How to Promote Interdisciplinary Activities of the Katachi Society

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This forum article is aimed at introducing the main activities of the Society for Science on Form, Japan since its establishment in 1985, and its relations to friend societies with similar characters. At present, we have two major friend organizations, i.e. the Society for Culture on Form (in Japan) and the International Society for Interdisciplinary Study of Symmetry (ISIS Symmetry). Next, meanings of "Katachi" and "Symmetry" are explained, so that the relations to these friend organizations are convinced. In addition, other small groups with interdisciplinary activities are introduced, i.e. the "Kutachi" group in USA (aiming at development of better artificial systems) and an NPO Interdisciplinary Institute for Science Technology and Art (ISTA), in which the present author is deeply involved. Then, the past and present situations of the journal Forma is mentioned, and some hints are given in order to elevate its status.

Key words: Interdisciplinary Activity, Science of Form, Katachi, Symmetry, Kutachi, ISTA

1. The Society for Science on Form, Japan

This society was established in 1985 in Japan by combining two scientific groups, those of the stereology and the physics of forms. The former is a research group which aims at reconstructing three-dimensional (3D) structures of objects from their 2D information obtained through observing their cross sections. The main fields of this kind of researches are medicine, mineralogy and technology for granular materials. The aim of this group has changed to that with a broader scope, i.e. investigating a relation between forms and functions. The latter is a group of natural scientists investigating mechanisms how various materials acquire their forms in nature, such as shapes of crystals and aggregations, branching structures of rivers and vortices in flows. This activity is partly influenced by the physics of pattern formation in non-equilibrium state, which was promoted by some physicists in the last century, such as I. Prigogine who constructed the thermodynamics of non-equilibrium state and H. Haken who investigated the mechanism of laser light. The key persons of these two activities in Japan were Prof. S. Ishizaka and Prof. T. Ogawa, respectively (both of them belonged to University of Tsukuba), and S. Ishizaka became the first president of the Society.

The first major project of this society was the 1st International Symposium—Science on Form at University of Tsukuba in November, 1985, where S. Ishizaka worked as a chairman. The Proceedings of this Symposium was edited by some stuffs of the Symposium including the present author (Ishizaka *et al.*, 1986). The participants of the Symposium varied from natural science to social and cultural sciences including the fine art, hence this Society was a widely interdisciplinary one from the beginning. The 2nd International Symposium—Science on Form was held also at University of Tsukuba by S. Ishizaka in 1988, where the scope of the Symposium was limited to the stereology (Ishizaka, 1990) and the famous scientist of this field, E. R. Weibel in Switzerland, was invited.

The Society began to publish a research journal "Science on Form" in 1895, where Prof. K. Baba worked as an editor-in-chief and the present author joined as one of editors. This journal included both English and Japanese papers, and its 2nd and 3rd volumes were published in 1986 and 1988 with the same style. In these years the present author was asked by K. Baba to become an editor-in-chief because of his health problem. At that time the present author proposed to change the title of the journal to "Forma" and to set up a rule to accept only English papers. These propositions were made according to the following comments from members of editorial board. A Japanese editor living in USA asked the present author to change the title of journal, because the meaning of "Science on Form" was not understood by American people. He said that the "on" in "Science on Form" was difficult to explain and his friends did not agree to submit papers. Another member of the editorial board said that the mixture of Japanese and English papers, as a common sense of scientific publishing, lowers the status of the journal. Finally, present author started the journal of the present style with a new name "Forma" in 1989 as volume 4.

In 1988 the present author succeeded the role of the president of the Society according to a strong wish of S. Ishizaka. At that time the present author expected that S. Ishizaka would stay at this post for further several years, and could not understand why he wanted to retire so early. But, the present author can imagine now that he might have been satisfied with his great effort to start the Society for Science on Form, which has a very unique character of bridging among

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various scientific fields with a single keyword "Form". In addition, he might have wanted to take in younger scientists to support this Society.

Since then, this Society is keeping a certain level of activity and we have several scientists working as presidents of the Society. As for the editor-in-chief of the journal Forma, Prof. S. Kai succeeded this post in 2009 and now Prof. H. Takada has succeeded it.

