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Anglo-American Connections in Japanese Chemistry

The Lab as Contact Zone

Yoshiyuki Kikuchi
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Preface and Acknowledgments

This book started its first life as a dissertation on Anglo-Japanese scholarly relations in chemistry submitted to the Open University in Milton Keynes, United Kingdom, in 2006, though research for the dissertation had started earlier while I was a graduate student at the University of Tokyo working with Takehiko Hashimoto. The OU, as it is affectionately called by students, faculty, staff, and locals, is no ordinary place to do a Ph.D. But there were many good sides to it. There was a research tradition, if not a school, in the history of chemistry created by the late Colin A. Russell in the 1980s and 1990s at the OU. He had already retired when I arrived in Milton Keynes in 2002, but I was fortunate enough to meet him and received invaluable advice from time to time, especially about the history of organic chemistry in which I had been ill-prepared.

Even more important was the intense and fruitful relationship with my supervisors. Gerryllyn K. Roberts and Ian E. Inkster spent countless hours discussing my topic, giving advice and counsel at crucial moments, and proofreading draft chapters in the final writing stage. The full extent of their generosity did not become clear to me until later when I heard about the experiences of other PhD students worldwide. I also had the good fortune of meeting a senior fellow student (senpai in Japanese) in sociology, Masaaki Morishita, who introduced me to the key concept of this book, the contact zone. I am proud of having been a student at one of the most forward-looking universities in the world and still cherish a fond memory of my experience there and my life in Milton Keynes.

The second life of this book, in hindsight, began when I moved to the United States to take up a postdoctoral position at the Chemical Heritage Foundation (CHF) in Philadelphia in 2008. I conducted key research there that would be necessary to add a crucial American element to this book. Hyungsub Choi, then at CHF, asked me to join his informal reading sessions (with mostly only two of us) in the history of science and technology in modern and contemporary Japan, giving me an opportunity to think about the wider relevance of my story beyond its immediate time.

However, it was after moving to the Massachusetts Institute of Technology (MIT) in Cambridge, Massachusetts, in 2009 that this book project started in earnest. David (Dave) Kaiser, my mentor there, encouraged me to really go for it, talked with me about reconceptualizing my project, discussed and proofread sample chapters, and helped me draft a book proposal—practically
everything you would need to get a book project started. Dave also organized a stimulating discussion group on the history of modern physical sciences where earlier drafts of chapter 5 and the book proposal were read and discussed. This process continued after I moved to Harvard University in 2011 and there came under the care of two exceptional mentors, Shigehisa Kuriyama and Janet Browne.

A major part of the writing was carried out in 2012 and 2013 at the International Institute for Asian Studies (IIAS) in Leiden, Netherlands, directed by Philippe Peycam and managed by Willem Vogelsang. Originally trained as a historian of science, I was not sure at first what to expect in this institute, except that it is located in a beautiful historic university town with a tradition in Japanese studies. Now I can say with confidence that it was the best place to finish my book project. Particularly noteworthy is IIAS’s firm commitment to colonial, postcolonial, and heritage studies and its vibrant research cluster for urban design called the Urban Knowledge Network Asia (UKNA). I did not become an expert in either field, but I received insights, stimulating discussion and conversation (distinctions between them were often unclear), and thought-provoking questions that sharpened my thinking and contextualized my project within broader Asian studies. Netherlands-based colleagues in the history of science and technology, especially Ernst Homburg (an old friend of mine), Lissa Roberts, Andreas Weber, and Martin Weiss kindly provided much-needed discussions and encouragement in my own area of specialization. Lissa also agreed to read an earlier draft of the introductory chapter and gave me invaluable advice on how to improve it.

My current employer, The Graduate University for Advanced Studies (Sokendai) and my new colleagues in its “Science and Society” teaching program—Mariko Hasegawa, Kohji Hirata, Kaori Iida, Kenji Itō, Kōichi Mikami, Hisashi Nakao, and Ryūma Shineha—supported me while I was adding finishing touches to the manuscript and kindly joined the stimulating discussion of a part of my book manuscript.

