commemoration of Professor Koshiba s receiving the Nobel Prize in Physics was held at the University Museum.

A 20-inch diameter PhotoMultiplier Tube, the logbook of the time when a neutrino was detected in February 1987, the real-time observational data from Kamioka Observatory Institute for Cosmic Ray Research (Super-Kamiokande), and a replica of the Nobel medal, among other items were exhibited. (They will be on display for the general public from January 16 through June 20.)

Professor Koshiba paid a visit to this preview and remarked I hope that this will contribute even a little to reducing young people s aversion to science.

January 16, 2003

A tree planting ceremony in commemoration of Professor Koshiba's receiving the Nobel Prize in Physics was held at the green zone in front of Building No. 1 of the School of Science. A Chinese Pistachio tree was planted, and the surrounding soil covered with interlocking blocks to keep it in good condition. This area has provisionally been named Koshiba Memorial Park.

Special lectures commemorating Professor Koshiba's receiving the Nobel Prize in Physics were held by the University of Tokyo, at the university's main Yasuda Auditorium.

Prior to the lectures by Professor Koshiba and Dr. Yoji Totsuka, director general of the Japanese National High Energy Accelerator Research Organization, President Takeshi Sasaki gave an opening address and Professor Emeritus Shigehiko Hasumi, former President of the University of Tokyo, delivered a congratulatory address on behalf of the guests of honor. Professor Koshiba delivered the same Nobel lecture that he had given at Stockholm University on December 8, 2002. For this occasion, he modified the lecture to accommodate students who were present.

Dr. Yoji Totsuka lectured on the further development of neutrino science and its significance for elementary particle physics and astrophysics. In a question-and-answer session, Professor Koshiba answered students' questions earnestly and affectionately. His character, particularly his consideration in fostering scientists, impressed the audience.

February 2, 2003

A lecture in commemoration of Professor Koshiba's receiving the Nobel Prize in Physics hosted by the University of Tokyo and Asahi Shimbun Co., Ltd., was held at Yurakucho Asahi Hall.

Professor Takeshi Sasaki, President of the University of Tokyo, delivered the opening address, followed by the sponsor's address by Mr. Masao Kimiwada, executive managing director of Asahi Shimbun. The lecture consisted of two sections: Part I, a special lecture by Professor Koshiba entitled "I wanted to become a person who deals with physics," and Part II a panel discussion under the title "How to harbor and pursue a dream." Panelists joining the Part II all have a close relationship with Dr. Koshiba: Professor Atsuto Suzuki, Dean of the School of Science at Tohoku University; Professor Gyo Takeda, emeritus professor of the University of Tokyo and Tohoku University; Ms. Keiko Toyama, pianist; and Mr. Toshikazu Hakamada, Electron Tube Sales Manager, Electron Tube Operational Headquarters of Hamamatsu Photonics K.K.

Professor Koshiba commented during the discussion that it is important for those in a supervisory position to select the right people and let them work on their own responsibility. Such opportunities enable people to develop their abilities.

February 7, 2003

Professor Koshiba was invited together with Mr. Koichi Tanaka to the official residence of Prime Minister Koizumi to be given a letter of appreciation and a silver cup. Attendants at the award ceremony, including Mr. Fukuda, Chief Cabinet Secretary; Mr. Hosoda, Minister of State for Science and Technology Policy; and Ms. Toyama, Minister of Education, Culture, Sports, Science and Technology, congratulated both the Nobel laureates' achievements

UT Forum 2002 in Singapore

Akinobu KURODA
Professor,Institute of Oriental Culture

The University of Tokyo has previously held two international forums, called the UT Forums, in the United States (in Boston and Silicon Valley) to explain the development and results of academic research taking place on its campuses, as well as to publicize the activities of its scholars more widely overseas. The third UT Forum took place on November 27 and 28 at National University of Singapore, the first time this Forum has been held in Asia.

This forum, with an overall theme of "Human Communities and Contexts of Nature," took a fresh look at the relationships among people and between human beings and nature in Asia, both past and present. The background was the current dangerous world situation, in which conflicts are increasing and the destruction of the global environment through human activities is advancing. This forum was an attempt to discern possible methods for settling fundamental problems by proposing new means of living together, while focusing on and taking advantage of the diversity unique to Asia. Reports on the respective themes of the coexistence of peoples and the coexistence between human beings and nature were given in two sessions by scholars in fields from the humanities, social sciences, and natural sciences; and about 200 people attended them.

