Recent Studies in Japan on the History of Chemistry

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Since 1965, the *Kagakushi Kenkyû* (*Journal of History of Science Japan*) has been publishing in serial form an annual bibliography of the history, of sciences and techniques in Japan. Mainly based on that bibliography, the present paper gives a general review of studies in Japan on the history of chemistry and also of the views of scholars of the history of chemistry in this country during the period 1965 to 1972.[1]

Japan's economic growth has been rapid since 1955 and has brought on various social problems in contrast to the scientific and technological progress. One such problem is Japan's increased military capability and another is environmental pollution so serious as to be unequalled in any other part of the world. In the face of Japan's rapid economic growth, the problem remains of what position should be allocated to sciences and techniques in the Japanese people's life. This has turned the attention of many Japanese historians of sciences and techniques to the question of how Japan, since the Meiji restoration, has imported and built up modern civilization from Europe.

The publication of "Nippon Kagaku Gijutsushi Taikei" (History of Science and Technology in Japan) in 26 volumes compiled by the Japanese Society of the History of Sciences ("Nippon Kagakushi Gakkai") was started in 1964 in commemoration of the centenary of the Meiji restoration (1868) and completed in 1972. The importation into and fostering in Japan of modern chemistry are analyzed in Volume 13.[2] One of the editors, Minoru Tanaka, in the introduction to the above publication divides the history of chemistry in Japan into the following five stages: I, the sprouting stage (Tenpô 8 to Keiô 3 or 1837–1867); II, the transitional stage (Meiji 1 to 9 or 1868–1876); III, the build-up stage (Meiji 10 to 33 or 1877–1900); IV, the independent development stage (Meiji 34 to Shôwa 5 or 1901–1930); and V, the current stage (from Shôwa 6 onward

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[1] Annual Bibliography 1965–1972 (J): *Kagakushi Kenkyû* (*Journal of History of Science, Japan*), No. 78 (1966); No. 82 (1967); No. 86 (1968); No. 90 (1969); No. 94 (1970); No. 98 (1971); No. 103 (1972). (in Japanese=J).

[2] 'Butsuri Kagaku' (Physical Science): Nippon Kagaku-gizyutusi Taikei (History of Science and Technology in Japan), No. 13, Daiichi Hôki (Tokyô, 1970) (J).

or from 1931 onward.)

The speed of build-up of modern chemistry in stage III was conditioned by Japan's own capability brought over from stages I and II and, on the other hand, was influenced by Japan's social problems of her capitalist economic structure, which was behind the Western capitalist countries in development. The independent development of Japan's chemistry in stage IV was reviewed not only in terms of Japanese chemists' own efforts and theoretical achievements, but also in terms of the system of study and education in relation to Japan's social background. Stages III to V were further divided into the following periods:

1. Development of a basis for chemical studies (Meiji 11–33 or 1878–1900).
2. Tradition formation in chemistry (Meiji 34 to Taishô 5 or 1901–1916.
3. Chemistry after World War I (Taishô 6 to Shôwa 5 or 1917–1930).
4. Chemistry during the Sino-Japanese war and World War II (Shôwa 6 to 20 or 1931–1945).
5. Chemistry after World War II (Shôwa 21 to 44 or 1946–1969).

Each of the above periods was described by the joint efforts of Tanaka, Masanori Ônuma (physical chemistry), Tokumichi Tsukahara (inorganic chemistry), Aiko Yamashita (organic chemistry), and Tatsumasa Dôke (biochemistry).

About the time Volume 13 was published 1969, these writers published their own papers on the history of chemistry in Japan, as follows:

M. Tanaka: Hundert der Chemie in Japan—1 (*Japanese Studies in the History of Science*, No. 3, 1964), Hundert der Chemie in Japan—2 (*ibid*, No. 4, 1965), Problems der Vorgeschichte der Chemie in Japan (*ibid*, No. 6, 1968), A note on the development of chemistry in Japan (*ibid*, No. 7, 1967).

