

Between the Laboratory and the Policy Process: Research, Scientific Community, and Administration in Japan's Chemical Biology

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Received: 14 July 2011 / Accepted: 7 March 2012
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Abstract This article analyzes the emergent new discipline known as chemical biology as part of the rapidly developing postgenomic research agenda. Despite chemical biology's academic as well as political significance in terms of its expected contribution to drug discovery, the international STS community has failed to pay serious attention to its dynamism thus far. The objective of this paper is to fill this gap by conducting a case study on the rapid formation of the Japanese Association of Chemical Biology, which is a global pioneer, in 2006. By bridging different theoretical concerns, namely laboratory studies in STS and the study of policy process, particularly the theory of policy window by Kingdon, this paper analyzes how three different levels—laboratory practices, community of scientists, and policy process—are mutually constitutive, and why both Japanese scientists and policy makers believe that chemical biology is important both in science and policy. This paper will substantiate the all-encompassing notion of coproductionism given by Jasanoff, by emphasizing more specific instances such as the role of policy entrepreneurs, international competition, and sense of scientific tradition, which are crucial for enabling coproduction.

I thank Hiroyuki Osada and the members of his laboratory, Tetsuo Nagano, Masatoshi Hagiwara, Minoru Yoshida, Mikiko Sodeoka, and others for kindly answering our questions. I also thank Akira Ueno for his collaboration, Joan Fujimura for general comments, Yannick Barthe for the comment on policy process, the participants of the “Asian Biopoleis” workshop at the National University of Singapore for their lively participation and valuable comments, and two anonymous reviewers for their insightful suggestions on earlier drafts of this article. This research was conducted with the support of grants-in-aid for scientific research from the Japan Society for the Promotion of Science titled “Research-path analysis of scientific practice—qualitative study of its dynamism and innovation” (19300293 2007–9). I am also grateful to the Murata Science Foundation for its financial support of my follow-up research in 2010 and 2011. Publication was further supported by the “Asian Biopoleis: Biotechnology and Biomedicine as Emergent Forms of Life and Practice” Project, funded by the Ministry of Education, Singapore, and the Humanities and Social Sciences (HSS) Division of the Office of the Deputy President (Research and Technology) at the National University of Singapore (NUS), Grant Number MOE2009-T2-2-013.

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Keywords Laboratory studies · policy process · postgenomic research · drug discovery · coproduction

1 Introduction: The Predicament of Postgenomic Research

Raymond Stevens, a well-known professor of structural biology at Scripps Research Institute and discoverer of the lead compounds for Tamiflu, the most prescribed medicine for influenza treatment, described the current state of biology research thus: “We’re in a very target-rich but lead-poor post-genomics era for drug discovery” (Henry 2001: 1). This statement gets to the essence of the problem of so-called postgenomic research. The tentative completion of the Human Genome Project in 2000, followed by the proliferation of such new research agendas as structural biology, proteomics, and systems biology, has contributed substantially to the understanding of how genes and proteins function in the dynamic mechanism of intracellular activities (Atkinson, Glasner, and Lock 2009).

The rapid development of systematic research shown above fostered widespread optimism regarding its immediate industrial application in the production of various types of drugs, in response to a variety of “target” proteins that perform pivotal functions in cells (Gray 2006). However, just as the phrase “lead-poor” quoted above implies, lead chemical compounds that combine with target proteins to control their functions have not been fully explored despite the “target-rich” quality of the research on genes and proteins conducted thus far (FitzGerald 2008; Fujii, Ôtaka, and Tamamura 2005).

Gary Pisano’s (2006) devastating analysis of bioventures corroborates this lead-poor quality by indicating the general failure of bioventures to make a profit. He concluded that bioindustrialists wrongly believe that as long as the information technology is sound, the biological products will succeed; clearly, a new approach is needed to improve the current situation.

It is easily imaginable that policy makers have had sleepless nights under increasing pressure to produce visible outcomes in order to justify enormous investments into life sciences research. One possible response to this challenge is to ask for assistance from synthetic and other types of chemists whose research on small-molecule compounds may lead to the discovery of lead compounds for new drugs (Sehgal 2002; Salemme 2003). This leads to the main theme of this article: the rise of the new field of postgenomic research known as chemical biology.

1.1 What Is Chemical Biology?

Chemical biology is loosely defined as the study of biological systems using synthesized small-molecule compounds such as inhibitors or fluorescent bioprobes (Wikström 2007; Kugawa, Watanabe, and Tamanoi 2007). In contrast to traditional biochemistry, which studies the chemical aspects of cellular activity, chemical biology uses chemical compounds to study life phenomena.

The growing attention to chemical biology in international scientific circles is evident in the launches of such journals as *Chemistry and Biology* in 1994, *Nature*

Chemical Biology in 2005, and *ACS Chemical Biology* in 2006. There are a total of eight chemical biology journals at present. At some major American universities, including Harvard, the chemistry departments have been renamed departments “of chemistry and chemical biology” (Schreiber and Nicolaou 1997). Furthermore, the National Institutes of Health in the United States launched the so-called Roadmap Initiative for Medical Research (National Institutes for Health 2003) that called for development of chemical compound libraries and screening centers essential for chemical biology research throughout the United States, in parallel with a plan for advancing systems and structural biology, bioinformatics, and nanomedicine. Together, these form the five pillars of postgenomic biomedical research (Wikström 2007).

In contrast with the increasing interest in chemical biology by scientists, policy makers, and industry, the reaction from the international STS community has thus far been literally nonexistent. Even the authoritative handbook of STS research on genetics and society (Atkinson, Glasner, and Lock 2009) has no entry for this topic. Compared with the mushrooming of STS industries in other streams of postgenomic trends, this indifference is odd and represents a serious deficiency in understanding the massive ongoing realignment of scientific research and policy in the rising “biomedical platform” where bench and bedside are reformulated to create a systematic continuum (Keating and Cambrosio 2003). Chemical biology is one of the missing pieces in the complex jigsaw puzzle of emerging configurations of biomedicine, policy, and industry.

1.2 Purpose

This article intends to fill this research gap in existing research by presenting a case study of the development of chemical biology in Japan. There are two issues here. One is the rapid organization of a formal society for chemical biology in 2006, which was the global pioneer as a formal association (Nagano, Hagiwara, and Osada 2006). The other is that leading researchers in Japan have repeatedly emphasized that *chemical biology* is merely a new name for work that Japanese scientists were already doing and suggested that Japan is the real birthplace of chemical biology.

The former issue is deeply related to the parallel development of three levels of activity: everyday practices in laboratories, the community of scientists, and the policy-making process. The latter issue addresses the practitioners’ sense of local “tradition” in scientific research in Japan, which in this case implies the long history of the intermediate area of research between chemistry and biology in Japan. Although these are deeply intertwined, because of space limitations this article’s main focus is on the parallel development of the three levels.