The above list of people and institutions that supported my project is far from complete. Yasu Furukawa convinced me that the history of chemistry was an exciting research field and initiated me into it in his seminar courses at Tokyo, and I am grateful for that. One of his suggested readings was The Fontana (Norton) History of Chemistry, written by William H. (Bill) Brock. It was by participating in its Japanese translation project, organized by Makoto Ohno, that I acquired the overall basic knowledge of this field. Later in England I had the privilege to get my dissertation examined by Bill himself together with Janet E. Hunter, a task they carried out with encouragement, constructive criticism, and helpful comments. Peter J. T. Morris generously shared his knowledge and enthusiasm about the history of chemistry, the chemical laboratory, and its design, which were both enlightening and infectious.

I am grateful to the following scholars (in alphabetical order) for taking part in the discussion of my research topic and for giving me invaluable
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At the publishers, I thank Chris Chappell, senior editor of Palgrave Macmillan USA, for his very patient guidance, understanding, and encouragement. I am grateful to Sarah Whalen, Mike Aperauch, assistant editors, for their hands-on supervision of the production process. I appreciate the thoughtful and carefully articulated comments of two anonymous reviewers that were useful to improve my draft.

This project was supported by several generous fellowships and grants, and I thank the following: OU’s Research Degrees Committee for the three year research studentship; OU’s Arts Faculty Research Committee for the extension of my studentship and for funding my short-term research trip to Japan in 2003; the Japan Foundation Endowment Committee, which generously funded my long-term research trip to Japan in 2004; CHF’s Sidney M. Edelstein Fellowship, which also funded research trips to New York, Baltimore, and Washington, D.C.; the Postdoctoral Fellowship in the History of Modern Physical Sciences at MIT, which also included funding of research trips to New Haven, Connecticut; Ireland, and Japan; the Postdoctoral Fellowship in the History of Science and Technology in Modern East Asia at Harvard University, which also included funding of research trips to Oberlin, Ohio; and the IIAS affiliated fellowship.

I am grateful to the following libraries that supported my project: The Bodleian Japanese Library; the British Library; Cambridge University Library; CHF’s Othmer Library of Chemical History; Harvard Yenching Library; Science Museum and Imperial College London Library; University Library and the East Asian Library, Leiden University; MIT Libraries; the National Diet Library; the Open University Library; the Library of the School of Oriental and African Studies, University of London; the University ofTokyo Faculty of Education Library; the University of Tokyo General Library; and the Widener Library, Harvard College Library. I especially thank the expert support of Noboru Koyama, curator of the Japanese collections at the
Cambridge University Library, and Kumiko Yamada McVey, librarian for the Japanese Collection at Harvard Yenching Library.

I would like to thank the archives listed under “Archival Sources” in the bibliography for their kind and competent support during my research. I am particularly grateful to the following: Yoshio Umezawa for allowing me to explore the archive of the Department of Chemistry, School of Science, University of Tokyo, as well as the records of the School of Science; the late Tetsuo Shiba for making the Sakurai Jōji Correspondence of the Chemical Society of Japan available to me; Hiroshi Motoyasu for the generous permission to explore freely the whole Sakurai Jōji Papers of the Ishikawa-ken Rekishi Hakubutsukan; and Tokuhei Tagai for giving me access to the notebook collection of Koto [the second o with macron] Bunjiro [o with macron] at the University Museum, University of Tokyo.


My parents, Yasuyuki and Noriko Kikuchi, have constantly encouraged and supported my venture since I first talked with them about my wish to choose the history of science as my major some twenty years ago. My wife, Naoko Kikuchi, accompanied me on a long journey to this end. Her unwavering support is many-sided, but its most important aspect for me is that she has believed in the value of my work. I am grateful for her trust and love, and it is to her that I dedicate this book.
Abbreviations