Before the start of the Forum, a ceremony was held to sign an agreement on short-term student exchanges between the University of Tokyo's Graduate School of Arts and Sciences and National University of Singapore's Faculty of Arts and Sciences. In the presence of his Excellency Kunihiko Makita, Japanese Ambassador to Singapore, Takeshi Sasaki, President of the University of Tokyo, and, Shih Choon Fong, National University of Singapore President, exchanged signatures on the agreement.

During the Forum, a new experiment was parallel workshops of students from both universities. Themes related to population growth in tropical Asia, the food supply necessary to sustain this, and environmental destruction through rapid economic development were taken up at these workshops, which saw the participation of 20 students from the University of Tokyo and 22 from National University of Singapore. Vigorous debates unfolded, and the students deepened their relationships with and understanding of each other.

During two presentation sessions led by professors, it was mainly students who were energetically posing questions. Their participation also meant that the reception was more lively than usual. Those two days made us aware that telling the world that the University of Tokyo is more than just a university in Tokyo depends on whether or not we can harness the power of students to develop a global vision.

Teachers in UT

The University of Tokyo has a faculty of approximately 2,800 professors, associate professors, and lecturers, all of whom devote their energies both to world-class research in their particular fields and to providing students with a solid education.

UT faculty members have received numerous awards for outstanding achievements in their fields.
Here we introduce a selection of four UT scholars who received prestigious awards in 2002, and who represent the rich variety and high level of scholarship at this university.
By introducing these award-winning scholars, we hope to give you at least a taste of the wonderful research and education being carried out at UT. We also know you are aware that there are many other faculty members engaged in similarly worthy activities.

Beginning of the universe
– Modern genesis described by physics

Katsuhiko SATO
Shijuhosho(Purple Ribbon Medal)2002
Professor,Graduate School of Science

Ever since the beginning of history, human beings have continued to ask the question of whether the world in which we are living today has always existed. Did the world have a beginning? These questions formerly belonged to the realms of mythology or philosophy, but with the discovery in the 20th century of relativity and quantum theory, the two pillars of modern physics, we entered an era in which science can also seek to offer an answer.

Scientists currently believe in the Big Bang model of the universe. This theory holds that space was born as a fireball which as it cooled gave rise to galaxies and stars, shaping the beautiful, abundant universe we see today. The Big Bang model fits well with our observations, but has a number of difficulties. One of these is that it cannot explain why the universe started out as a ball of fire. Nor can it explain the present large-scale structure of the universe, that is, the origin of clusters and superclusters of galaxies. In addition, on a large scale the universe is presently extremely homogenous and isotropic, as well as flat; in other words, this model is also unable to explain why Euclidean geometry is applicable for the present universe.

Around 20 years ago, on the basis of the unified theories of interaction, which had been making great progress at that time, I showed that in its early stage the universe rapidly expanded at an exponential rate. This happened as a result of the mutually repulsive force of vacuum energy predicted by the unified theories of interaction. When this vacuum energy disappeared it was transformed into heat energy, and the universe became a fireball (Fig.1). This model is now called "inflation," thanks to its felicitous naming by A.H. Guth. Inflation is not only the solution to the questions outlined above. The universe is undergoing inflation, with a mother universe giving rise to daughter universes, then on into further generations in an infinite creation (Fig.2). This idea that the number of universes is infinite has been readily accepted, and it is now known as a "multiverse."

Many people might think that it is impossible to prove by observation something such as inflation that happened during the earliest period of the universe's existence. To look far out into space, however, is to gaze into the past. Although we are now 14 billion years away from the birth of the universe, in principle we should be able to observe the instant when it all began. In 1992, the American COBE satellite succeeded in photographing a moment only 300,000 years after the universe was born. The fluctuations in the density of matter visible here, which form the basis of the structure of the universe, are in complete agreement with those predicted by inflationary theory. These observations have therefore provided strong support for inflation.

A surprising recent major discovery is that vacuum energy still pervades the contemporary universe, albeit at extremely low levels. The repulsive force exerted by this vacuum energy is causing a second inflation. Vacuum energy is now known as "dark energy." What is its true nature? Why has a second inflation begun now, over 10 billion years after the birth of the universe? Might this energy disappear at some point, as it did during the first inflation?

