

Synthesiology on the Second Anniversary

[Translation from *Synthesiology*, Vol.3, No.1, p.77-82 (2010)]

We have just completed the second year of *Synthesiology* which was launched in 2008. Four issues each of Volumes 1 and 2 were published during the two years, including 49 research papers and 14 articles and interviews. We received various responses from the readers through the questionnaires in each issue. The editors of the journal held a round-table talk on the second anniversary to reflect on the past two years and to project what lies ahead.

Synthesiology Editorial Board



Participants of the round-table talk

Hiroyuki Yoshikawa	Grand Emeritus Advisor, AIST
Akira Ono	Editor in Chief, AIST
Naoto Kobayashi	Senior Executive Editor, Waseda University
Motoyuki Akamatsu	Executive Editor, AIST
Koh Naito	Executive Editor, AIST

The second anniversary of *Synthesiology*

(Ono)

We have just completed the second year of *Synthesiology* which was launched in January 2008. I would like to welcome today the round-table talk participants who were involved in starting the journal. Please give your comments on the second anniversary.

(Akamatsu)

I have gone through all of the published research papers, and I feel that more people are becoming conscious of what “synthesiology” is. Such papers are written differently from conventional papers, and often speak “passionately” about how the authors carry out their researches. On the other hand, there were some authors who had difficulties in switching over from conventional paper writing. I am not sure whether every researcher of AIST understands “synthesiology” clearly, but I think anyone will be able to understand how to write a *Synthesiology* paper after reading its papers and articles.

(Kobayashi)

I sent two copies of *Synthesiology* last year to the President of Technology Management Council, IEEE of the United States, and I received a very sincere response: “I was extremely impressed.” Also, we received a submission of paper from abroad, and I am glad to see that our effort of publishing the English version is slowly but steadily producing results. I hope we can further raise the awareness of the journal

internationally.

I transferred to a university last spring. Since the university is organized according to specialties, it is quite difficult to conduct research across the disciplines. In my university we have been discussing how to establish interdisciplinary research projects since last April. “Creating research” is one aspect of synthesis, and I really feel it is necessary to nurture “synthesiology” as scholarly pursuits.

(Naito)

When I reread all the papers of the issue to write the “Letter from the Editor”, I found the authors write in manners unseen in conventional analytical research papers. They are gaining “insights” across the disciplines. I strongly feel that the style of writing and reading papers of synthetic approach is becoming established. This was unthinkable two years ago when *Synthesiology* was launched, or eight years ago when



Dr. Koh Naito

we started to discuss *Full Research*. I enjoy working as an editor as I see the style gradually become established.

(Ono)

I would like to share with you now two of my recent experiences. I gave a lecture “Synthesiological research and innovation” in Taipei, Taiwan last September. After that I dropped by at the Industrial Technology Research Institute (ITRI) in Hsinchu, and was asked on short notice to give a lecture under the same title to an audience of about 100 researchers including the director of ITRI. I talked about “*Full Research* and *Synthesiology* to express it”. Interest was high and many questions were asked. To the question, “How is it in the United States?” I answered: “I think America is a country of pragmatism, and therefore something like *Full Research* is done in actuality. The mental barrier between academia and industry is low in the States, as seen from the fact that the university professors often set up venture businesses. Yet they do not consider the industry-academia collaborations or the venture activities as research itself. While research and business are conducted without border, those are distinctly research and business. The Americans do not publish a journal like *Synthesiology*, and do not think in terms of accumulating such knowledge. I may be going too far, but I don’t think the Americans see the necessity of thinking how business is related to research, as long as the business is successful.” Another question asked was, “What was your motivation for starting *Synthesiology*?” I answered: “I think I have virtually practiced the equivalence to *Full Research* and *Type 2 Basic Research* ever since I started working at the Agency of Industrial Science and Technology so long ago. I started the journal to redefine these researches, to appropriately respect the activities of the *Type 2 Basic Research* and *Product Realization Research*, and to put the people who engage in these researches into the spotlight.” I think those are my sincere feelings. Since the people of ITRI have the same objectives as AIST, they seemed to share my feelings and therefore, to thoroughly sympathize with my lecture.