Ann. Sci.  Annals of Science
Ayumi  Tokyo Daigaku Daigakuin Rigakukei Kenkyūka Rigakubu Kagaku Kyōshitsu Zasshikai, ed. 2007. Tokyo Daigaku Rigakubu Kagaku Kyōshitsu no ayumi
ACJ  American Chemical Journal
BAAS  British Association for the Advancement of Science
BJHS  British Journal for the History of Science
CN  Chemical News
Columbia College Catalogue  Catalogue of the Officers and Students of Columbia College, for the Year
Eng. Calendar Imp. Univ.  Imperial University of Japan (Teikoku Daigaku), The Calendar for the Year
Eng. Calendar Tokyo Univ. Law, Sci., and Lit.  Tokio Daigaku (University of Tokyo), The Calendar of the Departments of Law, Science, and Literature
FCS  Fellow(ship) of the Chemical Society
Gs  Gakugei shirin
Hist. Sci.  History of Science
HSPS  Historical Studies in the Physical (and Biological) Sciences
ICET Calendar  Imperial College of Engineering, Tokei. Calendar. Session
JCSIUJTJ  The Journal of the College of Science, Imperial University (of Tokyo), Japan
JCST  Journal of the Chemical Society [London]: Transactions
JHU  Johns Hopkins University, Baltimore, Maryland, USA
JHUC  Johns Hopkins University Circulars
Jpn. Calendar (Tokyo) Imp. Univ. (Tokyo) Teikoku Daigaku ichiran
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<th>ABBREVIATIONS</th>
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<td>Jpn. Calendar Kyoto Imp. Univ.</td>
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<td>Jpn. Calendar Tôhoku Imp. Univ. Coll. Sci.</td>
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<td>Jpn. Calendar Tokyo Univ. Law, Sci., and Lit.</td>
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<td>Sakurai Jōji Papers</td>
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<td>Shiryō oyatoi gaikokujin</td>
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Note on Conventions

Japanese names in what follows are written in the order used in Japan, with family names preceding given names. The way of referring to historical figures in this study can be confusing because this book covers both the pre- and post-Meiji-Restoration periods for which different conventions are normally used. I have adopted the standard post-Meiji-Restoration custom of referring to people by their family names throughout. In transliterating Japanese words I have adopted the modified Hepburn-system (hebon shiki rōmaji) as is shown in Watanabe Toshirō, Edmund R. Skrzypckak, and Paul Snowden, eds., Kenkyusha’s New Japanese-English Dictionary, 5th edition (Tokyo: Kenkyūsha, 2003), p. xiv. I have shown transliterated Japanese words in italics with two exceptions: (1) proper nouns are written without italicizing, such as Itō Hirobumi and the Tokyo Kaisei Gakkō; and (2) words well-known to English readers, such as Tokyo, Osaka, Kyoto, sake, and samurai, are written with neither italicizing nor macrons. I basically follow Janet Hunter, ed., Concise Dictionary of Modern Japanese History (Berkeley, Los Angeles, and London: University of California Press, 1984) in rendering technical terms of Japanese history into English.
The object of this book is not to give the whole picture of the transmission of Western chemistry to modern Japan. Instead, this book is concerned with how scientific practices in different parts of the world are connected with each other. It is part of my conscious move away from the grand narrative of “Japan meets the West” or “the East meets the West,” which has for so long affected the historiography of modern science in East Asia. The strategy I am adopting is to stress the highly localized and temporized nature of the science by focusing on chemistry in Britain and the United States in the second half of the nineteenth century. The other more important aspect of this book is to look at human encounters in physical spaces. Scholars have identified various kinds of human agents as an essential medium of global circulation, communication, and appropriation of knowledge, which has inspired my approach. As will become clear, however, I take spaces unusually seriously as an independent agency because they fundamentally affect the nature of human encounters. This approach is summed up in the subtitle of this book, “the lab as contact zone.” By applying the concept of the contact zone this book sheds new light on the relevance of spaces and localities to scientific practice. The spaces are not only sites of the production, transmission, and legitimization of knowledge and materials—an aspect I never underestimate—but they are also sites of human encounter and the resulting intricate social interactions that in turn affect the shape of scientific practice.

There were several possibilities of such human encounter for Japan during the period under discussion. The opening of treaty ports in the 1850s and 1860s meant increased contact between foreign and domestic traders, their clients, and other personnel there. A long-standing ban on foreign travel was lifted in 1866, after which any Japanese could apply for permission to stay “for study and trade” in countries that had concluded treaties with Japan, among them major European countries and the United States. Early on, Japanese overseas travelers were predominantly students. Likewise, probably the easiest way for ordinary Japanese to get acquainted with foreigners would have been to become a college student, though even this option was out of reach for most of the populace, especially for women. In the nascent nation-state trying to build a Western-style higher education system as part of its industrialization policy, the new Japanese government established by the Meiji Restoration in 1868 hired a large number of foreign teachers and
sent the most successful students abroad for overseas study. This is why I focus on scientific pedagogy—on how young scientists are made—in this book.

