



CORE PROGRAM REPORT

Considering Science and Technology in the Age of SDGs and COVID-19 Pandemic

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International Institute for Advanced Studies

Introduction

1. Purpose and Background of the Study Group

This study group was established in 2017, three years ago. Two years before that, in 2015, all the member states of the United Nations agreed on the SDGs (2030 Agenda for Sustainable Development Goals) as the "Vision of all Humanity in the 21st Century." How can we create and use scientific knowledge to solve the serious issues that human beings and the earth in the 21st century face such as climate change, large-scale disasters, poverty, inequality, health, energy, cities, production and consumption? The expectation toward science and technology for the achievement of the SDGs is high. This effort is called STI for SDGs.

Science and technology have a long history of 500 years since the Renaissance, and values, spiritual cultures, methodologies, and systems for promotion have been established. Emphasis has been placed on the new discovery in nature, the creation of new knowledge, and the development of industry and society based on them. How will the framework of such modern science and technology be transformed toward goals and solution of issues that SDGs present? Recently, in addition to the phrase "STI for SDGs", the phrase "SDGs for STI" is used frequently. The SDGs are calling for a review of the values and ecosystems of modern science and technology.

The strengthening of the relationship between the SDGs and modern science and technology indicates that we have begun to move towards the full-scale realization of the concept of trans-science, which was proposed 50 years ago, and the World Declaration on Science and the Use of Scientific Knowledge (the "Budapest Declaration"), which the world's scientific community declared 20 years ago, amid the deepening crisis of the COVID-19. The "Budapest Declaration is called contract between science and society in the 21st century.

This study group is small, but consists of various researchers, mainly young people who are active both inside and outside Japan. With the year 2030 and further 2050 in consideration, we have been discussing from various angles how science and technology should respond to the SDGs, which have been agreed upon as a common good for humanity. Based on this accumulation, from the beginning of 2020, each member set a theme and started writing the final report as the basic research of International Institute for Advanced Studies. Just when we were about to write the report, the COVID-19 pandemic hit the entire human race.

2. Structure and Overview of the Report

This report is composed of the following three parts, based on the content of each committee member's writing, under the main theme of Considering Science and Technology in the Age of SDGs and COVID-19 Pandemic.

Part 1: Scientific Thinking and Methods at a Turning Point

Part 2: Historical View of Science and Transdisciplinarity at a Turning Point

Part 3: Science and Practice by the Scientific Community at a Turning Point

Part 1: Scientific Thinking and Methods at a Turning Point

(1-1) Mitsunobu Kano "In order to utilize the abilities of diverse individuals to diverse others: What are the elements that complement current science and technology?"

(1-2) Yoko Shimpuku "Role of Scientists and Inclusivity of Scientific Community"

(1-3) Satoru Ohtake "Transformation in Society and Science awakening from 'Unconsciousness' to 'Consciousness' after the COVID-19 Crisis"

Part 2: Historical View of Science and Transdisciplinarity at a Turning Point

(2-1) Shoji Komai "Concentrate, to digging deeper. Communicate, to creating together."

(2-2) Sayaka Oki "Collaboration between natural sciences and humanities/social sciences for social rationality? —In order that no one is left behind—"

Part 3: Science and Practice by the Scientific Community at a Turning Point

(3-1) Naoki Miyano "The Role of University and Academic Knowledge that I now feel about"

(3-2) Hidetoshi Kotera "A Review on Responsibility of Researchers in Case of Emergency"

(3-3) Tateo Arimoto "We Will Change the Relationship between Science, Policy and Society in the 21st Century for Sustainable Development - Science and Technology in the Age of SDGs Coexisting with COVID-19"

The contents of each are outlined below.

2-1 In Part I, Kano engages in discussions to reexamine the ideal form of science, focusing on the abilities of various individuals, while keeping the time frame in mind. Kano also presents a new perspective that goes beyond traditional scientific methods and provides an important clue for considering the future relationship between society and science. It is interesting that Shimpuku refers to efforts that further embody the ideas developed in Kano's study. "Global Young Academy" movement is introduced on the ideal way of collaboration between scientists and citizens that contributes to the development of citizen science. It is stimulating in regard to supporting the ideal way of science based on various individuals. Ohtake has presented the overall outlook for the discussion by reexamining the way globalization and SDGs should be, taking into account transition of time.

2-2 In Part 2, Komai looks back on the way human beings should be as creatures and considers the relationship between human beings as individuals and groups and modern society. On the other hand, Oki describes dysfunctional state of modern social and scientific framework that has developed mainly in Europe in the face of COVID-19 pandemic.

At the same time, Oki refers to the anti-racism movement that occurred frequently during the period and gender issues. The social upheavals and divisions magnified by the COVID-19 pandemic parallel these movements. This question is instructive when read her paper in conjunction with Komai's view of human-being as a species.

2-3. Part 3 focuses on the actual actions of science and the scientific community. Miyano develops his own learning theories in the first study. He argues that learning should focus on "things that do not change" because it is an era in which everyone is seeking change. He argues that what is required for learning is not making witty comments on current events, but words rooted in history and supported by deep thought. Miyano develops that in his second study in the form of talking about the time when he was a graduate student. He attempts to give present-day students and young researchers an opportunity to rethink what learning is. Kotera is conducting a comprehensive review of what role academic entities should play in case of an emergency, including preparations during peacetime. This responsibility should not be borne solely by some epidemiologists and scientists. Everyone involved in education and research should think about it seriously. Finally, Arimoto looks at developments in the global scientific community regarding the SDGs and the COVID-19 pandemic, and discusses the dynamics of the relationship between science, politics and society as well as the minds of scientists and the future of the world. Regarding the response to the COVID-19 pandemic, he argues that a long-term cooperation between Japan and overseas, which goes beyond the fields of medicine and health as well as science and technology in general, is indispensable, and that it is an issue that will be common to major disasters that will occur frequently in the world in the future.

3. Perspectives on people, the times, and the world common to each articles

The COVID-19 pandemic calls for a fundamental review of democracy, capitalism, and the enlightenment of science and technology that have been formed in the modern age. It can be said that concerns and problems that we may have in 10 years or several decades are suddenly emerging in front of us.

To overcome this difficulty, expectations for science and technology are high. On the other hand, the strength and weakness of each country's political and socioeconomic systems and science and technology systems are exposed to the public. The future development of the COVID-19 pandemic is uncertain. We are in the time where there will be various global disasters. The need for digital technology and data is growing rapidly, and the high-tech and geopolitical rivalry between the United States and China is intensifying.

What will remain and what will be changed in science and technology that the modern age has built? In the era where we face various crises and try to achieve the SDGs "What is science and technology?", "What are scientists and engineers?", "What is the relationship between science and technology and society?", "What is society?" Together with the SDGs, the COVID-19 pandemic calls for changes in the values of science, technology and innovation (STI) and its ecosystem that have been nurtured in modern times. In modern history, science and technology have been developed "by standing on the shoulders of giants". It can be said that now it is necessary to have the courage to step down from "the shoulders" and fundamentally reconsider the ideal state of science and technology.

In Japan, we cannot help but assume that the situations in the political, economic, diplomatic, civil life, and science and technology that will await us after the COVID-19 pandemic will be extremely severe. In the transition period and the subsequent period, the subjects and methods of science and technology that go beyond the conventional "common sense" are needed. We will examine in depth the ideal way of science and technology, values, methods and systems that are not extensions of the past, and identify problems from the basis. These considerations will be widely proposed both at home and abroad, and the solidarity will be expanded through dialogue with people. These activities are arising both inside and outside the country, and we believe this small study group of the International Institute for Advanced Studies has a role to play in consciously connecting and forming a network with them. The argument of the committee members who participated in the study group is that it is the attitude and ability to think and act from a perspective which transcends time and space that can present a firm perspective in times of crisis.

(Written by Arimoto and Sugitani)

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Part 1 Scientific Thinking and Methods at a Turning Point

Chapter 1 "In order to utilize the abilities of diverse individuals to diverse others: What are the elements that complement current science and technology? "

Mitsunobu Kano

Introduction

The essence of science, I think, is to evolve new ideas from one person into something that can be widely accepted by others. This characteristic of science has brought about various changes in society. Some features always produce both advantages and disadvantages. Advantages and disadvantages, however, only become advantages and disadvantages when certain characteristics are based on some kind of background or value. When those background or value changes, what becomes advantages and disadvantages will change. In this paper, this paper discusses the following characteristics of science: 1) Justification of new contents and (2) Generalization of new contents. I would like to consider what advantages and disadvantages these characters will have based on the background of the present era, and how to complement the disadvantages. The background of the present era is, in my view, a transition from a phase in which the properties of materials can be studied and used to a phase in which human society and individuals should consider how they will be affected, how they will look for the future, and how they will overcome the effects. The spread of SDGs and, in particular, the impact of pandemics, climate change, etc., are becoming evident. I think such are symbolizing the transition. The disadvantages based on the present era are: (1) lack of stakeholders' involvement in the creation of new ideas and difficulty in dealing with the future; and (2) difficulty in understanding individual circumstances and subjectivity.

Justification of New Content <Revised to Suit This Paper While Following the First Paper>: Alone and in cooperation, past and future

First, justification of new content is discussed. The discussion is divided into two parts. One is "Get New Idea" and the other is "Justification of Content" in which we aim to prove the content of idea by reproducibility and accuracy. The fruits of these factors have ensured reputation of science.

The former factor of "new ideas" has been formed primarily in individual scientists or small groups centered around them. Also, the process of "getting new ideas" is rarely disclosed. In the science for matter, these directions seem to be good because matter is basically outside the individuality of human mental activity. That is to say, a new idea about a substance relatively easy for others to confirm it once it is shared as the substance itself is immutable. For that reason, it would be important for individual scientists to make the most of their individuality to find a new point of view for observation. The novelty of new point of view for observation may not have been secured unless it was kept secret, especially to others in the same industry, until it is proven.

However, in the SDGs era, even if this matter is the subject, the focus of the task is on human acceptance of it. It can also be seen that factors of human side have been left behind only because we have mastered pure material science or science from a similar framework. I think the difficulty of "human factors" lies in how to deal with the uniqueness of each individual and the fact that there is no reproducibility within an individual, in contrast to the reproducibility and generality that science has sought.

In this situation, I believe that at least the process of "getting new ideas" or in a little more detail, the process of "identifying the issues to be overcome" and "asking questions" needs to be proceeded not by individual scientists but in cooperation with stakeholders.

Next, the factors of "justification of content" or "proof" have been more widely verified outside the science than the factor of "getting new ideas" and have become sources of trust in scientific methods. This process was often carried out in teams, especially in the natural sciences, rather than by oneself. However, most of

the teams were specialized in the same field. When a hypothesis that one would like to test cannot be addressed by researchers in one field alone (and there seem to be more issues that cannot be addressed by researchers in one field alone left in society), collaboration with researchers in different fields will be required. It will also be necessary to find what kind of professionals to collaborate with to achieve a goal of proving a hypothesis. Future scientists will need such experience to collaborate with researchers in different fields/industries.

Attaching importance to the elements such as "justification of content" and "proof" makes it difficult to advance research on the future. We can talk about past events but cannot about future events. Making a prediction is impossible in science. Though it is possible to predict the future to some extent, it is still difficult. "Justification of content" base on the analysis of events that occurred in the past is more reliable and easier than to predict the future. Of course, future projections are more reliable than non-scientific methods, as long as they are reproducible. For example, reaction when substance A and substance B are mixed under certain conditions will always be predictable. The orbit of a space probe launched under certain conditions could be predicted too. Even with a few more factors involved, weather forecasts for the next few days are more accurate.

However, with respect to scientific and technical advice, for example, which has become increasingly necessary in recent years, there is a growing desire not only to analyze and verify the past, but also to predict the future of a society in which complex factors are mixed. For example, if one wants to use scientific knowledge in the planning of future policies, such as guidelines for action in society during a pandemic or the realization of sustainability, predicting the future is inevitably required. It can be seen that if the emphasis is also placed on the element of "obtaining new ideas", the approach based on "justification of content" alone will not work.

Forecasting and backcasting are two methods of thinking about policies for the future while also utilizing science. A comparison is made mainly around these methods.¹

Forecasting x Past

Forecasting is a method of forecasting the future as an extension or extrapolation from current or historical experience. In other words, it is thinking about what we can do based on what we have had. Forecasting has been mainly used in the field of futures studies. One of the main factors that has been used is that it is easy to justify the content, that is, it is consistent with the causality that causes in the past determine the present and is deterministic. Through the rise of the natural sciences since Galileo and Newton as well as the recognition of the usefulness of its knowledge, causality has far surpassed the teleology which has been opposed to causality in Greek philosophy. According to causality, to take an extreme case, given an initial condition, one can explain what has happened and predict what will happen. Mathematical algorithms and mathematical models are often used as a forecasting technique. If an event does not include human intent, environmental adaptation of a vital phenomenon, or many other factors related to the variability of the event, it is likely to be adaptive.

However, the effectiveness of this approach is being questioned when addressing complex and long-term social issues. This is because current and past experience is based on current mainstream trends, it is not likely to produce solutions that require breaking those trends. However, in the long run, it is likely that there will be discontinuous changes from current trends or other variable factors that were not considered in the

¹ References

Karl H Dreborg, *Essence of Backcasting*, Futures, Vol 28, No. 9, pp. 813-828, 1996
Jaco Quist, *Backcasting for a sustainable future*, Eburon Academic Publishers, 2007

forecast (e.g., changes due to the current pandemic). In some cases, such changes should be deliberately sought for resolution. Alternatives, including backcasting, need to be considered for this purpose.

Backcasting x Past

Backcasting began to be used in predicting the future in the environmental and energy-related fields in Sweden in the 1970s. Backcasting has been widely used in Europe and Canada since the 1990s. Since the 2000s, multi-stakeholder participatory backcasting study has been conducted, and SDGs based on backcasting methods have been widely spread. Backcasting is a method in which we first envision future desired conditions then think about what to do from now on by working backward from the desirable future to the present. It is believed that backcasting can be used not only to think about how to achieve a desirable future goal, but also to avoid or predict an undesirable future result.

Backcasting is a better way to get new ideas than justification of content. It's a way to put your vision into action. It is not a deterministic (determinism) way, in which the past and the future are all determined when the preconditions are determined. First, backcasting is like teleology (a method that involves the perception that conscious and purposeful behavior is understandable in retrospect, but is generally impossible to predict). On the other hand, causality is not entirely absent. Even if an individual's behavior is intentional and purposeful, that is, if the individual's behavior is directed toward his/her future goal, it can be analyzed based on the causality after undergoing mutual influence with a large number of individuals in a macro manner. In other words, it becomes possible to conduct past-focused analysis of causes and results. Backcasting is a method that may tolerate new variables and uncertainties that may exist along the way.

Forecasting x Future

No matter how much backcasting has the advantage of overturning the status quo, for example, it is not easy to realize something that is too far from the things that are within reach technically. It is necessary to consider how to take the first step toward the envisioned future based on the current limitations. In addition, the results of backcasting will need to be verified by forecasting to make them reliable. That is, backcasting and forecasting are considered to be ideally complementary approaches.

In this way, forecasting is likely to be used with backcasting in the future taking advantage respective merits and achieving a balance. Relationship where backcasting has a key role and forecasting complements would be appropriate when an existing trend seems to be heading for an unfavorable situation.

Backcasting x Future

Backcasting is considered to be an appropriate approach when dealing with problems involving complex and diverse sectors of society, when changes in existing frameworks are considered insufficient, when current trends in society are considered to be a part of the problem, and when dealing with problems that market mechanisms cannot handle. For example, sustainability issues roughly have these characteristics at the same time.

When the future image obtained based on an assumption such as the most reliable model calculation by the forecasting does not reach the ideal future vision, a method of generating a future image meeting the target and a route to it can be considered using the backcasting method. On the other hand, even if the backcasting method is mainly used, it is important to check and examine the feasibility of the method toward the future target, if possible, quantitatively.

In backcasting, it is also important that users from different disciplines and sectors participate and progress

together through their experience. Backcasting is a way to find new ideas and needs to be based on knowledge and experience about society and technology. This type of participatory approach has just begun in Japan, but future progress is expected along with the trend of citizen science.

Backcasting methods that propose new concepts or images of the future may raise concerns that some values are included in the background of the proposal. To keep this in mind, it would be good to write on a study of what kind of values are included as the background for selecting future goals. By providing different images of the future based on different concepts, social norms or values, groups with different perspectives can leverage the results and gain a deeper understanding of the problem in question. It is better to try to emphasize the advantages and disadvantages of different solutions and strategies rather than sticking to a single clear solution. In this sense, a scenario presentation approach could be used too.

In the future, it will be necessary to develop methods to predict more ideal future and to go forward while the factors of "obtaining new ideas" and "content justification of contents" are achieving a balance.

Both sides of the aspect called generalization of contents: Common and individual/objective and subjective

The aspect of science called generalization also has advantages and disadvantages.

First, the advantage of generalizations is that their results are correct for everyone (to the extent it is generalizable). If a new idea can be generalized, that applies to everyone who are concerned. Material science is a particularly suitable area for generalization. The properties of a substance can be reliably described once the conditions are determined. For example, at 20°C under atmospheric pressure, water is a liquid, not a solid or gas. When hydrochloric acid and sodium hydroxide are mixed, salt and water are formed. These things are generalizable and always have a high reproducibility when the conditions are determined, which means that we can predict exactly the same thing to happen in the future if we repeat the same thing.

What about humans? Humans are similar to each other to some extent and different in some degree. The similarities are thought to have remained in the course of evolution because they were essential for life support, while the differences are thought to have been maintained and remained for groups that utilize each other. Regarding similarities, for example, "salt tastes salty" and "sugar tastes sweet" are relatively reproducible. In either case, it seems that the appropriate intake is generally indispensable for the life support. (The amount of water in the body is controlled so that the salt concentration in the blood is within a certain range. Glucose is essential for brain activity.) How about pollen? Some people feel nothing, and others have severe allergic reactions. How about medicine? If it is confirmed that a substance improves some disease statistically significantly, the substance will be recognized as a drug. The statistical significance, however, means that it is effective for some people while it is not for others. A substance demonstrates medicinal effect on effect on many people, but it cannot be said in advance whether it is effective on an individual like you or me. How about diseases? The more similar the causes of getting ill (for example, clogged heart vessels), the more scientifically the mechanism of a disease can be determined. However, progressive diseases, especially lingering diseases, have more causes, more variation, and less reproducibility, and are scientifically difficult to deal with. However, these are phenomena related to body functions mainly based on reactions between substances. This material aspect also has some commonality with forms of life other than human beings. So,

we can predict what will happen in the body of human beings to some extent through animal experiments.

What about mental activity? Of course, there may be a view that this is based on a substance and its reactions, but these reactions cannot be explained by the relationship of simplified substances alone. It is difficult to predict whether the mind and consciousness will be able to be explained by the relationships of substances in the future. To be moved, to feel nothing, or to be disgusted by reading some sentences, seeing an art work, or listening to some music. What kind of explanation will and will not convince us? These things vary from person to person, and from time to time even within an individual. In other words, the reproducibility is unknown, and the generalization is not easy. Behavioral economics has emerged in response to the possibility that it is rare to see a real person acting like the "homo economicus who makes reproducible and rational decisions assumed by economics².

