Axel Jansen, Andreas Franzmann, Peter Münte (eds.)

Legitimizing Science

National and Global Publics (1800–2010)

campus

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Acknowledgments

This collection of essays emerged from a workshop organized by the editors at Eberhard-Karls-Universität Tübingen (Germany) in September 2013, except for Fabian Link's contribution on the Frankfurt School of Sociology, which we subsequently asked him for. The arrangement of papers on the nineteenth and twentieth centuries and their focus on the natural sciences as well as the social sciences reflect our overall approach, first, to retain an investigation of science within general sociology and history, and second, to retain a comprehensive view of curious investigation that is represented by the natural sciences, the social sciences, and the humanities together.

The workshop at Universität Tübingen on "Science and the Public in the Nation-State: Historic and Current Configurations in Global Perspective, 1800–2010" took place in the context of a research project by Andreas Franzmann and Axel Jansen on "Professionalization and Deprofessionalization in the Public Context of Science since 1970." The project is co-hosted by the Department of History at the University of California, Los Angeles (UCLA), and we would like to thank our colleagues in both institutions for their kind support. We thank the Volkswagen Foundation for sponsoring the research project that provides the intellectual backdrop for this book, and we also thank the sponsor of our conference and of the publication of this book, the Vereinigung der Freunde der Universität Tübingen (Universitätsbund) e.V., and our second sponsor for this publication, the Dr. Bodo Sponholz Stiftung für Wissen, Kunst und Wohlfahrt. Lars Weitbrecht provided organizational support at the conference and Ian Copestake of slovos.com helped proofread manuscripts. We thank both of them, and also Jürgen Hotz at the Campus Verlag for facilitating this book.

Section I:
Approaches

Legitimizing Science: Introductory Essay

Andreas Franzmann, Axel Jansen and Peter Münte

1. The Continuing Dependence of Science on a Plurality of Political Communities

The pursuit of science requires legitimacy that science itself cannot provide. The most obvious reason why such legitimacy is required today is that science costs a lot of money. At an accelerating pace during the nineteenth and twentieth centuries, scientists have had to raise funds to cover salaries and apparatus at institutions such as academies, universities or research institutes. But science has needed legitimacy, even at times when science was run by experimental scientists not employed to do research but pursue such interests on the side. Then as now, investigating nature by asking unfamiliar questions requires resources but also protection, freedom from political or religious constraints, the leisure to tackle fundamental problems without obvious practical value, and authorization through cultural and political affirmation. All of these matters point to the issue of legitimacy, and in the context of the modern nation-state such legitimacy relates to a political public and its endorsement.[1] At a time of increased

1 The relationship between science and public has caused a great amount of interest in the last two or three decades. See, for example, Steven Shapin, "Science and the Public," in *Companion to the History of Modern Science*, edited by Robert C. Olby et al. (London: Routledge, 1990) 990–1007. For the debate in Germany, see Peter Weingart, *Die Wissenschaft der Öffentlichkeit: Essays zum Verhältnis von Wissenschaft, Medien und Öffentlichkeit* (Weilerswist: Velbrück, 2005). This interest seems to arise from debates on the role of science in society. Concerning this connection, see Peter Münte's essay in this volume. In the fields of history, the relationship between science and the public has become an important topic in the context of attempts to reintegrate the history of science with general history. See, for example, Rüdiger vom Bruch, *Wissenschaft, Politik und öffentliche Meinung: Gelehrtenpolitik im Wilhelminischen Deutschland 1890–1914* (Husum: Matthiesen, 1980); Rüdiger vom Bruch, "Wissenschaft im Gehäuse: Vom Nutzen und Nachteil institutionengeschichtlicher Perspektive," *Berichte zur Wissenschaftsgeschichte* 23 (2000), 37–49.

global interdependencies, furthermore, this raises the issue of whether the legitimacy of science is shifting to a transnational and global plane.

The need for a legitimacy of science has been particularly evident in times of conflict. In the past, opponents of an experimental approach to testing truth claims have represented the church, cultural *Weltanschauungen*, or political ideologies. Conflicts have tended to unfold when the results of research questioned conventional explanations. Galileo, Kepler, Darwin, and Freud are prominent examples in the history of science.[2] At the beginning of the twenty-first century, debates on cloning and on stem cells are a reminder that science continues to be associated with provocations to world views and ethical convictions.[3] Such debates challenge politics to balance the demands arising from such beliefs with competing demands for scientific freedom and economic opportunities. While we have come to accept and demand from science technological innovation relevant for the economy and for society's other needs, science has remained a potential source of cultural, political, and economic instability. Hence this particular mode of truth-seeking continues to require the kind of protection, promotion, and authorization for which science has sought the political sovereign's patronage since early modern times. Science claims to work out a collectively binding understanding of the world. This presupposes a general acceptance of science as the source of such knowledge and the continuous integration of such knowledge in general education and political decision-making.[4]

From the Renaissance and into our own time, political, cultural, and economic elites have played a key role in shielding the experimental sciences from religious or cultural attack and in supporting and transferring authority to them. Such protection, promotion and authorization has been granted by elites in the emerging context of the modern state, but also through private philanthropy or foundations that have provided essential support. Their decision to support research often reflected a broader na-

2 Joseph Ben-David, "The Ethos of Science in the Context of Different Political Ideologies and Changing Perceptions of Science," in *Scientific Growth* (Berkeley: University of California Press, 1991), 533–59.

3 See Axel Jansen, "Stem Cell Debates in an Age of Fracture," in this volume.

4 As in most debates in the sociology and history of science, the focus here is on the kind of science that evolved into the empirical or natural sciences that were institutionalized in Europe from the seventeenth century. Fabian Link's contribution to this volume demonstrates, however, that similar questions may well be asked with respect to the social sciences, in general, and with respect to a critical theory of society, in particular.

tional commitment to the role of science in society.[5] By supporting research financially or by endorsing such work symbolically, they bestowed public affirmation and significance on the larger scientific enterprise. Today, the principles of this approach have become relevant in all areas of political leadership and administration that touch on scientific knowledge. The relationship between the state and science has not merely served to protect science but also to endorse its particular commitment to establishing truth-claims on behalf of a wider community. Such an endorsement of science has become an important element in national cultures and their self-perception. For scientists, public affirmation of their work has translated into cultural prestige and leverage.