M. Ônuma:[3] History of physical chemistry in Japan (in the bulletin of his college), which compared the scientific achievements of Jôji Sakurai (1858–1939), Kikunae Ikeda (1864–1936), and Yûkichi Ôsaka (1867–1950) with those of their European teachers A. W. Williamson (1824–1904) and W. F. Ostwald (1853–1932), stating that the too hasty importation of physical chemistry into this country made it difficult to build up the tradition of this science in this country.

Aiko Yamashita:[4] Recollections of the lives and scientific achievements of J. Sakurai; Y. Ôsaka; Masao Katayama (1877–1961) who contributed to the independent growth of physical chemistry in Japan; Tokuhei Kametaka (1872–1935), one of the pioneers of organic chemistry in Japan; and Yoshizumi

[3] M. Ônuma: The History of Physical Chemistry in Japan. (1), (2). (J). *Memorirs of Tokyô College of Economics*, No. 18 (1968. 2), No. 19 (1968. 5).

[4] A. Yamashita: *Mol*, **4** (4) 83-86 (1966); **4** (6) 82-86; **4** (9) 84-87; **4** (10) 83-87; **5** (1) 108-112 (1967); **6** (1) 91-96 (1968); **6** (2) 92-96; **6** (3) 88-92.

Tawara (1885–1935) who first extracted tetrodotoxin, the poisonous compound from Japanese fugu fish. Those recollections were published in serial form in various journals. Yamashita wrote in the *Kagakushi Kenkyû* (*Journal of History of Science, Japan*) about Tawara and Kametaka.[5] Yamashita was further trying to contribute to improving the position of women scientists in Japan. She was conducting studies,[6] with the cooperation of Shôko Yoshimura and other women scholars of science history, on the scientific achievements of Chika Kuroda (1884–1968), a woman scientists well-known for her studies on Japanese vegetable pigments, and Michiyo Tsujimura who extracted the ingredients of the green tea and others. Yoshimura[7] wrote in the bulletin of her university about the activities and backgrounds of Japanese female scientists.

Various branches of chemistry in Japan reached an independent status after the years of World War I. Posthumous manuscripts and autobiographies of Japanese chemists who contributed to Japanese chemistry during the above stage, have recently been published. These publications include, in the realm of organic chemistry, the posthumous papers of Rikô Majima (1894–1962) who investigated urushiol (1970)[8] and the autobiography (1970) of Munio Kotake[9] (1894–) who investigated the toxic substances of the toad; in physical chemistry, the autobiography (1972)[10] of Jurô Horiuchi (1901–), ex-president of Hokkaido University, who was a student of Katayama and contributed to the theory of chemical reaction; and the autobiography[11] (1973) of Isamu Nitta (1899–) who applied x-ray analysis to the elucidation of the structure of organic compounds. An enlightening pocket book[12] was published by Sanichirô Mizushima (1899–) who modernized the study in Japan of the molecular structural theory. In the realm of inorganic chemistry, Tanaka is shortly going to publish a biography[13] of Yûji Shibata (1882–) who was a student of Alfred Werner (1866–1919) and Georges Urbin (1872–1938) and who pioneered spectrochemistry, complex-salt

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[5] A. Yamashita: Yoshisumi Tahara and his Study of the Globefish Gift; Tetrodotoxin. (J). *Kagakushi Kenkyû*, No. 87, pp. 150–158 (1968).
Tokuhei Kametaka (J). *ibid.*, No. 84, pp. 188–191 (1968).

[6] A. Yamashita (ed): A History of Modern Japanese Women, No. 4. Science. (J). 252 p., Kashima Kenkyujo Shuppankai (1970).

[7] S. Yosimura: A History and the Background of Women Scientists in Japan. (J). *Memoirs of Tsudajuku University*, **2**, pp. 113–126 (1970. 3).

[8] The Posthumous Papaers and Memoirs of Prof. Rikô Majima. (J). Prof. Majima Rikô Ikô-shû Kankô-kai, 567 p. (1970. 8).