When I was working as an internist in medical practice, I felt "same" and "different" about people every day. Patients are classified into a certain disease name based on their symptoms and test results, and the "same" treatment is given based on the disease name. However, the effectiveness of treatment ranges from "very effective" to "not very effective." Sometimes, the "average life expectancy" may be calculated when a diagnosis is made, but no one knows what it will actually be for the person in front of us. What is more diverse is how patients view the information and how medical professionals communicate. Some medical professionals tell with a grave look the average life expectancy to their patients as if it is their unquestionable time left. Some patients see it as a (death) sentence. In addition to the average, information about distribution, for example, is also needed to make a forecast. Life or death for individuals means only all or nothing in the first place. It also involves feelings of joy, anger, sorrow, and pleasure, and the degree of such feelings is greatly influenced by each other's expressions and the way of choosing words.

In this sense, we understand the expression "Medicine is an art based on science" ³by the late Dr. Shigeaki Hinohara, who helped me when I was working at St. Luke's International Hospital. According to Dr. Hino Hara, 'Art in medicine is "touch techniques of how to apply science to patients", and "communication with patients is important."' 'As medicine is modernized, the aspect of art that values "healing techniques" and "quality of life (QOL)" has been forgotten, and the aspect of science that values "therapeutic effects" and "life prolongation" has become stronger.' He said 'It is necessary to restore medicine as art', and 'physicians must be the ones who provide comfort to patients.' If I rephrase these words in my own words, I think we should not apply material generalities to the working of human higher-order functions that is different from person to person. The responses of human higher-order functions considerably differ from person to person. I think we should pay attention to its diversity. Suppose how we feel is called "subjectivity," and we refer to what can be widely acknowledged by others as "objectivity." If I put the above mentioned another way, it may be that we value "objectivity" too much and that objectivity is not balanced with "subjectivity."

The words "science" and "art" are used here. The discussion continues on the on the assumption that those words correspond to "Kagaku" and "Geijutsu" in Japanese. There are "same" and "different" between "science" and "art." When it comes to art, I have a hobby of playing music (as an amateur) in the field of "art."

²Richard Thaler (translated by Mami ENDO), 2016 "Counterattack of Behavioral Economics" Hayakawa Shobo

³Nihon Iji Shinpo, Web Iji Shinpo No. 4695 (2014.4.19) Dr. Hinohara "Understanding Medicine as Art" [General Meeting of the Internal Medicine Society] <https://www.jmedj.co.jp/journal/paper/detail.php?id=2189>

I have a few years of experience in conducting student orchestras for several years. Through this experience, I consider the "same" and "different" in "science" and "art." About difference, the highest priority is given to "intuition" or "emotions" between the sender and the receiver. Of course, music has theories, rules, and techniques, but they are supposed to prioritize how to move the audience. There is an old example. Bach's son says, "In my opinion, music must especially move people's heart."⁴ Science, on the other hand, is an activity that prioritizes "novelty" and "proof /certainty of evidence." In particular, "emotions" is not a top priority. How to balance these differences will lead to the above referenced expression of Dr. Hinohara. Intuition (which is more influenced by emotions) and logic are two sides that the human brain has (which Daniel Kahneman called system 1 and system 2).⁵ Dr. Hinohara also loved music and paid attention to the audience's feelings, emotions, or' subjectivity. That part seems to be a priority in art. However, as this paper relatedly says, as the age of SDGs is becoming more and more important, it seems that science will no longer be able to avoid incorporating such elements as individual's "emotions" and "subjectivity" in some way.

On the other hand, about "same" in "science" and "art" is "creation," which begins with "intuition." In fact, I think that science is also subjective regarding this part. We may say that science is the work of replacing that part with "objectivity" In that sense, art may be the work of directly appealing for "subjectivity" to "subjectivity" of others. Torahiko Terada (his object of art is mainly literary arts) said that "what scientists and artists see as life is fiction."⁶ In either case, it would be worthwhile for individuality to create new content (science) and expression (art) that no one has ever seen before, and to reach something that many others can agree (science) or sympathize (art) with, even though no one has ever noticed the difference. The works that are widely accepted as having realized that are called masterpieces or masterpieces in art.⁷

From the above discussion of "science" and "art", we have considered the possibility that the pursuit of generality, which science has sought, has led to a tendency not to give priority to individuality (or "subjectivity"), particularly with regard to emotions in human acceptance. The tendency not to give priority to the individuality of emotions may also come from, for example, the pursuit of generality (or "objectivity") in the

⁴Carl Philipp Emanuel Bach, 1773, in: Carl Burney, Der Musik Doctors Tagebuch seiner musikalischen Reisen, Bd. 3, Hamburg.C.P.E. Bach was a composer linking Baroque and the classical period, and at the same time wrote a keyboard instrument instruction book that Beethoven adhered to.

⁵Daniel Kahneman, 2011, Thinking Fast and Slow.

⁶Torahiko Terada "Scientists and Artists" https://www.aozora.gr.jp/cards/000042/files/1108_13798.html

⁷We may receive a related question, such as whether there is "creation" in playing old music. The idea is that musicians are inferior to composers. Understanding through the experience of the performance has room for "reproduction art", that is, "creation" by the performer. That's why there is great performance. There are many factors left to performers, such as how to express which sound patterns at what speed and how to pause. Even if the same music score is used, performers can move the audience or make them bored. No matter how good works the composers make, the works will not be understood without the understanding of the people who materialize them as sound. This may be the same in the theatrical performances. Even if they have a script, there is plenty of room for actors, directors and directors about whether to make the most of it. In music, a score is a script, and of course, the quality of the score itself determines whether those concerned can be encouraged to make efforts. Whether the audience can be moved depends on how effectively those who are inspired by the script or the musical score will be able to tell that inspiration to the audience. There is such a mutual relationship. A slightly different form of art from this is that works such as paintings, sculptures, and literature appeal directly to the audience without the intervention of performers or actors. However, even these works, especially when they are the ones by unknown authors, the works will not find a wide audience without the understanding of critics and others who have a role to spread them. This may be one aspect of the relationship between scientists and the profession called of science communicator.

sense of trying to measure everything in terms of economic value, or the pursuit of generality (or "objectivity") in the sense of trying to make a choice based on whether it leads to life support, which is essential to all, or to practicality, which is essential to many.

The concept of "well-being" has begun to be recognized in relation to SDGs. Well-being means "the state of feeling healthy and happy" according to the Cambridge Dictionary. The words "healthy" and "happy" both include considerable subjective or receptive component. It is defined as feeling in the first place, but "happy" is more subjective and may therefore be harder to generalize. Happy is "feeling, showing, or causing pleasure or satisfaction" according to the same dictionary. Feeling leisure and satisfaction depend on the way of individual acceptance. What brings pleasure and satisfaction depends on the situation of each individual and is different depends on each individual. There is also an effort mainly in psychology to find the extent to which this can be generalized.⁸ Although the content is convincing, it must be based on statistical knowledge to be "scientific," and it does not necessarily apply to all people. On the other hand, history and politics are created by individuals who show outliers.⁹

Summary

This paper considers the following regarding the ideal form of "science" required in the age of SDGs.

- The possibility that more stakeholder involvement may be needed in the creation of new ideas,
- The possibility that we may need to deal with the future more, and
- The possibility that we may need to better understand individual circumstances and individual subjectivity.

These include things that are different from the priorities that science has taken for granted, and it will take time to change them. However, considering the current context of the times, it is thought that there is no choice but to change in this direction. It may also be necessary to proceed in parallel with the construction of fundamental theories that will enable the scientific community to accept these new priorities.

⁸The followings are examples. Daniel Gilbert (2006), *Stumbling on Happiness*, Harper Collins Publishers (Daniel Gilbert, Translation : Junko Kumagai, 2013 "Science of Tomorrow's Happiness", Hayakawa Nonfiction Library).

⁹Hanna Arendt (1958, 1998), *The Human Condition*, The University of Chicago Press

1) The role of scientists in the COVID-19 pandemic

1-1 Science and Art

2020 is a year that marks the bicentennial of the birth of Florence Nightingale. The World Health Organization (WHO), the International Council of Nurses (ICN), and others organized a campaign called "Year of the Nurse and the Midwife."¹⁰ It was an unique coincidence that it has become a year in which the importance of medical professionals, including nurses, has been emphasized to the extent that Banksy, who is famous as an anonymous artist, released a work showing a boy playing with a superhero nurse doll instead of hero dolls.¹¹ Nursing science is a science to understand and support people of all ages in order to maintain/promote their health. There are many ways to understand people. The Methods include deductive understanding based on the verification of empirical scientific and medical hypotheses, describing events in a humanities-social approach, inductive understanding including theoretical construction, social criticism theories that critically consider the structures surrounding the socially vulnerable, science for "emancipation", and pragmatism that improves outcomes through nursing intervention in partnership with clinical engineering. Some researchers deepen certain research methods for a long time, while others take an eclectic approach in which they choose methods at different times to suit their research objectives. While its breadth and depth are attractive, it is also difficult to explain to scientists in other fields what characteristics it has as a discipline and a science. Dr. Shigeaki Hinohara, who had a great influence on Japanese health care, said, "Nursing is science and art." Introspecting values and ethics as a professional, taking creative approaches at times, and having the choice to live up to the feelings of the target show the significance of the artistic element.¹²

Nursing as a science aims to lead to evidence-based care and intervention as well as Evidence-Based Practice (EBP), and ultimately, to help the subjects maintain or improve health, whether objectively or subjectively, such as the subject's health index or satisfaction. In nursing as an art, nurses listen to the subjects, respect their values and feelings, and depict the "health" for the patients. The EBP also calls for the balance between four factors: the evidence tested by studies, patients' selection and behavior, clinical context and environment, and the specialized knowledge of healthcare professionals.¹³ It is required to carefully examine the impact on people of information derived from the results of scientific research and provide, taking into consideration the situation of the subjects, and to help them choose the information by themselves. I have considered if nursing should be science in time when the importance of nursing as art can be recognized. Despite the diversity of options, anything that is not scientific at all has concerns about safety as far as health care is concerned. The answer at this point is that science and art should aim to strike "a good balance". When thinking about not only nursing but also the connection between science and society, I also feel that there is a growing need for scientists to consider the aspects of art in that science. I believe that what "a good balance" is can be understood by having a wide range of knowledge and knowing opinions from people with

¹⁰ World Health Organization. (2020). Year of the Nurse and the Midwife 2020. Retrieved on May 17, 2020 from: <https://www.who.int/news-room/campaigns/year-of-the-nurse-and-the-midwife-2020>

¹¹Some say that the Banksy is not only paying tribute to healthcare workers, but also having ironic overtones that the medical professionals in the field should not be a disposable resource.

¹² Shigeaki Hinohara. (2000). EBN necessary for nursing, nursing as a science and EBN. Medical World Newspaper No. 2413.¹²http://www.igaku-shoin.co.jp/nwsppr/n2000dir/n2413dir/n2413_02.htm

¹³ Gyatt G, Rennie D. (2002). User's Guides to the Medical Literature-Essentials of Evidence-Based Clinical Practice. McGraw-Hill, NY.

diverse backgrounds. I would like to describe my experiences in this regard.

1-2. Like Gathering of Scientists at a Cafe

I have been selected as a member of the Global Young Academy (GYA), which consists of 200 scientists from around the world, and have been working as a member of the executive committee since 2018. When I explain what kind of place the GYA is, I think the word of former co-chair Koen Vermeir suits well. "The GYA is in a way the Re-Enlightenment project itself... The GYA is some kind of global scientific coffee house." "Re: Enlightenment"¹⁴ was the theme of the 2019 Annual General Meeting, but the above statement was from his speech at the ALLEA (All European Academy) meeting immediately after that.¹⁵ The implication is that the GYA is a kind of a place like a cafe where you can casually stop by without hesitation and chat freely. Young scientists from all countries discuss together as friends and try to come up with a common solution, even if there are political confrontations between their countries. He said that the GYA may be already changing the value of science. The GYA has a common question, "How might we...?" When we get stuck or try to coordinate different opinions, we use this expression. Then we can spontaneously find solutions and new way out. What is required of scientists through Re: Enlightenment is the establishment of a system in which various scientists can discuss and find ways to solve social problems such as conflict, discrimination, widening disparity, and global confusion and crisis.

1-3 The Role of Scientists in Society

Conflicts and social disparities are often overlooked as "someone's problems," but the global crisis caused by the novel Coronavirus has created a special situation in which everyone faces the same challenges and needs to think and act. Division and criticism by people, such as slander of a person who tested positive for COVID-19, can make people more cautious and less truthful, preventing taking precautionary measures against the infection. Amid such social turmoil, scientists have been asked how they can contribute to the society. In order for people who are stressed out by exercising self-restraint and anxiety to think and act rationally as well as to understand the situation correctly, it is necessary for scientists to communicate with people based on scientific knowledge. Scientists need to take a stance to understand those who are in a critical situation, such as those tested positive and medical personnel who care for them in this case, and to advise them not to collapse the national system. In other words, it is a role that connects people and the society, and connects people and the countries.

Scientists have participated in discussions on the Sustainable Development Goals (SDGs) to improve the lives of vulnerable people, especially to eradicate poverty and preserve the global environment. Although interdisciplinary discussions on the harmonization and coordination of the 17 goals have been required¹⁶, international cooperation was still very difficult politically. Scientists may have done more for international cooperation. However, due to the rise in competition for research funding and the instability of employment, scientists were required to acquire funds and to produce a large number of scientific papers. The evaluation of activities to make science useful to the society (academy activities, science communication, etc.) was limited.

¹⁴ Global Young Academy. (2019). AGM 2019: International Conference and Anniversary Annual General Meeting of the Global Young Academy. Retrieved on May 18, 2020 from:

<https://globalyoungacademy.net/events/agm-2019-anniversary-conference-and-meeting/>

¹⁵Global Young Academy. Re-Enlightenment? Truth, Reason and Science in a Global World - Global Young Academy. ALLEA. Retrieved on May 18, 2020 from: <https://www.youtube.com/watch?v=1M5hk6gbMAU>

¹⁶ International Science Council. (2017). A Guide to SDG Interactions: from Science to Implementation. Retrieved on May 17, 2020 from:

<https://council.science/publications/a-guide-to-sdg-interactions-from-science-to-implementation/>

Opportunities for such capacity building has also been scarce.

So how can scientists build the capacity to contribute to the society? The Global Young Academy (GYA) regards the capacity building of these scientists as part of its activities. The GYA members learn a variety of science from friends in café-like conversations, build their capacity for science advice through the Science Leadership Program, and gain experience in solving social issues. However, what I think is more important than building such a substantial capacity is that scientists have a basis for accepting diversity and expanding the inclusivity of the scientific community. In 2019, when the GYA became an official member of the IAP, the GYA, together with members of young academies in all around the world, announced the "Declaration on the Guiding Principles of Young Academies"¹⁷ at the World Science Forum in November to explain to the world what a young academy is. As the basic principles of young academies, the GYA mentioned scientific excellence, social impact, and inclusivity and diversity. By taking an inclusive approach, social problems can be solved from wider aspects. In order to achieve this, it is stated that young academies must include scientists from various disciplines on an interdisciplinary basis, and that they must engage in activities that enhance their inclusivity.

Being excellent as scientists and showing good results and intention in contribution to the society are considered as important criteria for selection of the GYA members. The selection of the GYA members is adjusted in the final stage by whether they will increase diversity. The fields of sciences are also diverse, and the number of women reached half of the total. While many scientists belong to the GYA have a keen sense of scientific accuracy, they are active in serving people and are good at making a statement based on their sensitivity and emotions. They are allowed to speak freely in consideration of others. It really feels like "chatting in a cafe." The facts that young scientists who are capable of contributing to the society are gathered and that they are involved actively in such group will further reinforce such foundation.

The Young Academy of Japan within the Science Council of Japan has also selected a wide variety of members and has conducted various exchanges and activities in an interdisciplinary manner in order to create a place of such nature. We repeatedly had discussions on SDGs and citizen science for making the distance between scientists closer and provided a forum for discussions including the general public at local symposiums, etc. At the World Science Forum and the Tsukuba Conference held in Japan, we have established forums for discussion with prominent scientists and other stakeholders, including Nobel Laureates from Japan and the world. By accumulating such experience, we have shown its role in linking scientists and society. The American Nursing Association says "21st Century nursing is the glue that holds a patient's health care journey together. Across the entire patient experience, and wherever there is someone in need of care, nurses work tirelessly to identify and protect the needs of the individual."¹⁸ In health care, nurses are proud of their role in linking individuals and health care, but in the scientific community, someone needs to play that role. I hope that young academies will be able to serve as "glue" to link scientists and the society. Scientists need to make a commitment not only to get close to but to connect to the society, and to stay connected without being separated immediately.

2. Changes in value in science

2-1. Dispersion and Diversity

¹⁷ Global Young Academy. (2019). Declaration on the Guiding Principles of Young Academies. Retrieved on May 17, 2020 from:

<https://globalyoungacademy.net/declaration-on-the-guiding-principles-of-young-academies/>

¹⁸ American Nurses Association. (2020). What is Nursing? Retrieved on Aug 31, 2020, from: <https://www.nursingworld.org/practice-policy/workforce/what-is-nursing/>

Next, I would like to delve into the significance of the diversity of scientific thinking and communities that emphasize variation.

Since it is difficult to measure and experiment with the same person over and over again, evidence for people is constructed using statistical methods, such as means, standard deviations, and confidence intervals in a group. Science has originally sought to minimize people's subjective "bias" in the construction of knowledge.¹⁹ Medical science has also built up ways that avoid biases that could arbitrarily deliver significant results. That is because they are necessary for verification of the effectiveness and side effects of drugs and treatments. However, the more strictly the methodology is set to remove subjectivity, the farther it tends to be from the real world. In addition, whether or not the result is applicable to individuals is only a possibility, and there is a limit. In the theories that have been discussed in education and psychology in recent years, "variation" is emphasized rather than average. Todd Rose of the Harvard School of Education suggested a breakaway from average in his book, "The End of Average."²⁰ For example, if you make the cockpit of an airplane to match the average size of a pilot, you get a cockpit that doesn't fit anyone. People vary widely in size and character, and the average is actually a "summary" of a population that does not apply to any individual. About the nature of a person, we cannot unconditionally say that a person is introverted or extroverted. Whether a person is introverted or extroverted is always influenced by that context. Individuals can become introverted or extroverted due to changes in their context, such as they are with their family or at workplace, etc. In other words, it showed the limitations of thinking in a unified way.

Similarly, Hans Rosling said that in the analysis of objective data such as demographics and mortality, "it is dangerous to use the average of the data."²¹ In Asia and Africa, too, there is great variability, from the rich to the poor. Even within countries, there is a huge gap in household income, which has become an important item of a social determinant of health. Regarding the aid of developing countries, Rosling said that thinking about average could lead to the danger of huge resources not reaching where they are needed. He said, "Improvement of the world must be highly contextualized," after examining the data in detail. The SDGs contains a principle of "Leave no one behind." Those who are left behind are referred as "the last one mile." In order to provide the aid to them, we have to think about variation, not average.

