REMEMBERING PROFESSOR T. ISHIHARA

Luigi M. Ricciardi

In 1970 I was a faculty member at the University of Chicago, but my appointment left me free to spend one quarter wherever I liked. My preference was the Laboratorio di Cibernetica, to whose birth I had been fortunate to contribute under the outstanding leadership of Professor Eduardo R. Caianiello, my thesis advisor in 1964 and for almost forty years my constant mentor and intellectual guide.

Around the end of September 1970, Professor Caianiello informed me that a Japanese professor was visiting the Laboratorio and invited me to join them for lunch. That was the first time I met Professor Tadashige Ishihara. I never imagined that this event was going to mark the beginning of a long-lasting collaboration that would develop and bear fruit for almost four decades.

I clearly recall that during that historic lunch Professor Caianiello elegantly exhibited his high proficiency in the Japanese language, which he had been voraciously studying for several years, simultaneously with Chinese. I also recall, not without a sense of shame, that without any shyness I recited a few Japanese rigmaroles and children's poems that my one-year-old daughter liked to listen to endlessly: *Daruma-san, Daruma-san, niramekko shimasho . . .* and *Zō-san, Zō-san, ohanaga nagainone . . . .* I remember Professor Ishihara was quite amused and wanted to know more about my family.

Later in the afternoon, Professor Ishihara was asked to give a seminar to the members of the Laboratorio. I recall that he was initially a little reluctant to do so, claiming that he could offer only a few comments on the neural network theory developed by Professor Caianiello [1]. After being warmly encouraged by us, however, he agreed and talked extensively about various interesting mathematical problems of what he called "Caianiello's neuronic and mnemonic equations", which were actually his own views on sensible mathematical approaches to the dynamics of neural networks. This seminar was received by the audience with great interest, which probably encouraged Professor Ishihara to extend some of his previous work while he was at the Laboratorio (see, for instance, [2]).[1] Indeed, he developed a model of short-term and long-term memory on the basis of an assumed induction of local network reverberations by a local reverberation, an essential role being played by mnemonic equations in which the adiabatic learning hypothesis was relaxed [3].

Probably also as a consequence of discussions with Professor Caianiello and with some younger colleagues, which included Professor Aldo de Luca and myself, Professor Ishihara conjectured that mnemonic equations and local reverberations could play a relevant role in generating conditioned reflexes by the nervous system, an idea that was unanimously appreciated. This was indeed the *leitmotiv* of other work that had been partially completed while Professor Ishihara visited the University of Southern California at the invitation of Professor Richard Bellman [4]. This work was followed by other more technical articles (see, for instance, [5]).

[1]I wish to thank Professor and Mrs. Shunsuke Sato for helping me to correctly locate some of my recollections in space and in time, and Mrs. F. Otsuki for providing copies of some of Prof. Ishihara's papers.

Professor Ishihara's interest in reverberating networks and in general on threshold systems never faded, as witnessed also by several successive papers, some of which are co-authored by M. Sato.[2] Two of these papers, [6] and [13], in particular, are clearly indicative of the deep interest of Professor Ishihara in the dynamics of non-linear systems consisting of aggregates of threshold units.

I had on several occasions taken note of the deep friendship that had been established between Professor Caianiello and Professor Ishihara. Both had visited the others country, and they never missed the opportunity to alternate discussions on mathematics with recollections of similar experiences in their hard younger days. I remember that one evening Professor Caianiello wanted to offer to Professor Ishihara a special token of his deep and sincere friendship. After thinking a moment, he handed to Professor Ishihara an object very dear to him: an elegant fan dating back to the mid-19th century that had belonged to one of his grandmothers. Professor Ishihara was apparently touched, and displayed his emotional reaction in a vigorous hand shake.

On October 22, 1993, Professor Caianiello unexpectedly passed away. I have no doubt that this event must have been a source of great sorrow for Professor Ishihara. He immediately invited me to prepare a biographical sketch of Professor Caianiello, which appeared the following year in the first issue of Mathematica Japonica, accompanied by a full-size color picture of his great friend [12]. In addition, Professor Ishihara proposed that a special issue of the journal contain articles by some eminent scientists who had been particularly interested in Professor Caianiello's vision of different areas of science. A volume was thus published that included scientific contributions by Paul Cull, Rudolf E. Kalman, Susumu Okubo, Giorgio Papini and Hiroomi Umezawa [7].