The emerging legitimacy of science may be studied with particular effectiveness by focusing on a period when its social and political position remained unsettled. The founding of the Royal Society in seventeenth-century England provides a well-known case in point.[6] After the Puritan interregnum, a small group of natural philosophers including Robert Boyle was able to commit the returning king to provide patronage and his seal for the founding of a scientific organization. The king's protection and endorsement of the Royal Society implied that after its founding period in the 1660s, no one else could lay claim to discovering the laws of nature in the name of the king and of the nation he represented. But Charles II had to leave it to the Royal Society's active nucleus to define experimental philosophy because the king himself could not provide that definition. The Royal Society used this privilege to establish principles of scientific activity, among them the rule that claims to findings had to be established through experiments among witnesses, that experiments had to be recorded, and that results were to be transferred to the Society's records. While a general endorsement of such principles would not take place for decades or even centuries, important norms of modern science had been recognized by an official institution representing the king, norms that otherwise would not have had the standing that they came to have. Without official endorsement such principles would have remained subject to fundamental ques-

5 Joseph Ben-David, *The Scientist's Role in Society; a Comparative Study* (Englewood Cliffs, NJ: Prentice-Hall, 1971).

6 Michael Hunter, *Establishing the New Science: The Experience of the Early Royal Society* (Woodbridge: Boydell & Brewer, 1995); Peter Münte, *Die Autonomisierung der Erfahrungswissenschaften im Kontext frühneuzeitlicher Herrschaft: Fallrekonstruktive Analysen zur Gründung der Royal Society*, 2 vols. (Frankfurt: Humanities Online, 2004).

tions concerning their relevance, validity, and authorship. Science would not have been protected against philosophical and theological attacks on experimental methods, and demands that they be replaced by other methods such as philosophical introspection or revelation. Charles II had delegated the power to define science as a mode of truth-seeking through experiment-based philosophy, and the Royal Society assumed responsibility for this particular set of universalistic principles shared by those committing themselves to the scientific project.

While the Royal Society's founding context was distinctly British, it remains of significance well beyond this particular state. The Royal Society raised a standard of aspiration for experimental philosophers in other countries and they soon sought to emulate that model. The *Académie royale des sciences* established similar principles for France, effectively adopting the aspirations for scientific achievement and the responsibility for protecting and enhancing this particular mode of investigating nature. The Paris academy served this role even though the state kept it on a much shorter leash, paying researchers a salary and charging them with official state business.[7] The British and the French institutions have provided a template for other countries and their histories suggest that the institutionalization of experiment-based science took place by association with a political sovereign.[8]

For science to unfold, it had to be embedded in a particular community through political representatives who bestowed legitimacy on this particular mode of testing ideas. Such a community, of course, is always particular and not universal, because it is bound to a concrete country with its own territory and history. An essential tension exists, therefore, between the universalistic endeavor of science (a generalized methodology aiming at a universal validity of research results), on the one hand, and political communities, on the other.[9]

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7 Roger Hahn, *The Anatomy of a Scientific Institution: The Paris Academy of Sciences, 1666–1803* (Berkeley: Univ. of California Press, 1971); Peter Münte, "Institutionalisierung der Erfahrungswissenschaften in unterschiedlichen Herrschaftskontexten. Zur Erschließung historischer Konstellationen anhand bildlicher Darstellungen," *Sozialer Sinn* 1 (2005): 3–44.

8 James E. McClellan, *Science Reorganized: Scientific Societies in the Eighteenth Century* (New York: Columbia Univ. Press, 1985).

9 Brigitte Schroeder-Gudehus, "Nationalism and Internationalism," *Companion to the History of Modern Science*, edited by Robert C. Olby et al. (London and New York: Routledge, 1990), 909–1007.

The rise of science in the wake of its empowerment by the political sovereign since the seventeenth century opens up two key questions. The first concerns the impact on science of significant changes in the legitimacy of political power. How has the role of science shifted during and after political revolutions? What has the role of science been as it carried over from a monarchic or aristocratic state into a democratic nation-state, and what has been the impact of such momentous transformations as the emergence of the public sphere and the rise of mass media in modern democracy? Different assumptions about the role of subjects or citizens within a state's political sphere, for example, surely must have had an effect on the role assumed by science. All of this, of course, points to the more general question of how the history of science relates to political history.

The other question concerns the national and global history of science as different states chose to empower it from the seventeenth century: How has science derived legitimacy from endorsement in some countries while being stifled in others, and how has the legitimacy of science evolved from an association with key supporters such as national political elites, intellectuals, occupations, and industries? Much like China, Brazil, and India in recent decades, France, Britain, Germany, and the United States in previous centuries have all created specific traditions of science funding, lobbying structures, and legitimizing discourses that have impacted public agendas, expectations, and controversies about science policy and the development of science disciplines. While each country's tradition is unique, global dynamics of science emerge on their basis. Among transnational effects of national patterns of science organization are shifts in centers of science, with researchers looking to particular countries or regions for the development and validation of important work.

The present volume provides an opportunity to explore the legitimacy of science historically by taking as a point of departure an assessment of present challenges and problems. Hence this collection of essays does not seek to identify and trace "origins" of modern experimental science—transformations that precede the nineteenth century. This book provides a platform for looking back from the early twenty-first century to identify, chart, and compare developments that have turned out to be important or representative in legitimizing science since 1800. If the authority of science has rested on its endorsement by the political sovereign, what has been the history of that relationship in the age of the modern nation-state?

In this introductory essay, we will proceed by first taking a step back to explain how we became interested in the science-politics nexus. We will then turn to a trend that has come to characterize the relationship between science and the public during the past two centuries: the growing emphasis on the utility of research. A presentation of select historical tokens to illustrate this point will then help prepare the ground for concluding questions on the role and integrity of science in a globalized world.

2. Legitimizing Science as a Profession

In recent years, the editors of this volume have been involved, with Ulrich Oevermann, in helping develop in the history and the sociology of science a revised concept of professionalization.[10] While sociologists of science have focused their investigation on institutions of knowledge production and the cultural formation of scientific knowledge, our interest in the vocation's political legitimacy relates to the pragmatic requirements, the prerequisites, and the specific demands arising from the essence of scientific activity: research.[11]

We begin by asking what goes on when empirical scientists try to make sense of uncharted realities. While this focus to us seems central in identifying the "unnatural nature of science," it has been absent from the recent

10 See Ulrich Oevermann, "Theoretische Skizze einer revidierten Theorie professionalisierten Handelns," in *Pädagogische Professionalität. Untersuchungen zum Typus pädagogischen Handelns*, edited by Arno Combe and Werner Helsper (Frankfurt: Suhrkamp, 1996), 70–182; Ulrich Oevermann, "Wissenschaft als Beruf: die Professionalisierung wissenschaftlichen Handelns und die gegenwärtige Universitätsentwicklung," in *Die Hochschule* 14, no. 1 (2005): 15–51; Peter Münte and Ulrich Oevermann, "Die Institutionalisierung der Erfahrungswissenschaften und die Professionalisierung der Forschungspraxis im 17. Jahrhundert: Eine Fallstudie zur Gründung der Royal Society," in *Wissen und soziale Konstruktion*, edited by Claus Zittel (Berlin: Akademie Verlag, 2002), 165–230; Münte, *Autonomisierung der Erfahrungswissenschaften*; Andreas Franzmann, *Die Disziplin der Neugierde: Zum Professionalisierten Habitus in den Erfahrungswissenschaften* (Bielefeld: Transcript, 2012); Axel Jansen, *Alexander Dallas Bache: Building the American Nation through Science and Education in the Nineteenth Century* (Frankfurt and New York: Campus, 2011).

