

Time's Arrow Viewed from Chaos

— Late Prof. Tasaki's book on foundation of statistical physics —

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In the 1980s, both Shuichi and I spent the time of post-graduate students at the same university, Kyoto university, where there is a strong tradition of academic research. That was a time when studies on chaos were becoming active, and I chose quantum chaos as the subject of my PhD thesis. Shuichi belonged to a laboratory of condensed matter. However, in Kyoto university, we had an interdisciplinary atmosphere, and students of different laboratories often mingled with each other and had stimulating discussion across various fields. It is a valuable experience for me to have established friendship with students of different research fields.

At that time, Shuichi was already well known by his originality of his own research and also ability of understanding topics of other research fields. His originality flourished when he became a member of Prigogine's group and started research on the foundation of statistical physics from the dynamical view point. He published many research papers on this subject. In addition to these papers, Shuichi also published a book on the origin of irreversibility for a wider audience. He wrote the book after he left Prigogine's group and became a professor of Nara women's university. The name of the book is "Time's arrow viewed from chaos", and it is in the popular series on science published by Kodansha. The book is meant for undergraduate and post-graduate students studying statistical physics and nonlinear science.

The following is the contents of the book.

- (1) Time's arrow and problem of irreversibility
- (2) Experiment of time reversal : spin echo
- (3) View of Gibbs : idea of statistical ensemble
- (4) Chaos
- (5) Diffusion as an irreversible phenomenon
- (6) Time's arrow inscribed in distribution

Shuichi starts his book by introducing a game which is a model of the kinetic theory of gas. In the game, the players move randomly, and exchange their points randomly every time when they meet with another player. By displaying results of the game, he says that the distribution

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of the points approach the Maxwell-Boltzmann distribution of energy. Then, he goes on to explain the H theorem of Boltzmann and the problem of irreversibility. In fact, these results of the game was taken from the master thesis of his student in Nara women's university. This way of introducing the subject is a typical example indicating his ability of explaining physics to students. These days, students tend to lack images of physical phenomena when they study physics. Therefore, it is very important to offer opportunities to have images of what is taking place when students encounter mathematical formula.

After he left Nara women's university, I succeeded to his position. In the course of statistical physics at Nara women's university, I use the baker's map to show that deterministic systems can exhibit stochastic behavior. Then, as an assignment of my course, I ask my students to write a report on Shuichi's book. Some students become very interested in chaos and its relationship with the foundation of statistical physics. I think that Shuichi's book deserves translation into English. It is worth obtaining much wider audience in the world.

When Shuichi was a professor of Nara women's university, he also had a course on pattern formation. His course was very popular, and some students chose him as the supervisor of their theses since they became interested in nonlinear science by Shuichi's lecture. When I became a professor of Nara women's university, I needed to prepare the course on pattern formation. Then, I asked Shuichi to show me his lecture note. The note was well written and was useful for me to prepare my own lecture.

Let me end this essay by recalling my last memory of Shuichi. When my son started thinking of which university he would go, I took my son to see the campus of Waseda university. That was on Sunday and we could not enter the campus because the campus was locked out. When we started to go back to the nearest station, we bumped into Shuichi. I did not have any appointment to meet Shuichi and it was a pure chance to see him. He said that he came to the university to do some managerial work, and he invited us to enter his laboratory. After knowing that my son came to see what it was like to study in the university, Shuichi showed to my son scientific toys which were meant to reveal the second law of thermodynamics. My son had a strong impression of Shuichi's eagerness of explaining physics. We spent one hour or so in Shuichi's laboratory and left his room. Unfortunately, this became the last time I met him. I miss him not only for his originality as a physicist but also for his eagerness and sincerity as a teacher of physics.

References

- [1] Time's Arrow Viewed from Chaos, Shuichi Tasaki, (Kodansha, 2000, in Japanese).