Lisa Feldman Barrett²², a psychologist who advocates a theory of constructed emotion, showed that the brain reactions to emotions are not one-to-one, but one-to-many. She said that emotions are not objects. They are categories consisting of many instances, and there is tremendous diversity in any emotional category. According to her, emotions are not made in a universal pattern, but are caused by individuals' predictions based on their past experiences. She said that there is an infinite variety of ways in what emotions are evoked and how they are expressed in response to an event. The same result can be obtained by various combinations of neurons. For example, in a baseball game, nine of the 25 players on the bench take the mound. While the players are replaced sometimes, the result of "they won/lost the game" is produced.. It doesn't mean that if which nine players are selected, they will always win or lose. Instead, they will rationally decide members who have a good percentage of wins depending on the opponents. Since the other side also comes up with a game plan, it is better to have more strategies to change a game plan when it doesn't work.

¹⁹ The National Academy of Sciences. (1995). On Being a Scientist: A Guide to Responsible Conduct in Research. 3rd.

²⁰ Todd Rose. Translated by Eri Kosaka. (2019). Harvard's Introduction to Individualism: The End of Average, Hayakawa Shobo.

²¹ Rosling, H. (2006). The best stats you've ever seen. TED Talk. Retrieved on May 21, 2020 from: https://www.ted.com/talks/hans_rosling_the_best_stats_you_ve_ever_seen?language=ja#t-875025

²² Lisa Feldman Barrett, translated by Hiroshi Takahashi (2019). How Emotions are Made: The Secret Life of the Brain and a Theory of Constructed Emotion, Books Kinokuniya.

In a medical setting, rather than applying a single method with the highest evidence, for example, method A, actual situations look like trying A and B, this or that, on a case-by-case basis and to find something that works best to a person. It is not hard to imagine that better health care can be provided by working as a team with diverse members that know more options about how to cope with a situation. It is also valuable that different approaches have been scientifically validated, and that there is extensive evidence that leads to different methods.

2-2. Decisions made by various participants

I would also like to talk about the significance of being determined by various participants.

There is a word "Mabeberu" in Swahili. I asked Tanzanians what it means. They said male goat is the original meaning, but it has become common for politicians to call foreign aid workers Mabeberu to backbite them. Although many African countries achieved independence in the 1960s, various foreign interventions and influences in the form of "aids" continued after that. In the case of global health, it is also required to achieve the global goal set by world-renowned researchers and people of aid organizations who gathered for developing countries with problems through the measures discussed there. International objectives often become national policies and projects without being properly localized. In 2016, when the international community was excited about the launch of the SDGs, I asked midwives in Africa who were saving their mothers and children every day if they knew SDGs. They said, "What's that?." That conversation is fresh in my memory.

In 1987, the Safe Motherhood Initiative was launched by international organizations to improve maternal and child mortality in developing countries. As women often gave birth at home that time, at first, midwifery education and risk management during pregnancy were carried out in the way that suited in such situation.²³ However, in the evaluation after 10 years, birthing at a medical facility with support from skilled birth attendants was uniformly recommended as the number of maternal deaths was not reduced enough.²⁴ In the 2000 Millennium Development Goals, the Goal 5 indicators of maternal health were set as "maternal mortality ratio" and "institutional delivery rate". Birthing assisted by Traditional Birth Attendants (TBAs) was banned together with penalty or a voluntary ban was imposed. The hospital was inundated with pregnant women who followed the regulation.

When I first visited Tanzania in 2008, hospitals were like a birthing factory. Midwives were busy assisting women who give birth one after another. Since they could not control the timing of birth, student nurses and assistants in charge of cleaning helped women give a birth when there were not enough midwives available. When that was still not enough, babies were sometimes born in a corridor. People talk about "collapse of medical care" amid the COVID-19 pandemic. I was reminded once again that the scene of birthing in Tanzania was in a situation of "collapse of medical care." Needless to say, medical policy should be based on the premise that medical care will not collapse. For this purpose, it is necessary to listen to the opinions of those who know the context and to develop policies that match the context, such as what and how much the medical personnel in the field currently bear, and how to establish a system to protect human lives without the collapse of medical care. I wonder how many times the words of medical personnel has been heard, "No, no. We don't have enough equipment, medicine and materials. It's impossible to handle double the number of births as the current number of midwives is limited." It is necessary to have discussions to localize the global

²³ Sai F. T. (1987). The Safe Motherhood Initiative: a call for action. IPPF medical bulletin, 21(3), 1–2. <https://pubmed.ncbi.nlm.nih.gov/12268687/>

²⁴ WHO, ICM and FIGO. (2004). Making pregnancy safer: the critical role of the skilled attendant. Retrieved on August 31, 2020, from: <https://apps.who.int/iris/bitstream/handle/10665/42955/9241591692.pdf>

goal “reduce a mortality ratio by improving the rate of birthing at hospitals” in due consideration of the local situation.

2-3. Importance of Local Knowledge (ZAIRAICHI)

Shigeta²⁵ called *ZAIRAICHI* (local knowledge) as “a type of knowledge formed through people’s practice and experience in their daily interactions with natural and social environments.” People in Africa live their daily life accessing to modern medicine as well as practicing medicine based on prayer, customs, and experience. My research team has started to examine the cases in African countries by treating diversity and variation of preventive behavior and patient's behavior as “medical *ZAIRAICHI*.”

In response to COVID-19, it is necessary to have discussions with various participants so as not to swallow the proposals by opinionated Mabeberu which do not fit the context. This is because the system of health care, the number and quality of health care providers, people's access to health care, including insurance, the laws that support it, and people's everyday lives are all different. It is necessary for various stakeholders who know the situation to participate in the decision-making process and to fully discuss the feasibility and applicability, including *ZAIRAICHI*.

Africa is showing a new trend in the COVID-19 pandemic. Africa, along with WHO, gave a firm “no” to French doctors who proposed clinical trials in Africa, saying that African people are not guinea pigs.²⁶ Artemisia is an herb, which has been used as it is effective against malaria. The Malagasy Institute of Applied Sciences named Artemisia “COVID-Organics” in the middle of a clinical trial, and African countries began importing it. The United Nation agency has asked the institute to refrain from claiming effects before completing the clinical trials, saying that African people have the right to use drugs that have been tested in the same standards as other countries. As of September 2020, the agency is actively promoting clinical trials. African countries have begun to use their own resources to solve problems without watching out for Western countries. The WHO has been negotiating with African leaders, who are often criticized for their own actions, and making efforts to make peace. All the above can bring a significant change in the scenery of international health in the future.

2-4. To Move on to Inclusivity

In summary, I would like to emphasize the followings. The scientific community is required to be inclusive and will produce a variety of evidence by its inclusivity. The contribution of scientists to society will be essential based on a variety of opinions. In order to achieve an inclusive society, it is necessary for the majority to accept a wide range of ideas and develop tolerance to stress caused by being shaken their idea “the world should be like this.” Stress can be reduced by knowing how to deal with it and knowing coping skills. Researchers will enhance their coping abilities by stepping out of the world they are looking at, acquiring various experiences, and exchanging opinions with scientists in other fields. It is to actively accepting differences and understanding what is different without prejudice.

At the World Summit for Social Development held in Copenhagen in 1995, an inclusive society was defined as “Society for All.” “Every individual, each with rights and responsibilities, has an active role to play (United Nations, 1995, para 66). Such an inclusive society is equipped with mechanisms which accommodate

²⁵ Shigeta, M., Hebo, M., and Nishi, M. eds. *Livelihood, Development, and Local Knowledge on the Move* (African Study Monographs, Supplementary Issue 48). Center for African Area Studies, Kyoto University. 2014.

²⁶ BBC News. Coronavirus: Africa will not be testing ground for vaccine, says WHO (April 6, 2020). Retrieved on May 21, 2020 from: <https://www.bbc.com/news/world-africa-52192184>

diversity, and facilitate/enable people's active participation in their political, economic and social lives. As such, it over-rides differences of race, gender, class, generation, and geography, and ensures equal opportunities for all to achieve full potential in life, regardless of origin. Such a society fosters, at the same time, emanates from well-being of each individual, mutual trust, sense of belonging and inter-connectedness."²⁷

This is exactly the society that the GYA is trying to achieve, and the Young Academy of Japan in the Science Council of Japan is engaged in discussions aimed at such a science and society. Both in society and academia, it is necessary to sustain a system where we understand each other without eliminating anyone through the utilization and cooperation of diverse human resources. It is necessary to create such a system in order to gradually approach the ideal. In that sense, it is meaningful for the Global Young Academy and young academies to explain their activities in the international community, and for individual researchers to participate in discussions as a diverse member of the society.

²⁷ UN DESA. (2010). Social Inclusion. Retrieved on May 20, 2020 from:
<https://www.un.org/development/desa/socialperspectiveondevelopment/issues/social-integration.html>

Chapter 3“Trnasformation in Society and Science awakening from ‘Unconsciousness’ to ‘Consciousness’ after the COVID-19 Crisis”

Satoru Ohtake

1. Recent social trends

The problem awareness of this paper is based on the view that the advancement in human society such as science and technology have, in a sense, promoted unconsciousness and indifference of people to various social changes due to the increase of complexity and information. As society is diversifying and new technologies such as artificial intelligence are emerging in society, it is a problem that humans will remain unconscious and indifference in the future. It is necessary to transform from unconsciousness to consciousness when we consider a better society and life for human beings. The role of science and technology is to provide facts and data for society and people at the crossroads where they think how to live in the future, to encourage people and society to have a sense of danger as their own, and to help them transform themselves from being unconscious and unaware into being conscious and self-aware. For this reason, this paper mentions the following three points: (1) to create an opportunity to transform from nothing to existence by showing the problems of modern society with various grounds; (2) to convey the experience and wisdom that mankind has accumulated so far for the progress of values and decision-making; and (3) to provide options for what kind of world to create in the future.

The impact of the COVID-19 crisis on people and society around the world is enormous, and efforts to cope with it are continuing.

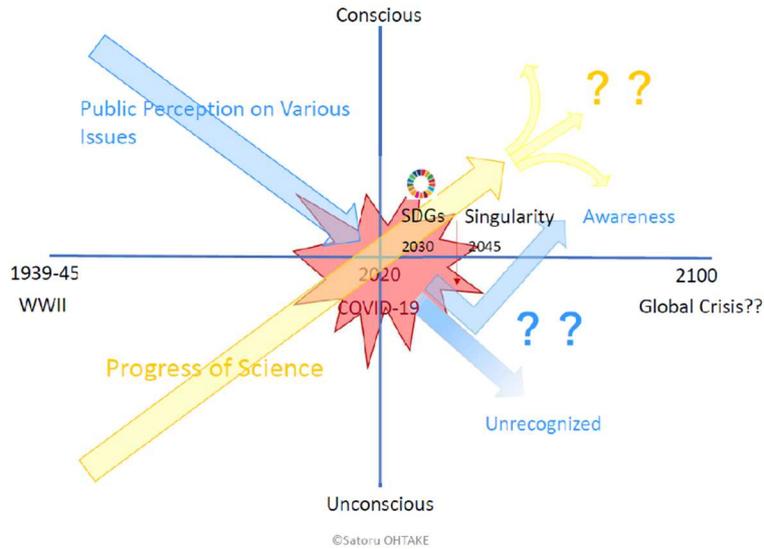
People and societies around the world are rethinking and transforming the lifestyles they have built and used to. Many of the crises experienced so far were serious for the parties concerned. However, in the case of a disaster, the affected areas were limited. In the case of a financial crisis, the damage varied depending on the occupation and financial assets held. In comparison, the COVID-19 crisis knows no national borders. All people encounter it equally. Since the past lifestyle is closely related to the propagation and spread of the virus, the crisis is common and familiar with the public. Therefore, a major reform has been proposed to pursue a new normal of life and society.

In addition, we are now being forced to respond flexibly to the balance between the essential elements of modern society (pursuing a compromise in a trilemma): the realization of public health through the control of the COVID-19; the realization of economic activities that involve physical contact between people; and the security of human rights in societies involved in the protection of freedom of action and privacy.

We had to rethink what we used to take for granted and what we managed to achieve a balance. In addition, we have been forced to face big but potentials issues such as a trilemma.

This paper considers what kind of relationship there is between academia, science, and society under these circumstances, what kind of issues there are, and what should be done in the future.

Figure 1 Changing trend of "Off-ward" to "On-ward"



2. Recent developments in society and science

COVID-19 crisis has a great impact on the relationship between society, academia, and science, and it seems to be great debate both in Japan and abroad.

First of all, in the relationship between society and science the progress of science is deeply related to people's lives, the state of society and its changes. In this sense, it can be said that the relationship between society and science is deepening, but it is a very ironic situation that this is amplifying people's "unconsciousness and indifference" to various phenomena including science. As a result of scientific advances that have fostered diverse knowledge and stimulated its use, for example, the development of artificial intelligence enables us to organize complex and diverse information in various situations. On the other hand, artificial intelligence makes proposals that match the results of analysis and individual tastes. However, the process is complex and will be like a black box. If this happens, the intelligent process that humans should be supposed to do will be entrusted to artificial intelligence, and that may become the ultimate unconscious.

Now, we have a look at the issue in the relationship between science and society that has emerged due to the COVID-19 crisis.

① Relationship between politics and science

In a time of COVID-19 crisis, the relationship in particular between politics and science in Japan and abroad has developed in various ways, and has been evaluated and criticized in many ways. This section shows what scientific advice science provides for policy decisions and how politics responds to that advice.

a) Example of the United Kingdom

Regarding scientific advice to the government, the United Kingdom has developed a system based on experience. Reflecting on the wrong scientific community's response to the bovine spongiform encephalopathy (BSE), or mad cow disease in the 1990s, that the disease was not transmitted by the oral route, various parties in the scientific community have deepened their discussions on the role of scientists in policy. In 2010, "Guidance: Principles of Scientific Advice to Government" were compiled, and the role and responsibility of scientific advice, its independence from politics, transparency and openness were shown. After that, the SAGE (Science Advisory Group for Emergency) was established to gather the science advisors of each ministry under the chief scientist and respond to emergency situations. Since 2009, SAGE has played an effective role in dealing with infectious diseases such as Ebola hemorrhagic fever and influenza, volcanic ash and floods in Iceland, and the actions of British residents in Japan at the time of the accident at Tokyo Electric Power Co.'s Fukushima No.1 nuclear power plant in 2011, and others.

According to the Asahi Shimbun, the United Kingdom's response to COVID-19 was "one step behind though that followed scientific advice. Some scientists of SAGE reportedly took a cautious stance on strict measures. As a result, the UK took relatively moderate measures and caused the most serious damage in Europe. Prime Minister Johnson spoke words of self-examination. The United Kingdom's most well-developed scientific advisory system failed to provide the best results for the COVID-19 crisis, although COVID-19 has many unknown factors. On the other hand, regarding the meeting of SAGE, minutes, handouts, and other references are compiled for each meeting, and they can be viewed on the website. They are important information for examinations in the future. It is no doubt that these documents will serve as a reference for improving scientific advice in the future and for dealing with unknown events that may occur in the future. The attitude to learn from tough experiences in past and improve for the future may be the basis of British scientific advice.

b) Examples of Sweden

Sweden also did not impose lockdown in cities, and took moderate measures such as practicing social distancing. As a result, death toll to the population is high in European countries. The Swedish government was said that they aimed to get herd immunity against COVID-19 at first, but they deny that. Rather, the government says that they decided the policy based on the opinions of scientists and experts considering the long-term approach as the response to COVID-19 will not be short-term efforts. A leading epidemiologist, Dr. Anders Tegnell explains to the public frequently, and as a result, public strongly support for government policies. It shows the importance of experts repeating and taking sufficient time to explain to people.

c) Other examples

On the other hand, there are leaders in the world who rarely listen to the advice of scientists and experts, or whose use of advice is seen as a problem.

Some politicians say "Corona is like a cold," and are reluctant to take measures that would hamper economic activities. However, I think the biggest challenge is skepticism about science. According to Australian environmental scientist Dana Nuccitelli, skepticism of science begins with "negation," followed by "buck-passing," "trivialization," and "criticism of the cost of measures," and leads to "belated pessimism." (Asahi Shimbun) A typical example of this is the skepticism about global warming, but the same is happening regarding COVID-19.

Skepticism about science in the United States is a typical example. It is said that importance is not attached to science in response to COVID-19. John Holdren, a former science and technology adviser to the Obama administration, said the previous administration understood the significance of science to national issues, but the current administration has no experts, or only silent experts. He also points out the division of society happened, such as the fact that some people accept the leader's claim as truth.

Both a blind belief of a skepticism and a blind belief of science, which is at the opposite pole, are problems. However, the skeptical discussions about science should not be denied. Excessive trust in science is also a problem, and it is sensible for society to have some skepticism and various discussions. In this way science is also polished. The sound relationship between society and science is strongly related to mature democracy.

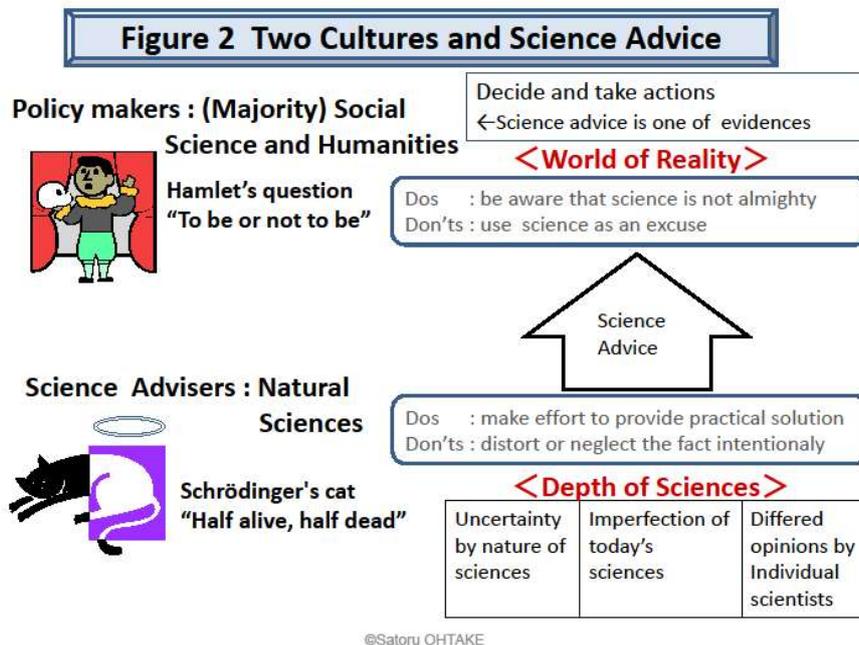
d) Example of Japan

With regard to COVID-19, the Government of Japan established the New Coronavirus Countermeasures Headquarters in January 2020 to practice infection control in cooperation with other ministries and agencies, such as the Ministry of Health, Labor and Welfare. In February, the Novel Coronavirus Experts Meeting was held with more than 30 members. Most of the members of the expert meeting were medical professionals and virologist, and their mission was to provide medical advice. The expert meeting did its best to analyze the infection situation and propose specific countermeasures against the novel coronavirus. However, people criticized, saying that the expert meeting went beyond their position to give advice and decided on the actual government countermeasures. After six months of their activity, the expert meeting made an announcement at a press conference, explaining that they were so concerned about the situation that they not only expressed their opinions on the Secretariat's proposal as they were required to do at first, but also suggested their own countermeasures. However, the expert meeting does not keep detailed minutes of what discussions took place, and politicians always give explanation, saying that they made their political decisions "in

consideration of the opinions of experts." Therefore, the public came to think that experts decide everything.