As the frontiers of knowledge expand, so new riddles emerge. Solving them will undoubtedly enable us to construct a new image of the universe for the 21st century.

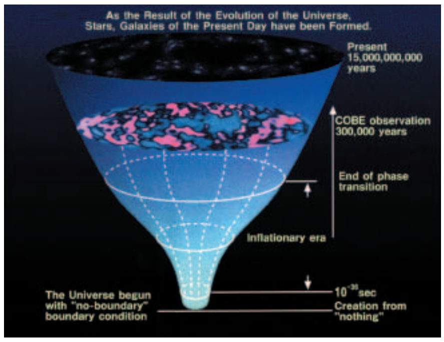


Fig.1 Picture of the birth and evolution of the universe as described by modern physics

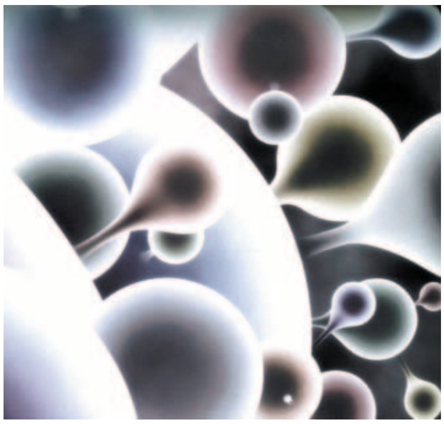


Fig.2 Multi-production of universes predicted by the inflationary universe model(K.Sato et al.1982) and quantum cosmology (A. D. Linde 1985)

Ca^{2+} Oscillation and Life Systems:
–The Role of Intracellular Ca^{2+} Oscillation in Cell Function

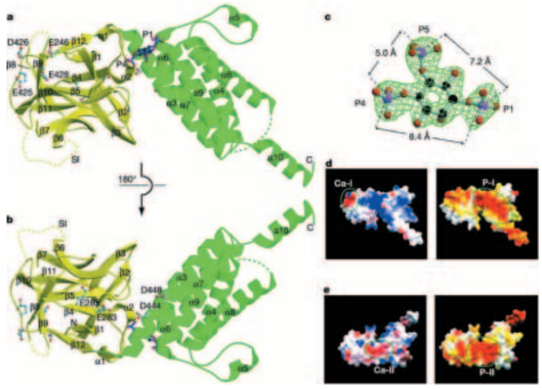
Katsuhiko MIKOSHIBA
Shijuhosho(Purple Ribbon Medal)2002
Professor, Institute of Medical Science

Calcium is the most abundant metal in the human body. Large amounts of calcium are stored in the bones that make up our bodies' skeletons. Calcium in bone (in its precipitated form) exists in equilibrium with ionic calcium in the vascular circulatory system. It is now well established that calcium ions (Ca^{2+}) play an important role in physiological functions of the cell.

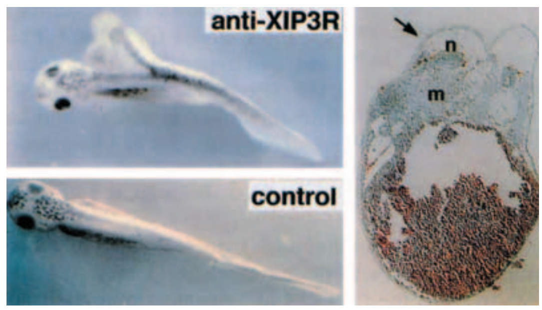
The concentration of Ca^{2+} outside the cell is 10,000 times that of intracellular Ca^{2+}. The traditional view is that the plasma membrane of a cell completely controls the passage of Ca^{2+}, which is allowed to enter cells only as needed. Recent research, however, is showing that Ca^{2+} is not only regulated from outside, but that there are also interior storage areas that contain large quantities of Ca^{2+}. Thus the emerging view is that signals recognized by the cell surface are converted to secondary messengers and released into the cytoplasm. IP_3 was found to be a messenger that releases Ca^{2+} from internal store and consequently an IP_3 receptor was hypothesized pharmacologically as a molecule involved in Ca^{2+} release. Many researchers have sought to unveil the molecular nature of the IP_3 receptor. We discovered that the IP_3 receptor is a P400 protein that is missing from mutant cerebell with deteriorated Purkinje neurons or in which the dendritic arborization of Purkinje neurons is abnormal (*Nature* 342, 32-38 [1989]). We cloned and identified the entire primary structure cDNA of the IP_3 receptor, and found that Ca^{2+} is stored internally in smooth endoplasmic reticulum.

