INTRODUCTION
NEW DIMENSIONS IN THE PHILOSOPHY OF SCIENCE: TOWARD A PHILOSOPHY OF SCIENCE POLICY

Carl Mitcham and Robert Frodeman

The philosophy of science — the attempt to understand the fundamentals of one of the most significant of human activities — has traditionally treated itself as a branch of the field of epistemology. Justification for this delimitation has relied on two distinctions. One is the difference between the contexts of discovery and of justification. The process of scientific discovery is viewed as a mysterious, non-rational process belonging to the province of psychology. In response, the philosophy of science limited itself to probing the logical procedures of justifying scientific claims. Second is the distinction between externalist and internalist features of science. The philosophy of science sets aside the external economic or political factors promoting scientific work in order to focus on those processes internal to scientific research.

In recent decades, however, these assumptions have faced two challenges. One challenge originated with arguments for the close, even symbiotic relationship between science and technology, and as a response to the external social problems of technology, from nuclear weapons to biotechnology. In consequence, the philosophy of technology developed as a complement to the philosophy of science, with a particular focus on ethical-political criticism. A second challenge originated with historical and sociological studies of science that revealed important non-epistemological features of its internal processes. Of special importance here are the ethical dimensions of scientific methods, with discussions of the professional ethics of science, and accounts of the material culture of science, where the

scientific method is placed within the larger framework of scientific tools, public and private institutions, and governmental funding streams.

Bridging the external social impacts of scientific activity and its internal social construction is the less well known but no less important activity of science policy. Science policies are manifest both outside science in public appropriations for the funding of science and regulatory legislation, and inside science with efforts to refine the procedures of peer review or promote the more effective and equitable sharing of data and peer review. Original recognition and analysis of these activities belongs to the social science, and to research undertaken by that interdisciplinary field known as science, technology, and society studies. As guest editors of this special issue of *Philosophy Today*, however, our goal is to promote the emergence — after the philosophy of technology and the professional ethics of science — of a third complement to traditional philosophy of science that focuses on this under-appreciated bridge. Philosophical reflection on science policy will expand our understanding of science, extend the activity of philosophy, and strengthen our grasp of the controversies facing policy professionals.

Philosophy of Science absent Policy

To repeat: Complementing science is another, no less significant activity, that of science policy — which is itself simply one aspect of what has been called the "policy orientation" (Lerner and Lasswell, eds., 1951) and the "policy movement" (Brunner, 1991) that promotes the development of systematic, intelligent, and effective public decision making. In a distinction that goes back at least to Harvey Brooks (1968) — and which is not precisely the same as that between external and internal science policy — science policy is commonly divided into "policy for science" and "science for policy." In either case, science

policy is distinct from science, in that it attempts to investigate, formulate, and implement guidelines for science-society relationships, so that society promotes the steady advancement of science (policy for science) and science benefits public decision making (science for policy). Like science itself, science policy is thus of considerable societal importance. Remarkably, however, although there exist efforts to advance science policy work itself and to examine it from the perspectives of science, technology, and society studies, there is little in the way of a research program in philosophy attempting to analyze and understand science policy more generally, either in its epistemological or its ethical dimensions.

The absence of any philosophy of science policy in the philosophy of science is easily documented. Consider, for instance, two of the most representative textbook readers: E.D. Klemke, Robert Hollinger, and A. David Kline, eds., *Introductory Readings in the Philosophy of Science* (1988); and Martin Curd and J.A. Cover, eds. *Philosophy of Science: The Central Issues* (1998). Klemke *et al*. collects articles dealing with the demarcation problem, the covering law model of explanation, relations between theory and observation, confirmation and acceptance, and two short sections on science and values (how science rests on distinctive values) and science and culture (how science is its own way of life). The Curd and Cover book likewise includes articles on the relation between science and non-science, scientific rationality, theory and observation, induction, confirmation, explanation, laws, reductionism, and empiricism. Neither text even so much as mentions the phenomenon of science policy or the role of science in public decision making.

Consider as well an influential systematic textbook authored by nine members of the Department of the History and Philosophy of Science at the University of Pittsburgh, a leading philosophy of science program in the United

States: Merrilee H. Salmon *et al.*, *Introduction to the Philosophy of Science* (1992). Part one identifies four general topics in the philosophy of science: explanation, confirmation, realism, and scientific change. Parts two, three, and four provide brief overviews of philosophies of the physical sciences, of biology and medicine, and of the behavioral and social sciences, respectively. Even in relation to medicine and the social sciences, both science policy and the policy sciences are conspicuous by their absence.

