

## **Science and Morality: Their Bases Are Supported by the Power of Imagination**

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In recent years, there seem to be increasing opportunities for us to see and hear news of events which cause us to wonder what has happened to the moral ability or professional ethics of the individual (ref. 1). Now that sciences and technologies are making marked advances to such a stage that they permeate deep into our everyday life, we feel we need to deal with the moral ability required of each and every citizen including scientists and engineers, in ways different from the past. In 1903, Antoine Henri Becquerel, Maria Curie and Pierre Curie were co-honored with the Nobel Prize in Physics in recognition of the extraordinary services they have rendered by their joint researches on the radiation phenomena. In his Award Address given in commemoration of the 1903 Nobel Prize awarded to him, Pierre Curie, the husband of Maria Curie, stated that while radium serves many useful purposes, such as treatment of cancer, it would also create great danger if and when used in crimes, but that he is one of those who believe with Nobel that mankind will derive more good than harm from the new discoveries (ref. 2). More than one hundred years ago, he already pointed out sharply the relationship of humans to sciences and technologies from the side of morality. In this article, we would like to give some consideration to man's moral ability from the viewpoint that the bases of morality and science are both supported by the ability to surmise, based on the knowledge in one's possession, in one way or another what humans have never experienced in real situation. This ability is the very power of imagination.

**Science Is Based on Imaginative Power (Creation is the Result of Accumulation of Imagination):** In 1895, Wilhelm Roentgen of Germany discovered X-ray while he was conducting research on low-pressure gas discharge. This discovery led to the imagination that "X-rays might be emitted also from fluorescent materials", and further to the investigation of uranium compound, one of fluorescent materials, by Antoine Henri Becquerel of France, who was then studying fluorescent materials, and finally to his discovery in 1896 of permeable radiation which is emitted from uranium irrespective of fluorescent phenomena. Stimulated by Becquerel's discovery, Maria Curie chose radioactivity as the theme for her doctoral thesis at the end of 1897, and discovered in 1898 polonium first and then radium, with the help of her husband Pierre Curie who successfully developed a device to measure radiation dose quantitatively, by paying attention to the fact that more radiation is emitted from uranium ores than from pure uranium and by chemically isolating "the new elements contained in uranium ores that emit powerful radiation" (ref. 3). In the world of natural science, knowledge and the imagination based thereon tend to lead to new discoveries and the creation of new materials or concepts.

Natural science constitutes an academic field in which one closely observes various phenomena occurring in nature and investigates their mechanisms. Through these processes, scientists exert themselves to create new things or new concepts. Imagination would be required when creating new

things or new concepts. At first they set up a new thing or new concept as a top-priority matter, and then develop imagination to create it based on the knowledge, methodology and concepts which they have accumulated till then. With these steps as the basis, they try to explore ways and means to arrive at a new thing or new concept while conducting experiments, hearing opinions from others and having discussion with them. If and when these steps do not turn out well by any means, they utilize imagination again to search other ways and means. Excellent ideas or intuition that come up during this process are born from imaginative power. Once its objective is achieved and a new thing or new concept is created by repeating the process of putting imagination to practice and verifying its results, the accumulated results of one's imagination is evaluated as one's creativity. How to set one's objectives at first which are meaningful from a social standpoint as well as from a scientific viewpoint also depends on imaginative power. Hence the basic power of science is considered imaginative power (ref. 4).

**Moral Ability Is Rooted in Imaginative Power:** Meanwhile, moral ability is based on the ability to exercise proper judgment on what kind of attitude humans should take toward other people and natural environment including animals and plants. One needs to verify one's own judgment in order to acquire the ability to make such a judgment and to improve it. To make it possible, one has to be capable of communicating with things other than humans as well as animals and plants. Since those things other than humans as well as animals and plants do not speak human language, one can only rely on imagination to communicate with them. It is also necessary to learn from the past and forecast future if one wishes to live a proper life as a member of society, and to inherit culture and pass it down to future generations. For such a purpose, communication with the deceased or those to be borne from now by making full use of imagination will also be required. At times even mutual understanding with those who are capable of having a dialog verbally may require use of imaginative power. The way to use imaginative power cannot help varying with the country, age, and experience of the other party. Another man's judgment within oneself like a judge within a human being, who gives us the criterion for one's judgment, normally varies slightly with each person. Accordingly, when one thinks how to behave toward the other party, it becomes necessary to make a judgment considering the other party's criterion for judgment by using one's imagination. Given this perspective, the fundamental power to exert moral ability turns out to be imaginative power like the fundamental power of science. The source of power to live one's life might as well be said to be imaginative power (ref. 4).

Thus, it follows that scientists are individuals blessed with a wealth of imagination. At the same time, it also follows that, only if they have a proper criterion for judging the difference between good and evil, they can prove themselves individuals capable of not only unleashing superb creativity but also possessing high moral ability. The possibility of science being abused by the thinking of scientists themselves, as feared by Pierre Curie, may as well be considered extremely low. It would be reasonable to consider that the abuse of science, such as nuclear arms, has resulted from the undue pressure exerted on scientists, which has been caused due to the lack of understanding and the low moral ability on the part of the civil society toward science.

