Recent Studies in the History of Biology by Japanese Historians

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This report reviews the activities of Japanese historians of biology during the later half of the 1960's and the early 1970's.

Section of History of Biology (Seibutsugakushi Bunkakai), History of Science Society of Japan, is the only organized group of Japanese scholars working in this field at the present time. Although the organization is seventeen years old, the number of historians have joined is very few. *The Japanese Journal of the History of Biology* (*Seibutsugakushi Kenkyu*), which is published bi-annually, has reached its 22nd issue. The sources of this report are mainly articles from the above mentioned journal, from *the Journal of History of Science, Japan* (*Kagakushi Kenkyu*), and from *Japanese Studies in the History of Science*.

History of Western Biology

Teiri Nakamura (1965a) noted that the interests of many researchers have been focussed on the biology of the "scientific revolution" in the 16th and 17th centuries. Nakamura, one of the most active researchers in this area, has studied the role of William Harvey's work in expanding biological knowledge. In 1965b and 1969, he reviewed his researches and those of other Harveyan scholars, and suggested that the process by which Harvey discovered blood circulation could be divided into the following phases: 1) observation that the blood always flows in the same direction, 2) measurement of blood stream volume, 3) conception of the idea of blood circulation by combining the knowledge gained in the first two steps, 4) verification of his idea through testing. Nakamura further concluded that the ideas held by Harvey in his later years concerning the movement of the heart were established upon the influence of Descartes' theory, and that Harvey was fundamentally not a mechanist but an Aristotelian.

After studying the biological thought of Francis Bacon, Nakamura (1968c) concluded that, although Bacon's mechanism did not reached Descartes' level, he was more mechanist than Aristotelian, and his ideas on biology were very progressive for his age.

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Nakamura (1972) also introduced the work of Richard Lower as an example of the relationship between the new knowledge of biology and the theories of mechanism which were common during the modernization of biology. He contended that, though Lower was not an Aristotelian, he had been deeply affected by the philosophy of mechanism, a fact which was detrimental to his work. His success resulted from the designing of experiments without a special philosophical system.

Several historians have studied the history of evolutionary theory. Toshiaki Yokoyama (1971), examining the relation between William Paley and Charles Darwin, asserted that, although Darwin did not accept Paley's theological theory of design, he was, nevertheless, influenced by this natural theology, and that Paley's influence was different in direction from that exerted by his experience in the Beagle and by Thomas Malthus' ideas presented in his work, *On the Principles of Population*.

Fuyuko Egami and Ryuichi Yasugi (1972) studied the influence on the works of Charles Darwin of the writings on the philosophy of science, considering especially the influence exerted by W. Whewell and J. Herschel. From the evidence of his autobiography and letters, they concluded that Darwin owed much of his academic motivation to Herschel and learned his approach to the scientific method from Herschel's writings, opposing T. Yokoyama's argument (1971) that Darwin had been influenced by natural theology.

Yoshito Sinoto (1969) reviewed the works of Mendel from the standpoint of evolution. He argued that, in the course of analysing the numbers and behavioral characteristics of hybrid offspring in successive generations, Mendel attemped to find some solution to the problem of evolution by discovering laws.

Several works have been published on the history of genetics and embryology. F. Egami (1966, 1967) studied works on cell differentiation and discussed the significance, methodological problems and the origin of ideas in the experimental works on nuclear transplantation conduced by R. Briggs and T. J. King. She also (1968, 1969a) studied the role of T. H. Morgan in this field and concluded that Morgan tried to explain developmental phenomena by relating them directly to the gene, the key element in explanations of phenomena in the field of genetics. In her view, Morgan's genetic ideas were founded on a mechanical mechanistic outlook.

Mieko Ishidate (1967), who is concerned with the history of molecular genetics, studied the origins of its establishment, and also (1968) compared the method of hypothesis, on which the operon theory was founded, with the method of analytical geometry advanced by Descartes. She concluded that the former method was the successor to the latter.

Keiko Miura (1970) analysed the mathematical method used by Mendel in his experiments on plant hybridization.