The other important reason for this focus is the long-term effect of scientific pedagogy on the development of scientific practice. Historians, philosophers, and sociologists of science have begun to look critically at scientific pedagogy as one of the central issues in science and technology studies. Recent work has highlighted three overarching questions: (1) how and to what extent does scientific pedagogy shape scientific research? (2) How different from place to place is a “pedagogical regime,” a social fabric that affects and controls what is taught, how a scientist is trained, and what role models and rules of conduct are honored? (3) How does a pedagogical regime interact with society at large? In light of today’s global and transnational societies, it is necessary, even pressing, to add to this research agenda a fourth dimension: cross-national exchange of ideas, people, and materials for the construction of a pedagogical regime. Considering complex national and regional cultural differences, we cannot assume that there is one single answer to the question of how best to train scientists and engineers. However, we can learn from historical case studies how educators in the past managed similar kinds of problems and reached some solutions.

Arguably the first laboratory-based science, chemistry has had a distinct history since antiquity as the hybrid of craft and philosophical activities where material production and the production of knowledge of matter are inseparably entangled. Until the end of the eighteenth century, the material culture of the chemical laboratory was virtually identical with that of workshops and factories. It was in the first half of the nineteenth century that these two spheres started to separate somewhat, albeit far from completely, with the spread of the Lavoisian theory of chemical elements and the Daltonian/Berzelian atomic theory across Europe and North America (together with their linguistic and graphic representations) and the miniaturization and standardization of chemical analysis, which logically assumed some kind of elemental and/or atomic theories.

It is for this historical reason that chemistry was widely considered the most practical and utilitarian of all scientific subjects throughout the nineteenth century and played a big role in the contemporary debates regarding “applied science” and “technical education” on both sides of the Atlantic. In other words, chemistry was a distinct and exemplary nineteenth-century discipline among others, such as natural philosophy (physics) and biology, on which chemistry had a great impact. Therefore, it cannot be considered a mere coincidence that chemistry was one of the first academic subjects institutionalized in Japanese higher education (together with law and engineering subjects), as I discuss later on in this book. The Japanese case instead underlines the truly international character of the debates about applied science and technical education and merits the serious attention of historians of science and technology.

Japan in the Meiji period (1868–1912) desperately needed foreign support to fill the perceived need for a Western-style system of higher education,
something that was essential for survival in an increasingly Euro- and American-centric world order after the First Opium War of 1839–1842. Japan’s political leaders and educators first flocked to Britain as a strong industrial sea power and to the United States as the country that triggered the whole process of Japan’s opening of diplomatic relations with world powers.\textsuperscript{13} Despite the long-lasting image of German science as a model for Japanese science from the Meiji period onward, British and American teachers were dominant in Japanese higher education between the 1860s and 1880s, and many Japanese overseas students went to British and American universities and colleges to finish their training during this period.\textsuperscript{14} Increase of German presence in Japanese higher education (and in politics and administration) came later, from the 1880s onward. Before then, the German presence was restricted to the medical sciences, including medical and pharmaceutical chemistry, because Dutch-style medical education, the strongest specialty of Dutch learning in Japan during the Tokugawa period, was Germanized in the early 1870s.\textsuperscript{15} As a result, Meiji Japan became a kaleidoscope of European and North American (as well as Japanese) styles in many aspects of institutional as well as material culture.

Chemistry was at the center of this educational development. Indeed, British chemists collaborated with American chemists in setting up chemical education at Japanese universities and colleges, and Japanese chemistry students in Britain and the United States became the first Japanese chemistry professors. These facts are known among historians of science in Japan on both sides of the Pacific and on both sides of Eurasia. But the process—how British and American connections in Japanese chemical education emerged, were sustained, and later diminished—and its consequences for Japanese science and technology has not been examined yet.