11 For the main paradigms in the sociology of science, see Bettina Heintz, "Wissenschaft im Kontext: Neuere Entwicklungen in der Wissenschaftssoziologie," *Kölner Zeitschrift für Soziologie und Socialpsychologie* 45, no. 3 (1993): 528–52; Uwe Schimank, "Für eine Erneuerung der institutionalistischen Wissenschaftssoziologie," *Zeitschrift für Soziologie* 22, no. 1 (1995); Peter Weingart, *Wissenschaftssoziologie* (Bielefeld: Transcript, 2003).

"practical turn" towards the situational realities of science.[12] In our work, we have come to assume that scientists engaged in research are not involved in solving established puzzles with established tools but that they engage with their curiosity in trying to identify new questions so as to advance their field through resolving them. The demands of their work leads them to develop a particular habitus, a habitus that is shaped by and informs a self-sufficient investigative perspective on a reality that will never conform to evolving theories about it.[13]

This approach offers an alternative to the main paradigms in the sociology of science and an answer to a key question in the sociology of the professions. The classical sociology of the professions could not explain particularly well what distinguishes science and other professions from vocations that are not professionalized.[14] Any explanation that goes beyond an institutional description of vocations claiming professional status would need to show, after all, how such claims are justified (or unwarranted) by pragmatically serving specific needs and responsibilities.

Work on this question has come to conclude that professions are distinct from other vocations in that they engage, not in solving problems by

12 Wolpert's perspective is similar to ours. See Lewis Wolpert, *The Unnatural Nature of Science*, (Cambridge: Harvard Univ. Press, 1994). On the "practical turn" in the sociology of science, see Andrew Pickering. ed., *Science as Practice and Culture* (Chicago: Univ. of Chicago Press, 1992); Moritz Epple and Claus Zittel, eds., *Science as Cultural Practice*, vol. 1, *Cultures and Politics of Research from Early Modern Period to the Age of Extremes* (Berlin: Duncker & Humblot, 2010).

13 The term "habitus" is commonly associated with Pierre Bourdieu's work, but we use it to depict the specific attitudes and responses elicited by problem-solving in science. Compare, for example, Pierre Bourdieu and Loïc Wacquant, *An Invitation to Reflexive Sociology* (Chicago: Univ. of Chicago Press, 1992), to Andreas Franzmann, *Die Disziplin der Neugierde: Zum Professionalisierten Habitus in den Erfahrungswissenschaften* (Bielefeld: Transcript, 2012). In referring to a scientific mindset, Max Weber uses the concept of *Geistesaristokratie* ("intellectual aristocracy"). Max Weber, "Wissenschaft als Beruf," in Max Weber, *Gesammelte Aufsätze zur Wissenschaftslehre* (Tübingen: Mohr, 1988), 582–613, quotation on p. 587.

14 For the "classical" sociology of professions, see Alexander M. Carr-Saunders and Paul Alexander Wilson, *The Professions* (Oxford: Clarendon Press, 1933); Talcott Parsons, "The Professions and Social Structure," *Social Forces* 17 (1939), 457–67; Talcott Parsons, "Professions", in *International Encyclopedia of the Social Sciences*, 12 (1968), 536–47; Thomas Humphrey Marshall, "The Recent History of Professionalism in Relation to Social Structure and Social Policy," in *Canadian Journal of Economics and Political Science* 5 (1939): 325–40; Everett C. Hughes, "The Social Significance of Professionalization," in *Professionalization*, edited by Howard M. Vollmer and Donald L. Mills (Englewood Cliffs, NJ: Prentice-Hall, 1966), 62–70.

only using technical standards derived from the established knowledge in their field, but in coping with crises for which no solution is at hand. Professions deal with crises that cannot be reduced to well-defined problems, and they try to resolve them on behalf of others, such as a patient, a client, or (in the case of science) on behalf of humanity at large.[15] In the case of science, researchers deal with crises of explanation and validity, crises they identify in the explanatory power of their field's theory when confronting that theory with unexplained observations. And they do so as part of a community of investigators that has come to develop and share convictions on how to do science, and on how to identify sound answers to scientific questions.

The specific nature of the activity in which empirical scientists are engaged explains why an assessment of their work through an evaluation in a market or through an assessment by administrators would be inadequate. An evaluation will have to turn to autonomous collegiate cooperation and critique rather than outside control and standards. Professional autonomy has evolved on different levels: (1) As part of a professionalized habitus, it includes the individual researcher's internalized standards of critique and refinement; (2) Professional autonomy involves criticism in a universe of discourses through colleagues and collegial control elicited through procedures of peer-review and evaluation; (3) Professional autonomy is made possible through institutions such as academies, associations, university departments and research institutes, all of which provide the field with a platform for its ongoing work, with the jurisdiction required to enforce adherence to its standards among colleagues, and procedures to raise and distribute budgets and to codify rules and standards for scientific work.[16]

It is one thing to develop an interest in the particular mode of investigation that empirical science has come to stand for, but quite another to

15 For a comparison of science to other professions, see Ulrich Oevermann, "Theoretische Skizze einer revidierten Theorie professionalisierten Handelns," in *Pädagogische Professionalität. Untersuchungen zum Typus pädagogischen Handelns*, edited by Arno Combe and Werner Helsper (Frankfurt: Suhrkamp, 1996), 70–182.