The second story I’d like to share is that I had an opportunity to speak with the chief editor of a famous academic journal of the American Chemical Society, when he was visiting Japan. I brought up *Synthesiology* and said, “I’m working on this journal.” He was astonished by the disclosure of the reviewers’ names. In fact, before I brought up *Synthesiology*, I asked, “Where do you put in the most effort to make a good journal?” The editor answered: “I take extreme care on reviewing. The reviewers are anonymous, and I try to make the authors anonymous to the reviewers, too. Also, I am trying to refine the review system by allowing the authors to appoint or reject the reviewers in an appropriate manner.” When I said, “In *Synthesiology* the reviewers are revealed and the discussions are disclosed”, he was so surprised he fell silent for a moment and then said, “That’s really impressive.”

Language in which science and society speak with each other

(Yoshikawa)

I’d been thinking ever since I was young how “synthesis” could become a discipline, and I feel that my grand dream has been realized here. There is the background where *Full Research* is practiced thoroughly at AIST, and certainly, *Synthesiology* is the crystallization of the efforts of many AIST researchers who work to make “synthesis” into a systematic discipline. I am hopeful for the future. Moreover, the editors and reviewers are extremely passionate, and there’s a feeling that AIST is really a great place to be. That’s my first impression.

More specifically, there is a development of a language with which the researchers can speak to people who are not specialists of the same discipline. The Science and Technology in Society (STS) Forum is a gathering of scientists, politicians, and businessmen, but its greatest difficulty is the lack of a common language. When a specialist talks about some specialized subject, the politician gets angry saying, “I don’t understand a thing.” What I claimed was: “The specialists speak in a language necessary for their research, which is jargon. When speaking to people outside their own disciplines, the researchers can explain what they are doing only in terms of what benefit will be brought by the results of their research. That is extremely difficult, because at times it will be a projection, and at times it may be vague. However, the researchers must spend effort to reduce the vagueness and raise the accuracy of the projection.” The fact that a reader can read *Synthesiology* papers and understand other fields is a proof that a very valuable methodology in terms of “verbal communication” is developing. That means a language of communication between science and society is being created. To this I shall give full marks.

Next, I won’t say there is something that only gets a zero mark, but I shall point something out. The papers are all fun and I feel the “passion”. The verbal quality is communicated through the passion, so I understand what the authors wish to accomplish. While “passion” is necessary, the



Dr. Hiroyuki Yoshikawa

explainable structure in the form of “synthesiology” is not yet established. I can see it by reading each paper, but I’m not sure whether the common structure is apparent to a third party who reads the paper. As I wrote in the “Introduction to service engineering” in Volume 1 No. 2, I think there is a temporary area of discipline. This temporary discipline is like a logical system that the researchers set up to solve a certain problem. Say there is an interesting device and the researcher must figure out how to create a concrete device from some abstract basic principle, and how to discuss it with the manufacturer, and in doing so the verbal quality must be raised to a logical level. I, however, can’t see that level being achieved in the papers even if I read between the lines or even through the lines. I think it will be better if the authors can present some logical quality.

Deepening “synthesiology”

(Ono)

We are working on “synthesiology” that seeks logical and common principles by accumulating the results of synthetic and integrating research activities, and it is necessary to deepen this practice. Dr. Akamatsu, you gave a lecture called “Expectation for ergonomics as ‘synthesiology’” at the annual conference of Japan Ergonomics Society.

(Akamatsu)

I compared the developments of the endoscope and the x-ray in the lecture. It took 100 years for the realization of the endoscope, while the x-ray was employed in medicine in less than a year. The negative aspects of the x-ray were unknown when it was employed, and lots of harm was done. I suggested that perhaps some period of “valley of death” is necessary. After that, I talked about “discipline”, “relationship between social expectations and academics”, “why ‘synthesiology’ is difficult”, “‘synthesiology’ and engineering”, and “ergonomics as ‘synthesiology’”.