In other areas of philosophy where it might be expected, science policy is equally absent. For instance, there is no article on policy in general or science policy specifically in Ruth Chadwick, ed., *Encyclopedia of Applied Ethics* (1998) or either of the two general encyclopedias of philosophy: Paul Edwards, ed., *Encyclopedia of Philosophy* (1968) with Donald M. Borchert, ed., *Supplement* (1996); and Edward Craig, ed., *Routledge Encyclopedia of Philosophy* (1998). In fact, the term "science policy" is not even in the index of either of these three major philosophy reference tools.

Finally, consulting *The Philosopher's Index* (1940-2004) yields no books or articles with "philosophy of science policy" in their titles, and only a small number of hits using "science policy" alone. Among important books in this category is Kristin Shrader-Frechette's *Science Policy, Ethics, and Economic Methodology* (1984), perhaps the first philosophical analysis to identify and link the ethical and epistemological issues embedded in science policy; and Philip Kitcher's *Science, Truth, and Democracy* (2001), the first book that might reasonably claim "toward a philosophy of science policy" as a subtitle. Even the journal *Philosophy and Public Affairs* (1971-present) largely limits itself to philosophical interventions in or contributions to particular policy issues (such as nuclear deterrence, health care, welfare reform, or criminal punishment, but seldom to the use or governance of

science), and only rarely (as with Lawrence Tribe, 1972) or indirectly reflects on policy making as itself a special form of human action. Among the less than twenty publications identified by a search for "philosophy of policy" in general, Sidney Hook's *Philosophy and Public Policy* (1980) stands out as representative of this issues-focused approach.

Science Policy absent Philosophy

The other place one might expect to find philosophy of science policy is, of course, in science policy work. Remarkably, however, not only is there no sustained philosophical reflection in science policy, there is even precious little by way of philosophical analysis of policy *tout court*. Although policies may be described as special types of action, these forms of behavior have not been accorded any attention in the philosophy of action.

Policies are both actions and commitments to courses of action — decisions, not so much about specific acts as of types of acts, commonly of a public character. The study of policy formation and implementation as a distinct intellectual tradition dates only to the post-World War II era (Dunn, 1994) and excludes. A leading figure of the early policy movement was Harold Lasswell, who with his colleagues fostered development of what he termed the "policy sciences" (Lerner and Lasswell, eds., 1951). Policy work and research has, however, since come to encompass diverse intellectual traditions, from policy studies (Nagel, 1994) and policy analysis (Stokey and Zeckhauser, 1978) to socio-economics (Halal and Taylor, 1999) and science, technology, and public policy (Lambright, 1998). Although Lasswell himself held out a role for philosophy in the pragmatist tradition (alongside political science, sociology, economics, psychology, and more), this has gone largely unrealized, except for modest contributions made by

philosophical analyses of the ethical dimensions of specific policy issues such as, e.g., nuclear deterrence, abortion, and environment pollution, mostly related to what has become known as applied ethics.

A slightly more extended assessment of the policy studies tradition reinforces perceptions of the limited role played by philosophy. In what remains a useful overview of the policy studies field, Stuart S. Nagel's edited *Encyclopedia of Policy Studies*, 2nd rev. and expanded (1994) is divided into two parts: general approaches to policy studies (11 chapters on methods, practices, and national comparisons) and specific policy problem areas (24 chapters divided into disciplinary-based work). With regard to disciplines that contribute to the interdisciplinary field of policy studies, the introduction to the first edition (1983) recognizes:

- political science (the primary contributor, focusing on political and administrative feasibility of alternative policies for a range of public problems);
- economics (analyzing cost-benefit relations of different policy proposals);
- psychology (examining reward structures to motivate policy implementers and the individual results of policies focused on personal outcomes);
- sociology (clarifying social problems themselves, their class bases and relationships);
- the natural sciences (providing data on physical and biological factors, especially related to policies dealing, for instance, with energy and health); and
- anthropology, geography, and history (broadening perspectives across time and place).

The *Encyclopedia of Policy Studies* gives the first five of these disciplinary

approaches extended attention. But although Nagel mentions philosophy as able to make a contribution through its "special concern for the values toward which public policies are directed and the ultimate logic of policy analysis" (p. xii), and includes a short chapter on "Values, Ethics, and Standards in Policy Analysis," philosophy gets as short shrift as history. The fact that policy studies is a post-World War II phenomenon is mentioned but not examined; there is no chapter on the history of policy or policy studies. Likewise, there is no chapter on the philosophy of policy or of policy studies.