Zenji Suzuki (1967) reviewed the history of genetics from several standpoints considering the effects of materials, instruments and tools, technics and social factors on the development of genetics.

Tatsumasa Dōke (1967a), an active historian of biochemistry, discussed the concepts of vital force held by several scientists of the 18th and 19th centuries. He suggested that, although there were differences in their concepts, they all shared the idea of vitalism outlined by Aristotle and that differences were the effect of advances in physics and chemistry.

T. Dōke (1968) further studied the origin of biochemistry by considering the controversy between Liebig and Pasteur. He wrote that biochemistry is a union of two sciences, *i.e.* chemical biology and biological chemistry, and can be said to be a field of chemical research of vital phenomena which keeps expanding and will expand indefinitely in future. Biological phenomena could be explained by a law of non-biological molecular movement and organic matter also could be synthesized with inorganic matter.

Kei Nagano (1968) reviewed the history of physiology and biochemistry from the viewpoint of the history of thought, especially the concept of vital force.

Akira Yoshida (1972) studied the scientific thought of Claude Bernard, and suggested that Bernard, who opposed to both vitalism and mechanism, had searched for a third viewpoint on living matter.

In addition, there are other researchers in this area: for example, Masao Kawakita (1971) has studied the history of researches on respiration; Makoto Kitsuya (1971) studied the history of researches on mitochondria and the role of the electron-microscope in researching mitochondria; and Sensi Sone (1968, 1972) also studied the latter problem.

In the field of ecology, Makoto Numata (1968), who is one of the most active ecologists in Japan, and is interested in the history of biology, has reviewed ecological history. In his paper, he pointed out the importance of Humboldt and Darwin in the history of ecology.

Kazuo Shibuya (1969) published a book on the history of ecology in which he discussed the role of Darwin and evaluated the works of Tōkichi Kaji who, like Shibuya, was a Japanese ecologist.

A few historians have been interested in the biological thought of ancient Greece. Kazuo Mahune (1971) for example, studied Aristotle's theory of plant nutrition, viewing it from the standpoint of Greek agricultural pattern.

In addition to these, some researches about Goethe have been conducted. Michiko Ōmori (1970) studied Goethe's idea of plant type "Urpflanze"; and Yukio Murakami (1968) compared Goethe's "Farbenlehre" with E. H. Land's dual color system.

Kanji Tachibana (1971) studied the origin of the Male and Female Symbols

in biology, and found that there were two theories on this subject, one that they originated in astrology and alchemy, and the other that they arose from the thought of the Germanic Race.

History of Japanese Biology

Several researchers have been interested in the process of modernization of Japanese biology by means of the introduction of the western biology.

Masao Watanabe (1967a) evaluated the contribution of Edward Sylvester Morse to three areas: Japanese zoology, the introduction of the theory of evolution to Japan, and the study and appreciation of Japanese culture, particularly Japanese pottery, architecture and ethanological matters. According to Watanabe, Morse's unique contribution was in the third field.

Watanabe (1967b) also considered John Thomas Gulick who was an American missionary in Japan. Watanabe discussed the contribution of J. T. Gulick to the development of science in Japan and his evolutionary and religious thought.

Following above-mentioned works, Watanabe and Yōko Ose (1968, 1969) studied the Japan's response to Darwinism, applying statistical analysis to the academic subjects published in three main journals in early Meiji era. From this analysis, it was made clear that the theory of evolution constituted an uncommonly high percentage of articles as compared with those on other subjects. This theory, however, was discussed mainly on the ground of social science rather than natural science in the two periodicals, the *Gakugei Shirin* and the *Toyo Gakugei Zassi*. In the other periodical, the *Rikugo Zassi*, which was a leading Christians' publication, Darwinian topics appeared more frequently.

Watanabe (1968, 1969) reported on the Japanese response to Darwinism at the International Congress, with the conclusion that Darwinism was first accepted in Japan mainly as a form of thought, particularly in its sociological aspects, and that science and Christianity were taken as being quite separate from each other.

Tadashi Yoshida (1968) introduced a letter written to Morse by K. Mitsukuri, a Japanese zoologist. Yoshida discovered the letter when he visited the Museum of Peabody, Academy of Science.