[9] Munio Kotake: Episodes in Kotake's Life. (J). *Kagaku*, **25** (11) 1066–1070 (1970. 11).

[10] Jurô Horiuchi: Thirty years of My Studies of Chemical Reaction. (J). *Shokubai*, **7**, 26–28 (1965. 12).
Autobiography of Jurô Horiuchi. (J). Hokudai Tosho Kankôkai (1972).

[11] Isamu Nitta: Memoirs of a Scientist. (J). Tokyô Kagaku Dôzin (1973. 4).

[12] Sanichirô Mizushima: A Story of Matters. (J). Kôdansha (1965).

[13] Minoru Tanaka: Yûji Shibata. (J). Dainihon Tosho. (In prep.).

chemistry, and geochemistry in this country.

These publications will strengthen the study of the independent growth of modern chemistry in this country.

In order to look into the question of what forms of European modern science were imported into Japan around the time of the Meiji restoration, M. Tanaka in 1964 carried out studies[14] on the scientific achievements of Yôan Udagawa (1798–1846), Saburô Utsunomiya (1834–1902), and Kômin Kawamoto (1810–1871), and in 1966 M. Tanaka in cooperation with T. Dôke paid a visit to the native land of Saburô Utsunomiya, Japan's first chemical technologist from the last days of the Tokugawa Government to the early Meiji years, and conducted on-the-spot studies of Utsunomiya's brewing, ceramics, etc., which resulted in a reassessment of his achievements.[15] Toshikane Ôkubo, a historian of Dutch studies in this country, also considered Utsumomiya as a pioneer in applied chemistry in this country.[16] After Yôan Udagawa, Kômin Kawamoto (1809–1871) was a chemist towards the last days of the Tokugawa Government, and, according to Tanaka, Kawamoto was a pioneer of Japanese modern chemistry on the basis of the theories developed in the "Atomism" of J. Dalton (1766–1844). A new biography of Kawamoto was published in 1971.[17] In a centenary meeting in honor of Kawamoto held by the Japanese Society of Medical History on July 17, 1971, reports on his scientific activities were read by Teiyû Inoue, Tomio Ogata, Kazuo Katagiri, and Hajime Sôda.[18]

Yôan Udagawa, a chemist in the last days of the Tokugawa Government, wrote Japan's first fully fledged book on chemistry, entitled "Seimi Kaisô" (Introduction to Chemistry) based on the system of chemistry developed by Lavoisier (1743–1794). Studies on Udagawa have become active in recent years. Masao Sakaguchi, a chemist at the Kyûshû University, has published numerous papers on Udagawa since 1963. Contributions to the studies on Udagawa have also been made by. M. Tanaka[19] (1967), T. Dôke[20] (1971, 1972), and Nagayasu Shimao.[21]

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[14] Minoru Tanaka: A History of Physics and Chemistry Prior to the Meiji Era in Japan, pp. 281–416. Nihon Gakushi-in (ed). 1964. (J).

[15] ——— and Tatsumasa Dôke: Early 19th Centurys Chemist, Saburô Utsunomiya. (J). *Reports of Tôkyo Inst. of Tech.*, **31** 77–90 (1966. 3).

[16] Toshikane Ôkubo: Pioneer in Applied Chemistry in Japan, Saburô Utsunomiya. (J). Nippon oyobi Nipponjin, No. 1481, 170–176 (1970. 1).

[17] Yûji Kawamoto and Kazumasa Nakatani: Kômin Kawamoto. (J). Kyôritsu Shuppan (1971).

[18] Commemoration of the Century of Kômin Kawamoto's Death. (J), *Nihon Ishigaku Zassi*, **17** (3) 251–263 (1971. 9).

[19] Masao Sakaguchi: On the Concept of Chemical Affinity in *Seimi Kaisô* (J), *Kagakushi Kenkyû*, No. 67, pp. 113–120 (1963).

———: Studies on *Seimi Kaisô* II—the Original of Translation—(J), *ibid.*, No. 72, pp. 145–151 (1964).