I believe the biggest problem is how policy makers handle scientific advice. I said in the case of COVID-19, politicians always explained that they made political decisions by saying, "in consideration of the opinions of experts." Politicians did not clearly explain what kind of advice they received from experts, what part of their advice was adopted, and what part was not, with clear reasons. The press and the media, who was at interviews with politicians, rarely asked these things clearly, and there were no clear answers. For these reasons, many scientists felt that politicians were using advice of experts as excuses for the purpose of revitalizing the economy, which is important but different from the purpose of preventing the spread of infection.

In the United Kingdom, there is a principle of scientific advice that ensures transparency and openness and makes clear where responsibility lies for policy making. In Japan, however, the Science Council of Japan only revised the Code of Conduct for Scientists in 2013, emphasizing the importance of dialogue between scientists and society under the chapter "Science in Society" and describing how to give scientific advice. This revision was made after reflecting on the diverse responses of various scientists to political issues caused by the nuclear power plant accident that occurred immediately after the Great East Japan Earthquake. However, unlike in the example of the United Kingdom, there is no provision that gives the government guidelines for receiving scientific advice, such as "the government should publicly explain the reasons for its policy decisions, and especially when the decisions are not consistent with scientific advice, the government should clearly show the evidence that led to such decisions." Scientific advice is only one of the grounds for decision making, and decision makers should understand the limitations of science and bear the responsibility for their decisions, rather than seeking responsibility for scientific advice.



② Relationship between society and science

Japan's society has a certain level of interest and trust in science and technology. According to a survey conducted in August 2019 by the National Institute of Science and Technology Policy, Ministry of Education, Culture, Sports, Science and Technology, 61% of respondents answered Yes when asked if that they are interested in news and topics related to science and technology, and 76% answered Yes when asked if they think what scientists say is trustworthy. The percentage of responders who answered yes when asked if they have interest in technology decreased by approximately 10 percentage points from 10 years ago, but it can be said it remains high. The percentage of responders who answered yes when asked if they have confidence in scientists has remain at 70 to 80% for the past 10 years, although it declined to 41% in April 2011 after the

Great East Japan Earthquake and the subsequent nuclear power plant accident.

People have a certain expectation to science and technology in COVID-19 crisis. The National Institute of Science and Technology Policy conduct a survey of 1500 people on the Internet in March 2020. According to it, 60.1% of the whole responders chose "promotion of research and development" regarding the measures to be taken by the government to predict and control infectious diseases including COVID-19, while 56.0% chose "provision of easy-to-understand information to the general public". Less than 40% of the whole responders chose other options, such as the establishment of research institutions and requests for cooperate from related companies.

As of September 2020, many points regarding COVID-19 remain unknown. Researchers have continued to try to elucidate the details. During the period, various information was conveyed, and there were some examples in which subsequent research and development revealed different results. However, it seems that many people take it calmly, probably because it is repeatedly reported in the media. It should be noted, however, that the high degree of public trust in scientists is inextricably linked to strong requests for information from the government. A deeper relationship of trust can be realized if the scientific community continues to face society.

③ Issues in Science Community - in the Case of Japan

Regarding the response of the scientific community, various research by scientists in the related field have been developed concerned in Japan and abroad. In addition, simulations of spread of infection were carried out by experts in fields such as mathematical science and theoretical physics making use of their respective expertise. Many scientists, such as Shinya Yamanaka of Kyoto University, who make efforts by utilizing their expertise, saying that scientists should humbly and calmly pursue facts and accumulate results, are good examples of scientists who have faced the challenges that society is facing.

On the other hand, in some cases, there is competition for results. The followings are such examples. Preprints are distributed as if they are definite research results without thorough examination of the papers well-established in the scientific community. A considerable number of such preprints were withdrawn later. In other cases, the results of research are made public by politicians before scientific examination. It is regrettable that this was one of the causes of social confusion.

It cannot be said that the Code of Conduct of the Science Council of Japan, which was mentioned earlier, has not been widely shared among scientists. The Expert Council on the New Corona would have received significantly different responses if it had understood and discussed each provision on responsibility of scientists, dialogue with society, scientific advice, and scientific advice to policy-makers and decision makers as set forth in the Code of Conduct. In particular, if scientists who provided scientific advice had put into practice the rule that "when a policy decision which is different from the advice of the scientific community is made, scientists will ask the policy maker and the decision maker to explain to the public as necessary," society would have been less likely to be confused. The "Code of Conduct" was not cited ever. This shows lack of effort of the scientist community which must have taken seriously the 2011 situation, which has severely damaged the trust of scientists. This is very much regrettable.

④ "Disconnection" of Science with Humanities and Social Sciences - Desired Collaboration and Transdisciplinary

Modern science, as typified by artificial intelligence and digital technology, has penetrated into society and people's lives. It is natural that scientific research should be conducted by experts with intellectual curiosity. However, it is more likely that the research by experts will have an unexpectedly large impact on society and people.

On the other hand, the challenges of modern society, such as the SDGs, are complex and interrelated, requiring the latest science to offer a variety of possibilities for solving them.

In addition, with advancement in information and communication technology, the diverse backgrounds of societies and people have been shared around the world.

Science has been trying to find common rules for various phenomena. The rule that holds true somewhere

in the world, or even in the universe, holds true everywhere else. However, the implementation of solutions to social problems based on these rules is not limited to one in other places of world. To give the clear example, a treatment or drug for a disease may or may not be effective depending on the personality or gene type of the patients.

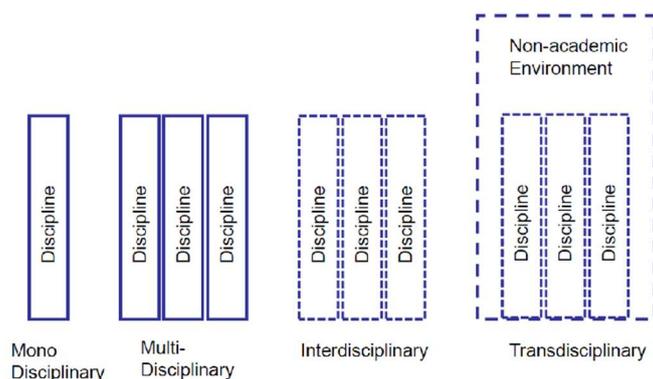
About the COVID-19 crisis, a new type of coronavirus, which has many unknown characteristics, has spread explosively in Europe and North America, following China. This has quickly become a social problem in Japan. Difficult issues were caused such as the prevention of infections by imposing lockdown, restrictions on private rights and protection of privacy related to infection control, and the maintenance of economic activities. It is like addressing a trilemma. On the other hand, the division of society came to the surface in Japan through discrimination against those who have been infected with COVID-19, and acts of “social distancing police,” who monitor the behavior of others, such as long-distance travel and mask wearing. These issues need to be addressed by gathering knowledge not only in science but also in the humanities and social sciences, and by maintaining full communication with people and society.

However, the relationship between science, humanities, and social sciences, especially between science and humanities, is deep. In general, it seems that researchers in these fields have been conducting research independently from each other. Of course, not a few scholars carry out research projects and activities that link both fields, but most of them seem to be confined to their own research fields. Scholars in the humanities and social sciences, especially the younger generation, are seeking collaboration with scholars in fields of science, including ones in the digital field.

It is now necessary for researchers to be aware of diversity, focus on social issues, and pay attention to the circumstances of people and culture of society in order to advance scientific research. In order to engage in such a wide range of activities as science, it is necessary to cooperate with researchers in the fields of humanities and social sciences.

Complex and interrelated varieties of social issues call for collaboration between disciplines, interdisciplinary cooperation through their activities, and partnership with a variety of stakeholders in fields other than field of academic study. For example, cooperation with business people, social activists, and the general public is required. This is called transdisciplinary, which goes beyond interdisciplinary collaboration.

Figure 3 Disciplinary



ISSC following Bunders et al (2009)

3. Three Risks

When looking at the current situation in Japan and abroad, and assuming that the progress of human society over the past few decades, especially the progress of science and technology has brought about various conveniences and at the same time made people unconscious and indifferent from many things, I thought that human beings and society were facing great risks.

With more convenience in society, more contacts with variety of people, societies, and cultures, and more information available, people should generally be able to make better decisions and gain deeper insights. However, things are not heading in the right direction.

First of all, there is so much information that it is impossible to understand and consider everything. Even if there is not, it takes time to think while paying attention to various things. On the other hand, advances in information technology have enabled us to integrate information and develop out thinking to some extent. As a result, options for thinking have become available as if they were ready-made clothing and ready-to-eat food. In addition to that, we now even have a system where AI analyzes each person's tastes and preferences and only offers things that match the person's preferences among various choices. This is considered to result in three risks.

The first risk is the lack of capacity to respond to crises. Crises will be greater when they are unknown to individuals, groups, and societies, or when we strongly believe they are unlikely to occur. COVID-19 crisis is an unknown case, and the accident at the Fukushima nuclear power plant was expanded by overconfidence that an accident would not occur. In today's flood of information, if we rely on SNS that relies too much on AI, only information that is in line with a particular way of thinking of an individual or a society will be emphasized. That is likely to lead to overconfidence in the current situation and misunderstanding in which we overlook problems. In other words, only the favorable facts that endorse what you like and judges what you don't like as being wrong is gathered together, and the opportunity to come into contact with other facts is lost. These may expand the danger and the wound be widened.

The second risk is the decline in people's acceptability for different ideas, historical backgrounds and culture, and the progress of fragmentation of society. Thanks to the development of transportation and the sophistication of information distribution, the world has become smaller and closer. People with different histories, languages, and cultures have been able to interact and enjoy the diversity that exists on Earth. When we look at nature, we can see the Earth has biodiversity. When we look at human society, we can tell that various people constitute the world and have the right to live their lives. In contrast, globalization in the past has involved people around the world in search of optimization of economic value. On the other hand, people and groups who have been deprived of their vested rights through globalization have opposed the globalization and have been moving toward the rule of other people in the world through unilateralism or hegemonism. The above-mentioned separation from inconvenient facts accelerates these movements and acts to promote the division of the world and society.

However, considering only human beings, the earth is indispensable for the survival of various people, and in reality, globalization has created a situation in which no great country can achieve by itself the optimum society that people seek. Now that such situation has arisen, there is a growing risk that will harm the diversity and interdependence of the world and the resulting development of humanity as a whole will be undermined.

Finally, through various intellectual activities exemplified by academic research including scientific study, human beings have made progress while sharpening their intellect and balancing their reason and sensitivity. On the other hand, the confusion caused by the delay in responding to the crisis mentioned in the first part, and the loss of diversity and division of the society mentioned in the second part, are contrary to human development that has been accumulated so far. For example, the logic and hegemonism of leaders who insist on unilateralism deny the ideals of modern democracy, which has been built up through trial and error, and have a great impact on the sound relationship between society and science. More than that, if we overlook these risks and enjoy the pleasure of convenient information, it will be a regression in intellectual activity in which we have always addressed complex issues with conflict of interests, and have made maximum use of intelligence to achieve the happiness of as many people as possible, rather than the maximum happiness of individuals or particular groups. It is a crisis of the loss of intelligence.

4. What can academy and science do?

I would like to think about what academy and science can do to avoid such risks, to restore human

development with balanced intelligence and sensitivity, and to realize the happiness of the people in the world.

① Science Communication

Science has systematically explained phenomena by analyzing various phenomena and finding common laws and rules, and has created new values by using predictability and acquired knowledge. However, science cannot explain everything accurately. This is because firstly nature has uncertainty and probability. Secondly, science is not a perfect at all times. Thirdly, different scientists have different interpretations and decisions about what matters even if they look at the same data or the facts, and the systemization of knowledge is different. First of all, scientists need to communicate the current state of science with society. It is clear that scientists working in cutting-edge scientific research cannot do good research without having excellent insight and a passion for the subject of their research. However, I think it is human nature that when they receive the latest results, they want to communicate its' greatness and potential. As I said earlier, Professor Shinya Yamanaka said scientists should communicate honestly and humbly. I believe that they should clearly explain what the results mean, the conditions and limitations. The Science Council's "Code of Conduct for Scientists" is consistent with that point. I believe that this is the first step in building trust between people, society and science.

② Think about science education: Compulsory education: Education of science not for entrance exams but for the common sense of the people living today

When the Government of Japan began formulating the Basic Plan for Science and Technology in 1996, the Government listed various policy items for the effective promotion of science and technology activities, including the promotion of public understanding of science and technology. In Japan, the government spends four trillion yen a year to push forward science and technology. This is a second biggest public spending following public works. The purpose is to have tax payers understand the science and technology in which the government has considerable investment. After that, the government changed the condescending expression, "have the public understand," into expression such as "science and technology communication."

However, I would like to argue that it is necessary to deepen people's understanding of science. First of all, science has provided people and society with a variety of conveniences, but this is only one of the scientific motives. In Japan, the improvement of convenience may be overemphasized as the significance of science. It is necessary to begin with the creation of understanding and sympathy that science is a more essential intellectual activity to understand the mechanism of the world around human beings. It is also necessary to deepen the understanding of people and society regarding the uncertainty, limitations, and diverse interpretations of science as mentioned in the preceding paragraph. That is to help the public understand science properly, neither too much nor too little, to gain deep understanding of it. Although the Japanese have a high level of education, they generally view science as the basis for technology that is historically useful. It is not always common to understand that science is an activity that is indispensable to human beings who are intellectual. Also, people may have excessive expectations of science and want 100 percent results. However, achieving 100 percent results is impossible in science. Science is probabilistic, and current research is not perfect. To explain this sincerely and honestly and gather prior knowledge and prepare, even if science is not perfect, is to show what can be done and to help people understand the current science and its potential.

It would be best if the following meaning would be attached to science education. The value of receiving science education for the general public other than scientists is not receiving mere knowledge but learning how to think in order to live in society. This is because that will lead to nurture competent members of society who can think for themselves, discuss, and decide the way that they and society should be.

It is not about explaining to taxpayers or getting funding, but it is about building deeper trust between people, society and science.

③ Understanding of diversity and culture by scientists

Next, I would like to ask scientists, who are the main players in science, to have a social perspective in addition to a standpoint of their own research subjects and fields, and to collaborate with researchers in other fields, especially in humanities and social sciences. That is, to try to conduct transdisciplinary research.

As mentioned earlier, the world will face various issues developing through more and more diverse countries, societies, and people. As seen in the trend in innovation in science and technology for the SDGs, the demand for utilizing the results of science in various social issues is increasing. In the future, when implementing the results of science in society, the involvement of scientists will be required in many cases. However, even if the rules found are universal, the implementation method needs to be sympathetic to the diversity and culture of the place and society in which it is implemented. In this sense, the scientists involved are also required to have a view of individualization that respects diversity, which is different from the role of generalization and standardization in science.

The primary ability required of scientists is the ability of scientific research, but the ability to respect and understand various societies, people, and their various histories and cultures is also required. It was C. P. Snow of the United Kingdom in the late 1950s who was concerned about the division of science, humanities, and social sciences in society. It is important for scientists to take this issue seriously and make efforts to overcome it.

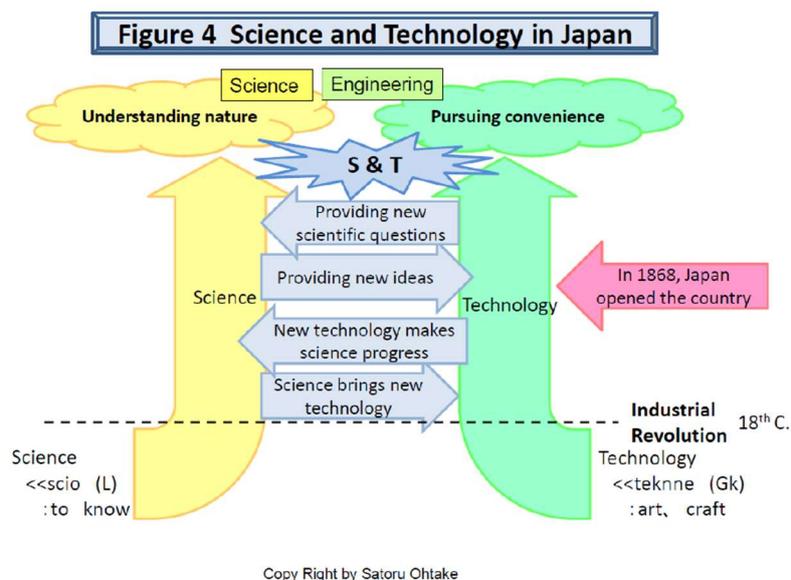
It is also useful for the research in their fields. One of the challenges of science is to doubt common sense, but it is consideration from various perspectives that will be hints for that. Such hints are likely to come from completely different cultures. Prof. Haruhiko Morinaga, who has been engaged in original research at Technical University of Munich for many years, talked about research as follows: "First of all, do what others don't do. Next, do what others cannot do. When reaching that stage, do what others have done." He told that researchers build their research capabilities by selecting original projects first. Next, they overcome more challenging projects. If researchers were able to cultivate their research capabilities by this time, they would be able to find new things from what others have already done and was considered as common sense. However, the last stage may require a different perspective from that of scientists in the same field.

④ Challenges that the Japanese Scientific Community especially needs to address

The relationship between science and society and between science and politics in Japan is hardly mature enough.

The Japanese view of science is different from that of Western countries. First, science, which has developed mainly in Western countries, is related to Greek and Christian cultures. For example, the attitude in which one seeking the elements of everything in the world is rooted in Greek philosophy, and it is said that the elucidation of the laws of nature comes only from the desire to understand how God created the world. In addition, it was during the Industrial Revolution that science was combined with technology to bring about rapid development, and at about the same time, modern science was established. At that time, the Edo period, Japan closed its country to the outside world, and Western science was indirectly passed down from China, which heard from the Jesuits in China. Since having the Christian Faith was prohibited in Japan, none of the experts or systematic literature was passed on. On the other hand, in the Edo period, Western science was introduced from the Netherlands and other countries free of Christian belief. It seems that the technology had evolved as there was also technical information.

After the Meiji Restoration, in promoting modernization of Japan, it was necessary to acquire the most advanced technology of the time rather than starting from the philosophical foundation of science in order to rapidly keep up with the standards of Western countries. Therefore, with regard to science, it may have been possible to regard science as the basis of useful technology. The following is related to the promotion of science education mentioned above. I believe that the Japanese scientific community should not readily believe that the history of science up to the present day is common sense in Japan, and that more discussion and dissemination should be conducted.



5. Conclusion

The purpose of this paper was to consider the relationship between SDGs and science.

The SDGs set out what can be done by 2030 on the issues that human beings will face in the future, and encourage the whole world to solve the issues. Although the SDGs encompass all issues, they are not logically well organized due to correlation between issues. However, the value of the SDGs is very significant as it is the first comprehensive proposal looking at the future of the entire planet. In this context, innovation in science and technology requires the creation and provision of knowledge leading to various proposals and elements for solving problems. This will be a great opportunity to consider the relationship between society and science.

COVID-19 has become a global issue, and it can be seen that one of the issues presented in the SDGs has become a reality. In this sense, both in the world and in Japan, we were forced to deal with common global issues. Considering the various impacts of this event, it was the second big event in the past 100 years since the second World War. COVID-19 has brought about various irreversible changes to people and society around the world. I think that COVID-19 has highlighted various problems and issues related to society and science.