16 While sociologists and historians have investigated the collegiate role of scientists as well as their institutional settings, an empirical investigation of the scientist's internalized habitus has remained a desideratum. Such a habitus was sometimes referred to rather philosophically as "professional ethics." In his recent study on this subject, Andreas Franzmann mobilized the close-reading approach of objective hermeneutics to interpret interviews with researchers, deducing from these interviews tacit assumptions informed by internalized routines and beliefs. See Franzmann, *Disziplin der Neugierde*.

claim to speak for it and to enforce professional standards with the authority of a wider community. This is where authority comes into play. The political sovereign provides empirical scientists with protection and sometimes with financial support, but also with the authority to deal with the profession's affairs. In early modern times, the court provided patronage for individual scientists, bestowing "social and cognitive legitimation" on such individualists as Galileo.[17] With the founding of institutions such as the Royal Society, the *Académies royale* and subsequent national academies in other counties, the practice of science received a continuous institutional foundation empowering not just one scientist, but the general logic of research represented by the academy. The king's endorsement entrusted scientists with organizing the profession so as to effectively safeguard on behalf of the sovereign the advancement of science.[18] With the advent of the democratic nation-state, such institutional support and endorsement of science then took place on behalf of the people. The nation-state came to assume the role of client and supporter of science as it began to dedicate itself to the protection and support of the freedom of scientific inquiry and education.[19] In this sense, nation-states through their endorsement of scientific institutions such as academies, universities, scientific associations, or research institutes entered a "contract" with experimental science by accepting, in principle, that science would challenge and test ideas about how the world works even if science came up with new explanations that undermined established beliefs or world views.[20] This development re-

17 Mario Biagioli, *Galileo Courtier: The Practice of Science in the Culture of Absolutism* (Chicago: Univ. of Chicago Press, 1993), 354.

18 The resulting embeddedness of the profession as a community in a wider community is the central theme in William J. Goode, "Community within the Community: The Professions," *American Sociological Review* 22 (1957): 194–200.

19 For a recent presentation of this argument, see Alfons Bora and David Kaldewey, "Die Wissenschaftsfreiheit im Spiegel der Öffentlichkeit," *Freiheit der Wissenschaft: Beiträge zu ihrer Bedeutung, Normativität und Funktion*, edited by Friedemann Voigt (Berlin: De Gruyter, 2012), 9–36.

20 This view takes for granted that the institutionalization of science is a component of building a political community, and it differs from another approach in the sociology of science prominent in Germany, i.e. an approach informed by systems theory. For the latter, see Rudolf Stichweh's contribution to this book, "Transformations in the Interrelation between Science and Nation-States: The Theoretical Perspective of Functional Differentiation." See also Niklas Luhmann, *Die Wissenschaft der Gesellschaft* (Frankfurt: Suhrkamp, 1990); Rudolf Stichweh, "Differenzierung des Wissenschaftssystems," in *Differenzierung und Verselbständigung: Zur Entwicklung gesellschaftlicher Teilsysteme*, edited by Renate Mayntz et al. (Frankfurt and New York: Campus, 1988), 45–115; Rudolf

sulted in a system of institutionalized training at universities where students internalized the scientist's role and its logic of inquiry. Eventually, this mindset would be directed at a growing number of subjects outside the natural sciences even if its proper adjustment to an investigation of culture, society, politics, and economies remains disputed. In this volume, such a broadened conception of science (in line with a German conception of *Wissenschaft*) is reflected in contributions on the history of sociology and philosophy by Fabian Link and on the history of Islamic studies by Andreas Franzmann.

So this is how the autonomy of science as a profession played out and how it was institutionalized. But the legitimacy of science has always had to go well beyond this framework. Science has never been self-referential in establishing the foci of its work, and questions researchers have chosen to pursue have not been provided by curiosity or the state of research alone. The legitimacy of science in public and in politics has drawn on a variety of motives, including cultural and utilitarian promises and competitive struggles for funding within and among disciplines. From the inception of institutionalized research science in the seventeenth century, utilitarian promises have played an important role in bolstering research, among them prospects for developing useful technology in such areas as agriculture, navigation, and medicine.[21] But the significance of such utilitarian prospects grew stronger and became dominant as science turned into a successful enterprise. In countries supporting science, administrations, the military, and industries became dependent on technological applications

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Stichweh, *Wissenschaft, Universität, Professionen: Soziologische Analysen* (Frankfurt: Suhrkamp, 1994; Peter Weingart, *Die Stunde der Wahrheit? Zum Verhältnis der Wissenschaft zu Politik, Wirtschaft und Medien in der Wissensgesellschaft* (Weilerswist: Velbrück, 2001). Approaches informed by systems theory commonly focus on an exchange of services or accomplishments by self-referential subsystems of society. We argue that the state's empowerment of science to cope with crises of explaining reality on behalf of a wider community represents a relationship structurally similar to that between a physician and a patient. A physician is "empowered" by his patient to cope with his/her health crisis. Unlike physicians, however, scientists cope with more general crises that are relevant for all humans, not just one patient. In a strict theoretical sense, therefore, the client of science is not concrete for it is neither a person nor any particular community. But this universalistic and abstract client is nevertheless represented by individual communities that are able and willing to dedicate themselves to the universalistic program of science. This structural similarity to the relationship in other professions such as medicine is what we mean when we consider a community to be a "client" of science.

21 See Merton's famous study on science in its formative period. Robert K. Merton, *Science, Technology and Society in Seventeenth-Century England* (New York: Harper & Row, 1970).

derived from investigating their underlying principles. When curiosity-driven research translated into spectacular technological solutions, furthermore, the success of science through technology has led to the demand that science should assume a more significant role in education. The growth of universities in many countries in the late twentieth century has had the effect of associating larger segments of the population with institutions dedicated to science (the *Massenuniversität* in Germany) while engaging a smaller percentage of university students in "real" research. Significant investments by nation-states in research and education have gone hand in hand with the growth of management structures, and this has also further changed the relationship of science to the public.

While these developments during the past two centuries may be understood within the context of individual states, they have taken place at a time of accelerating globalization since 1970. In our next and somewhat longer section we will focus on challenges to professionalized science in the context of technology-oriented states since 1800. We will close our introduction with a brief section on issues arising from globalization.

3. Legitimizing Science: The Challenge of Utility

3.1. Science and Technology

While technology is much older than science, science and technology have been associated ever since modern science was institutionalized in the seventeenth century.[22] Because of this link, matters related to technology-development have influenced the justification and support of curiosity-driven research.

Prior to World War II, science and technology had had a long interactive history in weapons technology, chemicals and pharmaceuticals.[23] Fran-

22 On the difference between science and technology that we have in mind here, see Wolpert's lucid observations in his *Unnatural Nature of Science*, 25–34.