I focus in particular on the practices and career of chemical biologist Hiroyuki Osada and his laboratory at RIKEN, the Institute of Physical and Chemical Research.¹ Osada’s laboratory has had a major influence on both the establishment of chemical biology as a discipline and its organization in Japan. I propose that the traditional

¹ RIKEN is an official acronym of *Rikagaku Kenkyūjo* (Physical and Chemical Research Institute), which was established in 1917, inspired by the Kaiser Wilhelm Institute in Germany. This acronym will be used in the following pages.

approach to laboratory studies should be complemented by analyzing the interface between micropractices in the laboratory and macrotrends in science and policy.

The fact that this laboratory is in a significant position in an influential national research institute in the context of science policy contributed to organizing scientists and influencing policy process. In order to analyze this complex process, this article is structured in the following manner. Section 2 presents the theoretical background for reviewing two different research traditions—laboratory studies in STS and the study of policy process in political science—and shows that the combination of the two can bridge the gap between these research domains and substantiate the meaning of “coproduction” of knowledge and society. Section 3 presents a case study of the development of chemical biology in Japan, which first describes scientific practices in Osada’s laboratory and then analyzes how Osada collaborated with scientists from different fields to the point where these activities became coupled with the policy process for the life sciences at the bureaucratic level. Section 4 reconsiders some theoretical concerns indispensable to the understanding of these parallel developments. To make it more concrete and critical, the meaning of coproduction is revisited.

2 Theoretical Concerns

Here I analyze how the everyday practices of a laboratory are intertwined with the policy-making process. First I give a brief overview of laboratory studies in the STS tradition and their relation to the study of policy process. I then move to theories of policy process in political science, with particular emphasis on the theory of policy windows. Finally, I show how this is related to the notion of coproduction of knowledge and society, now gaining currency in STS circles.

2.1 The Dynamics of Laboratories

Despite the rich inventory of descriptive analyses of laboratory activities (Latour and Woolgar 1979; Lynch 1985; Knorr-Cetina 1981, 1999; see also Fukushima 2009, 2010), these early works have been criticized for failing to address the relationship of those activities to the larger context of the policy-making process. For example, Bruce Bimber and David Guston (1995) insisted that Bruno Latour and Steve Woolgar’s (1979) approach failed to analyze the influence of science policy on Roger Guillemin’s laboratory that had a research fund of \$150 million (see also Kleinman 2003).

Later researchers sought to expand their scope by putting the work of individual laboratories in a broader context. Joan Fujimura (1996) analyzed genetic studies of cancer to describe what she calls the “bandwagon,” the formation of a large stream of research by sharing a “standardized package” of theory (the proto-oncogene theory) and method (recombinant DNA).

Alberto Cambrosio and Peter Keating further expanded the scope of their research by focusing on the network of laboratories working on monoclonal antibodies and immunophenotyping. In their analysis of the latter, they described a large number of laboratories that shared a single theory, analytical tools, standardized procedures, and

regulations that together constituted a wide collaborative infrastructure, which they called a “platform” (Cambrosio and Keating 1995; Keating and Cambrosio 2003).

Expanding the scope of research from intra- to interlaboratory processes brings the analysis closer to the level of policy process. These studies, however, still fall short of analyzing the interface between research and political machinery. An analytical focus on policy process is required to explore this topic.

2.2 Theorizing the Policy Process

2.2.1 *From setting the agenda to opening a window on policy*

I briefly summarize the tradition of theorization of policy process in political science. Among various approaches to this issue, the analysis of agenda setting must be mentioned first. Roger Cobb and Charles Elder (1972) provided a schematic map that formulated the process from issue creation, via initiators and triggering devices, to the setting of particular agendas at the policy level. Here the point is how to bridge the gap between various issue creators out of office and key decision makers in the government. Such bridging mechanisms are detailed below.

One influential theory is the “garbage can model” of organizational decision making. By observing the decision process within a university administration, Michael Cohen, James March, and Johan Olsen (1972; see also March and Olsen 1976) satirically liken the ambiguous process of decision making in an organization to throwing issues into an imagined garbage can, in which most issues are left untouched as if they had already been discussed. Occasionally, however, some are taken out and examined in a whimsical manner—the rare time in the decision-making process when the issues receive critical consideration.

John Kingdon (1984) applied this model to the policy-making process. He called the process of policy-related decision making a “stream.” He believes that three kinds of streams, problems, policies, and politics, are prerequisites to various issues becoming part of the policy agenda. The problem stream refers to the government’s perception of societal issues, the policy stream is the process of idea flow as it pertains to policy or the specialist community, and the politics stream is the process by which politicians assign priorities to political agendas.

These streams are thought to be independent. For a policy idea to become a policy agenda item, the streams need to flow together, or “couple,” opening what Kingdon (1984) calls a “policy window.” Kingdon emphasized the contingent and unpredictable character of these policy windows (see Zahariadis 1999; Kojima 2003). The advantage of this formulation is that it theorizes both the contingent character of agenda setting—by modeling the ever-changing flow of the policy process—and the institutional constraints on the process. The theory alleviates the conflict between the theory of network (Marsh and Rhodes 1992; Marsh 1998; Latour 1987; Callon, Law, and Rip 1986) and that of institutionalism (Meyer and Scott 1992; Steinmo, Thelen, and Longstreth 1992). In addition, the notion of a stream can describe the momentum with which an issue attracts attention by emphasizing the bandwagon effect of policy ideas (Kingdon 1984: 139–41, 161–62), reminiscent of Fujimura’s (1996) notion of a scientific bandwagon mentioned above.

The case presented in this article largely concerns the problem stream (from government officials) and the policy stream (from scientists). The relative insignificance of the politics stream in Japan can be explained by the domination of the Liberal Democratic Party in the postwar period, although the success of the Democratic Party in 2009 has changed this.

2.2.2 Policy community and policy entrepreneurs

In addition to the notion of streams and policy windows, two other theoretical concepts must be mentioned. One is the “policy community,” which is closely linked to the policy stream (Kingdon 1984; Walker 1974). A policy community is a group of specialists connected by involvement in a particular policy area, such as public officials, academics, and researchers.

Some researchers have emphasized the historical transformation of such policy communities in the United States.² But as Kingdon (1984) notes, the degree of openness of a policy community depends on the specific issue. For certain issues, a limited group of community members have still greater authority in determining the agenda-setting course, such as the case study presented in this article.

The other concept is that of “policy entrepreneurs,” which invest their resources in the promotion of particular policy ideas in order to realize these ideas (Kingdon 1984). Akin to analogous concepts, such as “cultural broker” (Geertz 1960) or even mischievous Hermes (Serres 1969), policy entrepreneurs take every necessary step to ensure fruition of their ideas (Hecló 1978; Kojima 2003). In the following case study, these concepts are crucial for analyzing the complex interface of the three levels presented above.