2. Introductions of Other Societies

2.1 Society for Culture on Form, Japan"

In 1992 a sister organization was born whose name is Society for Culture on Form, Japan, many of whose members belongs also to the Society for Science on Form, Japan. Prof. T. Kaneko was elected as president of this new society, who stays still at this post. This society includes more fraction of cultural scientists, and had been publishing Japanese journal "Katachi no Bunka-Shi (Journal of Culture on Forms)" annually since 1993, which had been sold in bookshops in the town. However, owing to financial difficulty of publishing it is stopped now, and a new journal "Bulletin of Cultural Study on KATACHI" started in 2005, whose editor-in-chief is Prof. N. Mitsui. Information of this Society is available in its homepage (http://katachi-imagination.org/shoukai/index.html).

In spite of the fact that both Societies are sisters, joint symposia by these societies were not organized often (only twice within 22 years!), which are mentioned in the next subsection. It is a strange situation that these societies, both searching for interdisciplinary activities, are not keeping close companionship. The present author would like to expect more frequent contacts in future among younger scientists of both Societies.

2.2 International Society for Interdisciplinary Study of Symmetry (ISIS Symmetry)

This Society was established by a Hungarian mathematician Denes Nagy and his friends in 1989 at Budapest, Hungary. At the time of its establishment they organized a symposium "International Symposium for Interdisciplinary Study of Symmetry, and soon later it became the name of society after changing "Symposium" to "Society". Since then, this Society gives Symposia every three years (Hiroshima in 1992, Washington, D.C. in 1995, Haifa, Israel in 1998, Sydney in 2001, Tihany, Hungary in 2004, Buenos Aires in 2007, Gmuend, Austry in 2010, Crete, Greek in 2013). Proceedings of these symposia are published with a title including "Symmetry: Art and Science". Precise information of this Society, the proceedings and a research journal "Visual Mathematics" published by it can be available in its homepage (for the Society, http://symmetry-us.com/; for the Journal, http://symmetry-us.com/Journals/pap.htm). The 2nd Symposium in Hiroshima was organized by Mr. T. Kajikawa, an artist treating geometrical shapes, but after that he stopped to have contact with the Society for Science on Form, Japan.

Here, a note is given on the meaning of "**Symmetry**", which is included in the name of the Society. In a narrow sense it means a geometrical property of an object, i.e. if shape of an object does not change after inversion with respect to a central plane, it has an "inversion symmetry" (or mirror symmetry). In the same way a rotation symmetry and a translation symmetry can be defined. In a broader sense this term is considered to be a composite of "sym" and "metry", where the former and the latter have meanings of "common" and "measure", respectively. Therefore, the symmetry means a common measure, i.e. a standard of beauty or a standard of value. The "Symmetry" included in the name of the Society corresponds to this meaning. For precise, readers are advised to refer an article by D. Nagy in the Proceedings by Ogawa *et al.* (1996).

On the other hand, "**Katachi**" is usually considered to be a composite of "kata" and "chi", the former being the mold for producing a lot of same objects while the latter being an ending giving a magical power. For example, the Japanese term "orochi" means a snake with magical power. In the same way Katachi has a meaning of "form with strength or importance", hence "Katachi" in Japanese culture corresponds to "Symmetry" in European culture.

The present author joins most of the symposia organized by ISIS Symmetry after 1995. This Society includes natural scientists and cultural ones including artists with nearly the same fractions, and is analogous to the combination of the two Japanese Societies mentioned above. Therefore, symposia of ISIS Symmetry have been a good chance for the present author to acquire knowledge of cultural problems.

2.3 Joint Symposia by two Japanese Societies and ISIS Symmetry

These two Japanese societies and ISIS Symmetry had joint symposia with title "The International KATACHI U SYMMETRY Symposium" for two times in 1994 (Ogawa *et al.*, 1996) and 1999 (Ogawa *et al.*, 1999, 2000). Note that "U" in this name means the mathematical symbol for union. Both of these symposia were opened at University of Tsukuba and the chairman was T. Ogawa.

In these symposia many of excellent scientists both from Japan and foreign countries were invited. Some of their names are nominated as follows from the Proceedings given above, with topics of lectures within parentheses (abbreviated by the present author):

In 1994 (key note lectures and invited lectures):

Prince Mikasanomiya (symmetries of holy patterns in from archaeological sites in Asia),

K. Husimi (Japanese traditional patterns preceding scientific treatments),

T. Ogawa (development of study of forms in Japan and proposal for cooperation),

D. Nagy (promotion of contact between Japanese Katachi and western symmetry),

K. Miura (proposition of a structure for spatial activities of humans),

G. Darvas (dichotomous and trichotomous concepts in eastern and western cultures),

R. Takaki (how to promote morphological sciences),

A. Yanabu (Katachi versus form from viewpoint of language).

In 1999 (plenary lectures and some remarkable lectures):

S. V. Jablan (Borromeab links, a kind of notting),

D. Weaire (a short history of pacjing problems),

H. Honda (limited role of genes in determining biological

shapes),

S. Matsuura (growth and colony patterning of Fungi),

H. Yanai (curves in traditional Japanese architectures),

V. Plester and D. Huylebrouck (Ishango artifact, archaeological patterns),

M. Takeno (shapes produced by the magnetic field).

The present author has an impression that the power of the Society for Science on Form. Japan had a peak point in these years. However, it does not necessarily mean that it continues to slow down in future. We could learn something from activities in these years in order to have a better status of the Society.