Moreover, although there are chapters on "Technology: Innovation and Consequences" (by Frederick A. Rossini and Alan L. Porter), "U.S. Health Policy in Developmental and Cross-National Perspective" (by David Falcone, Robert W. Broyles, and Steven R. Smith), "Energy Policy" (by Robert M. Lawrence), "Biomedical Policy" (by Robert H. Blank), and "Space Policy" (by Robert M. Lawrence), there is no chapter devoted to science policy per se. These chapters are all more devoted to how the sciences can contribute in specific areas to policy formation. They are concerned more with "science for policy" than "policy for science."

While science policy more broadly construed has been resurgent since the 1990s, it remains a subfield of the broader policy movement. Moreover and not surprisingly, most approaches to the study of policy continue to reflect the perspectives and methodologies of the disciplines in which they are based. For instance, for the most part political scientists engage in "policy studies," using characteristic methods and perspectives. Economists and those trained in economics apply the tools of cost-benefit methodologies to "policy analysis." Journal titles follow these conventions: *Policy Studies Journal* (1972-present) and *Journal of Policy Analysis and Management* (1981-present). *Policy Sciences*

(1970-present) remains a flagship of the Lasswellian tradition. None of these journals publish primarily on science policy.

Science Policy and Its Discontents

Despite such absences in philosophy and in science policy, the need for philosophical assessment of science policy has never been more pronounced — and has been emphasized repeatedly over recent decades by successive examinations of United States science policy. The economic decline of the late 1970s and 1980s, the disclosure of ethical lapses in science during the 1980s, the end of the Cold War in the early 1990s, and the ballooning federal budget deficits of the same period combined to simulate rethinking of post-World War II governmental policies toward the funding of science. It is not clear, however, that this reassessment has gone either deep or broad enough. While science policy discussions increasingly draw on skills and knowledge from the social sciences, they regularly fail to engage the humanities — thus limiting the dimensions of science policy reform.

Two paradigmatic experiences created the framework assumptions of post-World War II science policy. One was the corrupting influence of fascist and communist governmental interference with science. Nazi pursuit of "Aryan science" and the critique of relativity theory as Jewish decadence drove physicists out of Germany in droves. Likewise, the Soviet critique of "bourgeois genetics" and the defense of the evolutionary inheritance of acquired characteristics undermined Russian biological research and agriculture for decades. The response in the West was what may be termed the autonomy thesis: Science must be kept free from politics and insulated against all efforts at political manipulation.

A second formative experience was the development by U.S. scientists

(many of them German émigrés) of weapons such as radar and the atomic bomb that made decisive contributions to winning World War II. Given the freedom to pursue their science, scientists voluntarily rallied to the democratic cause. Given massive governmental funding, they did research and development that was of critical value to society. The response was what has been called the linearity thesis: Funding scientific research automatically produces social benefits. While it is not possible to predict exactly how pure research will benefit society, such knowledge always rebounds to the good.

On the basis of these two theses, there emerged the basic principle of post-World War II science policy: The government should provide no-strings attached funding to scientists, because scientific research invariably benefits society by making measurable contributions to its military power, health care system, or economic competitiveness. There were, of course, arguments around the margins regarding how much independence to give to scientists (limits had to be placed on classified research, for example) and what constituted a well-balanced social investment in mathematics, physics, chemistry, and biology. But none of these discussions affected the basic principle: Give money to scientists, let them make their own decisions about how to spend it, and this will ultimately make society strong.

The end of the Cold War at least temporarily allowed questions to surface about the need for the kind of military power science was thought to provide. Does the U.S. really need to build more and better high-tech weapons systems when there is no opposing superpower. Economic stagnation and budget deficits further called into question the effectiveness of federal investments in science. Why was it that with the largest number of Nobel Prizes in science the U.S. economy was in many sectors being bested by Japan, Germany, and other nations? Parallel to such

political and economic questions, the investigative journalistic exposures of ethical misconduct in science together with social studies of the social construction in science challenged the idea of the non-political character of science. Nazi and Communist efforts to control science were obviously crude failures at external control of the inner workings of science. But have there not been other clear instances in which political agendas (sometimes on the part of scientists themselves) successfully influenced the direction of scientific research? Feminist criticisms of investments in cancer research (more for prostate cancer than for breast cancer, despite the fact that more people die of breast cancer) clearly pointed up how the interests of scientific researchers (mostly males) could influence the directions of science. Taken together, such questions conspired to sponsor repeated discussions in and of U.S. science policy — discussions whose most prominent feature has been increasing engagement with the social sciences.

Initially these discussions focused on attempts to re-conceive the end-benefit of scientific research in terms other than military power. The most common substitutes were environmental sustainability and human health. For instance, all three post-Cold War Presidents — from Bush through Clinton to Bush — called for more research on global climate change and committed themselves to dramatically increase funding at the National Institutes of Health. Since 9/11, of course, the primary goal has become the war on terrorism.