All cells exhibit very slow calcium oscillation, which is essential for cell function. We found that the IP_3 receptor, as a Ca^{2+} oscillator, is important in the production of very slow Ca^{2+} oscillations inside the cell (*Science* 257, 251-255 [1992]). We found that the IP_3 receptor has many unique molecular properties different from other calcium channels on the plasma membrane (*Proc. Natl. Acad. Sci.* 96, 14955-14960 [1999], *Science* 287, 1647-1651 [2000]) which may be important in understanding the molecular mechanism of calcium oscillation. We recently succeeded in revealing the unique X-ray three-dimensional structure of the IP_3 binding domain at 2, 3 (*Nature* 420,696-700[2002]).

We found that the IP_3 receptor plays an important role in (1) fertilization (*Science* 292, 920-922 [2001], *Science* 257, 251-255 [1992]); (2) meiosis (*Develop.* Biol. 203, 122-133 [1998]); (3) mitosis (*J. Cell Biol.* 135, 181-190 [1996]); and (4) determination of dorso-ventral axis formation (*Science* 278, 1940-1943 [1997], *Nature* 417, 295-299 [2002]). We also demonstrated that the IP3 receptor is important in (5) normal development of brain function (*Nature* 379, 168-171 [1996]), as IP_3-receptor-deficient mice exhibit epileptic seizures and cerebellar ataxia. The IP_3 receptor was also highly involved in (6) neuronal plasticity (*Nature* 408, 584-588 [2000]).



Nature 420, 696-700 [2002]



Science 278, 1940-1943 [1997]

Thinking About Our Environment in the 21st Century

Tadao ANDO

American Institute of Architects(AIA) Gold Medal 2002

Kyoto Award 2002

Professor,Graduate School of Engineering

For me, the word "Kyoto" first conjures up the ancient buildings I visited during my youth. But the very next image that enters my mind is that of the Kyoto Protocol, which was adopted in 1997 at COP3 (the Third Conference of the Parties to the United Nations Framework Convention on Climate Change), an international agreement in which advanced industrialized nations set targets for controlling and reducing their greenhouse gas emissions.

After World War II, the Japanese embraced and followed an American-style, consumption-based civilization blindly. They worked to build a social system based on mass production and mass consumption, and achieved success. But that system also generates a massive amount of waste. It cannot continue to exist in a world that has limited resources.

In recent years, industrialized countries have at least realized the contradictions inherent in a consumption-based society. I had hoped that, with the adoption of the Kyoto Protocol, they would generate active proposals for the future of the global environment and announce their work to the entire world. Disappointingly, however, some nations have failed to ratify the protocol. Opinion has been divided because of fears that the protocol would have a dampening effect on economic activity. To my mind, however, preserving the environment in which people live is far more important than economic concerns.

Beginning with the Row House at Sumiyoshi, an early work of mine, and going right through to my more recent, relatively large projects, I have striven to design my buildings to coexist with nature, make optimal use of nature's strength, and show respect for the older things that are already found on each site. I believe this principle is consistent with the "sustainable architecture" that has become a popular topic of discussion in recent years. But I also think we have yet to achieve truly sustainable buildings, and I intend to give further, serious thought to how we can build structures that fit into a cyclical society.

With lawyer Kohei Nakabo, I have begun a campaign to solicit contributions to plant a million trees on the islands and coast of Japan's Inland Sea, which has been deforested and contaminated by modern civilization. Using the olive tree as our symbol, we have selected trees that are well suited to the region and began planting them with raised funds. I hope that through our foundation, the islands in the area will regain some of their original natural splendor, and that our children will gain an understanding of the need to raise living trees with their own hands and to create a healthy environment.

I believe it is our duty to create and hand down to future generations an example of a society that is cyclical in nature, and not a cul-de-sac. Through the pursuit of my own profession, I intend to do all I can to achieve this goal.

