Heat Transfer Research, 2002, Vol. 33, Nos. 5 & 6

TRIBUTE TO CHANG-LIN TIEN
Former Chancellor
University of California at Berkeley

by

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Professor C. L. Tien died in October 2002 after a year-long battle for his life in California. A personal and professional friend for many years, Chang-Lin will be sorely missed by the heat-transfer community.

Before he fell ill, Professor Tien delivered a Plenary Speech at the 2000 National Heat Transfer Conference in Pittsburgh. I consider this speech to be Chang-Lin's testament to the international heat transfer community and it is printed below.

Here are the words of Chang-Lin Tien which I call the Global Strategy on Technical Research and Development in the New Millennium[*]:

I have been working in heat transfer for 45 years and moved among its various areas. After serving as the Chancellor of University of California at Berkeley, I returned to the faculty with a title of University Professor in Management of Technology. My office is located in the Mechanical Engineering Department and I still work on research, guiding students and seeking funding. With my experience in the recent years, I would like to address the Global Technical R&D Strategy in this new Millennium. This is an especially timely issue in this era of a New Economy. This New Economy is showing that it has the volatile nature of dynamic changes. If we do not pay sufficient attention to our strategy of R&D, there is the risk that we will get lost and fall behind the competition.

Here is an example that illustrates the importance of R&D strategy. When I became the Chancellor in 1990, 50% of University of California research funding came from mission-oriented sources such as NASA and DOD. The fundamental research was composed mainly of 25% of NSF and 25% of NIH funding. I believe that university should put emphasis on fundamental research while the mission-oriented fund-

[*]The taping of Professor Tien's remarks was done by Professor S. C. Yao and it was transcribed by his daughter Shu-Dar.

ISSN1064-2285

ing, although essential, is usually unstable. Therefore, I wished to change the funding distribution to 1/3 each from these three types of sources. Various people advised me not to interfere with the university research direction, which is conducted usually in a bottom-up nature by professors.

Anyway, I executed the new strategy with the provision of incentives on overhead and seed money, etc. Professors responded actively. In 5 years we achieved 1/3 balance of the three sources. It turned out to be a good strategy to match with the increasing NSF and NIH funding in these years.

Strategy is important because it will allow us to foresee the new trend in this new economy. If you do not follow it fast enough, you will be left behind. Today, I will speak to you about three general aspects: One is about the global trends, which affect the global community. The second is how the global trends affect us. Then I will speak of how we should position ourselves in heat transfer research.

Although we work in heat transfer research, we have to pay attention to the trends outside of the heat transfer area to adapt to the new movements, to meet with the challenges, and to take the opportunities that are made available to you. Let me go back to the first issue of global trends. I view the 20th century as based on three very basic global trends:

First, it is the Democracy, which is a major movement in the 20th century. Especially, in the second half of the century many nations flourished or fell because of their movements toward or against democracy. We have already seen that at many places everyone can vote, everyone can speak, and the Political Economy is very well established. Now, the trend is to move into Democratic Economy, which is a free market economy. We talk about the WTO and the competition. That is economic democracy! And this changes the way we work; we are all becoming increasingly competitive. Now we are using the value system, whether you can exceed your rivals. A negative example of the importance of democratic economy is the Soviet Union. They collapsed die to the lack of democratic economy.

The second trend, obviously, is science and technology. One hundred years ago we had the basic science advances and discoveries. There were revelations such as the theory of atoms, relativity, and quantum mechanics. All those innovations really made a leap into the era of science. In the second half of the century you can see that the trend was making the transition into technology, such as transistors and computers. In the next 10–20 years, you can see that the new technology is information technology and biotechnology.

In January of 2000, President Clinton announced the movement into Nanotechnology. As integrated into the Internet, or the medical fields, miniaturization will obviously have tremendous influence on both information and biotechnologies. For instance, the economy of cellular phone is booming, they are now putting e-mail, the web, faxes, printers, and other things into this tiny device. In order to get more functions out of this device, everything has to be smaller and smaller.

Nanotechnology will have substantial influence on the future of other technology. Technologies are changing time. An example is the information technology. Two years ago the Internet dot-com was the hot area. Now it has collapsed, but optical network emerges as a hot subject. We have to see where the technology is going to position ourselves correctly.

The third trend is globalization. This word has been remarkably debated, even feared, especially outside the U.S. In Asia, including Japan and China, people are worried about WTO and globalization. In general, people like the Modernization, which implies the rise of the living standard. In contrast, Globalization symbols the threat of invasion of the market by Western countries.