These studies have shown up some problems on the route of Yôan's importation of Western modern chemistry into Japan. One of them is, what was the original of the "Seimi Kaisô". That is believed by some to be probably W. Henry's "Elements of Chemistry" (1799) rendered into the German version which Ypey later rendered into the Dutch version. This Dutch version by Ypey is believed by Tanaka to have been the "Systematisch Handboek der Scheikunde (SHB)", but believed by Sakaguchi to have been "Chemie voor Beginnende Liefhebbers." Another question is how Dalton's "Atomism" was imported into Japan. Yôan used the term "Aryô", which according to Sakaguchi seems to correspond to the term "atomic weight". Therefore, Yôan was believed to be the first importer of Dalton's "Atomism" into Japan. However, Tanaka believes that the term "Aryô" seems to have been a quantitative expression of chemical composition. Tanaka, therefore, asserts that the true importer of Dalton's "Atomism" into Japan was not Yôan but Kômin Kawamoto.

T. Dôke has been carrying on studies on Yôan's life and several dozen unpublished manuscripts including those of "Seimi Kaisô."[20] A modern Japanese language edition of "Seimi Kaisô" is shortly going to be published by M. Tanaka and others. A young reseacher, Kunika Sugawara[22] (Tokyo University), is engaged in studies on Japanese chemists in the early years of the Meiji era.

Masao Sakaguchi: Studies on *Seimi Kaisô* III—Yôan Udagawa and European Chemical Atomism—(J), *ibid.*, No. 78, pp. 49–53 (1966).

————: On the European Translations of Henry's Epitome of Chemistry and *Seimi Kaisô* (J), *ibid.*, No. 80, pp. 171–178 (1966).

————: On the Concept of Chemical Affinity in *Seimi Kaisô* (II) (J), *ibid.*, No. 83, pp. 124–131 (1967).

————: On the Chemical Nomenclature in the *Seimi Kaisô* (J), *ibid.*, No. 85, 10–21 (1968).

————: On the Pharmaceutical Reference Books used by the Author of the *Seimi Kaisô* (J), *ibid.*, No. 86, pp. 49–56 (1968).

————: Notes on the French Translation of W. Henry's Epitome of Chemistry (J), *ibid.*, No. 95, pp. 139–150 (1970).

————: On the Mountain Measuring Cited by Udagawa Yôan (J), *ibid.*, No. 96, pp. 185–190 (1970).

Minoru Tanaka: Einige Probleme der Vorgeschrechte der Chemie in Japan. Einführung und Aufnahme der modernen Materienbegriffe, *Japanese Studies in the History of Science*, No. 6, pp. 96–114 (1967).

[20] T. Dôke: A Study of Yôan Udagawa (1), (J), *Tokyô Kô-Dai Kagakushi Shûkan*, No. 6, pp. 95–109 (1971); Yôan Udagawa in the History of Western learning in Japan, (J), Kikan Geijutsu, No. 23, pp. 88–106 (1972).

[21] Eikô Shimao: The Reception of Lavoisier's Chemistry in Japan (J), *Kagakushi Kenkyû*, No. 99, pp. 174–178 (1971); The Establishment of Lavoisier's Chemical Nomenclature in Japan (J), *ibid.*, No. 100, pp. 213–214 (1971. 12); The Reception of Lavoisier's Chemistry in Japan, *Isis*, Vol. 63, No. 218, pp. 309–320 (1972); Yôan Udagawa and Lavoisier's Traité de Chimie (J), Edited by Takamichi Arisaka; Nihon Yôgaku-shi no Kenkyû II, pp. 245–279.

[22] Kunika Sugawara: The Chemists in Early Meiji Era Japan (1850's–1880's), (J), *Studies in the History of Physics*, **6** (1) 1–25 (1970. 3); **6** (2) 33–57 (1970. 6).

