I'm always dreaming.
New ideas, better ways
to do something...
That kind of thing.

The inventor of the semiconductor laser, super luminosity LED and optical fiber advocates effective energy usage

Engineer, Sophia University Special Professor

JUN-ICHI NISHIZAWA

Photographs/Satoru Naito,Interview/JQR

JQR : How did you come to research semiconductors?

Nishizawa: There was a special research system in Tohoku University at the time which I used, and I continued my research after graduation, then transferred to Professor Yasushi Watanabe's laboratory. In December 1948, Professor Watanabe visited the Allied Forces General Headquarters in Japan and heard that the Bell Telephone Research Laboratories in America had made a solid-state amplifier using semiconductors. In March the following year he ordered me "to start researching semiconductors too." That was how it began.

JQR : As early as September 11, 1950 you filed a patent for pin diodes with a working efficiency of over 99%. This was followed by the avalanche photodiode (APD) in 1952, the pin photodiode in 1953, and in 1958 had a withstanding voltage of 2300V and 400A, which was amazingly high for the time. How do you go about tackling things to produce such results?

Nishizawa: It's really quite ordinary. I suppose, when you come down to it, I think things through until I'm completely satisfied. Then, I use the conclusion I've come up with as the basis for testing. It's this process of continuing to think something through patiently, without missing anything, that leads to new discoveries. Young people may have the knack of skillfully absorbing information, but they're also quick to give up. (laughs)

JQR : Don't you ever have misgivings about following something through?

Nishizawa:Of course, plenty (laughs). Things like 'Is this the right method?' or 'Will someone get results before me?' But if you stop and give up, then there's nothing left. Even first-class researchers have some regrets about research they didn't stick to and get more deeply involved in. It's very important to not let an opportunity pass you by once you've discovered it.

JQR : In April 1958 you filed a patent for light amplification called a semiconductor maser. Back then the word 'laser' wasn't used, instead people spoke of the maser, something that amplified microwaves.

Nishizawa: In 1955 I was the first in the world to succeed at microwave amplification and come up with a solid-state maser. I then thought that if I used semiconductors, continuous amplification might be possible. The world doesn't give any recognition to ideas that aren't brought to fruition, and so I scrambled to find the funding for the research. However, industry bluntly refused to contribute anything, saying they couldn't spend money on something that they didn't even know was possible.

JQR : In the end you were scooped because America developed the semiconductor laser first.

Nishizawa:At the time Professor Zenichi Kiyasu said to me "I'd like you to think about what would be a good way to transmit semiconductor laser light." I suggested that "fiber would be good." Then in 1964 I filed a patent for a light-focusing glass fiber with an internal refractive-index distribution, which was a groundbreaking optical transmission line. The next year I published a paper in IEEE Spectrum. Even then Japanese reaction was slow, and the very first person to come and investigate this was Dr. John Pierce of Bell Laboratories. Immediately after returning to the U.S. he began joint research with the Corning Glass Works.

JQR : You're creative on a large scale, aren't you? Even when a paper concludes that something can't be done, you dare to challenge that. It seems like you have something that can get beyond the dominant view or frameworks of common thinking. How do you get your ideas?

Nishizawa: I'm always dreaming. I think about things and wonder if maybe this is possible, or if it would be possible if I did this or that. But you're not a scientist if you just dream. It's giving those dreams a solid shape that is important, and if you can achieve that then it's also a huge joy.

JQR : Scientific and technological research is advancing rapidly and as it advances there's always the next step, so there must be a lot of cost outlay required.

Nishizawa: There's a lot of expense involved in cutting edge research. The government should give science and technology a large budget because Japan is able to do that. Naturally researchers who receive research funding should be required to produce results. Waste can't be tolerated when taxpayer's money is being used. My research was largely not understood so I received little funding. That's why I used the money I received from patents to start a laboratory, but this is an uncommon solution.

JQR : In the budget screening of 2009 the question came up as to why second best wouldn't suffice for super computer performance. What do you think about this?

Nishizawa: It's important to be conscious of trying to be the best. Aiming to be number one, not part of the masses, spurs you on to try and overcome different obstacles. As every Japanese person knows, our country has no natural resources. So the security of a people who live on islands with no natural resources must be achieved by carrying out research that makes everyone in the world happy. Science and technology can make this happen. For Japan, science and technology truly is a lifeline.

JQR : The government has been criticized for its handling of the rapid aging of society and the fiscal deficit.

Nishizawa:A 'period of maturation,' is a nice way of putting it but the truth is that we haven't been able to pull out of this long-term stagnation. I believe it's necessary to keep on our toes and have a sense of mission. If we don't produce new science and technology we can't keep up. It's sad that the Japanese are not able to acknowledge excellence and capability in people. If we don't take the position of providing money to develop original ideas—even if the risk is great—then we'll lag behind in this age of technological competition. In fact I have a feeling that we're already falling behind.

JQR : At the end of the eighties we often heard about 'Japan as number one.' You don't think that prosperity will come back?

Nishizawa:It was practically a miracle that we were even able to compete with America at all up to then. My own opinion was that forty years after the war, we were finally able to stand at the same starting line. But then the bubble burst. Ambition faded away rapidly. Japan at that time had illusions. It had fooled the world. Certainly cheap, small and durable Japanese products gained popularity around the world and sold well. But that was only because we had the skills and technology to improve existing products. Coming up with something totally new is definitely not our forte. So when we entered the nineties and the world entered into a new IT technology competition led by Silicon Valley, we no longer knew where to focus our energies. We've drifted along with narrow vision and fallen behind, a state of affairs that continues to this day.