Concerning “discipline”, Dr. Yoshikawa suggested that in contrast to the “scientific discipline” of the natural sciences, we create a “temporary discipline” by focusing the target of the issue to be solved, and this will grow into a “mature discipline”, which shall be called “engineering”. While the “temporary discipline” attempts to solve the actual problem for some specific artifact, it becomes more abstract as the discipline advances, and when the temporary discipline becomes a mature discipline, and then becomes a scientific discipline, it tends to fall back to the analytical method. How one can stay adequately in the temporary discipline is necessary in synthesis. This is because when the researchers create a language for a discipline and seek law and principle, they start working to elaborate the law. Naturally, they delve into analysis to pursue consistency in the discipline and try to create a beautiful system, and this poses the danger of weakening the dynamics to face society. This is related

to “Why is “synthesiology” difficult?” When we cannot communicate with people in other disciplines, it is difficult to integrate and instead we turn to analysis.

In “‘synthesiology’ and engineering”, what we call *kogaku* is a Japanese translation of the English “engineering”, but the word origin of engineer is “wise and skillful people making things”. Originally there was no meaning of discipline in “engineering” but “synthesiology” is trying to make it into a discipline. *Engineering*, a temporary discipline, is created from the works of the people who are capable of creating complex artifacts. That is exactly the objective of “synthesiology”.

For “ergonomics as ‘synthesiology’”, when we define innovation as the introduction of scientific knowledge into society, “ergonomics is the study of creating an artifact that can adapt to human beings”, and it may play an important role in “synthesiology”. It may seem that something that is suitable for humankind can be made using knowledge of human beings, but things are not that simple. If the human characteristics can be known, we should be able to evaluate a product based on that. But unfortunately, current ergonomics cannot make something creatively. What is lacking? For example, “noisy” is a physical property of sound pressure, but the common issue today is that the noise from the floor above becomes bothersome in a quieter environment. When living conditions were poor, this issue could be explained by physics or the language of natural science, but when the poor living conditions improved, it became something that could not be discussed by the language of natural science. Here, the researchers realize for the first time that they cannot make something that is truly useful to human beings unless we study humankind thoroughly. Rather than creating a scientific discipline that studies a natural subject, we must practice “synthesiology” for making things that “will be used” in science of “society” that is created by human activities. This is the “social” science as proposed by Dr. Yoshikawa.

(Kobayashi)

In a recent experience, I helped an energy project at my university. The project never took off, but I had conversations



Dr. Motoyuki Akamatsu

with people of an automobile manufacturer, a battery manufacturer, a power network, and others. We set up a system starting from elemental technology, and were able to draw the image of the project in its entirety. I don't know whether this was because I was trained in synthesiology or whether because I worked at AIST, but I really felt that any research project or program must be set up with a synthetic approach.

Quoting the methodology of synthetic research

(Ono)

Dr. Naito, you also think that “research of synthesiology” is important, don't you?

(Naito)

Right now, I think it is seen merely as an extension of case study research. In the future, I think the true theory will be created when *Synthesiology* itself will become the subject of research, a model proposed by Dr. Kobayashi is applied, it is further developed for education and design, and we get an output in the form of some kind of design manual. I think personally this is the period where more case studies are collected, and after some accumulation, the researchers who wish to study this subject will be attracted, and the discipline as well as the education and design as its application will be ultimately formed.

(Akamatsu)

I want the authors to state, “the *Synthesiology* paper that I wrote has the same approach to some papers published before in this journal”. Dr. Naito mentioned that a third party could use these papers as subjects of research. As a research discipline, when a researcher quotes his/her own paper, he/she must take a stand such as, “My method is similar to this-and-that research approach, but is different here and there”. I feel that part is still lacking while the authors can talk passionately.

(Ono)

I feel the same way. I don't know whether the researchers cannot do so because they didn't think synthesiologically in setting the scenario or because they are unable to re-organize the actions they took as a process of synthesis.

Bronze and iron experiment methodology and methodology of synthetic approach

(Yoshikawa)

I think it is the latter. Although I may be thinking in my favor, I believe that people who conducted and created good synthesis were thinking synthesiologically.