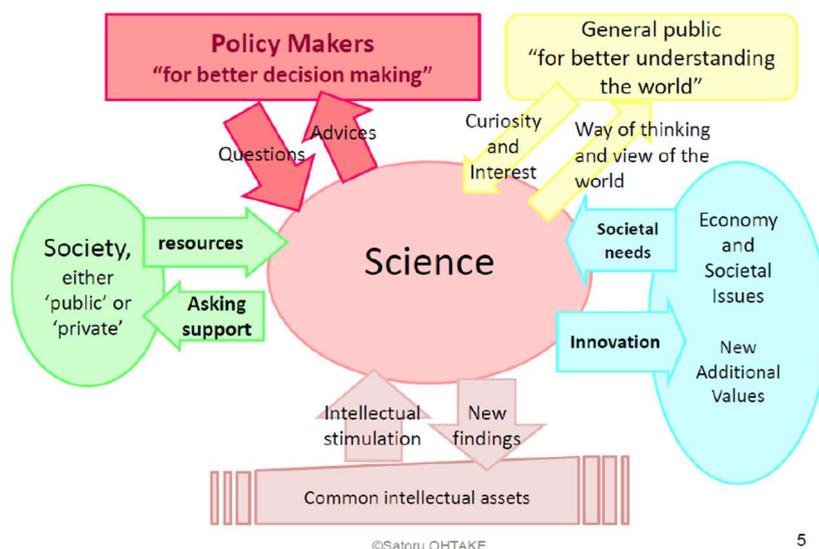
The world is still in the process of responding to COVID-19. This will have a major impact on the SDGs and other efforts to think about the future, such as The World in 2050(TWI2050) of IIASA, Vienna. I believe that the way to approach, priority and speed for some issues will change.

This paper is a summary of my social and scientific awareness along with my thoughts on various things that had occurred by the summer of 2020. As a result, I do not think the case studies and items are fully discussed.

In the project leading up to this discussion, it was discussed to whom each discussion would be sent as a message. My colleagues pointed out that the purpose and contents of this paper would remain ambiguous unless the target of the message was made clear. It was a reasonable comment. After all, I could not narrow down the targets for the discussion. The discussion has been aimed at all people including scientists, policy-makers and the general public due to my one's indecisiveness. Therefore, the contents of the paper are nothing special to some group of people. Based on my experience, the main content of the paper is to show the general public the way science is. However, my writing is not easy to understand. I am solely to blame for it.

I hope that this paper will be helpful in building a better relationship between science and society.

Figure 5 Relation between Society and Science



5

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Part 2 Historical View of Science and Transdisciplinarity at a Turning Point

Chapter 1 "Concentrate, to digging deeper. Communicate, to creating together."

Shoji Komai

1. Concentrate, digging deeper. Communicate, creating together.

People need a place to concentrate when they concentrate on some activities especially in which they work with logic, such as mathematics and physics. It is too famous that Andrew Wiles, who proved Fermat's last theorem, has been concentrating on proving this theorem for seven years. The coexistence of such deep concentration and absorption is confirmed in the "Flow Theory"²⁸ advocated by Mihaly Csikszentmihalyi. "Flow" refers to a state of deep concentration or immersion in one's limited field. When a person is in a state of flow, he or she is highly focused and experiences a subjective feeling of happiness and satisfaction as well as strengthened feelings of self-esteem. A flow state is attained by being spontaneously motivated, and there is widespread debate about how it is related to GRIT²⁹ and creativity.

In recent years, global IT companies such as GAFAM, have secured space for individuals to concentrate on their work in addition to the space for collaboration. Therefore, it can be said that the improvement of productivity by people focusing on their work is recognized and implemented in society.

On the other hand, if you concentrate too much, there is no input for your thoughts. You would not have the opportunity to come into contact with new ways of thinking, which makes it difficult to develop diverse thoughts. In order to solve these problems, many activities such as hackathons and ideathons have been carried out at the social end in recent years. Many ideas were created through activities such as workshops and seminars, and certain results seem to have been achieved.

God's viewpoint and a cycle of thoughts

However, it is required to think intensively in order to develop results of these activities concretely and implement them into projects and political measures. This cycle of concentration and communication is necessary for human creative and productive activities.

What is needed to make this cycle work? Logic is of course necessary to think deeply. In order to understand the existing various knowledge in the world, we need a language that extracts one aspect of the events we are interested in from these knowledge and the logic to take it to use.

Individuals cut out the knowledge based on their interests and develop logic according to the characteristics of the logic they hold. We have sought to understand the sum of all knowledge by accumulating and combining these individual logics. In order to understand the infinite sum of all knowledge, we have tried to fill the gaps between the knowledge by using various viewpoints and various construction characteristics of logic.

However, this is the viewpoint of God, and an individual cannot look around the whole sum of all knowledge and find a gap. In other words, the human cannot know where and what kind of gaps of knowledge exist. We have no choice but to combine the pieces we have as correctly as possible.

It is important to broaden the perspective of each individual, to make logical characteristics flexible, and to bring together the knowledge of multiple people. This is really bricolage.³⁰ New things can be imagined by

²⁸ A book written by Mihaly Csikszentmihalyi in 2008.

²⁹ "GRIT" by Angela Duckworth (2016).

³⁰ It is the word of Claude Levi-Strauss. It was used in the book "Wild Thought" in 1962.

gathering knowledge, which creates value.

Tolerance to accept different values and decision-making will be necessary to open your own eyes and to make your way of thinking flexible. First, we accept the viewpoints of others and look at the events we are paying attention to from those viewpoints. We also introduce other people's characteristics of logic and rebuild our own logic. This kind of attitude is required. Furthermore, when the viewpoint and the logical characteristics are unknown, it is necessary to decide by oneself whether these are good or bad. It is necessary to make decisions within the scope of one's knowledge on dealing with unknown events one faces by collecting as much data as possible and comparing it with known events. In other words, it is necessary to make decisions based on one's own value combined with the viewpoints of others and to build one's own logic based on the combined (collective) knowledge.

It is also true that many events have been understood and described by this way of thinking. However, we need to recognize once again that this intellectual cognitive process also includes the value judgments mentioned earlier. It is based on the fact that we ourselves cannot have the viewpoint of God, and our desire to go beyond that and approach the sum of all knowledge.

2. Crowds (psychology?)

Reliability

Humans have evolved by externalizing various things. By creating tools and working together to cover their low level of physical abilities, they were able to efficiently bring down larger animals. In order to cooperate, it was necessary for multiple people to coexist. Rules were necessary to avoid conflicts among individuals. However, multiple people could not remember detailed rules, so people handed down and described them in various ways. These descriptions made it possible to show the same rule to many other people.

But there is no change (evolution) unless you deviate from conventions.

Rules stabilize communities and organizations and allow people to focus on tasks and work to do. Each organization focused on delivering to the world the products and services that each person should produce, and people enjoyed many complex products and services and gained their own time ("The Rational Optimist" (2010) written by Matt Ridley). By externalizing rules, we can pursue what we want. However, sometimes the rules force standardization and refuse to change. If we seek change, we need motivation and driving power to review and change the rules themselves. These changes are caused by various factors, such as nature, society, and culture, whether or not we desire them. However, changes are often induced by outside pressure that deviates from stability.

Acceptability

These changes will need to be carefully examined. Here too, many organisms, including humans, are to be influenced by the evolution under homeostasis. Changes caused by outside pressure, such as the changes in social structure that have been seen in the recent COVID-19 pandemic, often go relatively fast (depending on the situation in each country), but in many cases, changes are not desired. This is especially true when we live without any problems. Personal justice is wielded for maintenance of homeostasis and a dislike for change. This is probably due to the abnormality in information caused by insufficient discussions as stated

before and misunderstanding with the filter bubble³¹, furthermore, information overload³² caused by an excessive amount of information.

On the other hand, various problems are occurring all over the world even in peacetime. It is necessary to pay attention to the transformation to solve these issues. The 17 Sustainable Development Goals (SDGs) adopted by the United Nations in 2017 are a good example. It seems important in a sense for an authoritative body like the United Nations to set a goal on the issues that human beings are facing. It is important that they set goals that each organization or group, such as a country or region, could not achieve due to their own expectation from a global perspective, and provided an opportunity to tackle global issues. However, this kind of problem is charged with danger to the modern people as mentioned above. We must comply with a goal as it is set by an authoritative organization such as the United Nations. Everyone must move toward a goal. The blind acceptance of a goal based on such ideas can undermine diversity and flexibility in value. Of course, it may be necessary to follow this goal in general and make efforts to achieve it from a global perspective as it is a global challenge for humanity.³³ This is only from a global point of view, so it is natural to assume that there are various local exceptions. Humanity may have seen many new values and ideas being generated in this heuristic situation. I would like to write it down here with my self-reproach.

However, speed is also important (the importance of transparent dialogue).

On the other hand, in modern society, speed is often required in decision making in various situations. Even in the realm of thinking and contemplation, this sense of speed is now required, perhaps as a result of consumer economic activity in a sense, this may be the direction of human evolution that we must accept. Can we have this sense of speed, deepen our thinking, and make better decisions?

The answer is clear. It's all about externalizing. The final decision should be made by oneself. In the process to that, where information is collected and narrowed down to several options, all we have to do is externalize these processes and make decisions with satisfaction.

So, where should we externalize them to? Artificial intelligence (AI) will be an option in the present day. AI will be able to handle a large amount of information, to classify it according to some boundary conditions. Humans will make a judgment with the organized information. It is conceivable that it will be the standard way of thinking in the future. On the other hand, there is naturally overemphasis on output due to imbalance in input information and over-learning. There is a possibility that an ethical problem may arise.

In retrospect, human evolution may have followed a similar course. One and others had communicated non-verbally and verbally, and their actions and attitudes have been determined based on the information obtained there. They had asked questions to their families, friends, and sometimes someone on the net, and have decided their own course of action using that information.

Humans are biased to a we-group and tend to make better assessments and have better impressions of members of the same group. This is probably due to the biological constraints of sharing limited resources embedded in the process of evolution. It is thought that the development of reciprocity through trust expanded the group, and a global balance was achieved by even externalizing the reciprocity. One form of

³¹ Eli Pariser named it in his book "The Filter Bubble" (2011).

³² It was first taken up in "Future Shock" by Alvin Toffler in 1984.

³³ Regarding this, it is necessary to answer the non-identity problem between generations taken by Delek Parfit (1987).

externalization of reciprocity is thought to be currency. It is thought that currency portability and objectivity of value have established the externalization of reciprocity.

Humans have evolved and developed their culture by discovering and exploiting the value of objectivity.

Western democracy can handle a great number of people.

Politics have been conducted as the government handled by God for a long time, but the people's dissatisfaction was accumulated due to unequal distribution of capital caused by active consumer consumption. In order to solve this problem, opaque politics were made transparent to a certain extent, and western democracy was established. This transparency has led to objectivity and trust, which has made it possible to govern a large number of people. For this, it has been possible for groups to make decisions for long periods of time.

The Meiji Government distorted Confucianism and tried to be under control of it, but what about the current government?

On the other hand, Japan governed the country by adopting Confucian thinking instead of Shinto and Buddhist ways. It has been said that God dwells within all nature. On the other hand, it can be said that modern Japanese politics began based on the teachings of humanity and justice and the distinction of rank.

In the midst of globalization, the political and decision-making processes of each country have affected the values of the people. The political structure has been forced to change, but the firmly-rooted political style may still be the source of distrust.

Advantage of externalization

We can do what we cannot do alone.

As mentioned above, externalization enables us to concentrate on what we should do for ourselves and what we want to do, leading to improved productivity. Furthermore, by working together, co-creation becomes possible in a way for each party to increase productivity. It also becomes possible to create something that cannot be done by individuals (not only manufacturing, but also creation of culture and value).

3. Not just physical: Goal Abstraction and Line-of-Sight Effect Strengthen Driving Force

Goal abstraction

Furthermore, by setting goals as an externalization, or something altruistic, the goals will be the satisfaction of others, making it difficult to compromise in achieving the goal. It is expected that it will become possible to steadily get closer to achieving the goal as being lenient on oneself and avoidance in the form of eliminating cognitive dissonance is unlikely to happen.

Line-of-sight effect

In addition, setting goals for others leads to a sense of being watched and makes it more difficult to compromise on achieving the goals. It is only others who decide whether or not the externalized goal (altruistic behavior) has been achieved. So, it will be possible for us to focus on continuing to work to achieve the goal.

“Imagine and Creation of God” and externalization

Population and organizations are growing in modern society. The interaction by SNS through the Internet has greatly expanded our social space. In addition, the transportation infrastructure has been improved, and it has become possible for us to easily visit various places all over the world.

Ancient people would not have led a social life in a group which was as large as it is today. The start of hunting and farming by groups led to division of labor. Organizations were formed and government were required. God was “imagined and created” and used as a power to unite people unconditionally.

Nature has continued to provide blessings and disasters at times. The authority tied to make full use of those power of Nature, raced in pursuit of their own interests, tried to satisfy their consumption behavior. It has been repeated many times in history, and people pressed the government for reform each time. However, this is human nature and may be characteristics which are hard to change.

To discard these inequalities and inconsistencies, people sought a transparent and coherent process of fact-based thinking and future prediction based on it. Reliable interpretation which was analyzed based on reliable data in order to make reliable predictions can make more reliable predictions. A theory that predicts various natural phenomena from micro to macro level with better accuracy than God's prediction must have been very attractive. Logic to accurately transfer thought and information must have become a very important tool in a complex society. This seems to be the origin of social recognition for the development of science.

On the other hand, the process from the development of AI in the present day to the externalization of decision making is very similar to the externalization of intelligence seen in the development of science. To what extent can humans trust science? To what extent can humans trust AI? Beyond that, what and how can humans communicate and think?

4. Manners for discussion

It is often said that when people with different ways of thinking and specialties talk, they can't reach an agreement because they have different dictionaries. Why not? Originally, we humans do not have a language immediately after birth, but acquire a language by listening to and learning a language spoken to by someone close to us as we grow up. There may be decline in this ability as we grow, but this seems to be a harmful effect due to swapping priorities on time and efficiency.

This is probably the result of recognition of low priority. It's not because of the lack of engagement. They don't feel the need to connect and communicate with others they don't know enough to trust. They don't try to connect each other as it is low-priority. They don't seem to put priority on others or compare and adjust their dictionaries.

(Episode) VR, AR, avatars, and enhanced body function have nothing in common and are difficult to empathize with.

Many people have been trying to enhance body function using virtual, augmented reality and robots. They have been developed in various fields such as assistance, nursing care, medical service, education and games. Some of them can be shared with others, and it is possible to have the same experience. For example, in a game, you can be in the same virtual space and share the same experience with others. While most artificial limbs and legs attempt to bring the body condition back to the original body condition, prostheses

used in the Paralympics are beginning to exceed the abilities of normal people. Some researchers have increased the number of fingers and arms³⁴ and introduced perception orientation by putting a compass into the brain of the rodent.³⁵ These technologies are possible, and probably also implementable. However, unless it is generalized, the sense cannot be shared, and it probably cannot lead to empathy. About clothing, shoes, eyeglasses, hearing aids, and the like that many people use or have used on a daily basis, a sense of wearing such can be shared. However, canes, wheelchairs, tails, and feathers are not common, and it is difficult to share a sense of using them. Changes in urban structures and systems, and changes in society and culture based on these difficult-to-share physical characteristics are very difficult to implement and will be. How will and will not our lives and society be changed in the future?

5. Sustainability of science

Science in a broad sense, which has developed for trust, has developed by “standing on the shoulders of giants.”³⁶ However, the giant has not become a giant by itself, nor have we on its shoulders. We need to establish bigger bodies of intelligence to make a bigger giant.

Why do not humans try to connect with others though they should do by nature? The important point is time. It takes time to connect people. You must take other available time. Money and manpower are required to find that time. If we put a lot of money and manpower, we can do what we should do. Interestingly, if manpower and money are provided too much, people won't try to do it when they don't have manpower and money. This is called undermining effect³⁷ and is considered to be an adverse effect of reward (extrinsic motivation).

Why did they need money and manpower in the first place? It was because they wanted time to deal with various things. It's time to guarantee connections with others and information. We human have physical and cognitive limitations. Therefore, it takes a certain amount of time to deal with various matters. We need the help of others and money as an externalized value to find this time.

Desi's lists three things as wants to be satisfied in order to enhance cognitive (intrinsic) motivation to achieve for oneself: autonomy, competence, and relationship. This hold the “flow theory” of Csikszentmihalyi, and is considered to have a common direction.

6. And once again, toward “academic woven by human”

“Science of Value”³⁸

The worldwide unrest and confusion caused by COVID-19 in 2020 exposed the vulnerability of human cognition and social structure as well as the danger of the virus itself. The term “Science of Value” originally refers to what value is in the political process and how it is communicated and used in decision making. However, this is not just politics. It may be a command to overcome the difficulties that mankind has faced many times and to open up a new society. There are two important axes of drive. We humans have to approach the science of value, while keeping these two axes in mind. We need to advance our understanding

³⁴ It is being developed by the Massachusetts Institute of Technology, the University of Tokyo and Keio University.

³⁵ It is the research conducted at the University of Tokyo.

³⁶ It is famous as a word written in a letter by Isaac Newton to Robert Hooke.

³⁷ Edward Desi's theory of intrinsic motivation.

³⁸ According to the Joint Research Center (JRC), an EU think tank.

and application of emotion³⁹ as the force that induces the drive for each of the value to make a decision and the value to connect horizontally for data collection in decision making.

Logos, Pathos and Ethos

Science has been established by building logic. However, a lot of decision making and value judgment are necessary for the accumulation of the logic. In the modern age, science and technology have greatly developed. Not only in natural science in a narrow sense but also everywhere in society, science and technology have enabled us to understand and create various things. This trend will become stronger, and we will utilize the externalized knowledge or cognition called information. Instead of the previous science biased too much toward the importance to logic, we need to balance between judgment based on individual values that can be used in various fields and judgment based on social, ethical and moral values.

Furthermore, as mentioned above, in order to co-create new value by connecting with others, balance between understanding and utilizing the ability to connect with others freely (Pathos or emotion) and rational nature for handling these (Logos or logic) will be strongly required. By doing so, humans will be able to overcome major problems that have never been overcome and open a new door.

³⁹ As described in "Strange Order of Things" written by António Damásio and "The Deep History of Ourselves" written by Joseph LeDoux, an emotion is formed when emotionality, which is a physical response, is attributed to some category or value by the cognitive process derived from perception or memory.

Chapter 2 “Collaboration between natural sciences and humanities/social sciences for social rationality? —In order that no one is left behind—”

Sayaka Oki

This study is written based on my impression on the two different but contemporary events: one is the response of each country to COVID-19 outbreak in 2020 and the other is Black Lives Matter, the movement against racism that has been intensified in the midst of the measures against COVID-19. I explain why I put these two together in this paper. My interest is to understand social rationality⁴⁰. That is, how the expertise of the natural sciences, humanities, and social sciences can be involved in the formation of the basis for decision making that is established as a public consensus. The two current events mentioned above are stimulating in considering this question, as they include both natural scientific and social scientific elements.