Destroyed Ieshima Island

瀬戸内オリーブ基金
SETOUCHI OLIVE FOUNDATION

Logo of the Setouchi Olive Foundation

Planting olive trees on Teshima Island

Planting acorns Campaign

Product Architecture and Japanese Industries

Takahiro FUJIMOTO
Japan Academy Award 2002
Profssor,Graduate School of Economics

Current diagnoses of the state of Japanese manufacturing industries incline toward pessimism. However, overreaction and oversimplification do not solve problems. There are some industrial sectors in which many Japanese firms still maintain world-class capabilities in manufacturing operations: automobiles, motorcycles, miniature consumer electronics, production equipment, and so on. The real problem, I believe, is that so many Japanese firms have apparently failed to appropriate profits from their manufacturing competencies.

The first step in solving this problem is to develop a clear strategic vision that identifies the strengths and weaknesses of each company, so that it can utilize its strengths while compensating for its weaknesses. The existing industrial classification, however, does not offer a good framework for this.

The concept of product architecture may provide additional insights. By product architecture I mean the basic design policy of mapping a product's functions to its structural elements and creating interfaces between these structural elements. My prediction here is that a certain "fit" between the organizational capabilities of firms and the architectures of their products creates competitive advantages in manufacturing operations.

Modular architecture represents a product whose components tend to be functionally complete and standardized, and the interfaces between them are simplified and standardized. "Mixing and matching" components can generate product variety without sacrificing functionality. Integral architecture refers to a product with component designs optimally customized for this product, and interfaces tending to be product-specific.

Three basic types of architectures are derived from the above classifications: open-modular type (with standardization across firms), closed-modular type (standardization within a firm), and closed-integral type.

A product with closed-integral architecture calls for a relatively high level of coordination in product development and production. This is one of the main reasons why Japanese firms in the second half of the 20th century, with integrative manufacturing capability (such as Toyota), tended to be competitive in products with integral architecture.

A product with open-modular architecture, by contrast, calls for a high level of capability in component technologies or strategic capability for systematizing business models. U.S. firms, for instance, tended to be more competitive in products with modular-open architecture.

Many Japanese firms need to pursue a business that features the product architecture to which they are suited (such as integral architecture products). Otherwise (as for open architecture products), the same firm may need to learn intensively from best practice rivals, with or without forming strategic alliances. That is, they need a "dual architecture strategy."

To sum up, Japanese manufacturing firms and industrial policymakers need to focus more on their architecture-based strengths. The traditional economic theories of comparative advantage have emphasized the fit between the resource endowment of a country and resource-use intensity of an industry. The architectural view of industries, on the other hand, focuses on the fit between the organizational capability of firms in a given country and the basic design approach of an industry.

Basic Types of Product Architecture

	Integral	Modular
Closed	small cars motorcycle game software compact consumer electronics	mainframe computer machine tools LEGO (block-builder toy)
Open		personal computer (PC) bicycle PC software internet

Biomagnetics: Leading the Way to a New Horizon

Shoogo UENO Professor, Graduate School of Medicine
http://medes.m.u.-tokyo.ac.jp/

Biomagnetics is a new research field for scientific investigation of the relations between living organisms and magnetism. Applying an interdisciplinary approach, it covers a wide range of fields from medicine and biology to physics and engineering. The relationship between living organisms and magnetism has long attracted attention as a mysterious phenomenon.

It is only quite recently, however, that scientists have begun to study the question both systematically and scientifically. Researchers are looking to use the results of these studies in elucidating brain function and therapies for brain-related disorders. These new findings are also beginning to be applied to tissue engineering and regenerative medicine.

Scientists have long dreamed of identifying the brain mechanisms that underlie the most sophisticated brain functions such as cognition, memory and learning. The recent development of non-invasive brain-function measurement technologies such as functional magnetic resonance imaging (fMRI) and magnetoencephalography (MEG) has enabled the identification of the locations of human brain functions, gradually shedding light on unresolved questions. Despite these technologies, however, it is still difficult to understand the dynamics of brain functions, which include millisecond-level changes in functional regions and dynamic relations between brain neural networks. With the aim of helping to understand the dynamics of brain functions, we are developing a new imaging method with millisecond-order high temporal resolution and millimeter-order high spatial resolution. This method regulates neural activities by local magnetic stimulation of the brain and uses a current-distribution method of imaging electrical nerve activities in the brain.