I have been fortunate to have had several opportunities to spend time with Professor Ishihara. Among such occasions I wish to recall a meeting of the Advisory Board of Mathematica Japonica held 29th January 1994, at the Machikaneyama Kaikan on Toyonaka Campus of Osaka University. On that occasion also my wife was able to meet and talk to Professor Ishihara and to the other members of the Board. Another less formal and very friendly meeting was at a dinner hosted a few years later by Professor Shunsuke Sato at an Italian cozy restaurant in the Ikeda region. Moreover, as a member for many years of the Advisory Board of the Journals published by the International Society for Mathematical Sciences, I had the privilege of collaborating with Professor Ishihara in his role as managing editor, and also in assisting him in handling a large number of submitted articles.

I wish to emphasize that Professor Ishihara was also very interested in the applications of mathematics to practical or socially relevant issues, such as cybernetic, biology and analytical approaches to modelling economical developments, as witnessed by some of his publications (see, for instance, [8], [9], [10] and [11]). I am particularly grateful that he displayed his this interest also by agreeing to publish in dedicated special issues of SCMJ collections of peer-reviewed articles presented in the 2002, 2005 and 2007 BIOCOMP International Conferences.[3]

I deeply regret that Professor Ishihara's health conditions ultimately did not allow him to participate in the BIOCOMP International Conference *Collective Dynamics: Topics on Competition and Cooperation in the Biosciences*, held at Vietri sul Mare on the Amalfi Coast in September 2007, for which he had happily agreed to deliver a lecture.

---

[2]At the beginning of the seventies, I had become familiar with some work by M. Yamaguchi, a mathematician from Kyushu University and a former student of Professor Tosio Kitagawa at the Research Institute of Fundamental Information Science. To my surprise, I discovered later that she had become the spouse of my friend Professor Shunsuke Sato, whom I had met for the first time in 1971 while from January 1971 to April 1972 he was doing research at the Laboratorio di Cibernetica.

[3]See the Special Issues of Sci. Math. Jap. *(i)* vol. **58**, no. 2, pp. 221494, 2003; *(ii)* vol. **64**, no. 2, pp. 173-507, 2006; *(iii)* vol. **67**, no. 2, pp. 1–228, 2008.

But more than that, I mourn the loss of a true gentleman, a great organizer and an inspiring colleague. The world is less for his absence, but our lives all the richer for having known him.

Napoli, 18th June 2009

References

[1] Caianiello E.R. Outline of a Theory of Thought Processes and Thinking Machines. *J. Theor. Biol.* **1**, 204–235, 1961.

[2] Ishihara T. On Caianiello's Neuronic Equations. *Math. Japon.* **15**, 119–125, 1970.

[3] Ishihara T. Local Reverberations in the Nervous System and Memory. *Math. Biosci.* **12**, 225–233, 1971.

[4] Ishihara T. Local Reverberations in the Nervous System and Conditioned Reflex. *Math. Biosci.* **12**, 23–31, 1971.

[5] Ishihara T. Some Mathematical Models of the Conditioned Reflex. *Math. Japon.* **17**, 195–201, 1972.

[6] Ishihara T. and Sato M. Variation and Stability of Reverberations in Threshold Systems. *Math. Japon.* **19**, 357–369, 1974.

[7] Ishihara T., Marinaro M., Ricciardi L.M., Sato S. and Scarpetta G. (eds). Tribute to Eduardo R. Caianiello (1921-1993): A Biography and a Collection of Dedicated Articles. *Math. Japon.* **41**, 1–124, 1995.

[8] Ishihara T. Cybernetics of Technology and Economics Growth. In *Current Topics in Cybernetics and Systems*, 1–14, Springer-Verlag, 1978.

[9] Ishihara T. Analysis and Modelling of Development Economy of the Less-developed Countries. In *Proceedings of the Asia Pacific Conference on Operational Research*, 1982.

[10] Ishihara T. Total System Approach to Analysis and Modelling of the Development of Economics in the Low-income Countries. *Math. Japon.* **28**, 1983.

[11] Ishihara T. A method for getting Approximate Input-Output Tables for Less Developed Countries. In *Proc. 4th International Conference on Mathematical Modelling*, Pergamon Press, 1983.

[12] Ricciardi L.M. Eduardo R. Caianiello (1921-1993), a Biographical Sketch. *Math. Japon.* **39**, I–XVI, 1994.

[13] Sato M. and Ishihara T. Graph Theoretical Approach to Threshold Systems. *Math. Japon.* **19**, 371–380, 1974.

Luigi M. Ricciardi
Dipartimento di Matematica e Applicazioni, Università di Napoli Federico II
Via Cintia, I-80126 Napoli, Italy
E-mail: `luigi.ricciardi@unina.it`