At this point, we would like to stress that when using radiation for medical treatment, the negative side of science, which may damage the patient's health to some extent by exposing the patient to radiation, should not be confused with the abuse of science. The negative side of science, such as health problems due to medical radiation and side-effects of medication, are almost unavoidable to some extent even if treatment is performed by a physician with superb capability and high moral ability. It is the important mission and duty of scientists to maximize the plus side of science and minimize the minus side of science, and citizens must offer full cooperation to this mission with the awareness that they should not just sit back leaving the mission to scientists alone. However, scientists need to give to interested citizens a thorough understanding of the problem involved and its meaning so that they may secure communication with those citizens to gain their support. Also this is the process which calls into question the levels of cultural accomplishments and imaginative power on both sides of scientists and citizens.

**How to Foster the Power of Imagination:** Then, how can we foster imaginative power? Anybody can imagine at any time and at any place. We remember that during our childhood we did not get bored seeing human faces or animals or at times even horrible devils pop up before our eyes when we stared at the wood grain of the high ceiling in dim light. Traditional Japanese wooden houses are full of structures, utensils and devices for daily life that show various ways of life of the people who lived in those houses. Those houses stimulate imagination and enable us to talk with the people who lived there in the days gone by or with the people who will be born from now and who may live there. Thus, old houses are considered as the classrooms that have potential educational power, i.e. the power of housing education (refs. 1, 5 and 6). They offer to children the world of imagination that they would like to keep it to themselves as a secret as well as the world of fantasy that cannot be shared with the other people. We are wondering if it is likely that those children who are privileged to spend leisure time playing in such places would be able to go, as they grow, into the world of imagination which is sharable with the other people and, what's more, blessed with abundant individuality.

When many people lived in old traditional wooden houses, such as registered tangible cultural properties and cherished their residences with fond memories of their grandfathers and grandmothers who had built those houses, their children were able to foster their imaginative power and enhance their moral ability quite naturally. However, there is practically no such an environment these days. Therefore, it is necessary to devise ways to make up for the lack of such an environment and improve the imaginative power of present-day children. Inspection tours of cultural properties by elementary-school pupils or extension lessons by the owners of cultural properties for them are a few examples of such approaches, but basically it is important to make efforts to develop their imaginative power and further their ability to display it at their schools, local communities and homes.

In order to enrich imaginative power, abundance of knowledge is required as its root. The broader and the deeper the knowledge is, the better. Like picky eating that is bad for health, learning only those things necessary for taking examinations will not foster well-rounded imaginative power and cannot be said to be a real way of learning.

It is no exaggeration to say that imaginative power is required not only for fostering moral ability but also for learning all subjects in school education. Understanding difficult points of school lessons starts with children trying to interpret such points respectively in their own ways by using their imaginative power. There are various ways of judging whether their interpretation is correct or not. One way would be to have discussion with their teachers or friends. Another way would be to go to a library and stay there to peruse books kept in the library. At this stage, children would realize by themselves that adequate knowledge is needed to arouse imagination, and they come to develop interest and curiosity in various phenomena and things regardless of their own likes and dislikes. We hope the Japanese people will deeply recognize that one of the important objects of "integrated studies" lay in this point.

Acquiring knowledge requires learning by heart. The difference between the recorder and the human brain lies in the point that we can comprehend knowledge and strengthen our memory by using our imaginative power in our own way to correlate the memories of various facts. Such a method of memorization, unlike mere rote memorization, will not cause imaginative power to be lost but rather strengthen it. If imaginative power is lost by memorization, it is not because of the memorization but because of the way it was done. The ability to imagine, think and judge, and the ability to memorize are positioned opposite to each other. It is a matter of no importance that which is important or which is not important. They are considered to act and function like the two wheels of one cart.

The phase of imagination must be most enjoyable for children. As mentioned above, anybody can imagine at any time and at any place. Also, even children are capable of generating new ideas through imagination or in other words carrying imagination to creation. Excessive study for passing entrance examination or cram education is feared to rob children of this joy of imagination, wither their imaginative power or curiosity, and cause those children to lack creativity. The purpose of study by

children is to develop their imaginative power and elevate it so that they will grow to become men and women with high moral ability who are capable of contributing to the welfare of mankind.

**Criterion for Fair Judgment:** However abundant one's imagination may be, if the judgment based on it should hurt human happiness, such a person cannot be said to have a wealth of moral ability. One must always have a criterion in oneself for making a fair judgment. This criterion is purely personal, but what is important is that it must be accepted by many people and must produce happiness for people. At this point, we would like to introduce to you the following four-way test advocated by the Rotary International, whose members include one of our authors, Koichi Hatada. This test is considered as a criterion for professional ethics, and represents the Rotary International's philosophy in simple and straight terms.

< The Four-Way Test >

Of the things we think, say or do

Is it the truth?

Is it fair to all concerned?

Will it build good will and better friendship?

Will it be beneficial to all concerned?

When we think of doing something, this test is the criterion for us to make fair judgment which allows us to take action if answers to all the four questions above are given in the affirmative. We hope they will serve as a good reference for you when you think of any criterion for making your own judgment.

**In conclusion,** we would like to touch upon the point that the moral ability currently in our mind may be too people-oriented. According to the recent report (ref. 7) issued by IUCN (International Union for the Conservation of Nature and Natural Resources), one fourth (1,141 species) of the world's mammals are facing extinction, affected mainly by human activities. On the verge of extinction now are 188 species of those mammals, and it is too late to save 29 species of them (ref. 8). The fact is that such a situation has been brought about by the daily activities of the human beings, one species of the mammals, with the influence of science and technology to some extent. Man's way of thinking about morality up to now has been narrow in range with too much emphasis on the human side. We would like to conclude this article by pointing out that we have now entered the age when the moral and ethical values of scientists and engineers need to be reviewed anew.

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