More significant than such straightforward goal substitution, however, has been a reassessment of both founding theses of science policy, in reverse order to their historical emergence. That is, reassessment began by admitting some weaknesses in the linearity thesis. Although nuclear physics led to nuclear weapons and electric power generation, this pure-to-applied movement took place only by way of extensive work in nuclear engineering, and because government

funders and scientist-engineers as a contingency of history happened to share a wartime consensus about potential and useful end-benefits. After the war, the consensus became much more qualified, and outcomes correspondingly more problematic. Moreover, not all pure research has an equal potential for application. As historical and sociological analyses of science have repeatedly shown, the pure-to-applied linearity equation is more a highly qualified special case than a general rule.

This questioning of the linearity thesis has been manifested in a number of government attempts to stimulate or manage the laboratory-to-marketplace relationship — to enforce linearity, as it were. Examples include the Bayh-Dole Act and amendments (1980 and 1984) of the Carter and Reagan administrations, which promoted the licensing of patents from publicly funded research; creation of the National Technology Transfer Center (1989) during the first Bush administration; and the Government Performance Results Act (1993) of the Clinton administration — the latter of which asked all federal agencies, including those funding scientific research, to provide more explicit and transparent procedures for evaluating their activities. Indeed, the decision of the Republican Congress in 1993 to reduce funding for high-energy physics research by canceling construction of the superconducting super collider (SSC) plus the subsequent commitment to double the budget of the National Institutes of Health were other prominent effects of linearity questioning. Finally as a more general policy measure, there was the 1997Congressional mandate to the National Science Foundation to alter its proposal review criteria to give equal weight to “intellectual merit” and “broader impacts” — thus complementing internal methodical assessment with external considerations and modestly qualifying the character of scientific autonomy.

Reassessment of the autonomy thesis in fact has taken weak and strong

forms. In the weak version, as David Guston has analyzed at length in his *Between Politics and Science* (2000), it is now recognized that conscious efforts need to be made to develop appropriate mechanisms to promote collaboration between scientists and some external stakeholders to guide certain specific areas of even the internal workings of science. The single most obvious case has concerned questions of research misconduct and integrity. Increased dependency on government funding tempts scientists to cut corners in ways they sometimes find difficult to resist and even more to police. Politicians have stepped in to demand, for instance, graduate education in the responsible conduct of research in association with the research grants from such agencies as the National Institutes of Health, and to establish an Office of Research Integrity in the Office of the Secretary of Health and Human Services to respond to allegations of research misconduct.

In a much stronger reassessment, the so-called "science wars" attacked the autonomy thesis head. In this maximalist version, the social studies of science proposed that the socio-political construction of scientific knowledge was a result not just of external guidance but also of the deepest internal workings of the scientific process. Although widely rejected in this maximalist form, the social studies of science have nonetheless exposed the formerly obscured social dimensions operative within the scientific community along side much of the scientific method.

Social Science for Science Policy

As a result of a fading memory about both the World War II experiences with the contamination of science by politics and the direct political benefits to large-scale funding for science, along with the corresponding challenges to the

autonomy and linearity theses, the social sciences have come to play an increasingly significant role in science policy. In the mid-20th century, social scientists simply measured inputs to science, and the Organization of Economic Cooperation and Development (OECD) created a scientific indicators industry around collecting and comparing national investments in research. The linearity thesis dictated this focus on economic metrics, and implied that other measurements were probably a waste of time and effort.

But once the contingency of outputs became an issue, social scientists become involved on the other end of things as well. One leading approach looks at projected social as well as scientific outcomes of particular research investments, and asks whether in fact such outcomes have been achieved or are likely — or might be achieved by other means.

Consider, for example, the war on cancer. Since President Nixon declared "war on cancer" in the early 1970s the U.S. government has spent over $30 billion on cancer research, and yet cancer survival rates have only marginally improved (see Proctor, 1995). Certainly a strong case can be made that more modest investments in prevention, education, and environmental clean up would have had a much more dramatic impact on cancer. But our collective commitment to scientific fixes over political or behavioral ones has encouraged scientists to promise more than they have been able to deliver and citizens to be more gullible than prudent. There seems to exist what Daniel Callahan (2003) calls a "research imperative" that tends to override more balanced assessments.