In addition to the above works, there are other researches on the history of evolution theory in Japan. For example, Sinoto (1970) reviewed the process of the introduction of evolution theory, and Tomoyuki Ishii (1968, 1969), after reviewing the history of evolution theory, called for researches on activities of farmers before and after the Meiji Restoration, for studies on the inheritance of acquired characteristics and for the ecological study of species.

Zenji Suzuki (1967, 1968a) studied the Japanese response to eugenics as a case study of the characteristics of Japanese biology, especially of its pattern of

introducing western biological thought and theory. From this study he discovered the following facts: (1) Yukichi Fukuzawa introduced the thought of Galton on human faculty in the middle of Meiji era, but this thought did not take root in Japan at that time. (2) When the thought of Galton, under the name of 'eugenics', was again introduced in late Meiji era, many people discussed it from social and political points of view. (3) Most geneticists were not concerned with eugenics, however, perhaps because human genetics was very difficult to handle. Therefore eugenics did not advance as a pure science but as a eugenics movement.

Hisaharu Tsukuba and Z. Suzuki (1967) evaluated the role of Fukuzawa in eugenics, and discussed the reason why Fukuzawa changed his idea of the human faculty. Suzuki (1968b) further compared the response to eugenics of Asajiro Oka and Kametaro Toyama. Oka, who was a famous Darwinist, criticized the introduction of eugenics, while Toyama who in the early 1900's rediscovered Mendelism by using insects, held that eugenics was necessary.

Next, Suzuki (1972a) studied the relationship between the development of human genetics and the eugenics movement in Japan, and concluded that while some geneticists were motivated by that movement, others were not.

Yasuaki Kimura (1968) asserted that the book "*Saishin Idenron*" (The modern theories in Inheritance, 1919) written by Asajiro Oka should be analysed in order to evaluate the works of Oka.

Eiji Tomizawa (1971, 1972) studied the social thought of Chiyomatsu Ishikawa who spread evolution theory in the Meiji era. Teiri Nakamura (1967) studied the thought of Yoshio Koya, a medician, concerning racial biology.

Zenji Suzuki (1968c, 1969a, 1969b) studied several subjects in genetics and cytology as case histories in the Japanese response to Western biology. He examined reactions to molecular genetics, to T. H. Morgan's theory of linear arrangement of genes, to population genetics and to Protoplasmics. From these studies, Suzuki concluded that, though its beginning was early, Japanese genetics always followed Western and American genetics.

In the addition to the works of Suzuki, the development of biology in Japan has been investigated by other historians in various branches of biology. Teiri Nakamura (1968a, 1968b) studied Japanese embryological works as a case study in the molecular approach in biology promoted under the influence of social surroundings and thoughts. Dōke (1966, 1967b, 1969) studied the establishment of biochemistry in Japan.

F. Egami (1969b) reviewed the biological thought and research in Japan after the Meiji restoration and concluded as follows: (1) The biological researches in Japan which were performed after the introduction of evolutionism did not grapple with the basic concepts of evolutionism. (2) In Japan the mechanistic view of life was not introduced in opposition to vitalism. (3) The

wholistic view of life produced nothing positive to the development of biology in Japan. (4) The dialectic view of life has not been fruitful to biological thought. Of all views introduced into Japan, the mechanistic view of life seems to dominated.

H. Tsukuba (1968) reviewed Japanese biology before the Meiji Restoration, comparing Japanese and European thought on nature, and discussing why natural science was not produced in Japan. In his opinion, the reason lies in the fact that the Japanese did not recognize human existence as being separate from nature, while Europeans did.

Concerning the history of biology before Meiji Restoration, several investigations have been done as historical study of "Rangaku" (The study of Western science and culture by means of Dutch Language). Gorō Achiwa (1969) published Studies of Herman Boerhaave in which he examined the influence of Boerhaave's thought upon Japanese medicine in the period of Dutch learning. In his opinion, Boerhaave's achievements have done much in the modernization of Japanese medicine.