23 Alex Roland, "Science, Technology, and War," in *The Modern Physical and Mathematical Sciences*, edited by Mary Jo Nye, vol. 5 of *The Cambridge History of Science* (Cambridge: Cambridge Univ. Press, 2002), 559–78; John P. Swann, "The Pharmaceutical Industries," *The Modern Biological and Earth Sciences*, edited by Peter J. Bowler and John V. Pickstone, vol. 6 of *The Cambridge History of Science* (Cambridge: Cambridge Univ. Press, 2009), 126–40.

cis Bacon considered the discovery of nature's secrets and the production of useful knowledge two sides of the same coin.[24] The founding of the Royal Society took place on the utilitarian assumption that science and technology were tightly intertwined.[25] During the eighteenth century, France had taken the lead in associating the interests of the state with the elite *Ecole d'Artillerie* or the *Corps des Mines* and the *Corps des Ponts et Chausées*.[26] Such developments carried on and expanded during the nineteenth century. But World War II provided a singular opportunity for science administrators to lay claim to authority well beyond the core functions of exploring nature. Physicists came to rely and depend on massive government funds legitimized by the Manhattan Project and national security. Their success in developing technology provided them with political leverage as they assumed influential roles in policy-making. Political scientist Donald K. Price argued that scientists constituted a "fifth estate" and the scientific community a model of democracy.[27]

Science seemed to provide the tools that made or broke a state's international influence and power in the contested terrain of the Cold War.[28] Following claims by scientists to cultural leadership in the US during the Cold War, and through a representation of science as a tool to solve all sorts of societal problems, the public came to associate science

24 Francis Bacon, *The New Organon*, edited by Lisa Jardine and Michael Silverthorne (Cambridge: Cambridge Univ. Press, 2000).

25 Thomas Sprat, *The History of the Royal Society of London for the Improving of Natural Knowledge* (1667), edited by Jackson I. Cope and Harold Whitmore Jones (St. Louis: Washington Univ. Press, 1966).

26 Charles Coulston Gillispie, *Science and Polity in France: The Revolutionary and the Napoleonic Years* (Princeton: Princeton Univ. Press, 2004); Terry Shinn, "Science, Tocqueville, and the State: The Organization of Knowledge in Modern France," in *The Politics of Western Science, 1640–1990*, edited by Margaret C. Jacob (Atlantic Highlands, NJ: Humanities Press, 1994), 47–80.

27 Paul Josephson, "Science, Ideology, and the State," *The Modern Physical and Mathematical Sciences*, edited by Mary Jo Nye, vol. 5 of *The Cambridge History of Science* (Cambridge: Cambridge Univ. Press, 2003), 590–91; Joseph Ben-David, "The Ethos of Science: The Last Half-Century," in *Scientific Growth* (Berkeley: Univ. of California Press, 1991 [1980]), 485–500, esp. 492. The key source for this observation, of course, is Vannevar Bush, *Science. The Endless Frontier: A Report to the President by Vannevar Bush, Director of the Office of Scientific Research and Development, July 1945* (Washington DC: United States Government Printing Office, 1945), https://www.nsf.gov/od/lpa/nsf50/vbush1945.htm. See also Don K. Price, *The Scientific Estate* (Cambridge: Belknap Press, 1965).

28 For the bomb's effect on American politics and a culture of fear, see Ira Katznelson, *Fear Itself: The New Deal and the Origins of Our Time* (New York: Liveright, 2013).

ever more closely with technology. References to "pure research" had begun to be replaced in the 1960s with terms such as "basic" or "fundamental" research, suggesting that science was merely a first step in developing technology. At the same time, sociologists supplied keywords such as "postindustrial" or "knowledge" society, setting the stage for what Ben-David a few years later called a "scientific utopia." Resources for knowledge came to be considered essential components of economic growth.[29] The close association of science and technology in many countries blurred an understanding of the distinct and limited capabilities of scientific research. It helped produce a technocratic ideology that reduced society to an apparatus.[30] The rise of scientism eventually prompted a reaction.

The context for science and for technology-development shifted dramatically in all Western countries during the sixties when the very idea of scientific progress met growing academic criticism, and the legitimacy for scientific work and for its institutions began to be reviewed by an increasingly discerning public.[31] Following periods shaped by world wars and political and social crises, national publics in Europe and in the United States established or reestablished a self-assured role vis-à-vis science that encouraged a critical view of promises associated with science. Ben-David has argued that this was the period when an overly optimistic assessment of science ("scientism") faced a critical reevaluation but also the rise of an "anti-scientific" movement.[32] A critique of science addressed scientists' "complicity" with the military-industrial complex, nuclear power, chemical

29 Ben-David, *Centers of Learning*, 174.

30 See, for example, Helmut Schelsky, *Der Mensch in der wissenschaftlichen Zivilisation* (Cologne: Westdeutscher Verlag, 1961).

31 Essential for the field of the philosophy of science: Thomas S. Kuhn, *The Structure of Scientific Revolutions* (Chicago and London: Univ. of Chicago Press, 1976 [1962]). Kuhn's work went along with a general shift in the sociology of science where criticism of Robert K. Merton's work began to set the tone. This shift is well-documented in two volumes: Peter Weingart, ed., *Wissenschaftssoziologie I: Wissenschaftliche Entwicklung als sozialer Prozeß* (Frankfurt: Athenäum, 1973) and *Wissenschaftssoziologie II: Determinanten wissenschaftlicher Entwicklung* (Frankfurt: Athenäum, 1974). Critical perspectives on science and technology where developed by others as well, including Herbert Marcuse, *One-Dimensional Man* (Beacon: Boston 1964) and Jürgen Habermas, *Technik und Wissenschaft als "Ideologie"* (Frankfurt: Suhrkamp, 1968).

32 Joseph Ben-David, "The Ethos of Science in the Context of Different Political Ideologies and Changing Perceptions of Science," in *Scientific Growth* (Berkeley: Univ. of California Press, 1991), 533–59.

disasters, and environmental pollution. It also aimed at the role of scientists in colonial affairs, in producing social inequality, and in developing psychological methods for assessing and dealing with minorities and deviant behavior by administrations and in schools. A shift towards a more critical public reception of science usually took place when issues arose from prominent fields of research that came to stand for the scientific project at large. Their resolution came to shape the subsequent public and academic discourse on science. In his contribution to this volume, Shiju Sam Varughese sketches such developments for India.[33]

In the US after 1945, the field of physics had become the "public face" of science. Physics represented technological achievements relevant for the military and consumers. The secrecy of nuclear facilities added to the field's aura but also shielded from public scrutiny work attributed to it. The sixties, however, witnessed the transformation of the public sphere in the transatlantic region that brought about a reassessment of the state's role and responsibilities towards its citizens as well as a reconsideration of science and technology in modern democracies. In the US, polls indicated that Americans, despite successes such as the 1969 moon landing, considered quality-of-life issues to be more relevant than the space race.[34]

The torch symbolizing science to the public was passed from physics to biology during a controversy about the safety of recombining (altering) the DNA of a living organism, a debate that was considered by some contemporaries as helping provide the critical public assessment that nuclear technology had not received.[35] The decade witnessed a "swing from the physical to the life sciences" as public critique and public hopes came to focus on biology.[36] This shift also led to a transfer of focus from federal to private funding. Physics during the Cold War had stood for federal support

33 Shiju Sam Varughese, "The State-Technoscience Duo in India: A Brief History of a Politico-Epistemological Contract," in this volume.