On the basis of studies by all these workers on the independence and growth of modern chemistry in Japan, T. Dôke conducted studies on the historical significance of Japanese chemists as regards their concepts and achievements in the light of the social background that permitted their scientific activities.[23]

2

Japan's journals seems to prefer the introduction of the achievements of earlier Western Chemists on the occasion of their memorial celebrations, *etc.* on the history of chemistry. Some papers were carried in scientific journals in 1965 in commemoration of the centenary of the description of the benzene structure by A. Kekulé (1829–1896).[24] Among those papers was short article by Nozomu Yamaoka, who had been conducting studies for many years not only on J. Liebig (1803–1873) but also on Kekulé, and was a pioneer in the study of the history of chemistry in Japan. In 1967, some papers in celebration of the centenary of the birth of Alfred Werner (1866–1919) were published in the journal *Kagaku to Kôgyô* (*Chemistry and Chemical Industry*) was edited by the Chemical Soc. of Japan, and other journals,[25] including a paper written by Yûji Shibata, who was a student of Werner's. In 1968, a paper was published by Hisateru Okuno[26] in celebration of the centenary of the birth of Mrs. Curie (Marie Curie, 1867–1934). A biography of M. Curie by Ève Curie, widely read in Japan for several dozen years, was published again as a new edition.[27] Okuno and a well-known Japanese analytical chemist Kenjirô Kimura[28] wrote in *Kagaku to Kôgyô* (*Chemistry and Chemical Industry*) in condolence of Otto Hahn's death. This journal and some other journals in 1969 carried papers[29] in memory of the centenary of the public announcement of the periodic law by D. I. Mendeleéf (1834–1907).

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[23] T. Dôke: A History of the Japanese Chemists, (edited by Minoru Imoto, Masanori Ônuma, Tatsumasa Dôke, Naoya Nakagawa), Chikuma Shobô (1971. 11).

[24] Nozomu Yamaoka: Commemoration of the Century of the Theory of Benzen's Structure, (J), *Chemical Education*, **13** (3), 319–324 (1965. 9).

[25] Yûji Shibata: Alfred Werner and Complex Chemistry, (J), *Chemistry*, **22** (7) 632–636 (1967. 7); Some Personal Recollections of Alfred Werner, Werner Centinal (ed. by G. B. Kauffman), pp. 1–2, (American Chemical Society 1867); A Short Autobiography of Alfred Werner and Coordination theory (J), *Chemistry and Chemical Industry*, **19** (12) 1422–1427 (1966). Taku Uemura: Alfred Werner (1866–1919), *ibid.*, **20** (11) 1244–1247; **20** (12) 1400–1405 (1967).

[26] Hisateru Okuno: Centenary of Mme Curie's Birth (J), *Shizen*, **23** (4) 11–13 (1968).

[27] Ève Curie: Madame Curie (translated by Atsushi Kawaguchi, *etc.*) 333 p. Hakusuisha (1968. 2).

[28] H. Okuno: The Late Dr. Otto Hahn (J), *Chemistry and Chemical Industry*, **21** (10) 1325–1329 (1968. 10).

Kenjirô Kimura: The Late Dr. Otto Hahn (J), *ibid.*, **21** (10) 1329–1330 (1968. 10).

[29] Masanobu Sakagami: Centenary of Periodic Law and Mendeleéf Musium (J), *ibid.*, **21** (10) 1317–1324 (1968. 10). Saburô Ôtake: Periodic Law and its Evolution (J), *Science through Experiments*, **20** (5) 478–487 (1969. 5).

Nozomu Yamaoka and Taku Uemura published in the same journal in serial form their biographies of Western chemists (1966–1970). Yamaoka[30] wrote about A. W. Hofmann (1818–1892), Liebig and English chemists in the middle of the 19th century, taking up the achievements of R. W. Bunsen (1811–1899) and W. Ostwald (1853–1943). In 1971, Yamaoka published a book containing an account of his visits to the historical places of chemical interest in Europe.[31] Taku Uemura, one of the Japanese pioneers in the study of rare earth elements, has since 1965 been writing a series of biographies of Western chemists[32] in the journal *Kagaku to Kôgyô* (*Chemistry and Chemical Industry*), comprising already a total of some 25 chemists extending from Robert Boyle (1627–1691) to Irving Langmuir (1881–1957).