2.2.3 The STS tradition on science and policy

STS researchers have addressed the interaction between scientific community and political machinery, such as Sheila Jasanoff’s (1990) research on the role of the scientific advisory board in regulating science. In a similar vein, David Guston (2000) emphasized the role played by intermediary institutions such as the Office of the Research Integrity and Office of the Technology Transfer at the US National Institutes of Health, which he calls the “boundary organization” coordinating the complex interaction of science and politics.

These researchers have focused on the bridge between science and politics rather than the microscopic process of the formation of the policy community. As a result, these communities have been described as relatively monolithic for the purpose of focusing on the boundary work between science and politics (Gieryn 1999), at the expense of describing the internal complexity and contingent character of their development. The emphasis on the regulatory aspects of such committees or organizations

² Frank Baumgartner and Bryan Jones (2009: 181) insist that the nature of such policy communities in the United States has undergone a historical transformation from a relatively closed system, described as subgovernment or the iron triangle of the Congress, bureaucrats, and interest groups (Theodoulou 1995: 6), to more loosely structured issue networks (Hecló 1978) or advocacy coalitions (Sabatier 1988). They believe that the “traditional policy monopoly” has been challenged by the exponential growth in the number of interest groups represented by those related to the environment (Baumgartner and Jones 2009: chap. 9).

has left a gap for further analysis of the formation of “research strategies” (Jasanoff 1990) or the “redistributive side” (Lowi 1964) of science policy, which is of central importance in the following case.

2.3 The Notion of Coproduction

At this point, a brief discussion of the notion of “the coproduction of knowledge and society” is essential. Jasanoff summarized the coproductionist approach as follows: “The proposition that the ways in which we know and we represent the world (both nature and society) are inseparable from the ways in which we choose to live in it” (2004a: 2). Jasanoff’s theory of coproductionism is almost identical to a comprehensive epitome of the approach taken by mainstream STS research, which is heavily influenced by the actor-network theory, with emphasis on the symmetry of nature and society (Latour 1987).

Jasanoff also divides coproductionism into the constitutive approach, which focuses upon the aspects of scientific practice that produce both knowledge and specific social circumstances related to it, and the interactionist approach, which places greater emphasis upon the interface between technoscience and relatively established aspects of institutions, such as politics, state, and law. In addition, Jasanoff pinpoints four themes essential to this approach: identity, to analyze how emerging aspects of science can be both stable and unstable; institutions, to provide stability to the essentially transient flow of knowledge; discourses, to see how new knowledge appropriates the old; and representations, to understand the political usage of scientific representations (Jasanoff 2004b).

Despite the apparent kinship with the concern in this article, Jasanoff’s all-inclusive formulation of coproductionism fails to provide specific clues about how it is attained in a particular context. For example, the aforementioned themes are not concrete conceptual tools but merely areas for researchers to focus on. For my own analysis, I needed to use analytical concepts from both laboratory studies and policy process. At the end of this article, I touch upon the limits of this coproductionist approach and its emphasis on symmetry.

2.4 A Brief Note on Research Method

My research, initiated in 2007, was intended at first to analyze the relationship between laboratory practices and their organizational history. RIKEN was chosen for its importance in the history of Japanese science, and the antibiotics laboratory was chosen for its historical continuity. The main laboratory research lasted for two years.

The first half of the research mainly involved participatory observation of laboratory practices, from official weekly reports to actual experiments both in biology and in chemistry, for an average of two days a week. Formal interviews with twenty-two researchers were conducted in and out of the laboratory during this period. I also attended several seminars conducted by bioventures in order to understand how to use their products. The second half was spent doing research on the development of

chemical biology. Much of the data used were documents, journal articles, government reports, and in-depth interviews with various key figures, in parallel with my observations of the ongoing reorganization of the laboratory and RIKEN. Currently, my research continues with occasional observation of the laboratory.

3 Case Study

This case study first provides a detailed description of how chemical biology was adopted by the antibiotics laboratory in RIKEN. Then the formation of the Japanese Association of Chemical Biology in 2006 is examined, followed by a description of how chemical biology was officially adopted as part of the government's policy agenda.

3.1 The Laboratory and Its Environment

The main subject of the study is Osada's antibiotics laboratory at RIKEN, which prides itself on its history of studying antibiotics for four generations. Antibiotic research was initiated by the discovery of penicillin by Alexander Fleming in 1929, and mass production of antibiotics began in 1942. In Japan, the history of antibiotics began in 1944, when a group of scientists was commissioned by the government to study antibiotics (RIKEN 2005).

The classical method of studying antibiotics, as part of the chemistry of natural products, usually entails the following steps: (1) search for living sources, mainly microbes such as fungi or bacteria; (2) extract and isolate bioactive substances; (3) analyze the substances' bioactivity and chemical structure; and (4) synthesize promising substances, making them reproducible for more extended use in experiments (see Fig. 1). Following this process, the predecessors of Osada laboratory produced one success after another, including the discovery of the plant growth hormone gibberellin by Teijiro Yabuta and Yusuke Sumiki and the discovery of polyoxin, an antibiotic for treating rice plant disease, by Kiyoshi Isono (Ueno 2008).

Osada worked in the laboratory of Teruhiko Beppu, an influential applied microbiologist (see Beppu 1990). Upon launching his own laboratory at RIKEN in 1992, Osada discovered a growing crisis in the traditional approach to antibiotics research, symbolized by the global trend of removing the word from the title of laboratories.³ Although antibiotics research (and natural products chemistry in general) had a long, successful tradition in Japan, the rapid development of molecular biology and the advent of new analytical instruments such as ultraviolet-visible spectroscopy, nuclear magnetic resonance spectroscopy, and high-performance liquid chromatography in the postwar period facilitated natural products research to the point that the research itself came to be regarded as routine manual work rather than a creative process. On top of this came the grim prospect that the effectiveness of new bioactive substances could be exhausted (Suzuki 1987).

³ Nathan 2004; Hiroyuki Osada, interviews by the author, 8 August 2007 and 24 June 2008.



Fig. 1 Historical storage of *Streptomyces* in the laboratory

3.2 The Rise of Chemical Biology in the United States

Osada and his colleagues closely followed the rise of chemical biology in US labs. Stuart Schreiber, a synthetic chemist at Harvard University, was one of its most zealous proponents, although the term had already been in use at Harvard before Schreiber made it a buzzword (Schreiber and Nicolaou 1997). Even in Japan, as early as the 1960s, an agrochemist noted that agrotechnical chemistry should be a sort of “chemical biology” (Mizushima 1964).

Schreiber, who trained in the laboratory of Nobel laureate Robert Woodward, achieved prominence for his study of FK506, an immunosuppressant developed by Japan’s Fujisawa Company (Hashimoto 2001). With the help of cell biologist Gerald Crabtree, Schreiber identified the binding protein FKBP and then successfully characterized the complex cellular pathway in its entirety (Schreiber 1991; Liu et al. 1991; Schreiber and Crabtree 1992). The uniqueness of Schreiber’s approach was in proposing a new type of biological research—not through gene knockout, the conventional method used by molecular biologists, but by controlling and manipulating the function of proteins using small protein-binding molecules. Schreiber called his work *chemical genetics* or, more comprehensively, *chemical biology* (Wikström 2007).