34 Daniel Kevles, *The Physicists: The History of a Scientific Community in Modern America*, Revised edition (Cambridge: Harvard Univ. Press, 1995), 398.

35 Joachim Radkau, "Hiroshima und Asilomar: Die Inszenierung des Diskurses über die Gentechnik vor dem Hintergrund der Kernenergie-Kontroverse," *Geschichte und Gesellschaft* 14, no. 3 (Jan. 1, 1988): 329–63.

36 Agar, *Science in the 20th Century and Beyond*, 508. For a statistical overview of US science spending, see, for example, James Edward McClellan and Harold Dorn, *Science and Technology in World History: An Introduction* (Baltimore: Johns Hopkins Univ. Press, 2006), 418. Also consider recent data on global private and public R&D funding by Scienceogram UK, http://scienceogram.org/blog/2013/05/science-technology-business-government-g20.

within the wider political atmosphere concerned with national security but biotech came to be associated with markets and opportunities.[37] The growth of biotech drew global attention and established a new competitive arena for scientific, technological, and economic leadership. Industry continued to rely on universities for basic research and the training of scientists but public commentators both inside and outside of academia (among them historians and sociologists) differed in their assessments of what some conceived of as a privatization of science or as the emergence of "technoscience". The shift towards biology and biotechnology from the 1970s provided new opportunities and challenges for legitimizing science.

At a time when the old dream of science as a source for technological solutions finally seemed to come into its own, therefore, a cluster of transformations set in: In many countries, a critical public increasingly reflected on the societal consequences of research practices and technologies; a reassessment of the state's role included a reevaluation of the support of science where the state's role had been strong; the intellectual framework that guided the debate came to use market-models even in the case of science organization; and an academic discourse on science increasingly focused on innovative modes of knowledge production, a top-down managerial approach to innovation, and on the regulation of science and technology. While this shift towards the utility of science was most pronounced in the sphere of science studies and in science management, it played out in education as well.

3.2. Science as a Basis for Modern Education

Before 1810, the modern empirical sciences were largely confined to institutions not in charge of education. In the seventeenth and eighteenth centuries, academies had empowered research science and it was from the nineteenth century that empirical science began to be implemented within institutions of higher education.

At that time, universities were affiliated with religious denominations in the United States or had become associated with emerging territorial powers in Europe. With the rise of nation-states after 1800, education began to be secularized in many countries as states sought to educate their citizens.

37 The broader context was a "rediscovery of the market" in political debate. Daniel T. Rodgers, *Age of Fracture* (Cambridge: Harvard Univ. Press, 2011), chap. 2.

After German universities began to expect relevant contributions to research from professors in addition to education, other countries such as England from the 1860s and France from the 1880s sought to emulate their success.[38]

In this volume Dieter Langewiesche charts the role of science in society that university presidents in German-speaking countries conveyed to the public in their annual addresses. Langewiesche points to the significance of formulating that role within the context of the state. In his essay on Alexander Dallas Bache, Axel Jansen explains how leading US scientists during the nineteenth century sought to implement experimental research in educational institutions. By proposing to include research science in university and school curricula, researchers questioned established educational contents and challenged patterns of elite formation. Developments that are frequently discussed under the distinct rubrics of a popularization of science and a history of education together advanced the legitimacy of science during the nineteenth century.

Such legitimacy came to be represented through different institutions in different countries. In German-speaking countries, universities assumed a key role. During the nineteenth century, leaders of American science had expected the founding of a national academy to provide public acknowledgment of the role of science in American society. While public universities in Germany associated research science with the state, most leading research universities in the US were private. The public role of research science was acknowledged through the profession's contribution to educating elites and through the endorsement of research at universities by private philanthropy (such as the Rockefeller and Carnegie foundations) during the 1920s and 1930s. Before World War II, however, research science remained one of several competing intellectual approaches offered to students at universities as traditions of a "liberal", humanistic, and Classics-based education remained strong. Andrew Jewett has reminded us that "the contextual understandings of science that emerged in the 1930s took their shape from a desire to augment science's cultural influence rather

38 Roger Geiger, *The American College in the Nineteenth Century* (Nashville: Vanderbilt Univ. Press, 2000); Roger L. Geiger, *To Advance Knowledge: The Growth of American Research Universities, 1900–1940* (New York and Oxford: Oxford Univ. Press, 1986); Joseph Ben-David, *Centers of Learning: Britain, France, Germany, United States* (New Brunswick, NJ: Transaction Publishers, 1992); Christophe Charles, "Grundlagen," *Vom 19. Jahrhundert zum Zweiten Weltkrieg 1800–1945*, vol. 3 of *Geschichte der Universität in Europa*, edited by Walter Rüegg (Munich: C.H. Beck, 2004), 43–76.

than to challenge it, as is typical today."[39] Before World War II, in other words, advocates of research science in the US continued to operate with a sense of mission.

Things changed with World War II, just as they did for the public perception of science through technology. The public role of science was transformed against the backdrop of the war and its sequel, the Cold War, as a sense of fear and national crisis continued to provide a rationale for nationwide initiatives to expand national integration through education. The expansion of higher education after 1950 introduced a new topic for legitimizing science. After 1960, more than 10 per cent of youths aged 18 to 21 were enrolled in colleges and universities in all developed countries, and that number has continued to grow.[40] The success and impact of university-based research in the US during World War II led countries elsewhere to try to emulate it, much like American universities had sought to emulate German successes during the nineteenth century. Many countries from the 1950s increased investment in research and in education. For the key period of university expansion, Ben-David observed in 1977 that every country

> wanted to imitate the American model exactly when there emerged in that system new and not sufficiently recognized problems. The American system … had grown into a position of leadership through an intricate division of labor between hierarchically arranged graduate schools and colleges and between university and industrial research. However, the imitators of the American system abroad were only faintly aware of this background of American university research. Their model was the American system's exceptional effort and success during the Second World War, and its post-Sputnik boom in research. […] This created a mirage of a vast university system educating about half of the relevant age group at good institutions that conducted research at a respectable level.[41]

Universities in many countries had become centers of research science but they were now also viewed as a means to advance a country's economic standing and enhance social justice through facilitating occupational opportunities. Access to higher education and the need to expand higher

39 Andrew Jewett, *Science, Democracy, and the American University: From the Civil War to the Cold War* (Cambridge: Cambridge Univ. Press, 2012), 235; Laurence R. Veysey, *The Emergence of the American University* (Chicago: Univ. of Chicago Press, 1965).