Translations[33] of several foreign books on the history of chemistry have been published. In 1967, Bunichi Tamamushi and Keijin Takeuchi published their translation of "A Short History of Chemistry" written by Isaac Asimov. In 1971, Yôjirô Tsuzuki translated "A Hundred Years of Chemistry" by Alexander Findlay. Since 1972, a translation of "The Development of Modern Chemistry" by Aaron J. Ihde has been being published by Chikayoshi Kamatani, Kiyohisa Fujii, and Chie Fujita. Other translations worthy of attention are Yamaoka's translation[34] (1966) of the famous correspondence between Liebig and Wöhler and Yoshirô Kobayashi's translation and publication[35] of "Arbeitserinnerungen" by Hermann Staudinger who laid the foundation for high-polymer chemistry. In Japanese chemical historical circles, translations of Western classic books well-known in the history of chemistry have constantly been in demand by readers in this country. Japanese journals are not always in favor of taking up such translations, however.

In recent times there seems to be some possibility of such translations being taken up by Japanese journals. For example, a publisher here has a project

[30] Nozomu Yamaoka: *Coal tar* (J), *ibid.*, **18** (6) 335 (1966)—**18** (12) 189 (1966); Aromatics (J), *ibid.*, **19** (1) (1967. 1)—**19** (12) (1967. 12); **21** (6) (1969. 6)—**22** (11) (1970. 11).

[31] ————: Looks of the History of Chemistry in Europe (J). 342 p. Uchida-Rôkakuho Shin-sha (1971. 3).

[32] Taku Uemura: *Chemistry and Chemical Industry*, **19** (2) 218–220 (1966), (3) 301–303, (5) 559–561, (6) 768–770, (8) 988–990; **21** (2) 233–235 (1968), (3) 363–316, (5) 642–646, (6) 801–804, (9) 1161–1164, (11) 1427–1430; **22** (2) 163–165 (1969), (4) 388–392, (9) 1047–1050, (12) 1456–1460; **23** (6) 728–732 (1970), (11) 1471–1474; **24** (10) 959–961 (1971), (11) 1054–1057.

[33] Isacc Asimov: A short history of chemistry (trans. by Bunichi Tamamushi, Keijin Takeuchi) 286 p. Kawade Shobô (1967. 7). Alexander Findlay: A Hundred Years of Chemistry (1937), trans. by Yôjirô Tsuzuki, Kôdansha (1971).

Aaron Ihde: The Development of Modern Chemistry (1964) trans. by Chikayoshi Kamatani, Kiyohisa Fujii, Chie Fujita Misuzushobo (1972).

[34] Aus Justus Liebig's und Friedrich Wöhler's Briefwechsel in den Jahren 1829–1873 (1888), trans. by Nozomu Yamaoka, Uchida Rôkakuho Shinsha (1966).

[35] Herman Staudinger: Arbeitserinnerungen (1961) trans. by Yoshirô Kobayashi, Iwanami Shoten (1966).

to offer translations of classic literature including Lavoisier's "Traité elementaire de Chemie."

"Kagakushi Den" (Chemical Biographies), a book on the history of chemistry published in 1922 by Yamaoka has been influencing many of those interested in the study of Japan's history of chemistry in recent years. A new edition of that book was published in 1968.[36] In 1965–1972, there were only a few books published by Japanese workers on the history of chemistry here. One of them, Yôjirô Tsuzuki, published "The History of chemistry" (in Japanese) (1966),[37] which contained, as stated in its preface, his studies of not only the history of western chemistry here but also the chemical industrial technical progress here. His most energetic studies mentioned in that book are on the history of chemistry in Japan. T. Dôke and M. Ônuma in cooperation with Jun Fujimura (physics) and Toshiyoshi Kikuchi (history of sciences in Japan) described, in the form of a pocket book, science in the 19th century in connection with its ideological, historical and social background. In that book, Dôke's description centered around the Liebig-Pasteur controversy while M. Ônuma gave a biographical account of W. Ostwald's relation to Atomism.[38]