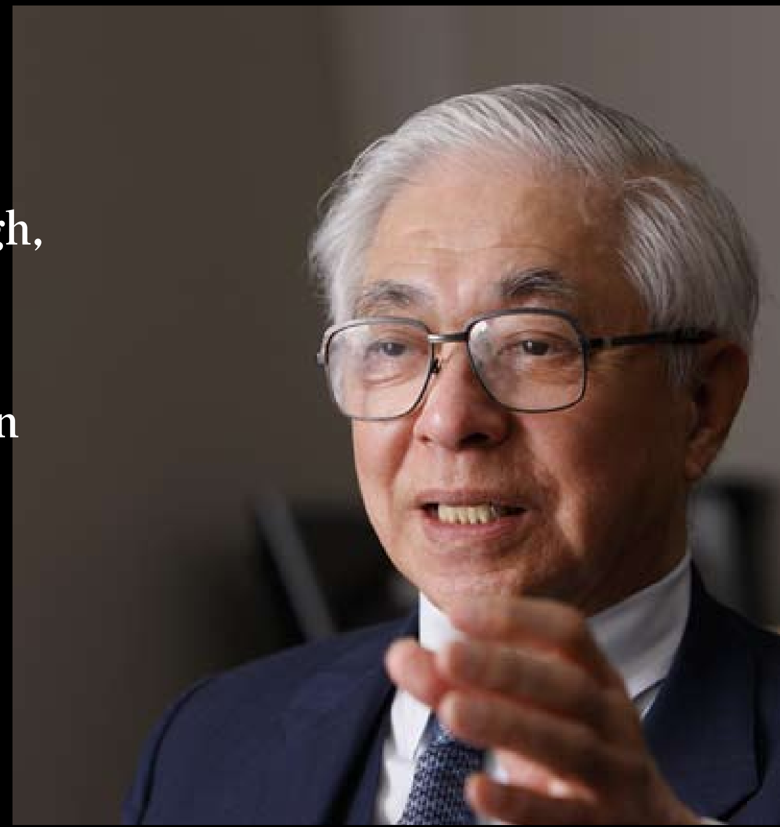
What do you see as Japan's role in the future?

Nishizawa: To deal with problems such as global warming. Although there are elements of uncertainty, and a great deal of global debate, we can say for

Institute of Electrical and Electronics Engineers (IEEE) The Jun-ichi Nishizawa Medal

The IEEE established a medal bearing Jun-ichi Nishizawa's name in 2002. Considered one of the highest distinctions in the field of electronics, the medal is awarded to individuals or teams that make outstanding contributions to the sciences of electronic devices and materials. In 2000 the IEEE awarded Nishizawa the Edison Medal for his advocacy of a global DC transmission network system.

Dreams are not enough, they must become something. The scientists' mission is to produce results.



certain that there is a looming energy crisis with the fossil fuels that have sustained our civilization, such as oil and coal. At the same time the harmful effects of the carbon dioxide that these fuels produce are exceeding tolerable levels for the world. There's a need for Japan to quickly develop new devices and supply them to the industrializing world. Raising the level of energy usage efficiency is an urgent issue.

What are the issues for the human race?

Nishizawa: So many there's no end to them! (laughs) To start with there's the food shortage, so foodstuffs that grow quickly and can grow even in the dark would be very useful. We have the sun's rays in daytime but not at night. So we could do something like bring electricity from the other side of the earth to grow things using LEDs.

Bringing electricity from remote places is the concept behind the static induction thyristor (SITHY) that you developed, isn't it?

Nishizawa: GE leapt straight in right after I published a paper in an IEEE journal in 1971, about using the principle of static induction transistors (SIT) in thyristors (electric switches made of semiconductors). I wanted to use direct-current power transmission with this SIT thyristor, and the question was how much loss there would be. That was the first time I learned about the importance of DC power transmission. Even at the Electric Power Research Institute (EPRI) there's talk of using it for the stabilization of power supply. When rows of solar cells in the desert generate electricity, the power has to be transformed to alternate current to transmit it along high voltage lines because solar cells are low voltage and high current. At an OPEC General Meeting in 1986 I gave a presentation on a system that could send hydroelectric power to factories and the surrounding environs of major cities via DC power transmission. SITHY has attained figures of 98% efficiency at 300KHZ, and 99% at 20KHZ generation.

Do you think that Japan might not founder if we can offer innovations and new industries that the world would welcome?

Nishizawa: We've come to a turning point that will determine our future and the survival of mankind. I want to use the power of technology to avert a global crisis, and pass the baton to the next generation of humanity.

What interests and worries are closest to your heart?

Nishizawa: Making artificial gasoline, or doing something that other people aren't, to show that it can be done. The fact that there are so many things I still want to do is another of my worries! (laughs)

Jun-ichi Nishizawa

Born in 1926, Nishizawa is an engineer, senior adviser and specially-appointed Professor at Sophia University. He invented the avalanche photodiode (APD, 1952), the pin photodiode (1953), semiconductor laser (1957), light-focusing glass fiber (1964), static induction thyristor (1970), and polarization fiber (1974). He has a track record of original results in developing semiconductor devices, semiconductor processes, and optical transmission. He has held posts as President of Tohoku University and Iwate Prefectural University, and is currently President of Tokyo Metropolitan University. He is Professor Emeritus at Tohoku University and a member of The Japan Academy. In 1983 he was awarded the Order of Cultural Merit. He also serves in numerous public posts such as chair of the High-Tech Industry Innovation Agency.