In fact, in this paper, I originally planned to treat a historical case to tackle this subject, such as the issue of establishing weights and measures (establishment of the metric system) in the period of French Revolution. A new unit was defined as one 10-millionth of the distance from the equator to the North Pole. I was planning to discuss how this grandiose idea, which lacked initially a certain social perspective came to a prima facie social consensus in later period.

However, I thought that that sort of content was very different from the purpose of the Study Group while I was writing, I quickly corrected and summarized the content as follows. As a result, the content has become quite different from the originally planned one including strict historical verification. Rather, the paper has been swept along by current events. With these limitations in mind, I hope you will read it as a way of thinking.

Lockdown experience and another aspect of "modern" society

Since the 19th century, the ideal form of society that developed around the Western world has been described as "modern" or "modernity." It can be said there are three components of its image: the development of a market economy with industrialization, being a democratic country under the rule of law, and superiority of (said to be) scientific thinking.

On the one hand, COVID-19 has shaken our image of this modern age, and on the other hand, it gave me an opportunity to deeply understand what the underlying issues were. This paper starts with a discussion of my own personal experience to deal with the above-mentioned.

I was in Paris for research in March 2020. I rented a house, and was living like a local resident though it was short period of time. When I first arrived there, I had an impression that Japan was still more strongly affected by COVID-19. However, the situation gradually changed. Italy first introduced an age-old method of measures against epidemics called lockdown, and it began. Soon after that, lockdown began in France too.

People listened to the televised speeches of the president and cabinet members. I felt as if I had an unrealistic dream as the scenery of the city changed suddenly from the next day. That situation seemed to be roughly the same as what Gottfried Wilhelm Leibniz, a philosopher in the 17th century, had written for a measure against the plague. In other words, “we have no choice but resort to preventive measures base on politics since no solid preventive measure yet has been found by the doctors.”⁴¹

However, “pre-modern” confusion was not seen in the process that led to the above-mentioned situation.

⁴⁰ Yuko Fujigaki, "Theory of Science Policy: Science and Public Nature", *The Present of Science Theory*, written and edited by Osamu Kanamori and Hideto Nakajima, Keiso Shobo, 2002, 155.

⁴¹ Leibniz, "Recommendations for plague measuresA memorandum for Duke Ernest August"(1681?) [Leibniz für Herzog Ernst August (?). Vorschläge gegen die Pest. 1681(?)], translated by Kesuke Nagatsuna into Japanese, included in Leibniz's Writings II, Technology, Medicine, and Social Systems-Towards the Realization of a Rich Society, compiled under the supervision of Kiyoshi Sakai and Yoshiaki Sasaki, Kousakusha, 2018, Vol.3, p. 208.

First, as if a scenario had been prepared, various expert teams were working rapidly close to the French government. The government's Scientific Advisory Committee seemed to have received mathematical models for predicting the spread of COVID-19 from research institutions in Europe and compared them to report to the government⁴². However, the members did not appear very much in the media, and it was the Health Minister, the Home Affairs Minister, and others who explained to us independently the governmental decisions based on their respective roles. It was also reported that the president had decided to impose lock down after consulting with former presidents including Hollande, Sarkozy and others, based on the report of the Science Advisory Committee.

When the lockdown came into effect, I was reminded of the fact that there are laws in Europe and North America that can significantly limit individual freedom for a while in order to protect their lives. In that circumstance, outings except for grocery shopping, jogging, doctor's visit, providing care for families, or going to work were not allowed. You had to have a travel certificate with you in any of these cases or you would be fined. The police were actually patrolling.

The nature of the media coverage itself also changed at that time, although there are some parts that cannot be understood without close verification. Once it was decided to go into a lockdown, there was no sign of much debate about the pros and cons of lockdown (in contrast to the debate about mask-wearing requirement, which is regularly reported). It seemed that bidirectional communication in normal times was lost and that crisis communication (transmission of information in crisis time) in which information comes from the top down was used.

However, what was most surprising was that the French people, who had produced violent protest movements, including the yellow vest movement accompanied by some illegal activities, perceived a change from daily life to emergency as if they had been pre-trained. They followed orders at least in the beginning with submissiveness, which was hard to imagine due to their previous life⁴³.

In addition, I think that experts other than medical personnel seemed to cooperate relatively well. Experts on measures against domestic violence were taking action from an early stage. They began giving emergency numbers and other information through public media. A short physical exercise program was aired during the news as some people were lacking in exercise. As I mentioned earlier, the media coverage was all about COVID-19 and somewhat monotonous. However, there was a fair amount of social media coverage related to civil groups, such as support for women who had been trafficked for prostitution and then placed in a lockdown environment. Legal professionals were busy working as people unhappy with the timing of the lockdown and the different treatment for each industry (such as owners of nightclubs that had to remain closed for a long time) initiated legal proceedings.

When the lockdown began, I was concerned that "this was a return to the pre-modern way." However, after seeing the reactions of the people, the professional groups in various fields that steadily played their roles and the work of civic groups, I understood that they reached the situation after the "modern" system itself functioned. This emergency response is built in the modern system, and experts in various fields and citizens know their roles. The only thing was, I didn't really understand that.

Freedom in "modern" times and social rationality in measures against COVID-19

Looking at the history of political thought, it has long been argued that democracy and government's

⁴² "Coronavirus: les simulations alarmantes des épidémiologistes pour la France », *Le Monde*, le 15 mars 2020, URL: https://www.lemonde.fr/planete/article/2020/03/15/coronavirus-les-simulations-alarmantes-des-epidemiologistes-pour-la-france_6033149_3244.html

⁴³ No major riots broke out in France between March and April. However, a different trend was observed from around May. In addition, people in the United States and the United Kingdom are more strongly opposed, and the reaction differs depending on the region.

exercise of power in an emergency situation are compatible. As various intellectuals point out, the lockdown accompanying severe restriction of private rights is affirmed even if we conform to the classic of liberalism like John Locke's. This is because, in Locke's view, the existence of laws that prevent members of society from harming each other is a condition of freedom. In other words, strong measures to protect individual lives is acceptable. This is illustrated by the example of parents who impose restrictions on their children. Children's minds are immature and they may take actions that are harmful to themselves. Parents can limit their children's actions to protect them from such harm⁴⁴. Figuratively speaking, an emergency means a situation in which a citizen as a child could hurt himself because of his ignorance. Therefore, the state acts as a parent imposing restriction.

I'm not sure if Europeans know the premise based on classical liberalism. As long as I roughly looked at Europe as a whole, the Green Parties and the feminist left were accepting lockdown, while the economic right-libertarians notably tended to regard lockdown as "infringement of freedom." This reaction is consistent with the premise based on Locke's liberalism. This is because such left-wing as mentioned above, basically regard the situation that the strong inhibit the freedom of the weak in the same society as a problem. That is, they have accepted restrictions on their freedom to avoid situations in which they could harm others or others could harm them through the unknown virus. In other words, it can be said to be a relatively loyal reaction to Locke's liberalism. On the other hand, the economic right-libertarians tend to be positive about "freedom" for the cutthroat market competition and negative about the regulation for overall economic activities. For them, lockdown appears to be a major regulation that prevents the shakeup that needed to be brought about.

By the way, some regions have tried to adopt a different model from the "modern" model, which is based on the principle of Locke's liberalism. Some countries in East Asia, which knew about the spread of infectious diseases such as SARS in the near past, were active in preventing epidemics using information technology. They introduced a method to know and track the behavior of individuals at risk of infection. In other words, the government did not deprive the people of their freedom of action. Instead, infringing of a right to privacy without exception, they took measures to prevent infectious diseases by picking up specific individuals at risk of infection and depriving them of their freedom. China has excelled in information intensity and enforcement of strong measures, but it is known that South Korea and Taiwan have also taken aggressive measures.⁴⁵

However, East Asia has diversity. Taiwan, in particular, has hired experts and has been emphasizing interactive communication between the people and the government, and transparency in information disclosure. Partly because of this, the people highly trust the government. It has been recognized that the people did not oppose to the transfer of personal information to the government ⁴⁶. The fact that Taiwan is a small nation and that it is always wary of China, which is a major power, may have influenced that. According to Audrey Tang, the IT minister, the Taiwanese people are more likely to be familiar with Citizen science activities such as the transmission of atmospheric observation data by individual citizens.⁴⁷ These points are interesting to consider, but the verification is beyond my competence. So, this paper will not discuss it.

⁴⁴ John Locke, *Two Treatises of Government/Book II*, Wikisource contributors, Wikisource, https://en.wikisource.org/w/index.php?title=Two_Treatises_of_Government/Book_II&oldid=8893093(accessed September 12, 2020), chapter VI, 57.
China used GPS data.

⁴⁵ Taiwan decided to use the radio waves of the mobile phone to carefully track people during their quarantine period and delete the data after the quarantine period is over.
<https://eetimes.jp/ee/articles/2007/03/news029.html> (Viewed on September 12, 2020)

The following article is a cartoon, but I think it is one of the good witnesses.

⁴⁶ <https://toyokeizai.net/articles/-/351882> (Viewed on September 12, 2020)

⁴⁷ "Dialogue between Yuval Noah Harari and Audrey Tang (3/3)" "Newsweek" July 17, 2020
https://www.newsweekjapan.jp/yukawa/2020/07/33_1.php (Viewed on September 12, 2020)

The East Asian approach has been examined in the United States and Europe, but it has not yet gained support from majority groups. As a temporary measure, a contact tracing app for COVID-19 was developed. The app uses Bluetooth instead of GPS to collect user location data and information except for personally identifiable information. However, the download numbers showed little growth. Westerners may have a strong tendency to prioritize spiritual mental freedom, such as privacy, over physical freedom of action. There are also practical problems. Some civil society groups have pointed out that such measures are effective only in the early stages of the spread of infection and that the effectiveness has been undermined by the large number of asymptomatic COVID-19 positive people who are not tested.⁴⁸ Nevertheless, Apple and other tech giants are starting to build contact tracing apps into the new mobile operating system. Some cell phones are beginning to have pre-installed apps which let us know the possibility of contact with a person who has tested positive for COVID-19 if the government permits it and the user turns the apps on. The relationship between technology design and individual's privacy is entering a new phase (as of September 2020).⁴⁹

Japan did not take an attitude toward "modern" freedom and specialist knowledge, nor did it actively seek for another model. On the contrary, in the media, headlines such as "Advice of Experts, Ideal Way is Challenge" appeared belatedly⁵⁰. The position of experts in policy was not stable. First of all, the decision made by the then prime minister Shinzo Abe on February 27, 2020 to close all schools was a political decision not based on scientific advice. Around the same time, several advisory panels related to measures against COVID-19 were set up. Members of the organization, known as the Expert Meeting, especially drew attention as they appealed to the public about their sense of crisis on their own initiative. The Meeting was later abolished because it was not based on law and its position was unstable.⁵¹ It is necessary to examine in detail what Japanese society wants and what it has failed to accept through this confusion.

Social rationality in the "late modern" and trans - scientific approaches

What do people see as acceptable and what do they find difficult to accept? What conditions would affect its political decision? Without facing this issue head-on, we may not be able to maintain the democratic society that "modern" has built. With such a sense of crisis, the Joint Research Center, a policy think tank in the EU, examined the relationship between political decision making and personal feelings and values under the keyword Enlightenment 2.0. The answer that it is the need for Science of Value, written in the report published in 2019 was the result after asking for experts in various fields for their opinions on the difficulties of rational, evidence-based decision making.⁵²

The questions addressed in Science of Value are not far from the problems that researchers who study

⁴⁸ For example, an opinion of the American Civil Liberties Union is a classic example. <https://www.aclu.org/news/privacy-technology/tracking-apps-are-unlikely-to-help-stop-covid-19/> (Viewed on September 25, 2020)

⁴⁹ <https://support.apple.com/en-us/HT210393#137> (viewed on September 25, 2020) However, this service is not available in Japan, and the Ministry of Health, Labor and Welfare continues to recommend COCOA, a contact notification. <https://www3.nhk.or.jp/news/html/20200902/k10012597021000.html> (accessed September 25, 2020)

⁵⁰ [Comparison of tone/Abolition of Expert Meeting] Yomiuri defended the government, Sankei said "keep the Meeting only consisting of specialists in infectious disease" Article of "News Socra" on July 20, <https://news.yahoo.co.jp/articles/900ce5fec943489cd8be6bb1c84b01037c2ec744> (viewed on September 13, 2020)

⁵¹ Hiroyuki Okada, "The Whole Process Until the Novel Coronavirus Expert Meeting Was Dissolved", "Article of Toyo Keizai" June 30, 2020: <https://toyokeizai.net/articles/-/359804> (Viewed on September 12, 2020). Article of "Mainichi Shimbun" on June 30, 2020 <https://mainichi.jp/articles/20200629/k00/00m/010/289000c> (Viewed on September 12, 2020)

⁵² D. Mair, L. Smillie, G. La Placa, F. Schwendinger, M. Raykovsk, Z. Pasztor, R. van Bavel, *Understanding our political nature: How to put knowledge and reason at the heart of political decision-making*, EUR 29783 EN, Publications Office of the European Union, Luxembourg, 2019, ISBN 978-92-76-08621-5, doi: 10.2760/374191, JRC117161

science, technology and society and historians of scientific thought deal with. However, the difference now is that researchers in the fields of natural science, engineering, political science and economics, have also turned their attention to this question all together.

From the perspective of science, technology, and society and the history of scientific thought, since the latter half of the 20th century, there has been a growing awareness of trans-scientific problems that cannot be solved by science alone though we cannot handle them without science.

At the same time, there has been consideration given to "something that people want to protect even if they deny the suggestions of natural scientists." In other words, they have focused on cases in which public consensus is not achieved on the basis of natural science, but is achieved based on other grounds. "Something" in that case can be called "social rationality" as long as "something" is based on careful consideration. This kind of analysis on social rationality, on one hand, has led to the realization that people cannot easily abandon "social constructs" that have no natural scientific basis. On the other hand, it revealed a series of widespread unfounded convictions or concepts which people considered (by mistake) as having a natural scientific basis.

Such efforts of analysis were made in parallel with discussions concerning what is known in thought as "late modern", "post-modern", "highly modern" or "post-industrialized society." These various expressions rely on the recognition that the next era of "modern" has arrived, roughly in the latter half of the 20th century. They share roughly the following three points. (1) The dawn of information-oriented society, (2) criticism of Western science centrism (professionalism), and (3) the deepening of the issues left by the concept of "human rights" through to the first half of the 20th century - colonial issues (including problem of slavery), gender inequality, and sexual minority discrimination.⁵³ Basically, in any case, it can be described as the return of the issues that were not well addressed in modern age.

There are a number of different examples for considering social rationality. However, what comes to mind when taking into account the topicality in 2020 is the issue of racial discrimination. At the end of the 20th century, it had already become clear that it is difficult to find scientific basis in the concept of "race". The frameworks such as white, yellow, and black races were old theories proposed as "scientific" in the 19th century. After the 20th century, the development of molecular biology revealed that there were no significant genetic differences among the groups that were considered to be different in race. Thanks to scientific achievements, some European countries, including France and Germany, have moved toward the removal of the word "race" from their various laws. This is based on the judgment that there is no point in specifying things that do not exist. However, experts in some fields, including legal scholars and sociologists, opposed the idea, saying it would cover up social problems. The opinion of African citizens was also divided. This is because racism still existed in everyday life even though it turned out that "race" as a biological concept does not exist⁵⁴.

It is well known that the source of Jean-François Lyotard's *The Postmodern Condition* was a report by the Council of Universities in Canada. Lyotard is known for so-called postmodern philosophy.

⁵³ As an advocate of the "late modern era," I keep in mind Jürgen Habermas, who discussed the public sphere that influenced EU policy. Post-Industrialization is also the starting point for Lyotard's discussions, and has been the basis for innovation policies since the 1980s.

⁵⁴ Angela Saini, *The Return of Race Science: From the Origin of the Racial Concept to the Latest Genome Science*, translated by Erika Togo, published by Sakuhinsha in 2020. The Genetics Society of America has issued a statement that the concept of "race" should not be used in scientific research. "ASHG Denounces Attempts to Link Genetics and Racial Supremacy", *The American Journal of Human Genetics*, Volume 103, Issue 5, 636, DOI: <https://doi.org/10.1016/j.ajhg.2018.10.011> Naoki Iso "Important way of thinking that 'Race does not exist. What exist is racism' "Modern Business", article on June 29, 2020 <https://gendai.ismedia.jp/articles/-/73415?page=1>(viewed on September 20, 2020.)

The United States was one of the countries that did not try to remove the word "race." The term is used in statistics such as the census. Moreover, most of the people who have been called "black people" could not abandon the concept easily. This is because the word "race" contains the history of slavery, in which their ancestors were brought to the continent and suffered from all forms of discrimination. They proudly call themselves Black (in this case B is written in capital letters). Even if they have white ancestors over generations, they continue to call themselves Black if they are descendants of African slaves or have any visible traits of African ancestry. They have been protesting for a long time because they have experienced discrimination in housing and employment. Some of them were treated as criminals on the streets. In a more subtle version of discrimination, it may happen to them to receive painful medical treatment due to the widespread prejudice such as "Black people are insensitive to pain." The Black Lives Matter movement was one of such protests, and the swell of the movement was the largest one ever in 2020.

There is no doubt that the wide participation from citizens is the most important element in such events. However, it can be seen that the natural sciences and the humanities and social sciences play their respective roles in the background. First of all, the natural sciences made it clear that the concept of "race" lacked the biological basis that was said in the 19th century. Discriminatory statements claiming its basis on science have lost their persuasive power. However, the concept of "Black people" could not be easily abandoned by both the people concerned and those who discriminated against them. In recent years, various studies, mainly in the humanities and social sciences, are revealing the background of "not being able to abandon the concept." Some studies may take the form of a historical description, others may take the form of a case study of discrimination that continues even today. For example, Norman Ajari, a philosopher, considers what supports the concept of "Black people" as their "profound historicity." Since it does not have a natural scientific basis in the first place, the concept continued to function as a standard of value judgment for several centuries⁵⁵. By integrating these approaches, it is possible to deal with social concepts in a way that does not harm the dignity of the parties concerned, while pointing out the problems of discrimination itself.

An approach in which importance is attached on human way of feeling and values is also seen in risk communication today. In this field, basically it is best not to speak as if the most valued data is the calculated risk information obtained using statistical data. First of all, there is the imperfection of the statistical data in the past. Second, it should be noted that people tend to feel strong fear against the unexpected and uncontrollable objects such as invisible radioactive substances and viruses. As experts, they should accept such human-specific risk perceptions as natural and engage in a dialogue.⁵⁶

However, it is a difficult question how much we should give consideration to people's feelings. In particular, if the object of fear is not a disease or a radioactive substance, but a human being who has an unknown condition for that person, such fear could lead to ethical problems. For example, suppose there is a person who has an intuitive fear of LGBT people as they are "existence that he/she doesn't know well." The problem of discrimination will not disappear if the person's fear is treated as "natural" reaction. In the case of radioactive material, humans trying to avoid it does not cause any damage to the avoided target (radioactive material) itself. However, if a person's object of fear is another human being, that latter may suffer irreparable harm or be hurt. It develops into a matter of personal dignity. Unfortunately, there are many situations where that kind of problem did happen. It is well known that the fear of radiation has been transformed into discrimination against people from Fukushima Prefecture, where the Nuclear power plant accident

⁵⁵ See the following as an example : Norman Ajari, *La dignité ou la mort*, Paris, La Découverte, 2015, "introduction", 9-36.