In understanding the history of chemistry, it is essential to look systematically into various scholars' interpretations of the components of substances, elements, atoms, molecules, etc. M. Tanaka has since 1965, been engaged in a study of the relationship between the history of chemistry and modern atomism, and part of his work was published in *Japanese Studies in the History of Science*.[39]

One of the endeavors at present required in writing the history of chemistry consists in the historical characterization of chemistry, the nature of chemistry and differences and interrelationships between chemistry and physics. Many things remain to be done for laying down the methodology for such a history of chemistry. Hazime Kashiwagi (Nagoya University) has recently published some papers[40] on the methodology of history of chemistry. Philosopher Chikatsugu Iwasaki (Hitotsubashi University) in collaboration with Shôhei Miyahara, a well-known researcher on the quantum-statistical theory of matter in this coun-

[36] Nozomu Yamaoka: A History of Chemistry (Kagakushi Den (J), 485 p. Uchida Rôkakuho Shinsha (1968. 3).

[37] Yôjirô Tsuzuki: A History of Chemistry, (J), Asakura Shoten (1966).

[38] T. Dôke, M. Ônuma, Jun Fujimura, Toshiyoshi Kikuchi: The Origin of 20th Century Science, Nippon Hôsô Kyôkai (1969).

[39] Minoru Tanaka: Role of Chemistry in the Establishument of Modern Chemistry (J), *Reports of Tokyô Institute of Tech.*, No. 29, p. 61–76 (1965); Über Ursprunge skeptisher Auffassungen gegen Atomhypothese der Chemie neuenzehnten Jahrhumderts (Ein Beitrages zur Geschichte der Atomistik—3—), *Japanese Studies in the History of Science*, **5**, 87–89 (1967. 7); Origin and Character of Wilhelm Ostwald's Anti-Atomistic Conception—A problem in the History of Atomism (J). *Kagakushi Kenkyû*, No. 82, pp. 49–56 (1967); Chemical and Physical Models for Atomic Motion, *Japanese Studies in the History of Science*, **8**, 125–143 (1970. 3).

[40] Hazime Kashiwagi: History of Chemistry, *Kagakusi Kenkyû*, No. 106, 49–65 (1973).

try, took up the classification and definition of modern sciences, and has also been studying the interrelationship between modern chemistry and physics again in the light of dialectical materialism.[41] Analysis of various problems of modern chemistry and reviewing the history of chemistry from today's viewpoint are necessary to establish a methodology for the history of chemistry.

3

The scholars of the history of chemistry have been voicing their various suggestions about chemical education, (for example, Bunichi Tamamushi and M. Tanaka).[42] Besides, teachers of chemical education have been referring to the great utility of the history of chemistry. They have organized "Kagaku Kyôiku Kenkyu Kyôgikai" (Council for Science Education) with its journal *Rika Kyôshitsu* (*The Journal of Science Education*) containing biographies of chemists and many papers on the history of chemistry. Yoshishige Hayashi,[43] a chemistry teacher, who has been discussing in other journals the nature of Japan's chemical education, centering around experimental tools is on the council. Sumio Mitsui[44] has been writing about the studies conducted by chemists Saichirô Nagami (1891–) and Tokuhei Kametaka (1872–1935) who contributed to the advance of Japanese scientific education. Sadaaki Shidô[45] wrote a book on the history of chemistry for teachers' information, and also published a paper on the role of the history of chemistry in chemical education.

Since Japan's postwar politics, economy, and technology have been dependent on the United States, Japanese government policies on scientific education have undergone changes. Especially, the Sputnik shock encouraged the direct importation into Japan of American science textbooks which again turned out to be a controversial subject. Detailed critical review of the American chemistry textbook "Chemistry: An Experimental Science" (CHEMS) was published by Tokumichi Tsukahara, editor of *Rika Kyôshitsu* (*The Journal of Science Education*) and a high-school teacher of chemistry in his journal in 1967 and 1968.[46] Tsukahara ended his review with criticism of CHEMS, including

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[41] Chikatsugu Iwasaki: Problems on Chemical Reaction and the Structure of Matter, *Memoirs of the Faculty of Literature Hokkaidô University*, **19** (1), 73–93 (1971–3).