To pursue their ambitious research, the chemical biologists had to produce and collect large amounts of these small molecules and develop a mass screening technology to analyze the interactions between the molecules and proteins. This led to the rapid development of so-called high-throughput screening technology and to the rise in the 1990s of combinatorial chemistry, which was expected to produce an infinite number of new chemical compounds by combinatorial synthesis with elementary structures of basic compounds (Takemoto 2005; Takaoka 2005).

3.3 Reaction to the Rise of Chemical Biology

Osada and his colleagues were aware of Schreiber’s work on FK506 and of the chemical biology trend, as evidenced by the creation of a new journal, *Chemistry and Biology*, edited by Schreiber and Kyriacos C. Nicolaou, a doyen of organic synthetic chemistry, in 1994. Schreiber actually tried to collaborate with Osada on synthesizing the chemical compound reveromycin, but Osada declined because he wanted to do it by himself.⁴ However, Osada and his colleagues then increasingly realized the coming trend of chemical biology, witnessing the launching of *Chemistry and Biology* (Osada, Imoto, and Yoshida 1998).

Osada and colleagues believed that chemical biology was simply a logical extension of their own work, going back as far as the 1920s. Osada’s background is in agrotechnical chemistry (*nôgei kagaku*), an umbrella discipline combining microbiology, natural products chemistry, biotechnology, and even synthetic chemistry, since the time of its establishment in 1911 by Umetaro Suzuki, who is well known for

⁴ Osada interview, 24 June 2008.

his discovery of Orizantin (vitamin B₁).⁵ Chemical biology felt like a similar hybrid field of research (Osada, Imoto, and Yoshida 1998).⁶

Osada and his colleagues aligned their research with Schreiber's work in the United States, reconstructing their laboratory to fit the new current of research. The traditional model of antibiotics and natural products research was modified to fit the new chemical biology regime, involving a balanced arrangement of chemists and biologists. Here, *balance* implies a more specified form of collaboration between trained molecular and cell biologists, on one hand, and synthetic chemists, on the other. This new balance was reflected even in the spatial arrangement of researchers in the laboratory: biologists and chemists shared the same space, similar to that analyzed by Peter Galison as the "trading zone" (1997). This was following what Schreiber called the "Kornberg experiment" after a well-known biochemist who reportedly experienced difficulty in making chemists and biologists get along with each other (Hopkin 2004).

Chemical biology permeated a circle of researchers around Osada's laboratory. But the traditional method of random screening of natural products was inadequate to meet the goals of chemical biology, which requires the whole set of bioactive compounds (Schreiber 2004). At a pan-Pacific chemical biology conference in Hawaii in 2000, Schreiber acknowledged to Osada that Japanese expertise in analyzing natural products surpassed that of American researchers, so his team had decided to focus on new technologies such as the use of chemical compound arrays.⁷

Schreiber also told Osada that academic institutions in the United States were building the infrastructure for screening chemical compounds. At the same time, internal reviewers at RIKEN were advising Osada to upgrade his laboratory's technology. Osada began to explore new technology such as high-throughput screening systems (see Fig. 2) and a library of chemical compounds for basic chemical biology research; he also hired more researchers.⁸

3.4 Spinning a Web of Allies within RIKEN

The process of establishing chemical biology involved other collaborators, including Minoru Yoshida's chemical genetics laboratory and Mikiko Sodeoka's synthetic organic chemistry laboratory. Both Osada and Yoshida had studied at Beppu's laboratory and shared an understanding of the importance of chemical biology from a biological point of view.⁹

Sodeoka came to believe that chemical biology would usher in a new era in synthetic chemistry by opening the gate to the expanding market of biological research.¹⁰

⁵ The analysis of the uniqueness of agrotechnical chemistry (*nôgei kagaku*) in Japan requires another full article. Here, it suffices to indicate that agricultural chemistry in the West is limited to the chemical study of the soil, while *nôgei kagaku* encompasses a wide range of issues related to agriculture and nutrition.

⁶ Minoru Yoshida indicated that Schreiber's new journal had the same name as the postwar review journal of the agrotechnical chemical society in Japan, *Kagaku To Seibutsu (Chemistry and Biology)* (Yoshida 1994).

⁷ In place of declining combinatorial chemistry, Schreiber developed the idea of diversity-oriented synthesis, which was expected to produce druglike chemical compounds (see Borman 2004).

⁸ Hiroyuki Osada, interviews by the author, 24 June 2008 and 26 February 2010.

⁹ Minoru Yoshida, interview by Akira Ueno, 27 November 2008.

¹⁰ Mikiko Sodeoka, interview by Akira Ueno, 17 December 2008. See also Uemura and Sodeoka (2006).



Fig. 2 High-throughput screener in the laboratory

For Osada and Yoshida, Sodeoka's laboratory has complemented the chemical side of chemical biology. The three scientists began to promote chemical biology within and outside RIKEN.

3.5 Toward the Japanese Association of Chemical Biology

Others, including the editors of various Japanese publications on chemical biology and those who wrote influential articles on the subject, also contributed to the establishment of the Japanese Association of Chemical Biology in 2006 (Osada 2006c). However, in view of the objective of this article, the key actors who substantially contributed to influencing the policy level by playing the role of policy entrepreneurs were limited in number. I believe mainly three actors were policy entrepreneurs: Osada, Masatoshi Hagiwara of the laboratory of biochemical pharmacology at Tokyo Medical and Dental University, and Tetsuo Nagano of the laboratory of chemistry and biology at the University of Tokyo.

Hagiwara contributed to the establishment of the first university course of chemical biology in the School of Biomedical Science in 2003 (Osada et al. 2006) and played a pivotal role in organizing the first meeting of the Japanese Association of Chemical Biology in 2006. Nagano, a specialist in bioimaging technology, not only was the first president of this association but also established the first public chemical library at his university, which is now developing as a hub for wider consortia for drug discovery in academia. Links between chemical biology laboratories and government were heavily promoted by the three men.

3.6 Hagiwara's and Nagano's Laboratories

In this section, I examine more closely the paths taken by Hagiwara and Nagano and how they differed from that of Osada. Biochemical pharmacology, which inherited the

tradition of research on phosphokinase inhibitors, developed the method of using small molecules as inhibitors of enzyme function in the 1980s, long before the work of Schreiber on FK506 received international attention. According to Hagiwara, Japanese research in this area was quite advanced, and academic sessions on inhibitors at international conferences in the 1980s were often monopolized by the Japanese.¹¹

Hagiwara believes that the most significant event in the evolution of chemical biology has been the National Institutes of Health's 2003 Roadmap, which highlights chemical biology as part of the postgenomic policy for biomedicine and calls for extending chemical libraries. He supports carrying out comprehensive screening of drug candidates using chemical libraries after the completion of human genomic analysis to find all chemical compounds that are compatible with the full host of target proteins. He admires the capacity of American policy makers for organizing such a policy. Hagiwara's reaction to this new American policy was to establish Japan's first chemical biology course.