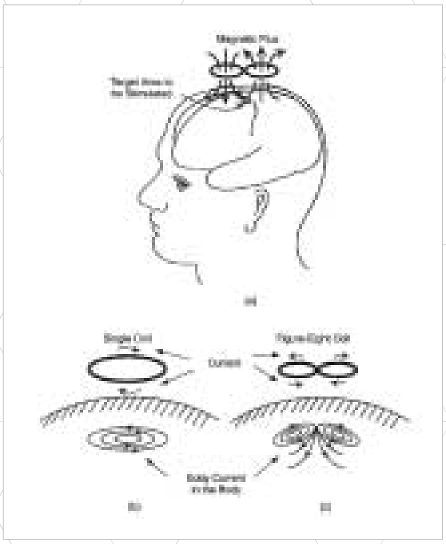
Our newly devised method of applying magnetic stimulation locally to the brain from outside (transcranial magnetic stimulation; TMS) uses a figure-eight coil. When a strong electric current is applied to a figure-eight coil over the head for 0.1 ms, a pulse magnetic field of 1T (tesla) is produced. This pulse magnetic field generates eddy currents in the brain, which stimulate the nervous system. For example, by electrically stimulating the motor area of the brain, which is responsible for movement control, a person's fingers can be induced to move involuntarily. We have succeeded in selectively stimulating the human cerebral cortex with a spatial resolution of 3-5 mm. TMS is a useful method to examine brain function and structure without causing any pain. In recent years, an increasing number of studies on the clinical applications of magnetic stimulation have been performed. There are high expectations for magnetic stimulation to regulate paralyzed muscles, promote regeneration of a damaged nervous system, regulate gene expression, and compensate for the loss of sensory functions. TMS may also provide beneficial therapeutic applications in treating patients with pain and psychoneurotic disorders. Results obtained in recent studies concerning TMS have provided a basic understanding of its clinical application in the treatment of depression and Parkinson's disease, as well as its clinical usefulness in protecting or repairing neurons damaged by cerebral infarction or other brain injury.

As described above, MEG and fMRI are imaging techniques for visualizing the localization of brain functions by using magnetism. MEG measures the very weak magnetic fields generated by neuronal current flow. These are measured by a superconducting quantum interference device (SQUID), which detects changes in a magnetic field as weak as 5 fT (femtotesla) or one ten billionth of the earth's magnetic field, with a millisecond temporal resolution. Although MEG allows us to follow changes in brain activity millisecond by millisecond, there are still many limitations in solving the inverse problem, that is in accurately inferring the source of activity inside the brain based on current distribution within the head as observed by MEG.

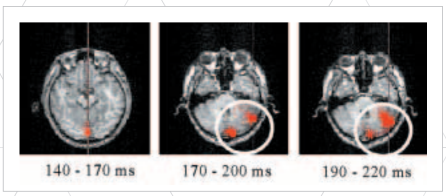
In comparison, fMRI enables visualization of the location of brain functions without such troublesome inverse problems. However, this technique only provides magnetically obtained information about changes in blood flow within the brain, which is only of indirect help in understanding brain function. Direct images of neuron electrical activity cannot be obtained by using fMRI. In terms of detection sensitivity, fMRI has temporal resolution of the order of 1 s, much inferior to MEG with its millisecond temporal resolution. We are presently investigating current-distribution imaging that offers direct images of neuron electrical activity as well as impedance imaging that is designed to visualize electrical conductivity in the living organism and electrical information on impedance. Current distribution imaging is an imaging technique that offers the combined advantages of both conventional fMRI and MEG. We have high hopes of its further development in future.

We have also observed that when an 8 T magnetic field was applied to adherent cells such as osteoblasts, vascular endothelial cells and smooth muscle cells, they proliferated in a direction parallel to the direction of the magnetic field. This result indicates the possibility of controling bone formation, angioplasty, and even nerve regeneration by applying a magnetic field from outside the body. This is the harbinger of new techniques for applying magnetism in tissue engineering and regenerative medicine.

Biomagnetics is thus leading medicine and biology into a new horizon through its novel applications of magnetism. With the increasing integration of medicine and engineering, biomagnetics is further developing into a new science that encompasses a wide range of fields including physics and cognitive science, integrating their diverse cultures to create a new, original discipline.