This book focuses on these important developments and argues that the Anglo-Japanese and American-Japanese connections in chemistry had a major impact on the institutionalization of Japanese scientific and technological higher education from the late nineteenth century onward; they helped define the structure of the Japanese pedagogical and research system that lasted well into the post-World War II period of massive technological development, when Japan became one of the biggest providers of chemists and producers of chemical publications in the world next to the United States, Soviet Union, and Western Europe.\textsuperscript{16}

As for the first theme of the process, I argue that among the earliest Japanese chemistry students in Britain and the United States in the 1860s were influential members of the Meiji government such as Itô Hirobumi and Mori Arinori. Their views on science, technology, and education were shaped through interaction with their British and American teachers, and these students became instrumental in implementing the government’s industrialization policies, a major part of which was higher education. These students developed Anglo-American scholarly relations in chemistry throughout the 1870s. These involvements of politicians and administrators gradually gave way to the choices of chemists themselves in the late 1870s and 1880s, some
of whom favored Germany while others kept close ties with Britain and/or the United States. How this happened provides the basic story line of this book.

I interpret the second theme of the consequences of Anglo-Japanese and American-Japanese relations in chemistry for Japanese science and technology as the issue of cross-cultural transfers of knowledge and models within what Mary-Louise Pratt called contact zones. She defined it as “a space in which peoples geographically and historically separated come into contact with each other,” and in which “transculturation”—the phenomenon of a “union of cultures” or merging and converging cultures—occurs. According to Pratt,

A “contact” perspective emphasizes how subjects are constituted in and by their relations to each other. It treats the relations among colonizers and colonized, or travellers and “travelees,” not in terms of separateness or apartheid, but in terms of copresence, interaction, interlocking understandings and practices, often within radically asymmetrical relations of power.

As is clear from this quotation, Pratt uses the concept of contact zones against the backdrop of colonial encounters. She carefully disentangles the dictionary definition of a contact zone from formal colonialism, but this recognition of sheer power inequality and the possibility of interaction in spite of it distinguishes “contact zones” from other similarly anthropology-inspired concepts such as Peter Galison’s “trading zones,” the space where people with different professional cultures, such as physicists, engineers, and instrument makers mingle, negotiate, and exchange ideas, instruments, and data.

This aspect of contact zones is relevant to my case in two ways. First, though Japan in the late Tokugawa and Meiji periods narrowly escaped formal colonialism, much of the actions of those in power were dictated by the painful recognition of power inequality (both military and economic) vis-à-vis Euro-American world powers, which is something akin to what Michael Herzfeld called “crypto-colonialism,” a hidden form of colonialism by means of cultural, economic, and epistemological hegemony. Second, the pedagogical situations I am about to analyze—in the classroom, teaching laboratories, etc.—are inherently marked by unequal power relationships of some sort (overt, disguised, benign, or subverted) to varied extents between teachers and students. Both kinds of dynamics are nicely captured by contact zones.

In examining the mechanism of transculturation of educational models by analyzing interactions between British and American chemistry teachers and their Japanese students in the Meiji period, this book focuses on several pedagogical spaces qua contact zones to highlight the importance of place, mutual give-and-take, and conflict-solving in cross-cultural interaction. Here we are looking at two kinds of interactions in the same contact zone: students’ appropriation of teachers’ professional culture (the very essence of scientific
pedagogy), and cross-national interaction between Japanese students and British and American teachers. This approach thus emphasizes personal contacts as the medium of transmitting chemical expertise and educational models, and it also brings the pedagogical regimes prevailing in British, American, and Japanese chemistry education together into the spotlight.

In light of the complexity of scientific pedagogy and the importance of laboratory training in chemistry, it is simply not enough to stay with classical topics, such as curriculum design, lecture notebooks, and textbooks as components of an educational model. Contact zones inform my approach by drawing attention to the manifold and inseparable relationships between pedagogy, research, and the material construction of pedagogical spaces that had a far-reaching impact on connecting—and separating—people, cultures, disciplines, subdisciplines, and research units. The crucial point here is the duality of a contact zone. First, as an actual physical space defined by a material building and furnished with a variety of equipment, such as glassware and gas, and second as a means for constructing social relations.