2.4 Other small organizations related to the Society for Science on Form, Japan

Some organizations are introduced in an order of years when the present author began to have contacts with them.

NPO ISTA

A small organization aiming at bridging among science and art was established in 2004 by Y. Watanabe (a member of the Society) as a non-profit organization **ISTA** (Interdisciplinary Institute of Science, Technology and Art; http://npo-ista.org/). Its office is located in Saitama prefecture in Japan, and it has about 45 members in 2015. The present author is working as a chief director, and making activities, such as workshops for local people including children and exhibitions a few times per year. The recent activity was an exhibition of science art, "ISTA Biennale", where about 15 art works were exhibited at a gallery in Tokyo. Here, the definition of the "**Science art**" is given as an art created by a science mind within the artist. The science mind is considered to be constructed in the two ways, one by expressing a scientific concept as an artwork (its style can be a conventional one) and another by creating an artwork with a newly developed method. Note that applications of modern technologies, such as computer, laser, etc., does not necessarily produce the science art, since these technologies are already established and can be used without science mind in the artists' side.

Kutachi Group

In 2008 two foreign scientists, T. Goranson and B. Cardier, joined the local symposium of the Society at Kyoto, and made a presentation with a title "Kutachi as an Approach to Design a Narrative Dissymmetry Metric" (Goranson *et al.*, 2008). The key word "**Kutachi**" was proposed by them though changing the Japanese word "Katachi" to include a special meaning, i.e. a really good form or concept with which one can create really good products which humans have never seen. This idea is supported by past experiences, such as the fact that a production of computer operating system takes a much time and cost while its goodness or defect cannot be foreseen until it is produced. There is a group of scientists and engineers of artificial intelligence who are investigating this idea, and the term Kutachi has become popular among them. In 2009 T. Goranson and the present author submitted a newspaper article on the concept Kutachi, which appeared in more than 50 newspapers in the world (Goranson and Takaki, 2009). The present author had one more presentation of this topic in 2012 (Takaki *et al.*, 2012), where functions of two softwares (WORD-2003 and -2007) were compared and inconsistencies in the new one were pointed out. The present author considers that Japanese scientists should join or at least support this movement, because they are going to learn Japanese cultures in order to apply them to their object.

Generative Art

In 2011 the present author joined the 14-th International Conference of Generative Art at Roma, and present a paper "Educational System of Science Art for Students of Art and Design" (Takaki, 2011). The term "**Generative Art**" means a kind of art which is generated by the use of a certain algorithm, and has become popular among artists in the world. The organizer was C. Soddu, who is a Professor of architecture at Milano Technical University, and investigates the styles of classical cathedrals. Most of participants were artists, but the present author had an impression that scientists can have activities within this kind of groups. An important point in such occasions would be that scientists should not hesitate to claim their opinions even in such environments.

IASDR

This term is an abbreviation of "International Association of Societies of Design Research", which organizes international conferences every two years. The present author joined the conference in Tokyo, 2013, and presented a paper "Cultural Education for Art and Design based on Scientific Experiences" (Takaki *et al.*, 2013). More than half of members are from Asia and Australia, and the next conference was held in Brisbane, Australia in 2015. This association is an interdisciplinary one and includes scientists and engineers also, and seemed to have a scope nearer to design than to art.

In this subsection organizations concerned to art and design are introduced. They will be useful when someone in the Society for Science on Form wants to make cooperation with organizations of those fields. The present author had an impression that their members are basically very friendly.

3. Publications by the Society for Science on Form, Japan

3.1 Publication of monograph

The Society is publishing two journals, Forma in English and Bulletin of the Society in Japanese. Here, discussion is given on the status of Forma and also on a monograph "Research of Pattern Formation" (Takaki, 1994). The latter is a report of activities under the financial aid from the Ministry of Education, Culture and Science, and most members of the research group belonged to the Society. Hence, this publication can be looked upon as an outcome of efforts of the Society.