⁵⁶ Michio Murakami "Seven Essences Required of Professionals in Risk Communication" "ILSI" No. 130 (2017.5), 3-10.

occurred.⁵⁷

Discrimination against transgender women is another example of human right issues caused by an excessive fear of people against those with unusual background. It is hard to say that this is a problem that is sufficiently visible in Japanese society. It is precisely because the people who suffer here are not yet well recognized in Japanese society in general, or even if they are recognized, they are perceived with distorted image. Japanese transphobia problem detonated when the Ochanomizu University announced in 2018 that it would accept transgender women students. Since then, discussions have been ignited on social media, mainly among women who are not transgender (cisgender women). In their fragmentary tweets, the topic moved away from its original context and developed into an expression of fear on the basis of speculation, such as "I am afraid of person who was previously a male coming into women's restrooms and bathrooms." On the other hand, many transgender women and the experts who supported them argued that such a logical leap itself did not reflect reality, and that it was just a discriminatory thought, which is the same as one that he/she has in mind when he/she immediately takes a Black man crossing his/her yard as a criminal.⁵⁸ This kind of quarrels has been going on in other countries for a long time and has not yet been fully resolved.

Conclusion

SDGs contains a pledge that "no one will be left behind" as a goal. It aims at a society in which individuals can live with dignity. At present, however, we are in the process of trial and error to achieve a society in which the dignity of everyone is protected. In addressing social issues, researchers certainly have a greater awareness of collaboration between researchers in natural sciences, engineering, and medicine, and humanities and social sciences than before. However, the challenge is how to overcome the situation in which the majority of society, including politicians, is opposed to the views expressed by these academic experts, or in which people are divided into pro and con and argue too fiercely with each other. In addition, there are problematic cases in which the academic researchers do not hesitate to conduct research misconduct in favor of their subjective value rather than of scientific rigor.⁵⁹

As a key to overcoming the situation, at least those with expertise should be conscious of the unconscious biases and partisanship that always follow them as human beings, while at the same time devising ways to convey their expertise. When people feel that something is unknown or threatens their familiar values, they become defensive and difficult to communicate. While preventing such a situation from occurring as much as possible, researchers should seriously consider whether there is a way to convey information to let many people think about it seriously. I think of it because I saw with my own eyes that the "modern" framework, sometimes accompanied by even violence, has taken hold in some regions due to its oldness in terms of time

⁵⁷ It has become necessary to appeal to the public the discrimination of the saying that "radioactivity is transmitted." For example, refer to the following materials posted on the website of Miraikan.

https://www.miraikan.jst.go.jp/resources/docs/lesson_311_201611_zone3_panel_data.pdf

⁵⁸ A summary of the dispute can be found at the following URL: <https://transinclusivefeminism.wordpress.com> (viewed on September 12, 2020; viewed on September 12, [https://wan.or.jp/article/show/9075\(2020\)](https://wan.or.jp/article/show/9075(2020))) Detailed information on relevant systematic measures are found in the following opinions by the Science Council of Japan. Law Committee, Subcommittee for assuring the rights of LGBTI in society and education, "Recommendation: Protection of Sexual Minority Rights (II)—Development of Laws Seeking to Ensure Dignity of Transgender" Science Council of Japan, September 23, 2020.

⁵⁹ As noted in the first paper, the controversy has also led to almost unfair practices by some researchers. Y. Gavriel Ansara & Peter Hegarty, "Cisgenderism in psychology: pathologising and misgendering children from 1999 to 2008", *Psychology & Sexuality*, Vol. 3, 2012, Issue 2, pp. 137-160, Published online: 28 Jun 2011, <https://doi.org/10.1080/19419899.2011.576696>.

and familiarity, or trust of society. When people recognize the mechanism as their own creation or at least feel familiar with it they are able to find certain social rationality in the decisions they make. So people could find social rationality even in severe lockdown measures in some countries.

Perhaps the new era is still in the process of formation. If the government is to follow the next path after "modern times," it will be necessary to further increase the level of citizen participation. Whether it's a question of "late modern" identity or a new form of democracy that uses information technology, it is necessary to seriously consider efforts like Citizen science in all areas. At present, we are still in the process of trial and error for that.

**Part 3 Science and Practice by the Scientific Community
at a Turning Point**

Chapter 1 "The Role of University and Academic Knowledge that I now feel about"

Naoki Miyano

Keywords: Universities, society, academics, intellectuals, and researchers

Amid the global pandemic in June 2020, the response to this emergency is continuing, including the care for new students, the provision of online lectures, and the management of experimental materials and equipment requiring minimal maintenance. By the time the situation is under control, it would be deeply reconfirmed that universities were dependent on the accumulation of students, researchers, teachers and staff. That is, universities were the place to encourage, practice and support learning. At the same time, people would start thinking what universities were in the first place and question the value of universities again. Below is my personal opinion about it.

Although I think it is still too early to conclude, I feel that this situation has clarified two aspects of the world's dependence on universities. One is the function to directly utilize expertise, including infectious diseases and crisis management, in society. It goes without saying that we should make full use of our expertise in this situation. However, we should not forget that there are researchers in other fields who continue their research (even if their research doesn't see the light of a day for the rest of their lives) based on their belief, such as "I study this as it can be a threat to humanity if the worst comes to the worst." Nevertheless, the space-time of university is not so small as to conclude that the significance of the existence of university in society is for risk avoidance. In other words, one of the functions of universities is a role like a museum in society and such function, which can cover all aspects to understand the world (or understand human), from research on the ecology of insects to the decoding of ancient characters.

The other is a role as a spiritual pillar. From the beginning of this situation, I have seen many articles in which not only researchers of infectious diseases, but also famous philosophers, sociologists and historians interpret the situation from their respective viewpoints. Understanding of the times from a historical point of view is a valuable expression that raises fundamental questions in everyday life where we are busy dealing with situations. Opinions of so-called human society experts are all important. However, what is more interesting to me is that the world (or rather the reporters) is requiring a perspective that re-examines everyday life from the principle with a metaphysical perspective for academics. In the midst of the unspeakable uncertainty of the times, I wonder how I should see my own life and how I should think about the state of society. "Learning" will be necessary when one is get tired of the atmosphere where people try to make something unclear by simply criticizing politics and others based on one off information, and suddenly one becomes conscious of his/her situation and the way he/she should be. This is evidence that the world expects that "learning is having eyes for something that transcends time and people."

From the "academic" side, what does this pandemic look like?

I think I'm too cold but simply say that such things can happen no matter how the situation is perceived. This does not mean the introduction of facts such as that there was an outbreak of Spanish influenza in the long history. It is not limited to a global pandemic. Humans have never been able to read the future since the dawn of history. I don't know why, but it is impossible in principle to predict the future in this time base in which time flows only in one direction. If science and technology are the ones that resisted such principles, the winner was determined from the beginning. For us who believe that tomorrow will always come like today and who built a life on the unstable terrain, nature has given many opportunities for re-awareness. For those who have the spirit to correctly question everyday life again, that "everyday life" is the most surprising thing. This is

not the discussion about values, such as "Be grateful for the ordinary life," but means the fundamental surprise about the existence of day-to-day life in the first place. Why does it exist? There is nothing more surprising than your present existence. Even if aliens attack Earth tomorrow, it is nothing for (the spirit of) learning. The universe is so vast. The knowledge we humans have is like a grain of dust. We don't know anything including our existence. The recognition of human ignorance and the attitude toward the unknowable is all about learning. In any academic field, the essence of learning is to pursue absolute life. With that in mind, living in the present is nothing more nor less than rightly feeling despair and rightly being free. Therefore, the future is not at all worrisome anxious. We cannot be worried in the first place. As Sorai Ogyu and Socrates said, no matter what happens, everything is what humans do. Or, as Parmenides said, Things have always taken their own course up until now and have never gone off course. The attitude toward this existence (= life), which I tried to express using the words of the great persons, is not an optimism or a philosophical view, but the mere fact and a sincere attitude toward the whole human history.

Using the words such as post-COVID-19, after-COVID-19, with-COVID-19, and so on, in the real world, the intellectuals are also looking for and talking about "tomorrow" that beyond the COVID-19 pandemic. However, learning is to wait and see them. In this world, where dynamic equilibrium is natural, changing is the usual state of things. Rather, it is the role of learning to pay attention to and listen to "things that do not change" by "changing." That is why, as I said before, the world depended on "learning." In order to live up to their trust, learning must be learning, and we must not neglect the effort for that. Of course, the opinions of experts (researchers) such as "the value will be polarized in the future" and "one's view of work will change from quantity to quality" are important. However, I don't think that is what the world really wants from the university (which is in charge of studies). I wrote the words that society would really want, with the risk of exposing my incompetence.

Chapter 2 "A Review on Responsibility of Researchers in Case of Emergency"

Hidetoshi Kotera

Keywords: Responsibilities of researchers, emergencies, and scientific advice

This paper considers the role of researchers in disasters and emergencies such as the COVID-19 pandemic that occurred in 2019.

Japan has suffered many natural disasters. In the past 30 years, the following natural disasters have occurred: The Great Hanshin-Awaji Earthquake that occurred before dawn on January 17, 1995, the Great East Japan Earthquake that occurred on March 11, 2011 and the subsequent accident at the Fukushima Dai-ichi Nuclear Power Plant, the heavy rain in western Japan caused by Typhoon No.7 and the seasonal rain front from June 28 to July 8, 2018, and Typhoon No. 19 in October 2019 (Hagibis). Looking back at these natural disasters, we can see researchers in the fields of disaster prevention and meteorology have been transmitting a lot of information through media and academic papers immediately after the occurrence. For example, immediately after the Great Hanshin-Awaji Earthquake in 1995, explanations were given using ground simulations using particle simulations. Immediately after the Great East Japan Earthquake in 2011, explanations were given using tsunami simulations, etc. The Japan Society for Natural Disasters published an emergency special issue on the Great Hanshin-Awaji Earthquake in 1995. In this way, information has been transmitted based on expertise from a professional perspective to both experts and citizens. Among them, not only Elucidation of phenomena such as numerical simulations related to disasters and explanations based on them but also the actual state of the psychological care system for disaster victims and its evaluation have been discussed. Information on the results of the studies and predictions in terms of life and health has been disseminated.

It can be said that in the era when science was not developed, there were many harmful rumors caused by information that many people spread irresponsibly. The same could have happened when natural disasters occurred in recent years. However, as mentioned above, analysis based on scientific grounds and information transmission based on it were conducted. It can be said that not only those who are well-versed in science but also the general public who are not familiar with science obtained the information and used it as a standard for their own actions and ideas. I also believe that much confusion was avoided as a result of the efforts by the information media to convey accurate information and the situation. A study meeting was held in Miyako City in April 2009, two years before the Great East Japan Earthquake in March 2011. I remember that someone at that time told us tsunami had reached to the venue in the past. I also remember that the tsunami was featured in a TV drama. The records of natural disasters are important for various measures. It is clear from these cases that it is important to scientifically verify the records and to run a simulation of measures based on the verification.

At the GSF (Global Science Forum) under the CSTP of the OECD, Japan strongly stressed significance of Science advice, which was reflected in the report in April 2015

(https://www.oecd-ilibrary.org/science-and-technology/scientific-advice-for-policy-making_5js3311jcpwb-en). The title of the report is The Role and Responsibility of Expert Bodies and Individual Scientists. The report discusses the roles and responsibilities of individual scientists.

Now, let's take a look at COVID-19 outbreak, which occurred in late 2019. COVID-19 pandemic is caused by a new type of coronavirus. From January 2020, the news about COVID-19 began to be reported, and until the middle of February, after the news about the status of the Diamond Princess began to be reported, not only the general public but also the researchers did not expect the situation where state of emergency would be declared nor did they expect the post COVID-19 world or living with COVID-19. I believe this is based on the experience that the outbreak of SARS (severe acute respiratory syndrome), which occurred in China in

November 2002 and continued until July 2003 (WHO declared SARS contained on July 5, 2003), did not cause a pandemic all over the world. Amid the COVID-19 global pandemic, research related to current biotechnology, life science, medical technology, and medicines have started, and the information on their results, including the disclosure of DNA sequences of the virus related to COVID-19, survival probability of the virus in different environments, and an infection routes tracking system, has been transmitted promptly. Information gathering and dissemination using the IOC and ICT, such as smartphone apps for tracking infection routes, was carried out to the maximum extent possible, as seen in South Korea. On the other hand, how was it in Japan? Researchers have started sharing the DNA sequence data in Japan too. In addition, vaccine researchers, drug-discovery researchers, and researchers involved in the development of a PCR test for rapid diagnosis have begun research and development, and are announcing the results one after another. I believe the government's early establishment of the Novel Coronavirus Expert Meeting and its efforts to disseminate information are the results of policy making based on science advice.

In addition, Professor Shinya Yamanaka of Kyoto University, summarized the information that he could obtain, and has started to disseminate it on his website though he said his research field is not infectious diseases. (<http://www.covid19-yamanaka.com>). Similarly, the Japan Medical Association established the JMA COVID-19 Expert Meeting on April 18, and launched the website and has provided information (<https://www.covid19-jma-medical-expert-meeting.jp>).

I wonder what other researchers think about these activities. I assume most of the researchers were standing idly by, saying that their fields are not viral research or drug discovery research. Even though I myself examine the data that is being reported and read articles in various fields, I have not been able to make any new ideas or analyses, and have not been able to transmit them. I assume many researchers have thought of the research as part of the studies in the field of medicine and pharmacy as the research target is the infectious disease. Based on the fact that infection is caused by droplets from coughs and the information such as the need to wear masks, how many researchers who specializes in fluid engineering in the mechanical engineering field have thought that they could conduct theoretical analyses of air circulation and droplets of the virus passing through the mask or run simulations using computer and have tried to do them? Makoto Tsubokura, a team leader of the Institute of Physical and Chemical Research (RIKEN) and a professor of the Graduate School of System Information at Kobe University, has been engaged in research on simulation of air flow around cars and people during exercise. He conducted simulations of airdrops before others and made public the results of the simulations. The results serve as guidelines for human behavior and wearing a mask wearing, furthermore, the placement of shields.

When researchers present their findings, it is essential to specify their hypothesis and methods of solving the problem, as well as the results and considerations. Reproducibility is also required for the results. For this reason, researchers are required to repeat many checks during the research process and publish their papers that can be published with confidence. For this reason, they seem to become reluctant to take on research in areas which are not their fields. For this reason, I assume that they are not sure of conducting research in areas where they have no experience. Even if a direct solution is not given to COVID-19, I believe it is necessary to conduct studies based on one's own expertise from the viewpoint of the environment, human behavior, various materials, and machines, and to discuss the results among experts. I hope that many academic societies will consider these issues.

Currently many researchers are engaged in research due to acquiring competitive funding. The research funds are a result of citizens paying taxes. Considering this, those who are receiving such funds on a daily basis should take this opportunity to think about giving their research results back to society as researchers. It can be imagined that many environments surrounding researchers and institutions will change in the post-COVID-19 era. It is necessary not to think about life post-COVID-19 but to consider how to conduct new

research, as well as the way researchers should be.

With that in mind, researchers as well as the above-mentioned Professor Tsubokura are making efforts in the following five areas at RIKEN where I work. They are making maximum use of the R & D capabilities and resources only available at RIKEN. The announcement has been made on the website <https://www.riken.jp/covid-19-rd/>.

1. Disclosure of data and research through utilization of state-of-art large-scale shared facilities.
2. Development of detection methods
3. Research for development of therapeutic medicine and vaccines
4. Research to sustain life and society
5. Basic research and research in other fields

In order to quickly create results that contribute to countermeasures against the novel coronavirus, which can be said to be a national disaster, the Institute of Physical and Chemical Research, in cooperation with the Ministry of Education, Culture, Sports, Science and Technology, has decided to provide the calculation resources of "Fugaku" to related R & D as much as possible and has been providing technical support. Regarding the research results, please refer to the website of RIKEN. Not only simulations using Fugaku, but also data-scientific research using AI, such as research on drug discovery and human movement, has been conducted. It is expected that these research results will be utilized effectively in the present and future society.

In the information transmission using these HP, efforts have been made to explain the technical contents to the general public in an easy-to-understand manner. However, compared to similar sites in other countries, RIKEN's website includes technical terms that are quite difficult to understand. Since the simulation result is shown using a video, it is considered to be easy to understand. There are concerns about how easily research results can be explained to the general public no matter how technical terms are included and whether they will lead to too much expectation or too little evaluation to science. However, I believe it is important to disseminate examination information and the results based on scientific discussions that one believes in.

I think researchers in various fields need to think about this.

I believe that the results of the efforts of many medical professionals and researchers in various fields to treat and prevent COVID-19 amid the pandemic have led to the resumption of research and development, including in today's public life. I would like to express my deep gratitude and respect to those people.

In conclusion, I believe that results of research in many fields that have been promoted even under this emergency situation will be disseminated in the future. I expect the results. I also hope that these results will not only be disseminated and shared among experts, but also be disseminated for the general public in an easy-to-understand manner

Chapter 3 "We Will Change the Relationship between Science, Policy and Society in the 21st Century for Sustainable Development - Science and Technology in the Age of SDGs Coexisting with COVID-19"

Tateo Arimoto

Keywords: STI for SDGs & SDGs for STI, Science and Technology and Pandemics, Reconsideration of Budapest Declaration, Who Are Scientists, Universality and Individuality, Beyond the boundaries, Global and Local, Transdisciplinary, Forum for Discussion

1. Introduction

Due to response to the global COVID-19 pandemic in 2020, policymakers and citizens began to recognize the importance of science and technology as their own issues. There is a deep sense of stagnation and distrust increasing in society as science and technology expose their limits. The outlook of the pandemic is still uncertain, and its impact on socioeconomic life is complex. The future is uncertain. On the other hand, even under the pandemic, international discussions on the way of the SDGs and science and technology have been deepened. It is important to deepen the relationship between the SDGs and science and technology and to address future crises.

2. From the age of bridging science and policy to the age of co-creation of science, policy and society

- SDGs and the COVID-19 pandemic are stimulating the transformation from linear model to co-creation model in science technology systems.

All the member states of the United Nations agreed on the "Sustainable Development Goals," a common vision for humanity in the 21st century, in 2015. Collaboration between diverse people involved and organizations is essential to achieve that goals. This chapter discusses changes in the framework for traditional science and technology systems and people involved to achieve the SDGs goal, based on recent international discussions and reports from international organizations that take into account the serious impacts of the COVID-19 pandemic.

First, let's focus on changes in the Global Sustainable Development Report (GSDR), which is prepared by the UN Scientific Advisory Committee every 4 years. The title of Chapter I of the 2015 edition (GSDR2015) is "The Interface between Science and Policy for Sustainable Development." The chapter describes many examples and methods of bridging both science and policy (1-1). 4 years later, the 2019 edition (GSDR2019) emphasized the framework for science, policy and society (1-2). A similar statement can be found in the EU Scientific Advisory Group (2). This year (2020) when COVID-19 pandemic occurred, there has been an increase in discussions focusing on the relationship between science, policy and society for response to SDGs and COVID-19. For example, the Policy Brief, published in April 2020 by the Secretariat of the United Nations Economic and Social Council, emphasizes the cooperation required of Science, Policy and Society (1-3).