Nagano, the first president of the Japanese Association of Chemical Biology, is known for his research on bioimaging probe technology, with early attention to bioactive substances in the living body. Since he was registered in the Department of Pharmacology at the University of Tokyo, he suspected that his own department could not succeed in developing drugs, even though it partially supported drug discovery and the analysis of target proteins.

During his studies at the Duke University School of Medicine in his thirties, he became deeply impressed with the fact that the doctors there understood chemistry well and could discuss structural formulas of chemistry with fluency. He told me he has long believed in the importance of chemical libraries for drug discovery and was inspired by the Roadmap's call for expanding such libraries, without which he believed no serious infrastructure for drug discovery could be established.¹²

3.7 A Digression: Predecessors

The research backgrounds of the three men were distinct. The antibiotics laboratories at RIKEN were largely concerned with agrochemicals, not drugs for humans, which were Nagano's main concern. Hagiwara's research—using chemical inhibitors for the study of biological activity in medicinal settings—fell in an area between that of the others.

I must also mention a predecessor who played an important, if indirect, role in setting the stage for the eventual collaboration of the trio. This helps to show that their collaboration was rooted in Japan's own scientific history and was not merely a response to trends in the United States.

Hagiwara's mentor, Hiroyoshi Hidaka, a professor of pharmacology at Nagoya University, bridged the gaps between chemistry (inhibitors), biology (networks of kinases), and drug discovery by studying inhibitors of the network of protein kinases and by being a pioneer in the establishment of a bioventure. Before Schreiber made the term *chemical biology* an academic buzzword in the United States, Hidaka realized

¹¹ Nagano, Hagiwara and Osada 2006; Masatoshi Hagiwara, interview by the author, 19 March 2010.

¹² Tetsuo Nagano, interview by the author, 6 April 2010.

almost all the aspects of chemical biology by himself. His research program “Biological Functions and Designed Probe Compounds” (1997–99) was one of the midwives of Japanese chemical biology. Hagiwara worked closely with him, and Osada also participated in this research program, if indirectly.

This historical fact explains why people like Hagiwara felt a sort of *déjà vu* when they heard the concept of chemical biology from the United States and wanted to react to such a trend immediately.¹³

3.8 The Establishment of the Japanese Association of Chemical Biology in 2006

Osada, Nagano, and Hagiwara became acquainted with each other around 2005 but did not work together until Hagiwara and others applied for a grant and were then prompted by the Ministry of Education to join forces and apply together.¹⁴ This is a repeated theme—guidance from the government to scientists to form a group for a particular objective—that I expand upon in the following sections.

In 2006 Hagiwara and colleagues finally won a one-year grant to research chemical biology trends around the world. They launched a forum for discussing chemical biology and invited Osada, Nagano, and others to a symposium on the issue, at which they agreed to establish a study group. Hagiwara entrusted the pivotal role of negotiator to Nagano in order to collaborate with policy makers, and Hagiwara himself assumed the role of chief secretary of the new group.¹⁵

The first meeting of the Chemical Biology Research Group, later known as the Japanese Association of Chemical Biology, was held in 2006. Most of the participants were from pharmacology, chemistry, and the biomedical sciences. A limited number were from agrotechnical chemistry. There were twenty-nine oral presentations and sixty-eight poster presentations at the 2006 meeting. The presentations were largely divided into two categories of research: the chemists, represented by studies of chemical tools such as imaging and screening techniques and synthesis of inhibitors, and the biologists, represented by studies of various biological functions using these tools.

A number of key players from the international chemical biology community were invited: an editor from *ACS Chemical Biology*, another from *Nature Chemical*

¹³ Hagiwara interview, 19 March 2010; Osada interview, 26 February 2010; Hiroyuki Osada, personal communication, 19 December 2011; Nagano, Hagiwara, and Osada 2006. Hidaka’s name is rarely mentioned in the brief historical narratives of chemical biology in Japan (for an exception, see Nagano, Hagiwara, and Osada 2006); this is because he was involved in a legal issue in 1998 and had left the academic circle. Hidaka’s collaborator Masaaki Suzuki, a specialist in molecular imaging in chemistry from Nagoya University, succeeded Hidaka to supervise the program to its inconclusive end in 1999.

¹⁴ The earliest interaction between Osada and Nagano occurred around 2004 through the Japanese Society of Chemistry’s Division of Life Science, when Osada, representing agrotechnical chemistry, became acquainted with Nagano as a representative from pharmacology. However, their substantial collaboration developed through their shared goal of establishing a public chemical library around this period, which is discussed in the following sections (Hiroyuki Osada, interview by the author, 16 February 2010; Hiroyuki Osada, personal communication, 23 December 2011).

¹⁵ Hagiwara interview, 19 March 2010. Another significant occasion for the society was Nagano’s five-year grant for research on bioimage probing awarded in 2005 by Core Research of Evolutional Science and Technology (CREST) of the Japan Science and Technology Agency (JST). This grant facilitated the work of a substantial number of young researchers studying bioimaging and resulted in a large number of presentations on this theme in the upcoming Japanese Association of Chemical Biology (Osada interview, 16 February 2010).

Biology, and the head of Germany's Chemical Biology Core Facility. The largest number of presentations was on imaging techniques. Notably, Nagano's team provided seventeen out of sixty-eight poster presentations (Nihon kemikaru baiorjî kenkyûkai 2006), which demonstrated the influence of his style of research in Japanese chemical biology.

Osada's agrotechnical chemistry colleagues were less active at the meeting. Osada told me that researchers in microbiology and the chemistry of natural products found the meeting's focus too limited, and they may also have been alienated by Hagiwara and Nagano's undisguised orientation toward medicine.¹⁶ These differences later caused a serious schism.

3.9 Coupling with Policy: Chemical Library as Policy Agenda

So far, I have described the gradual confluence of different lines of research toward a common goal, the Japanese Association of Chemical Biology. However, the narrative above is insufficient to clarify the role of public institutions—both policy makers and public research institutions such as RIKEN—in legitimizing the role of chemical biology in public science policy. I discuss separately the key figures' efforts to establish public chemical libraries, which were essential for chemical biology to take root. This process, taking place in parallel with the activities described above, demonstrates the complex interplay between scientists and policy makers.

3.9.1 *Institutional politics of a chemical library in RIKEN*

To understand the intricate politics involved in establishing a public chemical library, it is necessary to expand upon the role played by RIKEN, as such a library depends upon the support of such an institution.