This duality, together with the fact that the contact zone as a concept has remained a heuristic device and not been used as an analytical tool to interpret actual spaces, makes it necessary to marry the concept with other conceptual and empirical tools to bring to bear its full potential on elucidating how a space and place affect scientific practice and pedagogy and vice versa. There are two points of reference in my approach to this question that correspond to this duality. The first is the early Meiji educationists’ holistic approach to material culture. That is, their attitudes toward scientific pedagogy and architecture, for example, did not exist in isolation but was part of their overall attitude toward British or North American material culture. This is indeed congruent with Jules David Prown’s definition of material culture as “the manifestations of culture through material production.” However, we cannot assume automatically that historical actors thought or felt this way; our understanding has to be empirically grounded. That is part of what I do in chapters 2, 4, and 5.

The second point of reference is the Foucauldian analysis of architecture that looks at supervision, surveillance, and other means of social control as key tools for analyzing architecture and the spaces it helps create. This perspective was inspired by the panopticon, the prison with a tall watch tower surrounded by cells, conceived by English utilitarian philosopher Jeremy Bentham. Recent architectural historians and urban designers, however, have started to depart from Michel Foucault’s pessimism and have begun to treat supervision and surveillance more as the means of allowing effective social interaction among residents in urban spaces. Likewise, I am concerned with the question of who stood at the center of the network of human relations between teachers and students that was created by pedagogical spaces as contact zones.

Accordingly, in what follows I often use the term “assistant-centered structure” vis-à-vis a “professor-centered structure” to show my answer to
this question in a particular space. The former refers to a pedagogical space, such as a teaching laboratory, where assistants, not professors, have daily contact with students. In contrast, in the latter, professors impart knowledge to students, such as in a lecture hall, and assistants play the role of true “subordinates” helping professors’ demonstrations. This does not preclude the possibility of one assistant playing both roles, but it is important to distinguish two very different pedagogical spaces and situations.

This distinction also enables us to highlight the importance of assistants and advanced students within the “assistant-centered structure” as “cultural mediators” between foreign-trained professors and Japanese students, which has an obvious parallel with what Simon Schaffer, Lissa Roberts, Kapil Raj, and James Delbourgo called “go-betweens.” This structure largely determined what kind of people Japanese chemistry students would be most likely to interact and work with. In this way, the contact zones functioned both as a medium and a model, and that is why they are important to my story.

Thus far I have put aside another important aspect of cross-cultural interaction: communication within contact zones. It is to unravel the haphazard and at times destructive but occasionally also productive aspects of cross-cultural communication that I introduce the fourth interpretative tool, “Translatability of Culture.” It was born out of interdisciplinary discussions among researchers in philosophy, fine arts, music, and literature as well as in science and technology studies. The basic idea here is to look at the process of unavoidable semantic changes caused by two-way processes of translation of cultural elements and the associated cognitive problem of “incommensurability” of different cultures. This approach emphasizes the dual meaning of the word “translation”: (1) to change speech or writing into another language, and (2) to move something from one context to another, thus making it possible to talk about “translation” of nonverbal cultural elements, such as painting and music. This double meaning of translation is particularly relevant to my case of the transculturation of British or North American models of scientific pedagogy in Japan.

Even if one succeeds in finding or coining more or less appropriate Japanese words to express an idea of British or American origins about scientific pedagogy, the meaning may be unintelligible, destroyed, or totally changed in the Japanese context, just as might be the case for foreign art objects and musical compositions transplanted into the Japanese context or vice versa. That is where paraphrasing or explanation with languages familiar to Japanese audiences begins. As I argue in the following chapters, particularly in chapter 4, that was exactly what Japanese scientists had to do to varying degrees; skilful and minute adjustments were in some cases not only unavoidable but the key to succeeding in the transculturation of British or American models of scientific pedagogy in Japan.