Achiwa (1966) also introduced the public Tōyō Yamawaki's first anatomical chart in Japan and referring to his predecessors' opinions, clarified the great significance of his marking the first step in the modernization of Japanese medicine.

Yōan Udagawa was one of the most famous "Rangakusha" (scholars of Dutch learning) in Edo era. Though his works of chemistry have been studied by some historians, there are few studies of his biological works. Ichiro Yabe (1971a) translated "*Shokugaku Keigen* (Textbook of Botany)" from the classical Japanese used Udagawa into modern Japanese; he has also examined Udagawa's thought on spontaneous genesis (1971b), genetics (1972a), fermentation (1972b), classification (1972c), reproduction (1972d), etc. as case studies in introduction of the western biology during the Edo era.

According to Yabe, although Udagawa knew about the classification system of A. L. Jussieu, he introduced mainly that of Linné, perhaps because he did not recognize the importance of natural classification. Udagawa also introduced Kölreuter's ideas on genetics and, realizing that almost all living things reproduce sexually, denied the theory of spontaneous generation. Yabe (1971c) also studied Udagawa's "*Shokugaku Dokugo*".

Shizu Sakai (1972) studied the introduction of Harvey's blood circulation theory into Japan, and concluded that it was introduced first by the book "*Kaitai Shinsho* (Anatomical Book)", but that book "*Ihan Teiko* (Anatomical Book)" written by Genshin Udagawa (1805) showed a better understanding of the theory.

Yojiro Kimura (1970) studied Japanese herbals mentioned in Carl Peter Thunberg's books, "*Flora Iaponica* (1784)" and "*Travels* (1788–1793)", and found

that Thunberg made use of six kinds of herbals.

Teiichi Ishiyama (1970) considered historically the botanical name of Eupteleae polyandra and discovered it to be a new genus named by von Siebold.

Theoretical Biology and Biology Education applying History of Biology

Ryuichi Yasugi (1966) reported that, given the complicated nature of living things, and the imprecision of biological concepts, precise systems such as in physics can not be developed in biology; therefore, induction from facts is of central importance in this field.

Hideo Mariko (1970) took up the Theory of hierarchy in biological phenomena, and suggested that these theories could be divided in three as follows: (1) theories which do not recognize the existence of hierarchy in living matter, (2) theories which do not fully analyse the law of each level as an indication of historical development, and (3) theories which all phenomena of each level could be explained by the law of the lower level. Mariko (1972a, 1972b) further studied Ludwig von Bertalanffy's view of life.

Akio Kusanagi (1972a) reexamined the history of biology with the aim of establishing a new philosophy of science. He suggested the possibility of applying to biology the "Theory of three step development" proposed by the famous physicist, Mitsuo Taketani, givining the process of the discovery of the materials of inheritance. Kusanagi (1972b) further pointed out the need to clarify prescription of causality in view of the frequent confusion of condition and cause.

There are several activities on the use of the history of biology in biological education.

Z. Suzuki (1967) proposed that case histories should be studied by science teachers, because they provide a useful guide to the study of scientific method. He cited as examples the history of respiration, photosynthesis, and genetics. Suzuki (1971) discussed the teaching of enzymatic conception from a historical standpoint, and further (1972b) that of gene conception.

Nobuyuki Kato, science teacher actively applying the history of biology to biology education, reported (1970) on the practical application in his classroom; further (1971, 1972) he reported a similar attempt, using the case history of the plant hormone. He emphasized the need for students to understand science.

K. Mahune (1970) reported the relationship between the history of the investigation of photosynthesis and the study of that subject in primary education; he emphasized the need for the application of de Saussure's level of research in investigations in this field. I. Yabe (1970a) commented on Mahune's articles.

In addition, Kiyoshi Takeuchi (1968) discussed the relationship between

the history of science and the science education, and Takashi Katsuya (1968) emphasized the need for science teachers to study the history of science well.

Lastly, reports on science textbooks will be surveyed.

I. Yabe (1970b) analysed the textbook "*Seibutsu no Kagaku* (The biology science)" from the viewpoint of history of science. Kazuo Mori (1971) also analysed textbook of biology published after Meiji era from the viewpoint of evolution theory.

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