[42] Bunichi Tamamushi: Science-Education-Thought (J) 371 p. Iwanami Shoten (1970. 6). Teaching of History of Chemistry in Japan, *Japanese Studies in the History of Science*, No. 8 (1970. 3). Minoru Tanaka: Science-Human-History (J), Kokudosha (1971).

[43] Yoshishige Hayashi: History of Chemical Education in Chemical Instruments in Japan. (J). *Science Through Experiments*, **21** (3) 11–19, (5) 105–112, (7) 81–88 (1970).

[44] Minoru Tanaka and Sumio Mitsui: Notes on Saichirô Nagami (J), *Studies in the History of Science and Technology*, No. 4, 65–70 (1966. 7).

Sumio Mitsui: Saichirô Nagami and his text book of Chemistry, *ibid.*, No. 5, 29–30 (1967. 12). Tokuhei Kametaka and his Studies on Organic Chemistry (J), *Memoirs of Urawa Technical High School*, No. 1, 1–10 (1970. 1).

[45] Sadaaki Shidô: The development of Chemistry (J), Daiichihôki (1970. 5).

the remark that the dominant interpretation of science in CHEMS is too biased towards the inductive method, tending thereby to make light of the entire previous achievements of man in natural sciences. As a matter of fact, as stated by Tsukahara, it is not right to blindly admire scientific education in the United States or to borrow only a part of those American achievements for scientific education in this country. Tsukahara's idea is that the methods of modern science and its high level of achievements all have to be taught to the Japanese people without discrimination.

In Japan, which was virtually an advance bridgehead of the United States in its war in Vietnam, military dangers have constantly been a source of concern to the Japanese people since 1965 with the growing intensity of the war. Especially, many scientists and historians of science in this country have been voicing their concern lest science should be made use of for military purposes. Numerous papers have been written and published about biological and chemical weapons[47] by pathologist Akira Wake. S. Rose's "CBW" (1968) was translated by journalists T. Sunobe and A. Akagi. Numerous papers[48] have been written by chemist Yasuo Miyake on the risk of radioactive pollution of Japanese harbors by American unclear submarines and on the risk of sea water pollution by nuclear arms.

In Japan, with more environmental pollution than in any other part of the world, many platitudes have been uttered in that connection by Japanese scientists and historians of sciences. In the papers written by Takahisa Hanya[49] a new field of scientific studies termed "Sociogeochemistry" has been created dealing with environmental pollution is connection with geochemistry. Kunioki Katô,[50] an historian of chemical technology, also have written sincerely many papers about environmental chemical pollution or public nuisance.

Military uses of chemistry and environmental chemical pollution are the problems that face Japanese scholars of the history of chemistry, who must weigh the position of chemistry in the social life and historical position of this nation.

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[46] Tokumichi Tsukahara: Polemic on CHEMS (J), *The Journal of Science Education*, 9, 10, 11, 12 (1967); *ibid.*, 1, 3, 4, 5 (1968).

[47] Akira Wake: Science to Death—B.C.W. (J), 202 p. Shinnihon Shuppansha (1969. 10). S. Rose: C.B.W. (trans. by Toshio Sunobe, Akio Akagi), 272 p. Misuzushobô (1970. 9).

[48] Yasuo Miyake: Nuclear weapon and Radio activity (J), 228 p. Shinnihon Shuppansha (1969. 4).

[49] Takahisa Hanya: Sociogeochemistry (J), 202 p. Kinokuniya (1966).

[50] Kunioki Katô: The Chemical Industry in Japan and Minamata Disease (J), *Hôritsu Jihô* No. 5, Vol. 44 (1972. 4); On Public Nuisance Problem in Pre-war days, *Journal of Japanese Scientists*, No. 6, Vol. 4 (1969. 12).