To understand RIKEN's role in the landscape of Japanese science, we must first look at the recurrent conflicts between Japan's Ministry of Education, which is in charge of universities, and the Science and Technology Agency, which used to deal with public research institutes such as RIKEN. Although the agency was integrated into the Ministry of Education in 2001, divisions have remained to date.¹⁷

The chief scientists at RIKEN's core facility, the Central Research Institute, until recently enjoyed relative autonomy despite pressure from the ministry (Miyata 1983). However, this autonomy was eroded by growing general pressure in the government to privatize Japan's national research institutes, which forced them to differentiate themselves more visibly from universities by becoming more project oriented. This trend is evidenced by the establishment of limited-time research centers, such as the Tsukuba Life Science Research Center in 1984, in line with the national policy of promoting molecular biology (RIKEN 2005).

¹⁶ Hiroyuki Osada, interview by the author, 15 February 2010.

¹⁷ Until integrated with the Ministry of Education in 2001, the Agency of Science and Technology in the Ministry of Internal Affairs took charge of large-scale scientific projects. After 2001, some divisions, such as the Life Science Division, as the descendant from the agency, still show their character as inclined toward big science projects, such as the Protein 3000 Program, described further below.

In 2003 RIKEN was made an independent administrative body. Its new director, Ryôji Noyori, a 2001 Nobel laureate for his work in synthetic chemistry, moved to make RIKEN's social contributions more conspicuous with such projects as integrating RIKEN's various centers throughout Japan to establish an infrastructure for more coordinated research as a whole. (Noyori 2003).

Noyori's statement, "Better a lead compound than an article in *Nature*," impressed Osada. Noyori, despite not having a background in life sciences, quickly realized the potential of chemical biology and became an important supporter of Osada's proposal for a public chemical library. A chemical biology research group was established at RIKEN in 2003, followed by a RIKEN Director Fund grant for a chemical library in 2004.¹⁸

3.9.2 *A chemical library in public: Intersections with political machinery*

For Osada and his allies, this was a step toward a larger plan for a library for an "all-Japan team" open for all the Japanese researchers. Osada's emphasis was also on a library of chemical compounds based on natural products. Such compounds were usually stored in laboratories and often discarded when the researchers retired. Osada's plan was to collect these compounds for use by a wide range of researchers (Kakeya, Saito, and Osada 2007).

But various ministries "turned him away at the door, saying that it's simply impossible, unjustifiable, or even it is hard to understand its necessity," as Osada recalls.¹⁹ Only the Life Sciences Division in the Ministry of Education showed some interest in his proposal. However, the division informed him of two things: that he should collaborate with other petitioners and that the proposed library should be part of the Protein 3000 Program.²⁰

3.10 The Protein 3000 Program and Chemical Biology

The Protein 3000 Program—probably the first "big science" program in Japanese life sciences—was an ambitious project for determining the basic structure of three thousand proteins. The Ministry of Education invested 53.5 billion yen (approximately US \$618 million) into the program for five years, beginning in 2002.

This program was intended to rally the limited contribution of Japanese scholars to the Human Genome Project, with only 6 percent completion, through an intensive investment in structural biology that deals with the structure of proteins. However, from the beginning, this project stirred heated controversies regarding its huge budget, as well as the feasibility of determining structures of such a large number of proteins in a period of only five years (Ôshima 2007; Tsukihara and Nakamura 2008; Cyranoski 2006; Yokoyama et al. 2007; Isaji 2009).

One of the most acute problems for policy makers was that the program made no visible contribution to medicine because of its focus on basic proteins of a smaller size—

¹⁸ Osada interviews, 8 August 2007 and 26 February 2010; Hiroyuki Osada, personal communication, 29 December 2011.

¹⁹ Osada interview, 8 August 2007.

²⁰ Osada interviews, 24 June 2008 and 26 February 2010.

not the proteins that are crucial for medical purposes, such as membrane proteins. In the face of mounting criticism, policy makers were forced to change direction and move toward a more concentrated focus on drug discovery (Ministry of Education 2006).

Shigenori Yokoyama, an internationally known structural biologist at RIKEN and the chief scientist of this program, began to focus on chemical proteomics as a sort of new combination of structural biology and chemistry. He also began to actively communicate with key chemical biology figures such as Osada and Nagano.

At this point, the concept of drug discovery entered the stage of policy for life sciences, and the purposed proper method for this was roughly identified with the idea of establishing a chemical library, to form a new stream of concrete policy. The Division of Life Sciences' suggestion to Osada that he link the chemical library with the Protein 3000 Program is what Kingdon (1984) calls the coupling of the problem stream (how to end the Protein 3000 Program for policy makers) and the policy stream (the creation of a chemical library for scientists), leading to the opening of the policy window, which resulted in the Targeted Proteins Research Program.²¹

3.11 The Targeted Proteins Research Program and Chemical Biology

The Protein 3000 Program was succeeded by the Targeted Proteins Research Program, which began in 2007 and represented a drastic change in objectives. The new program focused on proteins important for medical research but difficult to analyze, such as membrane proteins and those of large molecular size. Another change was the conspicuous inclusion of a chemical library as a pillar of the research plan (see Fig. 3). Thus, the chemical library acquired a legitimate position in national policy (Ministry of Education 2007; 2011).

In the process of transitioning from one program to the next, however, the symbolic meaning of the chemical library also changed. Osada, with the help of RIKEN and various scholars, was involved in preparations for the new program. He created a preparatory committee for the establishment of the library with the emphasis on natural products.²²

However, in this process, conflicting anticipations for the library came to the surface. Osada wanted the library to be for an "all-Japan team," namely, open to all the Japanese researchers, but the Ministry of Education disagreed because it went beyond the competence of the ministry. A new preparatory committee was formed, and Osada was replaced with Nagano.²³

This replacement had an important political implication because of the authority of the new steering committee to decide who would be in charge of the new library. After much deliberation, it was decided that the library would be located at the University

²¹ Osada interview, 24 June 2008.

²² Osada interview, 24 June 2008; Osada, personal communication, 29 December 2011. Nagano, for his part, became acquainted with Yokoyama about two years before the end of the Protein 3000 Program. It was mainly on Yokoyama's initiative, when he and his collaborator, a pharmacologist from the University of Tokyo, came to see Nagano to explain the rough plan for drug discovery in the future. This developed into a more concrete collaboration when Nagano was invited to give a lecture on chemical biology at the public forum on the upcoming project (Nagano interview, 6 April 2010; Tetsuo Nagano, personal communication, 17 December 2011).

²³ Osada interview, 24 June 2008; Osada, personal communication, 29 December 2011.