40 Ben-David, *Centers of Learning*, 161.

41 Ibid., 121.

education became a key political issue in many countries because it was associated with economic success and social justice.

The growth of student populations has also had the effect of strengthening those areas within universities not dedicated to research but to general education. Many more students attended universities and not all of them were carved out to be research-minded. Not all students could enter the professions either, for which universities in the past had prepared them. The widening of subjects taught at universities in recent decades reflects the broader responsibility that institutions have taken on. While a much larger cohort of the population in many countries today will have had exposure to higher education and to institutions representing "science", such exposure has not always been associated with an immersion in the peculiar explorative outlook represented by research. While science and science-derived technology has come to shape all walks of life, even university students may not be susceptible to how it works. Max Weber's famous example of the commuter who rides the streetcar but hardly understands how it works reflects not only the rationalization of everyday life, but also the inability to follow its underlying developments.[42]

Such developments have gone hand in hand with a shift in the finances of higher education. In the US, the Higher Education Act of 1972 introduced student loans. Today, about seventy percent of American college students take on loans and the total volume of student loans exceeds one trillion dollars.[43] The effect of shifting the financial burden of higher education from the state to students and their families has been that science-based education has turned from a public good into a personal investment. Changes in numbers have surely led to changes in educational content. The larger the cohort in higher education, the more such education will have to accommodate students seeking to pursue careers in administration and business. In the US, such functions could perhaps be relegated to second or third tier institutions. In Germany, research universities implemented new degree programs in line with European policy ("Bologna"). For many students at German universities (and young researchers emerging from its degree programs), university education is no longer associated with curiosity-driven research.

42 According to Weber, such developments are part of an ongoing process of "intellectual rationalization." "Wissenschaft als Beruf," 593.

43 Andrew Delbanco, "Our Universities: The Outrageous Reality," *The New York Review of Books*, July 9, 2015, http://www.nybooks.com.

3.3. The Rise of Science Administration

The two areas we have discussed so far to sketch a trend towards utility in science—technology and education—are connected with a third area in which utility-orientation has played out: administration. The management of science expanded rapidly after 1945 as the US and other countries began to invest in science by building up large structures to accommodate research.[44]

The growth of such structures has challenged the professional autonomy of science because administrations could develop interests distinct from researchers in their organization. As a general trend, expanding science administrations have appreciated routinized and formal procedures, procedures that tend to develop a life and persistence of their own, instead of spontaneous adjustment to unpredictable research. In Max Weber's terminology, we have witnessed a shift in emphasis from "material" towards "formal rationality."[45]

Discourses informing science administrators since the 1970s have highlighted practical solutions, rates of innovation, and opportunities for translation to technology. As a result of administrative developments, even institutions controlled by researchers themselves have been inclined to adopt perspectives of planning and control because they are in line with

44 Alex Roland, "Science, Technology, and War," in *The Modern Physical and Mathematical Sciences*, edited by Mary Jo Nye, vol. 5 of *The Cambridge History of Science* (Cambridge: Cambridge Univ. Press, 2002), 564. John Agar considers as one prominent theme in the twentieth-century history of science the "extraordinary and unambiguous importance of the working world of warfare in shaping science." Jon Agar, *Science in the 20th Century and Beyond* (Cambridge: John Wiley & Sons, 2012), 6. Important effects of outside intervention probably consist in delaying or accelerating work in relevant research fields, in bloating areas of research that suddenly have proliferating budgets and opportunities or depressing others through diminishing budgets and expectations. For the growth of science administration, also see the introduction Gili S. Drori, John W. Meyer, Francisco O. Ramirez, Evan Schofer, "Introduction: Science as a World Institution," in *Science in the Modern World Polity: Institutionalization and Globalization* (Stanford: Stanford Univ. Press, 2003), 3–7.

45 Max Weber, *Wirtschaft und Gesellschaft* (Tübingen: Mohr, 1980 [1921]). See also Wolfgang Mommsen, "Personal Conduct and Societal Change," in *Max Weber, Rationality and Modernity*, edited by Sam Whimster and Scott Lash (Abingdon, UK and New York: Routledge, 2006 [1987]), 35–51.

science policy.[46] Such developments have evolved into a search for "new forms of science governance" that consider scientists, not peers in self-governed bodies, but employees of research companies infused with ideas of a "New Public Management."[47] NPM has played a significant role in Europe where it evolved in the context of public service reform, providing an agenda for implementing management ideals derived from the private sector. During the 1990s, NPM has prompted public university administrations to tap private sources for funding, accept target agreements between the state and university departments, and adopt modes of reporting and monitoring performance.[48] Science administration has established its own courses of study as well as its own degrees, associations, and journals.

Such transformations do not take place overnight and they are by no means complete. We are not suggesting that structures of science, in Europe or elsewhere, have been absorbed completely by utilitarian interests aimed at technology development or by discourses focusing on society's "great challenges" such as climate change, green energy, migration, or educational reform. The wider scientific culture has produced proponents as well as opponents in such debates, and in debates about a legitimate role of science in society.

From the perspective of a professionalization of science, therefore, the potential utility and practical value arising from research science has in-

46 To cite an example of a critical investigation of ties between industry and academia: Martin Kenney, *Biotechnology: The University-Industrial Complex* (New Haven and London: Yale Univ. Press, 1986).

47 Literature on a New Public Management includes Uwe Schimank, "Die akademische Profession und die Universitäten: 'New Public Management' und eine drohende Entprofessionalisierung," in *Organisation und Profession*, edited by Thomas Klatetzki and Veronika Tacke (Wiesbaden: VS Verlag, 2005), 143–64; Bettina Heintz, "Governance by Numbers: Zum Zusammenhang von Quantifizierung und Globalisierung am Beispiel der Hochschulpolitik", in *Governance von und durch Wissen*, edited by Gunnar Folke Schuppert and Andreas Voßkuhle (Baden-Baden: Nomos, 2008), 110–28; Andreas Knee and Dagmar Simon, "Peers and Politics: Wissenschaftsevaluationen in der Audit Society," in *Governance*, edited by Folke and Voßkuhle, 173–85; Richard Münch, *Akademischer Kapitalismus: Zur politischen Ökonomie der Hochschulreform* (Berlin: Suhrkamp, 2011); Andreas Franzmann und Peter Münte, "Von der Gelehrtenrepublik zum Dienstleistungsunternehmen. Ausschnitt aus einer Deutungsmusteranalyse zur Erschließung kollektiver Bewußtseinslagen bei Protagonisten der gegenwärtigen Universitätsreform," in *Zwischen Idee und Zweckorientierung: Vorbilder und Motive von Hochschulreformen seit 1945*, edited by Andreas Franzmann und Barbara Wolbring (Berlin: Akademie Verlag, 2007), 215–29.