Consider, too, the case of global climate change research. Since 1989 the U.S. has invested over $20 billion in global climate change research. In almost every case this research has been justified as leading to greater scientific understanding of climate change dynamics (especially the anthropogenic

dimensions of such dynamics) leading to increased environmental sustainability. Despite this investment, the error bars surrounding the range of predicted climate change by 2100 provided by the Intergovernmental Panel on Climate Change report (2001) were larger than for those given a decade earlier. Rather than adjudicating the process, science provided fodder for an increased range of interpretations of the climate data.

Recognizing the gap between scientific research and social utility, the National Cancer Institute began to ask social science to play a larger role in helping bring research to the public. Social scientists have also become involved in monitoring scientific integrity and promoting transfer from laboratory to marketplace. Similarly, the National Center for Atmospheric Research, the leading US institution for research into climate change, has recently made a major commitment to increasing the prominence and funding of its social science directorate. But to a large extent all such social science work has merely taken the messy reality of non-linearity and tried to make it as linear as possible. Economics is thus the social science that is most commonly funded; and quantitative and descriptive accounts predominate over the qualitative and the normative.

But a recent cadre of scientists and social scientists have gone further and put forth what can easily be termed a new science policy. The new science policy goes beyond trying to enforce linearity or to work around the kinks of non-linearity. It looks at the publicly stated goals of science funding, sometimes setting them in more expansive social contexts that raise questions of equity and impact, and then considers whether the projected end-benefit outcomes have been or are likely to be achieved by means of the research program so justified. If not, it proposes that we give serious consideration to other means. Science should not be the only means to public policy ends, nor should the vested interests of well

established scientific programs be allowed to obscure alternative research projects. Science policy should itself be subject to (social) scientific examination.

Although this new science policy may be a substantial improvement over the old, it nevertheless limps in one important respect: It often accepts whatever social goals may have been given a rhetorical blessing by the existing body politic. It is concerned with connecting effort more effectively to stated or assumed end-benefits; but it does not reconsider the worthiness of the end-benefits. Yet in any politics worthy of the name, this must surely be done as well. Ends must be reflected upon as well as means — which is where philosophy (at least in its traditional sense) comes in.

The social sciences serve two related functions: (a) to assess whether the specified social aims of a scientific research project have been achieved, and (b) to help a scientific research project achieve these specified social aims. There has also been some discussion that the social sciences can help formulate proper aims for science — perhaps by providing effective mechanisms by which the public will contribute to or participate in the formulation of the social aims of scientific research. Yet short of merely instrumental methods that equal broader quantitative participation, the social sciences *sensu stricto* can do little in this area.

Theoretical Dimensions in the Philosophy of Science Policy

The most methodical approach to policy research is what Lasswell calls the policy sciences. In the course of his long, interdisciplinary career, Lasswell sought to advance a method for the systematic analysis of any policy problem (see Lerner and Lasswell, eds., 1951, and Lasswell, 1971). Lasswell's method centers around five intellectual tasks: clarification of goals, descriptions of trends, analysis of conditions, projection of future developments, and invention, evaluation, and

selection of alternatives. These tasks are necessary to address intelligently any number of policy issues, whether public or private, from those associated with taxation or warfare to problems of manufacturing and marketing.

But the special need for policy science is perhaps best seen in relation to science itself broadly construed (that is, in relation to science and technology taken together as interacting aspects of what is often called technoscience). As Lasswell argued in an entry on the policy sciences in *The International Encyclopedia of the Social Sciences* (1968), science is presenting society with a suite of opportunities:

> Weapons of a novel kind lie close at hand, including bombs that paralyze temporarily without inflicting permanent damage. Teaching and research are already in active reconstruction as a result of new instruments of storage, retrieval, and instruction. Competent biologists foresee that the genetic inheritance of man can be deliberately modified. We are told that death itself may be abolished by the substitution of molecules as they wear out. Engineers expect to devise machines that simulate or improve on existing forms of life, including man. (Lasswell, 1968, p. 189)

Given such opportunities, the most demanding questions are not simply scientific but philosophical and policy-oriented: Which of these various forms of science should be promoted or funded? By what mechanisms? What should society do with the products? Should there be any societal regulation? If so, to what ends, and how?

Surely the discovery of the distinctive aims and appropriate strategies for science policy makers, implementers, and researchers must include a significant measure of philosophy, critically reflecting on the clarification of goals, descriptions of trends, analysis of conditions, projection of future developments, and invention, evaluation, and selection of alternatives — and whether these are

the necessary and sufficient intellectual tasks in the science policy process.

But what, more precisely, might a philosophy of science policy look like? There are two ways to respond to this question. One would try to envision the philosophy of science policy as philosophy, the other would sketch a view of the philosophy of science policy as policy research.