The third report of "TWI2050" (The World in 2050) (published in July 2020 by IIASA (International Institute for Applied Systems Analysis)), is drawing attention by emphasizing the reform of innovation systems and governance for the realization of a sustainable society, and sufficiency as well as efficiency as values aimed at (3). With the advent of the SDGs era, from the traditional linear model to formation of an eco-system of science, policy, and society (and people), the report emphasizes aiming at not only economic expansion but also well-being (quality of life), or satisfaction and "to learn to be contented" in Japanese (see the figure below).

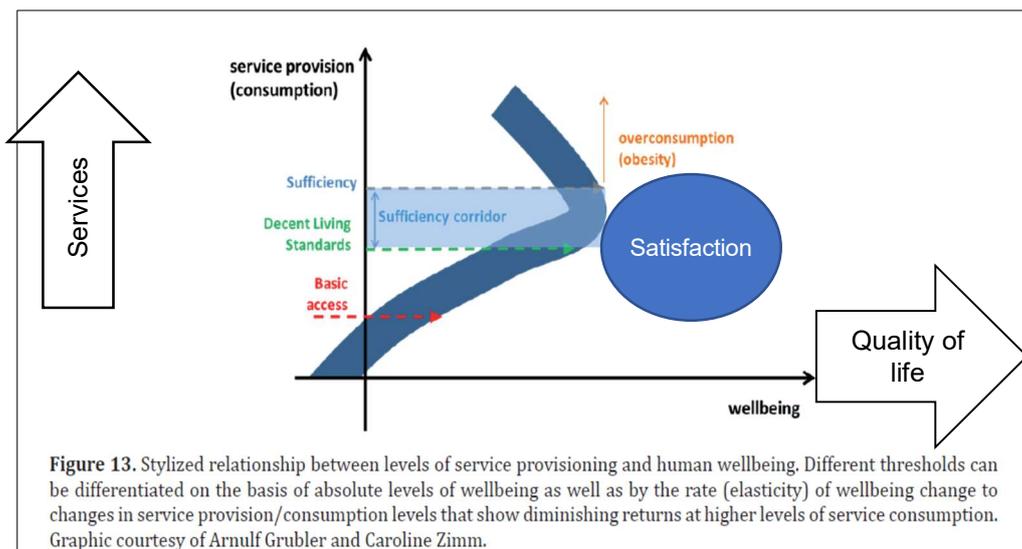


Figure. Cited from TWI2050, Third Report (2020), Chapter 3, "Efficiency and Sufficiency for Human Well-Being."

In July 2020, the OECD published a report entitled "Transdisciplinary Research" (4-1). The paper analyzes 28 cases collected from various countries. Regarding the cross-disciplinary collaboration between the natural sciences and the humanities and social sciences and the co-creation with the participants, which are necessary for the realization of a sustainable society, the report emphasizes the systemic approach of the methodology and cooperation among each organization (government, funding organizations, universities, research institutes, enterprises, and international organizations).

The COVID-19 pandemic caused considerable confusion in policy-making and the lives of citizens because even the functions and organizations of the scientific advisory system in the developed countries, did not function well (5,6,7). It is now being modified tentatively, but the root cause will be analyzed and redesigned in the future. I believe that the existing scientific advice mechanism is a linear model based on the knowledge and experience of science and technology under certain conditions (4-2,4-3,4-5) and fails to respond to emergencies ("beyond the scope of the assumption") that involve citizens and sectors on a global scale, such as the COVID-19 pandemic, and whose assumptions (science, economy, society, region, and life) change rapidly in time. There will be a need for a transformation to a co-creative advisory process in which diverse persons involved, sectors and citizens can participate in a timely manner. The target is not only COVID-19. Large-scale disasters such as heavy rains, floods and earthquakes, as well as urban redesign will be included. It is necessary to consider not only the emergency response, but also the mobilization of science and technology and the advice system in accordance with the flow of time from preparation, emergency response after an occurrence of disaster to restoration and reconstruction (4-5). These will lead to the redesign of modern science and technology that has been established over the past 200 years. It is not easy to transform these systems at once. However, in the era of advanced big data, AI, and measurement systems, we are entering a stage where we can develop and implement them from the fields and regions where we can do them, accumulate experience, and theorize them.

3. What is society? Diversity of places and spaces to realize the value of SDGs

Based on the discussions on the SDGs at the UN Expert Meeting over five years, the perspective of a place that actually realizes a sustainable society is broadening not only globally but also to regionally (e.g., Asia and Africa), nationally, and locally/sub-nationally (prefectures, cities, provinces, etc.). The practice of setting goals for "local SDGs" (localization of SDGs) in accordance with the needs and issues of the locality, and carrying out cooperation among politics, citizens, industry, academia and policy measures in accordance with individual contexts is spreading. As shown in the figure below, the population of the region (individuals and

families, 5,000 people, 100,000 people, 1,000,000 people, 10,000,000 people etc.) is an important factor in doing so (3).

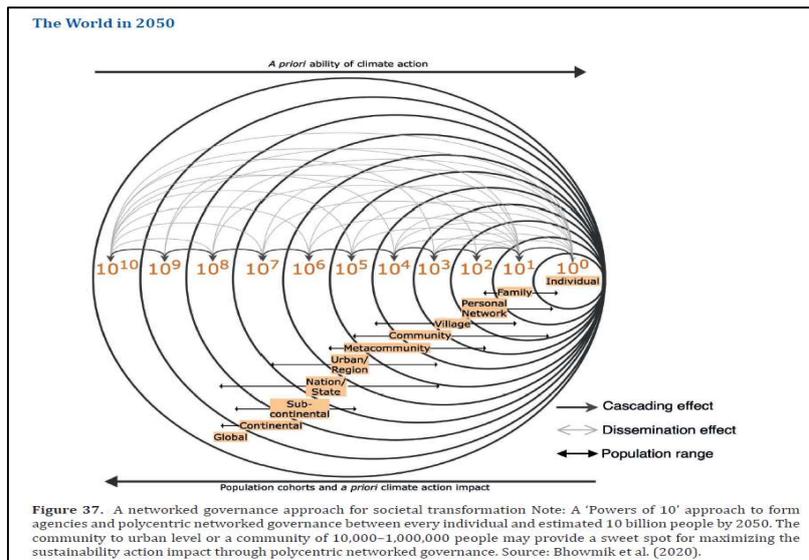


Figure. Quote from TWI2050, the 3rd report, Chapter 4, "Innovation in Political Systems, Governance and Society."

This trend is accelerated by the COVID-19 pandemic. Over the response to the COVID-19, the roles and responsibilities of local governments as well as the central government, have become important in each country. Science, technology and data will form an important foundation for the dynamic collaboration under mutual trust at the global, national and local levels.

It is a difficult task to adapt science and technology, which is supposed to be universal, to specific conditions such as regional culture and history. Reforming the values, institutions and systems of modern science and technology, which has a long history of institutionalization, will be a challenging task to overcome to ensure the SDGs era.

4. Beyond the Budapest Declaration: Change in thinking and revitalization of declarations

Since the resolution on SDGs, I have participated in the UN Expert Meeting to discuss the role of science and technology in achieving that goal. It was STI for SDGs Forum. When I was talking with William Colglazier, a physicist and the former Science and Technology Adviser to the U.S. Secretary of State, who was leading the forum, we had an idea to reverse the order of the words "STI for SDGs" and think about it as a pair of "SDGs for STI." This change in the framework is stimulating and greatly expands the idea. In order to solve the problems of SDGs, not only is the knowledge of science and technology developed and utilized in a linear manner, but also the SDGs are pressing the existing values and systems of science and technology to change.

This shift in thinking leads to the revitalization of the Budapest Declaration. In 1999, 20 years ago, UNESCO and the International Council for Science (ICSU) organized the World Conference on Science in Budapest, the capital of Hungary. 2000 scientists and policy makers there from all over the world. The role and responsibility of science in the 21st century is discussed, and the conclusion is the World Declaration on Science and the Use of Scientific Knowledge, commonly known as the Budapest Declaration. It has four frameworks. 1.Science for Knowledge, 2.Science for Peace, 3.Science for Development, and 4.Science for Society & Science in Society.

As with the words "STI for SDGs" and "SDGs for STI" mentioned above, the order of these words is changed to 1. Knowledge for Science, 2. Peace for Science, 3. Development for Science, and 4. Society for Science & Society in Science. For example, "Knowledge for Science" in 1 can be understood as seeking a change in science and technology methods based on knowledge fields in order to develop the frontiers of knowledge in the 21st century. I believe the item 4 is pressing for a change in scientific and technological thinking and methods for the redesign of society and people in the 21st century. The item 4 implies regaining the framework for rethinking and practicing the relationship between science, society and people (8), the limitation of human beings (9) suggested by philosophers in the 20th century.

In 2018, ICSU (International Council for Science, established in 1931, an international organization in the field of natural sciences) and ISSC (International Social Science Council, established in 1952) merged to form ISC (International Council for Science). The main mission of new ISC was to contribute to the resolution of social problems through cooperation between fields of natural sciences and social sciences (10-1,10-2). Following the COVID-19 pandemic, the ISC has begun developing a long-term strategy for the next 10 years. It is "Defining a Decade of Global Sustainability Science Action" (10-3). As its pillars, science for sustainability transformations, and transformations of science systems are proposed. This would hold true about a shift in thinking on the Budapest Declaration.

20 years have passed since the Budapest Declaration. How will the declaration be realized? The declaration was positioned as the basis of science and technology policy in Japan. The Research Institute of Science and Technology for Society has been established. Science, Technology, and Society (STS) has been established as a knowledge, the concept and the practice of ELSI (Ethics, Law and Society) has been gradually established. In the wake of the Fukushima nuclear power plant accident, the Science Council of Japan revised its Code of Conduct for Scientists (11). The SDGs are a major impetus for the materialization of the Budapest Declaration, which has been preceded by philosophical construct and call for a review of the values and systems of science and technology that modern society has formed over the past 200 years. The COVID-19 pandemic is accelerating this trend.

5. Conclusion

The world is seeing intensifying unilateralism, hegemony, and expansion of populism, which is the opposite trend of what has been said in this paper so far. Due to the serious impact of the COVID-19 pandemic, there have been critical discussions on the long-term nature of SDGs (12). Various discussions will be held in the future. I understand that the goals of the SDGs are universal as a vision shared by mankind and the earth in the 21st century, though there is room for improvement in the processes and methods for achieving the goals.

In this drastic transitional period, what will remain and what will be changed in modern science and technology the modern age has built? Cross-Sectoral, cross-organizational, cross-generational, cross-border and cool-headed discussion and new systemic policy approach is essential. I would like to conclude this paper with the following action items.

- Securing places for free discussion and networks. It can be virtual or real. "If you go there, you will be able to get knowledge, understand the long historical background, deepen your thinking, meet various people and have exciting discussions about future education, science, technology and knowledge.
- Establish a system to discuss and communicate freely and continuously on the "spirit and climate of scientists and engineers" and the "relationship between science and technology and politics and society" across the boundaries of citizens, politics, enterprises, universities, academia, government, public organizations, regions, and countries.

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Editorial Note

This report summarizes the results of research projects of the International Institute for Advanced Studies, "Considering Science and Technology in the Age of SDGs and COVID-19." This research project has been ongoing for three years. However, I was involved from the stage of compiling this report.

As I was engaged in the editorial process and was exposed to a number of studies which urged important problems to be raised using a multilateral approach, I realized that these studies were relevant to all academic systems. As mentioned below, highly suggestive issues are presented in the field of public policy, which I specialized in. This is because I would like to present one of the ways to read this report through my work.

As Arimoto's study suggests, the relationship between expertise and science needs to be further examined in the context of a balance between global, national, and local perspectives. Unfortunately, there is very little research on the advisory system for policy in Japan, and this is a major issue for future policy research. In this regard, it is important to have a perspective to consider the aspect of scientific advice as "art." Kano's study deeply reexamines the relationship between science and art and provides clues to the development of this idea.

In addition, the relationship between professionalism and politics will never be productive unless researcher has a firm attitude and serious thinking about his or her studies. In this regard, Miyano's study presents a deeper point of contention about the relationship between society and scholars by deepening the fundamental question of what learning is. Ohtake's study, which urges researchers to review their relationship with society, is interesting as it also provides concrete reasoning.

Oki's study, which vividly describes the origin of the academic system and its fluctuations, Kotera's study, which shows the ideal way of society through the viewpoint of individual ability beyond time and space, and Komai's study which fundamentally reexamines human being as a species, present indispensable viewpoints for understanding the context of learning and society. In this regard, the Shinpuku study is stimulating as it suggests future directions for the scientific community through her diverse practices at the Global Young Academy and elsewhere.

I briefly explain the various studies in this report in accordance with my interests. In this chaotic era, researchers are required to establish a firm viewpoint and have courage to examine the discussions of much concern to society. This is something that I keenly felt by participating in the conference of this study group and reading the discussions of each member.

We, young researchers, are at the mercy of national policy, exposed to competition in the number of papers, and forced to continue our research in an unstable employment environment. As one of the parties concerned, I sincerely hope that this situation will improve as soon as possible. However, rather than complaining about this, it would be more productive to build a network with a variety of researchers, share the awareness of each issue, and consider a perspective that is not influenced by the times. This would lead to fulfilling a social mission as a researcher. While working on this report, I realized that I lacked in breadth of vision. Working with various researchers brought forth this realization. In the future, I would like to not only actively participate in such efforts, but also aim to become a researcher who can create such a place.

The task of compiling this report and coordinating meetings was one of the most important tasks I have received as a Specially Appointed Researcher at International Institute for Advanced Studies. The relationship between the International Institute for Advanced Studies and myself began in 2016 when I attended a junior seminar as a teaching assistant. The job was to assist high school students in discussing and presenting their

ideas after receiving lectures from three researchers (Keishi Saeki, Takenori Inoki and Satoru Ikeuchi at that time). Despite being overwhelmed by the highly advanced lecture content of the researchers and the high problem awareness of the high school students, I managed to finish my role. This was a very meaningful and strange experience for me. Education at a research institution that is neither a university nor a high school. It seems that we, the teaching assistants, and the high school students who participated were able to discuss freely and without any restrictions.

Writing this report was also a valuable experience for me. The work for universities and other research institutions has very set parameters. Unexpectedly, it is difficult to use my creativity and originality. However, I was rather required to use them for this work. In the case of the junior seminar, maximum creativity was required in educational activities where there was no syllabus or no credits. This work was the same in that it also required maximum creativity. I would like to continue my research in order not to waste what I have learned through my encounters with all of you. (Written by Sugitani)

Activities of the Study Group

- Meeting (1): April 23, 2018 / International Institute for Advanced Studies
Meeting (2): July 2, 2018: Annex of Tokyo Headquarters, Japan Science and Technology Agency
Meeting (3): October 15, 2018: Kyoto Shigaku Kaikan
1st Workshop: October 19, 2018: Annex of Tokyo Headquarters, Japan Science and Technology Agency
2nd Workshop: January 9, 2019: Kyoto Shigaku Kaikan
3rd Workshop: February 25, 2019: Annex of Tokyo Headquarters, Japan Science and Technology Agency
4th Workshop: May 29, 2019: Annex of Tokyo Headquarters, Japan Science and Technology Agency
Meeting (4): October 5, 2019 / Kyoto International Conference Center
5th Workshop: November 1, 2019: Kyoto Shigaku Kaikan
6th Workshop: January 31, 2020: Annex of Tokyo Headquarters, Japan Science and Technology Agency
7th Workshop: March 11, 2020: Annex of Tokyo Headquarters, Japan Science and Technology Agency
8th Workshop: May 25, 2020/ Online Workshop
9th Workshop: July 28, 2020/ Online Workshop

Members of the Study Group * Official positions as of April 1, 2020

- Tateo Arimoto [Research Representative]Vice Director, International Institute for Advanced Studies
Visiting Professor, National Graduate Institute for Policy Studies; Senior Fellow, Center for Research and Development Strategy, Japan Science and Technology Agency
- Satoru Ohtake Deputy Director, Tokyo College, The University of Tokyo, Project Professor, Institute for Future Initiatives
- Sayaka Oki Professor, Graduate School of Economics, Nagoya University
- Mitsunobu Kano Professor and Vice Executive Director, Graduate School of Health Systems Integrated Science, Okayama University,
Deputy Science and Technology Co-Advisor to the Minister of Foreign Affairs of Japan
- Hidetoshi Kotera Executive Director, RIKEN, Japan Representative and Vice-Chairman of OECD
Committee on Science and Technology
Professor Emeritus, Program-Specific Professor, Kyoto University
- Shoji Komai Professor, Faculty of Engineering, International Professional University of Technology, Tokyo(IPUT)
Chairman, Science Agora Promotion Committee, Japan Science and Technology Agency
- Yoko Shinpuku Professor, Graduate School of Biomedical and Health Sciences (Health Sciences), Hiroshima University
Global Young Academy Executive Committee
- Naoki Miyano Associate Professor, Center for the Promotion of Interdisciplinary Education and Research, Kyoto University

Compilation of Report

- Kazuya Sugitani Doctoral Course, Graduate School of Human and Environmental Studies, Kyoto University, Special Researcher, International Institute for Advanced Studies
- Sachiko Mitsuishi International Institute for Advanced Studies
- Yukari Moriguchi International Institute for Advanced Studies

International Institute for Advance Studies (IIAS)

Founding Philosophy

Humanity is currently facing a number of challenges to its continued existence caused by a range of factors. Can we or future generations continue to live on this planet in the same way and with the same values we've held up to now? How can we resolve such problems that have historical and social origins? And in the 21st century, what form should our culture, science, and technology take? There are no set methods for developing ideas when it comes to such challenges.

The founding philosophy of the International Institute for Advanced Studies (IIAS) is to "conduct research for the future and happiness of mankind" and we address these issues through fundamental research based on cooperation among government, industry and academia. By consolidating wisdom from around the world and taking research forward, we aim to produce new directionality in academic research or orient ourselves towards creating new concepts, and contribute to the development of academic research culture.

Mission

Our society has reached a turning point where we veer off the path of "single-minded pursuit for development and efficiency" and follow the one of "peaceful and sustainable coexistence of all mankind." Along this new road lie fundamental questions that need to be answered in order to secure the future and well-being of mankind. IIAS takes it on as its mission to explore those questions, uncover new problems and present our "findings" to the world. We are committed to leading in-depth discussions and shedding light on the discovered paths towards solution.

History

IIAS was established in August 1984 as an incorporated foundation strongly supported by entities from industry, academia and government that agree with its founding philosophy outlined above, and has since been running on donations from major companies and philanthropists across Japan. In October 1993, IIAS opened a research facility in the Keihanna Science City (officially known as Kansai Science City) on a land granted by the Kyoto Prefectural Government. The Institute serves as the central research organization or the "brain" of the Keihanna Science City.

CORE PROGRAM REPORT

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International Institute for Advanced Studies
3-9, Kizugawadai, Kizugawa-shi, Kyoto-fu, 619-0225
TEL: 0774-73-4001 FAX: 0774-73-4005 E-mail: ra@ias.or.jp
<http://www.ias.or.jp/>



International Institute for Advanced Studies

9-3, Kizugawadai, Kizugawa city, Kyoto 619-0225 JAPAN TEL: +81-774-73-4000 FAX: +81-774-73-4005
<http://www.ias.or.jp/en/>

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