Unfortunately, the globalization is a trend, which cannot be stopped or avoided. Just due to the effects of air transportation and Internet, we simply cannot resist globalization. Whether you like globalization or not, you cannot avoid it. The only way to do is to reengineer your system, to face it and take advantage of it.

This is important to Asia. After the last Asian Financial Crisis, most countries have not done much to reorganize themselves to accommodate the globalization. This is also important to U.S. at both universities and industries. For example, IBM, Xerox, HP, and Apple have gone through a tough time before having to adjust to the new environment. Now, IBM, Xerox, etc. have reacted very well and have come back with glory. These companies now have design, manufacturing, marketing, and accounting distributed at different locations in the world due to globalization.

What are the effects of these Mega Trends and how are they affecting us?

Firstly, it is the Economic Democracy. One feature is the competition. In the universities, the economic democracy also occurs. We are now competing for graduate and undergraduate students, grants and centers. In order to get ahead, we have to take risks. Just like the Venture Capitalists are taking risks. The issue is assessment. It is important to judge a risk as being worth taking or not.

Another feature is the importance of timing. In the industry, the issue is the time to market. For example, in the past, Xerox made a new model of their copier every 2–3 years. Then it has improved to six months. Now it is three months and, in the near future, it will be in the order of one month. Only by putting out new products can they move ahead. Today, even patents cannot be relied on to keep the market edge. This is especially true at this Internet time. The first company that has the product on the market will have the majority of the market. This includes both the new and the traditional industries.

The last feature is Cost Control. The U.S. has made a substantial progress in this aspect. This is why the U.S. enjoys the great economic growth in the last ten years. Much of this is due to the use of information technology. Today's Bell Lab, IBM Lab and GE, etc. are not the same as before. On the other hand, the university research is becoming more important. Companies are more and more relying upon universities to provide new idea for new products.

The second effect emanating from the Mega Trend is the Technology.

The research now needs very deep knowledge and have a very high added value. We have to open up ourselves, even the Professors, to explore various opportunities. This is also intellectually very challenging.

Here is one example. In 1997, an assistant professor at UC Berkeley wanted to resign. He invented a new search engine and had a graduate student start a company. He intended to leave for the company and the university seemed not able to keep him. I talked with him and advised him to spend one day per week plus the weekend on that company, while staying at the university for academic research. In this way he may get both advantages. He decided to stay. Now, that company is very successful, it is the Inktomi Co. This year he was also promoted to an Associate Professorship at UC Berkeley.

For us, at the Heat Transfer community, how are we to move into the Infotech and Biotech? Here is an example: Professor Rubinsky is at UCB's Mechanical Engineering. He had an idea of passing electric current through a cell membrane to change its permeability. This change of permeability can be used to control the penetration of drugs into the cell. We have been used to work on porous media and permeability and we could also look into this field. Another example is the study of thermoelectric phenomena of the super-lattice, which has a significant effect on the thermoelectric cooling of electronic products. A typical person is Professor K. Chen at UCLA who works in this area.

For my personal experience, I have worked on thermal radiation. But now I have a company developing optical switches using my radiation background. I simply applied the knowledge of thermal radiation in the applications.

The Third effect of the Mega Trend is Globalization.

The more Globalization, the more Regionalization. The typical example of regionalization is the Silicon Valley and the Boston High Tech Region. In these regions, there is a concentration of technical expertise, lawyers, businessmen, and venture capitalists. Other successful cases are Taiwan Science Park, Japan Sukuba Science Park, and possibly the Biotech Park at Cambridge in England. Not all attempts of establishing high tech regions are successful. Boston High Tech Region has collapsed ten years ago and now is being rebuilt with strength. We have to work with the industries at our region and prosper together.

In all, I have worked in Heat Transfer for many years and changed for many areas. The competition for funding is increasing and you to have new ideas and willing to take risks. The research moves into molecular scope. We have to work together with industry, venture capitalists, and even startup companies. We may consider the transferring of patents to the companies for making products.

On the other hand, the industries are having severe competition and cannot maintain a large research laboratory. For us, working on heat transfer, will have a lot of opportunity by working with industries. We have to move into new directions of research; however, it could be still the same research area in which we have expertise. For example, I presently work on the heat transfer in microelectronics and optics.

Also, I work on two-phase problems on a molecular scale. I try to explore the smallest liquid drops or smallest stable bubbles to apply in the areas such as ink jet printing of very minute features. The electrical or electronics engineers do not know this at all, but need our contribution. There are many areas like this for us to explore and to be excellent in it.

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