The chapters that follow are laid out roughly in chronological order, but each has a particular thematic focus. Chapter 1 is about Anglo-American contact zones where Japanese students from Chōshū and Satsuma domains (han), without any experience in Western-style scientific pedagogy, interacted
with British and American teachers and formed their views on science, technology, and education in the 1860s. Their views mattered because these two domains, semi-autonomous provinces owned and ruled by feudal lords, soon toppled the Tokugawa Shogunate in 1868 and formed the core of the new Meiji government, providing influential politicians and educators. Those students’ views are good examples of Japanese reactions to the contemporary debate in Britain on technical education, because two of their teachers, Alexander William Williamson and Charles Graham, were active participants in the debate. I examine a variety of contact zones and elucidate how such spaces affected Chōshū and Satsuma students differently. I also introduce the term “assistant-centered structure” of laboratory contact zones at UCL, which plays an important role later in this book. I finish this chapter with the other major difference between Chōshū and Satsuma students, i.e., Satsuma students’ subsequent move to the United States and study at Rutgers College in New Brunswick, New Jersey.

In chapter 2 we move to contact zones in Japan. The chapter scrutinizes one of the earliest cases of laboratory-based chemical education in early Meiji period, the Department of Chemistry led by British chemist Robert William Atkinson at the Tokyo Kaisei Gakkō and Tokyo University in the 1870s. Though located in Tokyo, this school had a multinational faculty. Its classrooms and laboratories effectively became contact zones whose physical spaces exhibited a hybrid material culture. I elucidate how Atkinson used the legacy of his American predecessor William Elliot Griffis, his own experience in London, and Japanese cultural elements (Japanese indigenous manufactures of sake and soy sauce, for example) to construct his style of chemical education as an example of transculturation. This chapter also highlights the crucial roles of cultural mediators, such as school director Hatakeyama Yoshinari (a Satsuma student at UCL) and the assistant to Atkinson, Masaki Taizō (another Japanese student at UCL, from Chōshū).

Chapter 3 is about Japanese students who experienced both Japanese and Anglo-American contact zones. There were four chemistry students from the same Tokyo Kaisei Gakkō and Tokyo University who later moved to different places in Britain and the United States for overseas study: Matsui Naokichi (Columbia College School of Mines), Sakurai Jōji (UCL), Takamatsu Toyokichi (Owens College Manchester), and Kuhara Mitsuru (JHU). They have been chosen on the basis of their subsequent roles in the establishment of scientific and technological education in chemistry in Japan. The central question is how those four chemists developed totally different visions of chemical education despite their common origin in Tokyo. The chapter also emphasizes Masaki’s continued role as cultural mediator between Japanese students and British teachers in his capacity as superintendent of overseas students in London.

Chapter 4 follows the career paths of the same protagonists we met in chapter 3 after they returned to Japan to take up positions at their alma mater. I tell the story against the backdrop of arguably the most important restructuring process in the history of Japanese higher education, namely,
the merger of Tokyo University and another prominent engineering school, the Imperial College of Engineering, Tokyo, into the Imperial University in 1886. In that chapter I focus on several “translation” strategies (ranging from “literal” translation to careful cultural adjustment) with which the former students used their experiences in Britain and the United States to negotiate for and construct their own pedagogical spaces between 1880 and 1886. The languages they used such as distinctly Japanese “manufacturing chemistry” (seizō kagaku) and “pure and right chemistry” (junsei kagaku) show the variety and subtlety with which the Euro-American rhetoric of “applied science” was negotiated in a different locality. I conclude this chapter with a section on the organizational structure of the Imperial University and describe how its high-ranking administrators looked at the place and meaning of chemistry within the Japanese system of higher education and society more generally and how their views affected the activities of chemistry professors.

In the next three chapters I examine the two major products of the restructuring process examined in chapter 4. Chapter 5 addresses the question of the kind of pedagogical space Sakurai, with support of the British chemist Edward Divers, constructed for the Department of Chemistry at the Imperial University in Tokyo in the late 1880s and 1890s with the Foucauldian analysis of architecture as a starting point. The main question here concerns the way Sakurai juxtaposed classrooms, laboratories, and office spaces and thus structured contact zones between teachers and students. What stands out in Sakurai’s and Divers’s pedagogical space is the strong influence of the British “assistant-centered structure,” where the junior faculty had an important role as experimental trainers and as cultural mediators, in spite of the German origin of the “departmental space.” That chapter also reveals a distinctly cross-cultural element: the Zasshi-kai (journal meeting), an informal discussion and socializing event held weekly at the library that combined Anglo-American style reading seminars with Japanese leisure culture.