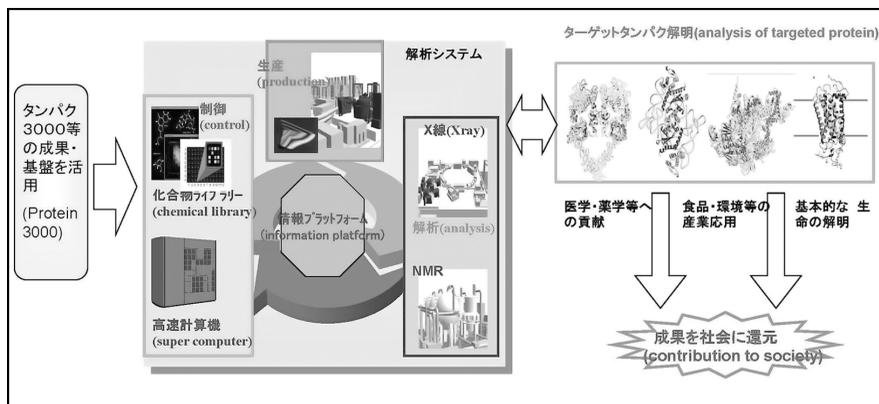


Fig. 3 A schematic illustration of the Targeted Proteins Research Program (English added by the author), courtesy of the Targeted Proteins Research Program at the Ministry of Education, Culture, Sports, Science and Technology, Japan

of Tokyo. As a result, Nagano's laboratory became the hub of the network of screening centers in Japan, while Osada's library—the RIKEN Natural Products Depository—pursued a separate path, collaborating with the Max Planck Institute in Germany and the Korea Research Institute of Bioscience and Biotechnology (Osada 2006a, 2006b, 2007).

The largest difference of interpretation between Osada and Nagano with regard to the role of the library is that while Osada adhered to the importance of natural products as the weapon to compete with the American style of chemical libraries based on synthesized compounds, Nagano was not concerned with its contents as long as it helped accelerate the process of effective drug discovery.

The schism between Nagano and Osada was broadened by the government's budget allocations by public hearing (*jigyô-shiwake*) in 2009, when there was a large cut to the national science budget (Cyranoski 2009). Nagano, responsible for the budget of the library section of Targeted Proteins Research Program, concentrated the budget to his own library at the University of Tokyo, indirectly distancing himself from the idea of the library based on natural products.²⁴ As a result, the temporary confluence of scientists and policy makers began to show clear and ominous signs of falling apart, as if reaffirming the well-known Buddhist tenet that “all things must pass.”

4 Theoretical Considerations

4.1 The Parallel Development of Laboratory Practices, Scientific Community, and Policy

Thus far, I have attempted to describe the relationship between collective decisions by a few laboratories and the administrative policy process. I have shown that behind the

²⁴ Osada interview, 26 February 2010; Nagano interview, 6 April 2010.

rapid establishment of the Japanese Society for Chemical Biology, scientists from different research traditions found a loosely defined common ground. I have also shown that this process progressed in parallel with the establishment of the public chemical library.

In both processes, the role of the national administration was of substantial importance. Even the formation of the community of chemical biology researchers cannot be described simply as a bottom-up process like “spontaneous order” (Polanyi 1951; Von Hayek 1979), because the administration played an indirect role as a catalyst for bringing together scientists of different orientations.

The administration’s role was more evident in the establishment of public chemical libraries. I have employed both the perspective of laboratory studies and Kingdon’s theory of policy windows to show the process of the gradual formation of a policy community with the help of policy entrepreneurs, such as the trio mentioned above, and the opening of the policy window by the coupling of the problem stream (post-Protein 3000 Program) and policy stream (the idea of the chemical library).

The strength of the policy window theory is its capacity to theorize both the contingent character of agenda setting and the institutional constraints in which the process is embedded. The adoption of a public chemical library as part of the national science policy agenda was contingent upon the timing of the proposal by scientists to policy makers who desperately needed an acceptable exit strategy. The appropriateness of Kingdon’s framework is corroborated by the fact that if the idea had been proposed any later than 2007, this coupling might not have been realized, because the explosive new scientific discovery involving induced pluripotent stem cells that began in 2006 would have drastically changed policy priorities among the core policy makers.

Notwithstanding the temporal success of coupling these streams, the narrative above ended by hinting at the probable schism among the main characters with regard to both the nature of the chemical library and chemical biology itself. The disagreement over the meaning of chemical biology, seen in the different approaches described above, is not confined to Japan.

In the United States, Schreiber was oriented toward basic research in the early days, while the National Institutes of Health emphasized the use of chemical biology for drug discovery. This resulted in Schreiber’s establishment of the Broad Institute of MIT and Harvard in order to pursue his ideas without the help of the National Institutes of Health (Schreiber 2004; Kotz 2007).

Despite these differences, however, both approaches to chemical biology require a chemical library to attain their goals. In this sense, the chemical library is an example of a “boundary object” (Star and Griesemer 1989) that connects heterogeneous groups—in this case, scientists—and mobilizes them in the direction of a shared public policy. Yet this can work only as long as the actors believe that they are working toward a shared goal. The schism described above suggests that a boundary object has its own “life,” and we are witnessing its possible death, and even its afterlife, which can also be theoretically predicted by the idea of policy windows, because the window may close when the proper timing for the coupling of streams is past.

4.2 Elements beyond the Laboratory and Policy Processes

So far, I have analyzed how three levels—the laboratory, the community of scientists, and the policy process—have developed in parallel by joining different theoretical traditions. I have also made reference to a number of elements beyond the laboratory and policy process that I believe have facilitated, or even accelerated, these developments: the peculiar character of policy entrepreneurs, the international environment, and the cultural mood, which together promote such parallel developments.

4.2.1 *The role of policy entrepreneurs in promoting parallel development*

I have focused on how policy entrepreneurs created bridges between domains, such as the traditional sciences and chemical biology, and between scientists and policy makers. Science and institutions or, more generally, new knowledge and society are not simply coproduced in the manner of *autogenesis* but are consciously managed by the efforts of these concerned policy entrepreneurs to attain their goals.

Policy entrepreneurs are political animals who do not hesitate to spend their time and energy extravagantly to achieve their goals, which not every scientist is suited for. Even among the actors discussed in this article, the degree of political entrepreneurship varied, and the one who seemed to have the strongest “animal spirits” (Keynes 1936) appears to have won the game to make his ambition materialize in the form of both the Japanese Association of Chemical Biology and the public chemical library. I believe this aspect of policy entrepreneurship deserves further research.

4.2.2 *International environments*

Still other factors have influenced the developments I have discussed. Most notable is the role of international competition and perceived scientific trends in the United States.

Both scientists and policy makers in Japan are keenly attentive to trends in scientific research and policy in the United States. The term *chemical biology* was coined there, and the three Japanese researchers highlighted in this article initiated their activities in response to American trends. Naturally, the Japanese government also paid attention to what was happening in American science policy. The coupling of these different streams apparently was facilitated and promoted by similar perceptions of the international environment.

4.2.3 *A particular “mood” (kūki) for drug discovery*

The third factor that facilitates the parallel development can be dubbed as symbolic or cultural: a vague theme of drug discovery (*sōyaku*). If we take this concept as a rhetorical device, its importance is revealed by its appearance in various contexts with a different emphasis on what it actually means.