(a) Magnetic stimulation of cerebral nerves by a figure-eight coil
(b) Eddy current generated by a single coil
(c) Eddy current generated by a figure-eight coil



Visualization of brain activities during mental rotation processing by magnetoencephalography (MEG)

Marketing Science

Makoto ABE   Associate Professor, Graduate School of Economics
http://www.e.u-tokyo.ac.jp/fservice/faculty/abe/abe.e/frontpage.abe.e.htm

Business cannot survive without customers. Because marketing is the only function of management that acts as an interface between a company and its customers, it needs to play a central role in corporate management. Marketing Science is an interdisciplinary academic field that looks at marketing by means of scientific approaches.

The objectives of Marketing are to understand customers' perceptions and preferences, design products and services accordingly, and finally sell and deliver them to users. Marketers must decide what product to sell (Product), how much to charge (Price), what advertising and promotion to carry out (Promotion), and which channels to use (Place), the so-called 4Ps of Marketing. In a mature society, it is especially important to recognize differences between consumers in areas such as product preference and sensitivity to marketing stimuli, and to respond appropriately. From early on, marketing has put into practice the idea of heterogeneity, offering different products and conducting different marketing activities to different consumers through concepts known as segmentation, positioning, and targeting.

In the present era of information technology, in which data on individual customers can be collected and analyzed without the need for aggregation, this idea is even more crucial. For example, by combining a frequent shoppers program (FSP) with point-of-sales (POS) data, one can obtain time-series purchase records of individual consumers. Via the Internet, one can collect not only customer actions such as catalogue requests, inquiries, complaints, and purchases, but also page-viewing history accumulated on log files. Because such a huge volume of data is stored without being aggregated, we now have a better opportunity than ever before to understand individual customers in depth and carry out customized marketing activities.

On the other hand, unless we can extract useful insights and information, these individual-level data can become mere garbage. These days, many companies have trouble extracting useful information from this vast amount of data to conduct more effective marketing. Because most supermarkets, discount stores, and airlines offer similar fixed-rate rebate programs based on purchase amounts, they are embroiled in fierce price competition. Companies wonder "Why isn't our new FSP increasing our profit?" and consumers are forced to carry many competing retailers' lookalike FSP cards, which no longer function as loyalty cards.

The problem is that software has yet to catch up with the advances in hardware. In terms of hardware, it is easy to catch up with, or be overtaken, by competing companies. All that is necessary is to buy an information system from the same hardware vendor. When a Japanese or Western company relies only on hardware, it is therefore vulnerable to competition from East Asian companies who adopt the latest hardware. Worse than that, by taking advantage of low wages, East Asian companies can surpass the company. It is not an overstatement to say that the real competitive advantage of a company, including that of manufacturing, comes from software.

In today's marketing, where the idea of the "average consumer" is becoming obsolete, if individual-level data are aggregated, looked at in terms of means and variances, and only then analyzed, this means that full advantage is not being taken of the individual data.

The first step in data analysis is to investigate descriptive statistics. Increasingly, marketers are using exploratory disaggregate data analysis, so called "data mining." Econometrics, and more recently Bayesian statistics, are often used for more sophistecated analysis using models. Why is Bayesian statistics attracting attention in marketing science?

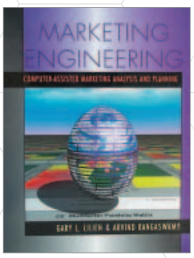
The main interest in economics until now been to estimate the effect of policy variables on the population as a whole. For this purpose, heterogeneity among individuals is something that causes biases in estimation and must be dealt with, but heterogeneity itself is not a focus. On the other hand, in areas like one-to-one marketing and customer relationship marketing, marketers are able to interact with each individual differently. This makes it useful to know individual unique values for model parameters. Because individual-specific parameters must be estimated from that individualÅfs data, which may not be a large amount, estimation is often impossible, or at best highly inaccurate. For marketing professionals, it is especially important to understand the uncertainty in parameter estimates and accurately assess the risk associated with each marketing decision. In contrast with traditional methods of obtaining a point estimate for a few parameters such as means and variances from a large amount of pooled data, and conducting yes/no statistical hypothesis tests based on asymptotic theory, the Bayesian concept of "a parameter itself has a distribution" is especially useful here.

Marketing is an information industry. Companies that understand this and act effectively have a competitive advantage. Microscopic analysis of data incorporating individual heterogeneity will help marketing to provide further value to consumers, thereby increasing both corporate wealth and the prosperity of the whole of society.