The monograph is composed of nine chapters, as listed below with keywords characterizing these chapters:

1. Introduction to science of pattern formation, 2. Geometrical aspects of forms, 3. Crystal growth, 4. Growth of aggregation and other phenomena, 5. Dynamical behavior of fluids, 6. Cellular structures and phase separations, 7. Geographic patterns, 8. Stereology, 9. Digital image

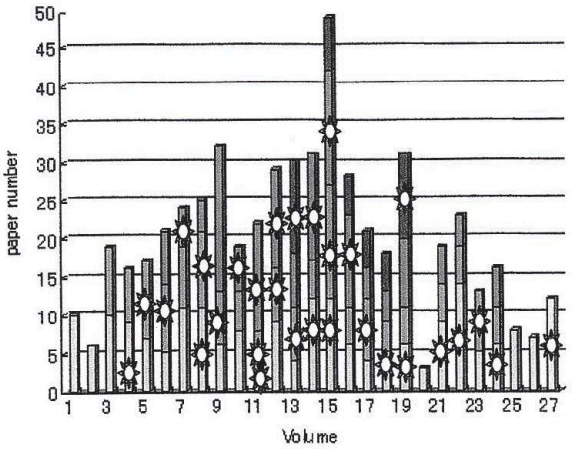

Fig. 1. Number of papers in Forma for each volume. Grey levels in columns indicate separate issues, and the star-like symbols indicates special issues.

processing.

This construction of chapters reflects the activities of the Society at the end of the last century, and the present author is not claiming that they cover all important topics. Interests of scientists vary with time, and new topics can appear among young scientists. What is important would be to publish monographs sometimes when we feel a need to summarize the results of research activities.

3.2 Publication of Forma

The present author would like to confess that he made the greatest efforts among jobs for the Society in keeping the level of the journal Forma during he was working as an editor-in-chief. Here, the level means that of quality of papers and also the quantity of accepted papers. Figure 1 shows the number of published papers in each volume until 2012, where grey levels of columns indicate separate issues in one volume. The issue with star-like symbol indicates that it is published as a special issue with a particular topic. This figure shows that about half of issues were special issues, and that the activity of publishing is enhanced by editing special issues. The number of papers attained a peak in the year 2000, which corresponds to the situation that the activity of the Society also attained its maximum level.

Some special issues were edited by foreign editors, as listed below with volumes-numbers, years and editors' names. One of them was reproduced as a monograph (11-3, 1996).

8-2 (1993) T. Sekimura and T. Murray: "Proc. Workshop on Morphogenesis",

10-3 and 11-1 (1995–6) P. K. Maini: "Travelling Waves in Biology, Chemistry, Ecology and Medicine",

11-2 (1996) G. Bernroider: "Brain Views",

11-3 (1996) D. Weaire: "Kelvin problem" (reproduced as monograph by Taylor and Francis) (Weaire, 1997),

14-1 and 2 (1999) A. Mackay: "Crystal Souls" (English translation of the monograph by E. Haeckel with additional scientific papers),

14-4, 15-1 and 2 (1999–2000) T. Ogawa, S. Mitamura, R. Takaki and D. Nagy: "Proc. 2nd Int. KATACHI U SYMMETRY Symposium",

19-1 (2004) G. Bernroider, S. Roy and R. Takaki: "Brain Patterns behind the Physical Correlate of Mind",

19-4 (2004) J. Kappraff: "Golden Mean".

It is noted here in addition that we had a lot of submissions to Volumes 8–19, which were edited by foreign editors. These data are considered to be instructive for those who are engaged in editing scientific journals.

4. Concluding Remarks

In the preceding sections a lot of instructions, comments and propositions were given. The present author would like to list up some hints here, which are based on his own personal opinions.

(1) We are not isolated in the world, but are attracting attentions from foreign scientists. Note that full contents of papers of Forma are accessible through internet, and good papers will become known immediately. Therefore, international cooperation is always possible.

(2) The characters of the Society and Forma are quite interdisciplinary, and we should keep a flexible thinking and a naïve mind as young students do.

(3) Basically, progress of interdisciplinary activity is slow. Therefore, we need to be optimistic and have patience.

(4) In the interdisciplinary activity we have a lot of occasions where we discuss with scientists from different fields from ours. In those occasions we must be rather impudent while not loosing politeness. At the same time we will be sometimes disappointed by failure of fruitful communication. We must be quick in recovering from this situation.

(5) Finally, it should be pointed out that we need to discuss on these problems in various occasions.

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