In what sense is philosophy of science policy genuine philosophy? Philosophy may be subdivided along two major axes. The first axis is defined by the fundamental questions that constitute philosophical reflection, of which it is common to distinguish five: (1) logic, with which rhetoric and methodology may also be associated (What constitutes a valid argument or sound inference?); (2) ethics (What is right and wrong in human action? What is the nature of the good?); (3) political philosophy (What is justice and injustice?); (4) epistemology (What is knowledge?); and (5) metaphysics and ontology (What is real? How are the different aspects of reality properly distinguished and related?)

A second axis is constituted by the particular fields or *topoi* where such fundamental questions are deployed. This axis yields an indefinite series of regionalizations such as the philosophy of science, of art, of religion, of law, of language, etc. In each of these "philosophies of X" the fundamental questions are re-asked and regionalized, often with differential and distinctive emphases. For instance, in the philosophy of art questions are raised concerning the logic of aesthetic expression, the ethics of artistic creativity, the justice of specific artistic reward structure, the epistemology of artistic knowledge, and the ontology of art objects. However, in the philosophy of language, epistemological questions tend to predominate and ethical questions play hardly any role. The philosophy of science, likewise, is characterized by the prominence of logical and epistemological issues, with only subsidiary attention to ethics, political

philosophy, or metaphysics.

With regard to the philosophy of science policy, it is important to note that if science policy is not as prominent a human phenomenon as, say, art or language, it increasingly rivals science itself as deserving philosophical attention. Moreover, it is important not to prejudge the parameters of this new "philosophy of X." For instance, granted the lack of attention in philosophy of science to political philosophical questions, and given that science policy can be viewed as a kind of politics, it is tempting to present this new field as an appendix to political philosophy, focused primarily on questions of justice in and in relation to science. But, in fact, there are also important questions of the logic of science policy arguments, the ethics of science policy decision making, and the character of science policy knowledge. Finally, because every science policy makes assumptions about the status of science itself, the philosophy of science policy must consider not just the epistemological status of scientific knowledge, but also the ontological boundaries of science as a human activity and of its various institutions.

As a new regional expression of philosophy, the philosophy of science policy will thus include a spectrum of key concerns such as:

(a) The logic of policy methods, including the proper rhetoric of policy recommendations;

(b) The ethics not just of professional scientists but of the relations between scientists and the public, including the special ethical obligations of scientists who are publicly funded and policy analysts supported by public funds;

(c) Justice issues within the scientific communities and between the science and society, including but not limited to questions about the adequacy of

conceptualizations of the social contract for science, the role of scientific expertise in a democratic state, and the proper parameters of public participation in science;

(d) The epistemological strengths and weaknesses of models and simulations; and

(e) Ontological questions related to scientific institutions and their manifold boundary organizations.

Practical Dimensions

But granted that philosophy of science policy may, with attention and development, make a reasonable claim to be philosophy, is it possible also to argue that it can also contribute to policy research? One favorable indicator comes from noting the role of pragmatism within policy research. In his influential outline, *A Pre-view of Policy Sciences* (1971), Lasswell begins by explicitly allying his work with "the general approach to public policy that was recommended by John Dewey and his colleagues in the development of American pragmatism" (p. xix). To date, however, almost no post-Dewey developments in pragmatism — such as those advanced by Willard Van Orman Quine, Donald Davidson, Hilary Putnam, or Richard Rorty (to name only the most luminary) — have been brought to bear on policy science. Indeed, lesser known pragmatists such as John Stuhr (1997) and Larry Hickman (2001) have important contributions to make in order to update Lasswell's analytic scheme for a world of internet communications and globalized economics.

In a précis of the *Pre-View* a quarter century on, Ronald Brunner deftly summarizes the fundamental postulate of policy science: "that people act selectively to maximize preferred outcomes according to their own perspectives; but the acts are less than fully rational because the relevant perspectives are

incomplete, distorted, and unconscious in various respects and degrees" (Brunner, 1996, p. 623). Philosophy can assist people, including policy researchers dedicated to this task, to understand better what rationality consists of, thereby helping to develop a richer and more nuanced sense of rationality by reflective analysis and criticism. This is a time honored contribution to human life from philosophy, even in its most professionalized or academic form. But philosophy can make such a contribution only by becoming engaged with policy and policy research, in the present instance in the form of science policy.