Suppose that, in engineering, an experiment was done with some material, or in mechanical engineering, a detailed

change in shape was observed with high speed, and then a theory was made. Suppose also that one researcher did it with copper, and another did it with iron. The latter can write a paper with iron in the same manner, but that would be copying the former following a superficial process. Yet, the former who did it for the first time was not superficial, but engaged in an analytical research by setting up a program of how to investigate the essence of a material. There is bound to be some synthesiological element like this in true research.

(Kobayashi)

When I reviewed a paper, although the author was not conscious that a synthesiological way of thinking was employed, I mentioned, “Didn't you get to this because you made your strategy step by step in the process of strategic selection?” The author realized, “Oh, so this is what it's all about.” That was a case of discovery through the discussion between the author and the reviewer.

(Ono)

Taking a deeper look, it can be said the author himself already engaged in synthesiological thinking, and that it manifested itself when he was given a chance to write this type of paper.

(Kobayashi)

The paper of “Study on the PAN carbon-fiber-innovation for modeling a successful R&D management” in Volume 2 No.2 was written by Osamu Nakamura and others when they saw that the polyacrylonitrile (PAN) carbon fiber, which was invented by Dr. Akio Shindo at the former Osaka National Research Institute of the Agency of Industrial Science and Technology in the 1960s, eventually developed into business. There are a few points to be raised here. It is true that the carbon fiber was originally an excellent material, but one day he was told by some American military personnel: “This has excellent mechanical strength. This can be useful.” Then, “synthesis” started in an aspect totally different from the original scenario. I think the important point here is the “meeting with people,” that the logic alone does not lead to success. It seems to finally become something through turning points including random chance.



Dr. Naoto Kobayashi

Synthesiology listens to social wishes

(Yoshikawa)

That story is really important. When the American military personnel said, “We need something strong”, he was expressing what I call the “social wish”. Such things exist outside research, and the researchers are often not aware of them. A social wish and scientific ability meet, and I call that “chance meeting”. How would they meet? In the 19th and the 20th century, “synthesiology” was suited in areas where new discovery produced new functions. Now, the social wish is greater, and there is a sense of risk that unless we invent such-and-such a thing the earth will be destroyed, or in other words, the expectations for some power that will enable overcoming the risks spur research.

(Akamatsu)

The people who were involved in the carbon fiber research were trying to look at the property of carbon fiber from various aspects, and recognized its potential when “strength” was mentioned. The reason of its success was the presence of a social wish. There are many elemental properties to be investigated. Therefore, when the researchers are left to decide for themselves which property of carbon fiber they should study deeply, they may jump right in, and they may end up nitpicking the corners.

(Yoshikawa)

When they start nitpicking, it means they do research that’s easy to write out as a paper. The motivation to do research is that the researchers must do something that has never been done before, and if they find a corner that has never been explored, they will dig deeper there. In contrast, it is not easy to write a *Synthesiology* paper, but they will move in that direction because there is a social wish.

Expansion of Product Realization Research in industry

(Ono)

There are many people who regard *Synthesiology* as the “study of synthesiology”, and we are getting submissions of such papers. People who are engaged in “research that stretch across various disciplines”, or those who are trying to do new research based on such results are becoming interested. In addition, I would like to see submissions from industry.

(Akamatsu)

I also want more submissions from industry, so I am considering the “*Product Realization Research* paper (tentative title)”. I am thinking about making a collection of case studies of product realizations by having industry submit papers of actual product realizations that are valuable for “synthesiology”.

(Yoshikawa)

When a company develops a product, aside from the actual product to be sold, they also produce an invisible product called the thinking methodology, but it is discarded. While it remain in the head of the researcher and may remain as skills and experiences, it cannot be seen by a third party.

(Ono)

That part vanishes into air, but I think that is the source of corporate power. The “Technical Reports” published by companies present some aspects, as they show which items were successful along with scientific backgrounds, but I wish they would write what lies underneath. I think sharing this knowledge in depth will further strengthen the Japanese companies.