My detailed analysis elsewhere of its use at the laboratory level has revealed that its definition varies among different types of researchers (Fukushima 2011). Those who are engaged in basic research tend to regard *drug discovery* at a very rudimentary level and feel they could contribute to the process even by establishing a new assay system.

In contrast, for those who have closely experienced its actual process, the term signifies more concrete elements, such as clinical testing and marketability, so their assessments of the laboratory situation could be critically negative (Fukushima 2011). In fact, Nagano agrees that the notion of *drug discovery* is used in a very vague manner in Japan, and he is not sure what is signified by the concept—whether it is about basic research, lead compounds, clinical trials, or about releasing the drug in the market.²⁵

Despite such ambiguity, the term shares an undeniable aura of legitimacy similar to other political buzzwords like *eko* (“eco-”) or *kyōsei* (“symbiosis”) in Japanese politics. As an administrative catchphrase, the concept of drug discovery is most palatable in the context of the political trend toward *shakai-kangen* (to plow back profits into society) of scientific results, which both bureaucrats and even STS researchers have promoted. In fact, the superficial—and very problematic—kinship of chemical biology with the concept of drug discovery attracts both researchers and administrators in their own context. This tendency can be regarded as a vague atmosphere, a sort of zeitgeist, or in a more specific cultural term, *kūki* (mood, literally “air”) that was once analyzed by Japanese social critic Yamamoto Shichihei (1983) as a societal and emotional mood that binds and leads people to specific directions.²⁶

4.3 Revisiting Coproductionism

Having expanded upon the process of parallel development by specifying the factors that facilitated it, I must return to Jasanoff’s coproductionism (2004a, 2004b). I believe there are several aspects of her approach that should be revised.

First, her general distinction between constitutive and interactive coproduction does not work well in the case presented here. Although chemical biology is an emerging field that demands both new knowledge and new institutional settings (hence constitutive), this newness should be formulated in the context of scientific traditions of various scientists, as well as institutional backgrounds such as RIKEN and the bureaucracy (hence interactive). This also suggests the general importance of institutional settings—or what I call the “network of constraints”—that largely restrict any efforts directed toward so-called constitutive network building, which followers of the actor-network theorists are now being criticized for underestimating (Kleinman 2003).

Second, while acknowledging that Jasanoff’s four themes of coproductionist research—identity, institutions, discourses, and representations—partially fit the topic of this article, the three factors that enable the parallel development I discussed do not fit neatly into her categories. For example, behind the repeated themes of competition and contrast between American and Japanese science lies what I call

²⁵ Nagano interview, 6 April 2010.

²⁶ To perceive the *kūki* of the situation correctly is an important cultural guideline in Japan. A recent topic in the mass media, the slang of KY (pronounced *kei-wai*) that is in fashion among young people as an adjective for denouncing those who are insensitive to *kūki* (e.g., *kūki yomenai*: “cannot read *kūki*”) is believed by some academics to show the increasing public pressure for conformity among Japanese youth. Yamamoto’s (1983) criticism of this phenomenon in the 1980s also pointed to the tendency toward mass hysteria at that time and he further contended that an act of war had been attributed to *kūki*.

the “global geopolitics of science,” which I believe does not represent the coproductionist approach, which, with its emphasis on symmetry, cannot deal with it appropriately. In this geopolitical context, the rivalry between the two countries is but a small part of the international politicoscience order in which the US hegemonic status in science is still felt as both the point of reference and a constant challenge among the researchers I have observed thus far.

This means that the parallel development of the three levels in this study was within the constant influence of a type of “electromagnetic field” of a hegemon or hegemony that could not easily be avoided. However, this does not mean that this electromagnetic field, so to speak, is unilaterally deterministic, as neo-Marxist theorists may assume. Rather, on each occasion of this recurrent theme of international competition, with the United States as the powerful center of science, both policy makers and policy-conscious scientists have sought the appropriate way to play the game, which is exemplified in cases like the Human Genome Project, the Protein 3000 Program, and even the stem cell research competition.

Chemical biology has been interpreted by various researchers, including the trio I have focused on in this article, as “old wine in a new bottle.” In a published dialogue commemorating the establishment of the Japanese Association of Chemical Biology in 2006, the trio emphasized that chemical biology was a name given to the area of research that had been the forte of Japanese researchers (Nagano, Hagiwara, and Osada 2006). This powerful sense of scientific tradition legitimized the establishment of chemical biology in Japan not as a copy of American trends but as a counteroffensive in the international competitive arena in postgenomic research.

By highlighting the overwhelming influence of the hegemon(s) in the international politicoscience order, I have already departed from the coproductionist assumption of symmetric anthropology. This departure is amplified by another recurrent theme: the cultural meaning of advanced science or, in this case, chemical biology.

This topic is too large for me to develop here. Suffice it to say that the theme of this article is deeply related to another theme: scientific researchers’ sense of local “tradition.” There is a need for research on the relationship between cultural tradition within and beyond scientific research in such global geopolitics of science. To be fair, Jasanoff also refers to the importance of this line of research, asking “how culture may condition the process of scientific inquiry, producing a different style of research on the ‘same’ problem of knowledge” (Jasanoff 2004b: 36). But so far, inclusion of cultural elements has been rather neglected in STS research.

5 Conclusion

Chemical biology is a neglected field of STS scholarship on the rapidly expanding realm of postgenomic research. I have attempted to show that the development of chemical biology in Japan resulted from an intricate interplay among laboratory practices, the community of scientists, and policy processes. To understand this development, I exploited the rich tradition of laboratory studies in science and technology studies and the study of policy process in political science, looking also at policy entrepreneurs, the influence of global science, and even the cultural meaning of *drug discovery*, while trying to overcome the limitations of symmetric coproductionism.

I conclude this article by briefly commenting on the significance of studying science and politics in countries like Japan. Since the early introduction of Western science more than one hundred years ago—or as early as the late eighteenth century, since the publication of the translation of a Dutch anatomical textbook—Japanese science has occupied a unique position in the global context of science: it is advanced yet also entangled with a complex web of institutions, and its distinctive cultural practices are different from major Western traditions. In view of this unique historical experience, I hope that this case study, if at all possible, will stimulate further research rather than simply blur the boundary between nature and society (Latour 1993) and will help to overcome other obsolete conceptual dichotomies, such as those involving West/East (or the obscure notion of “Asia”), advanced/developing, high science/local culture, and so forth, which still seem to (if implicitly) haunt STS scholars’ minds and are in need of unrelenting academic re-examination. In this sense, this study, together with the other articles in this special issue, is expected to introduce a series of new queries, which have been neglected by scholars from both sides of the Atlantic Ocean, in order to prove that the Pacific Rim, which all of these articles are concerned with, is not a vast empty backyard of the West but is, in fact, a cornucopian *terra nova scientiae*, impatiently awaiting further exploration.

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