The case for the ability of the philosophy of science policy to make a contribution to science policy research — and even to science policy work itself — is strengthened by focusing on ethics. Policy research and policy work require ethical guidelines of honesty, integrity, loyalty, and more, all of which require protection against incompleteness, distortion, and unconscious or inappropriate adherence. Although it is reasonable to maintain, as Lasswell himself appears to do, that normative positions ultimately rest on meta-normative understandings of reality, still there is a sense in which ethics may be taken as first philosophy. Ethics is not only an analysis of and reflection on moral conduct; it also makes a contribution to the practice of morality and indeed is itself a form of morality. In like manner, the philosophy of science policy should not only analyze and reflect on science policy, but in the process of its reflection contribute to and even become itself a kind of science policy. The philosophy of science policy as policy research and as policy practice will step beyond the bounds of interest group politics and quantitative cost-benefit analyses (without rejecting their achievements), to broaden and deepen science policy decision making and implementation.

The upshot of the pursuit the philosophy of science policy and its integration into science policy work will be a widening and deepening of both — not just in

historical perspective, but in ways that help us confront the daunting challenges we face in living with science. For instance, professional ethical questions have implications not just for personal conduct, but for the structuring of social institutions. The epistemological problems of modeling need to be considered in assessing scientific predictions. And the distinction between science for policy and policy for science may be less ontologically sound than is commonly assumed. Discussions that move from interest group power and economic efficiency to questions of truth, goodness, and beauty can make science policy work richer and more robust — and thus, in a deeper than a political or economic sense, more effective. The philosophy of science policy holds out the promise of promoting science policies that are less incomplete, distorted, and unconscious than they might otherwise be.

The Present Papers

The goal of the present collection of papers is thus to advance a more complete, less distorted, and more conscious reflection on science policy. To this end they include a diversity of issues from different philosophical and national perspectives.

The first paper, by Andoni Alonso, Carlos Castro, and Fernando Solís, describes "Research, Development, and Innovation in Extremadura: A Gnu/Linex Case Study." Against a background of political philosophical concerns for the loss of community in a high-tech, scientific society, the authors analyze the impact of a decision by the regional government in Extremadura, Spain, to support development of free and open source software during the early 2000s. Their argument is that a technoscientific policy may be judged on grounds other than straightforward economic benefit. In this case, benefits of a particular policy have

included communitarian development — a point that will also be suggested as a new and quite appropriate science policy assessment criterion in Turaga and Turaga essay.

The second paper, Eric Cohen's "Science, Democracy, and Stem Cells," is another case study focusing this time on debates regarding stem cell and embryo research. Between Alonso et al. and Cohen the two major technosciences of our time — information technoscience and biological technoscience — are thus given critical case study attention. Following an overview of the current stem cell discussion, Cohen argues its importance as introducing a level of philosophical seriousness into public life, referencing especially the efforts of President George W. Bush's Council on Bioethics. Stem cell research is an occasion for debate between liberals and conservatives about the meaning of science and the nature of the human condition.

"Prolegomenon to a Future Humanities Policy" by Robert Frodeman, Adam Briggle, Erik Fisher, and Shep Ryan is a collaborative essay on how philosophy and the humanities might become more engaged with science policy. It points up a gap between the abundant knowledge produced by the natural sciences and the concrete needs of decision makers, suggesting that neither more science nor more "scientific" policy analysis by themselves will lead to better decisions. A better hope for bridging this gulf lies in bringing the normative and acculturating perspectives of the humanities to bear in policy debates in a way that complements the research of both physical scientists and policy scientists, thereby making their work more relevant to society.

Matthias Gross and Wolfgang Krohn's "Science in a Real-World Context: Constructing Knowledge through Recursive Learning" provides an extended historical and philosophical review of proposals for how the specialized world of

scientific experiment properly contributes to larger (or real) world. In the course of considering the views of philosophers Francis Bacon and René Descartes, poet Johann Wolfgang von Goethe, chemist Justus von Liebig, and social activist Jane Addams, the authors argue that the social support of modern natural science is itself a major historico-social experiment, and must be assessed as such. Frodeman et al. and Gross and Krohn between them offer new ways to see philosophy at work in relation to science, not just in professional philosophy but in the humanities more broadly construed.

With "On the Autonomy of the Sciences" Philip Kitcher undertakes a frontal criticism of the widely assumed idea that the sciences are and/or should be independent of social and political pressures. According to this view, scientists should seek truth no matter where it leads. But exploring a criticism that scientific knowledge production sometimes ignore the common good, Kitcher argues instead that scientists must seek not just truth in general but truths that matter, and truths that matter not just to scientists but also those truths that matter to the larger society in which scientists live and work. This essay thus constitutes an important gloss on the larger argument of his book *Science, Truth, and Democracy* (2001) that seeks to develop the notion of "well-ordered science."