Educational material at the Innovation School

(Ono)

We train young, post-doctorate researchers at the AIST Innovation School. The students were divided into groups of ten to take turns doing paper reports of *Synthesiology*. Some commented, “It captures the social trend and presents the total picture, and it helps me see where I stand.” Many post-docs felt fresh surprise, and it gave them quite an impact. Dr. Akamatsu was also a moderator of the School. What did you think?

(Akamatsu)

At the paper reports session, I provided supplemental explanations, and the post-docs were able to read from the perspective of “What is “synthesiology”?” There were six moderators, and one of them said, “The students really thought it through, and now I finally understood what *Synthesiology* is from their reports.” Some papers state, “It is important to occasionally return to *Type 1 Basic Research* when doing *Type 2 Basic Research*”, and the students were happy to see that perspective. When one is deeply involved in a topic, one may unconsciously create a sanctuary. It seems that the students learned the importance of looking at the big picture, drawing a scenario, and going forward without getting entangled in something immediately in front of their eyes.



Dr. Akira Ono

(Yoshikawa)

Those were the greatest objectives of the Innovation School: to actually create something by breaking the rock-hard specialism supremacy, and to have wide-ranging contact with society. It is good that they were able to learn that.

(Ono)

We send post-docs for a few months to companies, and have them experience corporate OJT. They become new channels for communication between AIST and the companies, and it is an important experience for us. The people of the companies that accepted the students evaluate the OJT and provide comments, and they are mostly very positive. Normally, the companies do not have the opportunity to work with young doctoral researchers, and they see it as a new opportunity and are surprised that we've got good researchers here.

(Yoshikawa)

It's a learning experience for companies. That is good. The Innovation School is one model where one can learn while working. The students are learning that "it is not good to be fixed in a narrow field", and also learn what synthesis is through *Synthesiology*. They understand that to engage in a new work is to "think".

Future expectations and prospects

(Ono)

How about the future expectations and prospects for *Synthesiology*?

(Akamatsu)

One of the students of the Innovation School commented: "The papers are good because the quality of the reviewers are high. To continue being a good journal, you must nurture good reviewers that can review in terms of what is 'synthesiology'". I felt that was important. The reviewers function as a kind of connoisseur. The reviewers are trying to bring the "synthesis" out of the papers, and we would be in trouble when we step down for the next generation if they are unable to do the same. This is a future issue.

(Kobayashi)

I've been thinking about the exact same thing. We ourselves grew up in the past two years, but I feel we must increase the

number of people who share "synthesiology" as a discipline. We must do more symposia and workshops and communicate the concept through word of mouth. We must also spend effort to increase the reviewers, particularly getting people outside AIST to participate, and to raise the awareness of *Synthesiology*.

(Naito)

It is really fun to discuss various points with the authors in the process of a review, and I think the quality of both the authors and the editors is raised through this dialog. Perhaps the number of submissions may increase if we create some mechanism where the author-editor dialog is enhanced further, and if we carry on such dialog with outside people. I think we will be able to learn many things from each other if we set up symposia, seminars, and lectures as part of this activity.

(Ono)

My comments are the same as everyone. By doing the review, the reviewers have fun making new discoveries and getting inspiration, and I myself am surprised at how much I can understand the values of other research fields.

(Yoshikawa)

Since Japan's population is small, the ratio of GNP will decrease. It is now a 9 % nation, but in 2050, it will become a 3 % nation and its presence will decline. What we have to do to avoid this is to increase the number of researchers. If the number of researchers increases within the same population, the presence will increase at least in terms of science. I call this "policy to double the number of researchers", but it won't be good if we simply double the number of closed, sectionalized researchers. We want to have researchers who are all-inclusive including the developers that write papers in the Technical Reports. At the same time, we need a kind of a social passage where there is a professional continuity from secluded researchers to corporate developers, and people should be able to move freely. I think *Synthesiology* will be a powerful tool to accomplish this, and I think it can become a kind of social movement.

(Ono)

Thank you very much for discussing such a wide range of interesting topics today.