Finally, I would like to introduce one of my research themes, relating to a one-to-one advertising delivery system in the broadband era. As a result of this research, a patent was filed through the Center of Advanced Science and Technology Incubation (CASTI), a technology and licensing office for the University of Tokyo, and has been licensed to a private company.

"Broadband technology makes it possible to target advertising video images at the individual subscriber level. This research develops a media planning system for one-to-one advertising in which many advertisers want to deliver their advertising to viewers who possess certain characteristics. Because availability of the desired type of viewers is limited, advertisers, in essence, compete for these viewers whereas other types of viewers are unwanted. The proposed system allocates viewers with different characteristics to advertisers based on a market mechanism, so that the allocation is fair and optimal for all advertisers.

The system, in comparison to traditional media planning, possesses many distinctive features. These include: (1) it considers plans for many advertisers at the same time, accounting for their interactions; (2) media price (price per contact with each type of a viewer) is determined according to demand by advertisers; and (3) the resulting allocation of advertising contacts is fair and Pareto optimal for all advertisers. Such attractive characteristics could potentially introduce a brand-new business model for media allocation in the broadband advertising industry. The system can be applied to other media such as browser phones for target advertising, as well as to areas beyond advertising."



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[*Journal of Marketing Science*] Japan Institute of Marketing Science

News in Brief January to December, 2002

January

01

A special lecture on Brain Science was given by Professor Susumu Tonegawa of MIT, a Nobel Prize laureate.

A joint concert featuring the Choir Academy of the University of Tokyo and the Mixed Choir of Seoul National University was given in Tokyo. This event was held to celebrate 2002 as a year for cultural exchanges between Japan and Korea.

February

02

The University of Tokyo presented Professor Amartya Sen, Master of Trinity College, University of Cambridge, with the title of Doctor honoris causa for playing a leading role both theoretically and empirically in studies on poverty.

The first entrance examination for undergraduate students was held. The candidates, 8,464 young people who had already passed an initial examination, competed for the prize of admission. Just 2,913 were admitted.

March

03

The second entrance examination for undergraduate students was held. Out of 1,568 candidates, 350 were successful.

The Nursing School and the Midwifery School of the University Hospital closed their doors. Both schools ended careers that had lasted about 110 years.

Commencement for the 2001 academic year was held for 3,407 undergraduate students, and 3,436 graduate students had their degrees conferred. Sir Colin R. Lucas, Vice-Chancellor, University of Oxford, and Dr. Masatoshi Koshiba, Professor Emeritus of the University of Tokyo, attended the ceremony as guests of honor and gave congratulatory speeches.

April

04

The University's matriculation ceremony was held. A total of 3,315 freshmen began to participate in the activities and campus life of the University of Tokyo. At master's level, 2,774 students were admitted to graduate school courses, and 1,404 entered doctoral courses.

Professor Katsuhiko Sato, Professor Katsuhiko Mikoshiba and Professor Emeritus Osamu Kitani received the Medal with Purple Ribbon.

May

05

The 75th Students' May Festival was held at Hongo Campus. About 56,000 people visited the campus to enjoy the festival.

June

06

The 1st UT Homecoming Day, a large-scale alumni meeting, took place at Hongo Campus. About 600 alumni gathered in the main auditorium to hear a lecture. The meeting concluded with the school song.

July

07

"Open Campus 2002" was held at the Hongo Campus, with

1,200 senior high school students selected on a first-come-first-served basis to take part in the event.

The 3rd Open Academic Lecture was held at the main auditorium. About 500 people listened to lectures given by Professor Katsuhiko Sato and Professor Katsuhiko Mikoshiba, who had received the Medal with Purple Ribbon that spring.

October

Professor Emeritus Masatoshi Koshiba won the 2002 Nobel Prize for Physics for pioneering contributions to astrophysics, in particular for the detection of cosmic neutrinos. (See page of 18)

Three students and the cheerleading group of the University of Tokyo were awarded the UT President Award for outstanding extracurricular activities and their contribution to social work and international exchanges.

November

The University of Tokyo held UT Forum 2002 in Singapore, with the assistance of and in close association with the National University of Singapore on the NUS campus.
(See page of 22)

Komaba Festival was held on the Komaba Campus.

December

The 4th Open Academic Lecture took place in the main auditorium. Professor Takahiro Fujimoto, Japan Academy Award winner, and Professor Tadao Ando, American Institute of Architects (AIA) Gold Medallist, lectured. As many as 1,200 people attended.

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