48 For an overview see Walter J. M. Kickert, ed., *Public Management and Administrative Reform in Western Europe* (Cheltenham, UK and Northampton, MA: Edward Elgar, 1997).

creasingly challenged the profession in various countries to reassess its role and to reassert its autonomy. Reassessments have concerned the role of research in the light of demands for practical solutions and in view of demands for a "relevant" university education. The professional autonomy of research science has played out in specific national settings, but some developments since 1970 have evolved on a global scale. This raises the question of how globalization plays out for science as a profession.

4. Global Challenges to Science as a Profession

In recent decades, the professions and the nation-state have both come under scrutiny in academic discourses on modernity. Science has increasingly been considered to be a mere component of developing technology, a component whose economic productivity and sustainability were to be optimized. At the same time, however, transnational developments suggested that nation-states were quickly losing their political grip and relevance. The rise of military alliances, the globalization of markets and organizations, environmental issues such as climate change, the emergence of global communication networks, and the internet all seemed to point towards the growing relevance of social movements and modes of governance transcending traditional states.[49] In recent years, academic criticism that takes aim at traditional agents of modernization such as the professions or the state seems to have lost some steam. But real-world developments persist that continue to challenge the integrity of both professions and nation-states. In concluding this essay, we would like to identify three dimensions of globalization that touch on science as a profession: (1) the development of supranational structures for the promotion of science, (2) the increased international mobility of researchers, and (3) the emergence of global frameworks for comparing and evaluating science.

49 Overviews include Emily S. Rosenberg, ed., *A World Connecting: 1870–1945* (Cambridge: Harvard Univ. Press, 2012); Akira Iriye and Jürgen Osterhammel, eds., *Global Interdependence: The World after 1945* (Cambridge: Harvard Univ. Press, 2014). Insightful through its focus on a particular industry: Peter Borscheid, "Introduction," in *World Insurance: The Evolution of a Global Risk Network*, edited by Peter Borscheid and Niels Viggo Haueter (Oxford: Oxford Univ. Press, 2012), 1–34.

Supranational structures of science have grown rapidly since World War II but their professional implications are most severely felt in Europe.[50] They have been of particular concern here because the promotion of science has traditionally been in the hands of national states but is now being superseded by a supranational "European Research Area," a new platform for research funding whose effects on national traditions are not yet evident. Nina Witjes and Lisa Sigl describe how European states are building up infrastructure for internationalizing science and technology development and they propose that such growth has been significant enough to speak of a new field, that of the "Internationalization of Science, Technology, and Innovation (STI)."[51] On the level of European institutions, Arne Pilniok's contribution to this volume suggests a number of questions about the evolution of an organizational structure that anticipates replacing national ones.[52] The national setting has played a key role for the cohesion and integration of the research profession in the past. How will such cohesion evolve on the supranational European plane? How will Europe alter the public legitimacy of science? Perhaps an emerging bureaucratic superstructure continues to rely on national science systems for legitimacy and funding. Or the European research profession and community will evolve into an integrated counterpart to an emerging European public and its institutions, similar perhaps to integrational ambitions by nineteenth-century leaders of American science.

The second issue concerns the increased international mobility of researchers. Beyond the issue of a "brain drain" among students and postdocs, such mobility raises questions when leading researchers move to a different country. How does their decision to move abroad affect their commitment to the scientific profession, represented through national

50 For a chart depicting the rapid growth after 1950 of science organizations and structures such as national science policy organizations, inter-governmental science organizations, science ministries, nongovernmental science organizations, and international science education organizations, 1870–1995, see Drori et al., "Introduction", *Science in the Modern World Polity*, 3. See also Elizabeth Crawford, Terry Shinn, and Sverker Sörlin, "The Nationalization and Denationalization of the Sciences: An Introductory Essay," in *Denationalizing Science: The Contexts of International Scientific Practice*, edited by Crawford, Shinn, and Sörlin (Dordrecht: Kluwer, 1993), 1–42, esp. 1–3.

51 Nina Witjes and Lisa Sigl, "The Internationalization of Science, Technology & Innovation (STI): An Emerging Policy Field at the Intersection of Foreign Policy and Science Policy?," in this volume.

52 Arne Pilniok, "The Institutionalization of the European Research Area: The Emergence of Transnational Research Governance and its Consequences," in this volume.

associations and organizations? Would such mobility result in a weakening of national science, and by implication, of science as a profession?[53] In the past, national organizations and associations have played a key role in representing the professionalized discourse in a given field. The founding of international organizations such as, for example, the International Society for Stem Cell Research (ISSCR) suggests that this discourse is being lifted onto a new plane, but international organizations have no political counterpart. This raises the question of the role of these organizations. Are they a result of efforts within the scientific community to ensure that the field adheres to standards of good practice even where national organizations may not be able to enforce them? Such questions seem particularly relevant in countries like China, India, or Singapore because they aspire to world class research through significant investments and competitive international hiring. In emerging nations, such ambitions will likely result in efforts to stimulate processes of professionalization and create the cultural setting within which research can thrive and recruit new students and researchers. In order to create sufficient momentum, such efforts will ultimately have to be in line with a broader political and cultural commitment to freedom of speech and freedom of research. Shiju Varughese delineates the peculiar interests associated with developing science in the context of emerging public awareness of large-scale technology in India.[54]

A third dimension of globalization relates to the rise of science administrations discussed above. The management of science and its institutions is increasingly shaped by discourses that emerge from the social sciences, theoretical premises that structure and shape the evaluation and assessment of science around the globe. A comparison between the relative achievements of science in particular countries or by individual institutions, has, to be sure, been around for a long time. The essays by Dieter Langewiesche and Axel Jansen respectively, show that spokesmen of science sought to explain the relevance of scientific institutions within national settings, tak-

53 There have long been concerns about a "brain drain" in various countries. For an interesting case of how such concerns have been instrumentalized by ambitious German academics abroad, see Axel Jansen, "Patriotismus- und Eliteninszenierung im deutschen Hochschulreformdiskurs. Analyse des 'offenen Briefes' der Initiative Zukunft Wissenschaft vom September 2005," in *Zwischen Idee und Zweckorientierung: Vorbilder und Motive von Hochschulreformen seit 1945*, edited by Andreas Franzmann and Barbara Wolbring (Berlin: Akademie Verlag, 2007), 185–94.

54 Shiju Sam Varughese, "The State-Technoscience Duo in India," in this volume.