In "From Frontier to Terrorism: Toward an Interdisciplinary Assessment of Science Education Policy Making" Juan Lucena places current arguments in support of increased science funding as part of the defense against terrorism in their larger historical and social context. As his interdisciplinary analysis demonstrates, a rhetorical strategy that first became dominant after World War II was simply adjusted to continue a long-standing appeal for increasing science education for national benefit. Lucena case study thus illustrates again the argument of Frodeman et al., that to ignore humanities perspectives is to fail to

appreciate important dimensions of science policy.

Alison Shaw and John Robinson's "Relevant but not Prescriptive? Science Policy Models in the IPCC" offers a case study in order to describe a new type of relation between science and policy as it has emerged in connection the Intergovernmental Panel on Climate Change (IPCC), the largest example of "mandated science" ever undertaken. Previous studies of the IPCC have emphasized issues related to the scientific credibility of its findings; the focus here is on the credibility of the process and protocols employed to assess "policy relevant but not policy prescriptive scientific information." As a background for this case study assessment, an appendix provides an extended description of the IPCC itself. But the more philosophical argument is that the negotiation of meaning that takes place within the IPCC represents a credible and useful way to bridge the science/policy divide and offers insights into the future role of science in society.

Daniel Sarewitz, Guillermo Foladori, Noela Invernizza, and Michele S. Garfinkel, in "Science Policy in Its Social Context," develop three case studies to support criticism of three common instrumental justifications of scientific research: that it is necessary to create new wealth, to solve particular societal problems, and/or to provide the information necessary for effective decision making. In each case there exist significant disparities between theoretical justification and practical results that arise because the relevant science policy decisions have been made without adequate consideration of the broader social context. Attending to the broader context will improve the capacity of science policy to achieve desired social outcomes, reduce the potential for negative outcomes, or at least create more realistic expectations for what science can actually contribute to society.

Kristin Shrader-Frechette writes, in "Models of Panther Biology and

Radibiology: Philosophy of Science as Scientific Citizenship," with a white heat of moral indignation about the methodological shortcomings in two cases of science for policy. The attempt to use science to downplay dangers of economic development to the Florida panther and of radiological exposure to human health are not just ethically indefensible; they are also bad science. If science is to be used to inform policy it first has to be good science, not just a rhetorical appeal to science to justify special interests. In this essay Shrader-Frechette proposes a new ideal for the professional scientist, that of scientific citizenship, and a justification for her own extensive practice of criticizing science for policy work that is ostensibly science but is in truth aimed to buttress policy decisions that are themselves defective.

"Science Policy for India: A Memo to the Indian Council of Scientific and Industrial Research" is adapted from a real-world white paper by Uday T. Turaga and Rama Mohana Turaga. India is currently reassessing its national science policy, and as part of this process these two early career scientists were asked to contribute their views to a national commission. While granting the value of science they argue, first, that the Indian government should be more critical in applying its own traditional criteria for assessing science funding and, second, develop new metrics for assessing such funding. Serious consideration should be given to developing new criteria for assessing policies for science related to the ability of science to assist weaker members of society, increase scientific literacy, and promote national integration.

Ambrosio Velasco Gómez's "Toward a Political Philosophy of Science" provides a fitting conclusion to this collection by returning to the 20th century roots of standard approaches to the philosophy of science, and then deploys the resources of analytic philosophy of science to argue for the relevance of moral and

political issues even when focusing on the epistemological or internalist aspects of science. His claim is that insofar as Otto Neurath, Pierre Duhem, and others have correctly noted the under-determination of theory by empirical observations, there are good reasons for collaboration between scientists and citizens concerning the production of scientific knowledge. Reinforcing Kitcher, Velasco Gómez argues that even from within the framework established by debates regarding assumed distinctions between the context of discovery vs. the context of justification as well as externalist vs. internalist approaches to science, there exists an implicit political philosophy of science. The attempt to privilege epistemology over politics inevitably has political ramifications. The conceptual analysis presented here thus complements and confirms the more historical-social analysis developed by Gross and Krohn, that experiment takes place not only in the laboratory but in the science-society relation as well — and calls for philosophical assessment.

Three features of these contributions deserve highlighting. First, the 23 authors of these 11 papers represent seven different countries (Canada, Colombia, Germany, India, Mexico, Spain, and United States). Second, more than half (six out of eleven) of the papers are co-authored — in two cases by four authors. Third, few of the authors are professional philosophers; indeed they represent more than a dozen disciplinary backgrounds. None of these features are accidental. Pursuit of the philosophy of science policy is inherently international, collaborative, and interdisciplinary. Also of note is the importance of case studies and the complementary character of historical and analytic approaches. It is our argument and the witness of this collection that in all these respects possibilities for the philosophy of science policy offer opportunities to enrich philosophy — and thereby to contribute to science policy.

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