Any study of a pedagogical space would not be complete without looking at what actually occurred in it. Chapter 6 looks at how differently these two senior professors at Tokyo’s Department of Chemistry made use of the same space analyzed in chapter 5 to deliver lectures, to supervise advanced students’ works, to do their own research, and to connect to students in other ways. The chapter also examines how the students, most notably Ikeda Kikunae (physical chemistry), Haga Tamemasa (inorganic chemistry), and Majima Toshiyuki (organic chemistry), responded to the teaching both as followers and as dissidents.

Chapter 7 is about another product of the restructuring process, the Department of Applied Chemistry of the College of Engineering. Again, it was an outcome of cross-cultural interaction between Britain, Germany, and Japan. Takamatsu and his German-trained colleague Nakazawa Iwata set up a teaching program of applied chemistry for the Imperial University and technical colleges in the late 1880s and 1890s. They had to meet the special challenge of reaching out to the manufacturing sector that lay outside
the hierarchy of the national educational system. As a result, the Imperial University developed a pair of completely separate departments for pure and applied chemistry with different teaching philosophies and social networks.

The brief epilogue summarizes theoretical innovations in this book and draws conclusions from it. It also looks at Kuhara, Majima, and other Japanese chemists trained at Tokyo Imperial University who held positions at the next generation of imperial universities, such as Kyoto and Tōhoku (Sendai), at the turn of the century to show a wider nationwide effect of this story in the twentieth century. Focusing on the role of intergenerational and intragenerational conflicts, the epilogue traces how these chemists reused the legacy of their teachers and yet partly deviated from them in the construction of pedagogical spaces and other aspects of teaching, resulting in the “fiefdom” structure that was later misleadingly called the kōza (chair) system and in a blurred but still existent distinction between pure and applied chemistry.

One last word to clarify what I mean by “the highly localized and temporized nature of the science.” One example of such temporized and localized culture is the teaching chemical laboratory, which is so ubiquitous all over the world today. There was not even a beginning of it to be found in any part of Europe and America in the eighteenth century. In addition, it is misleading, if not completely wrong, to assert that this institution simply spread from Justus Liebig’s chemical laboratory in the Hessian town of Giessen to the whole of Europe and North America in the mid-nineteenth century.28 The cross-national “genealogy” of teaching chemical laboratories is much more complex. Like a common theme with variations, this development played out in a variety of local, national, and cross-national contexts.29 It is my hope that readers get a renewed sense of such complexities through the lense of Anglo-American Connections in Japanese Chemistry.
Chapter 1

Japanese Chemistry Students in Britain and the United States in the 1860s

Two pioneering groups of young Japanese studied chemistry and other scientific subjects at UCL in the 1860s. They came to London in 1863 and 1865 from the Chōshū and Satsuma domains (han) in Western and Southwestern Japan, respectively. Some of the Satsuma students went even further across the Atlantic and ended up studying at Rutgers College in New Brunswick, New Jersey. It was a treacherous business in many ways. In addition to being on the sea for such a long time, which was much more dangerous in the 1860s than it is today, it was illegal under the laws of the Tokugawa Shogunate (Bakufu). By sending retainers abroad, these two domains defied the long-standing ban of overseas travel imposed by the shogunate and eventually joined force with other anti-Tokugawa domains to overturn that shogunate’s regime and usher in the Meiji Restoration in 1868.1

At first glance, this event might seem to be a false start of our story about scientific pedagogy of chemistry in Meiji Japan. In fact, it is a perfect example of how nonexperts have a tremendous impact on scientific pedagogy as politicians and administrators. While former retainers of the Chōshū and Satsuma domains formed the core of the new Japanese government under Emperor Meiji (reigned 1867–1912), several members of these groups later held senior government and academic positions and were consequently involved in the employment of British and American chemists and the overseas study of Japanese chemists in Britain and the United States. Therefore, in addition to their central roles in Japanese history, their views on science, technology, and education are important for understanding how Anglo-Japanese and American-Japanese scholarly relations in chemistry developed, and for understanding the general process of institutionalization of scientific and technological education in Meiji Japan.2

Unlike later students in the Meiji period, the first students from the Chōshū and Satsuma domains had to make sense of what they were doing in Britain and the United States on their own without any previous experience...