

Polanyi On Science Policy

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INTRODUCTION

Science policy implements a social contract. In the US since World War II, this arrangement has amounted to society – through government – giving science – both money and relative autonomy while, in return reaping the practical benefits that inevitably result. The arrangement once may have been appropriate, but it no longer is; we now need a new understanding of how science serves national needs.¹

This comment comes from a 1998 article in *Physics Today* and is a part of a larger set of discussions about science policy in the United States that have been occurring for at least a decade. With the end of the Cold War, values and assumptions long in place have come up for question. Scientists, policy makers, and other scholars have been working to help the scientific community, as this article puts it, “negotiate a new contract with the society that funds it.”² U.S. political culture has begun to reconsider questions about shaping science for the public interest; many speak an overtly utilitarian idiom. This is a return to issues that Michael Polanyi was vitally concerned about in the middle decades of the last century. It is thus interesting to revisit today some of Polanyi’s ideas about science policy. That is the project I undertake in the discussion that follows. Polanyi’s approach to science policy cannot, however, be simply framed in the utilitarian, contractual idiom suggested by the recent article I have quoted in *Physics Today*. That is, good policy, in Polanyi’s account, requires a broader appreciation of the nature of science and the relation between science and

¹ Roger A. Pielke Jr. and Radford Byerly Jr., “Beyond Basic and Applied,” *Physics Today* 51:2 (February, 1998): 42.

² Pielke and Byerly, 42.

society. My discussion begins with a biographical note on Polanyi's introduction to questions about science and society; following this, I outline the broad issues Polanyi treats as germane to science policy as these appear first in his early essays and then in his late writing.

THE SEEDS AND GROWTH OF POLANYI'S PHILOSOPHICAL IDEAS

At the beginning of his 1966 book *The Tacit Dimension*, Polanyi announces that his move into philosophy was an "afterthought to my career in science."³ Polanyi here is acknowledging that he became interested in the issues treated in philosophy of science only because in his scientific career he was confronted by questions about power and authority in science. Such questions came from both Polanyi's personal experience as a research scientist and his experience as an interpreter of scientific affairs in the Soviet Union during Stalin's era. Each of these roots of Polanyi's thought merits a brief initial comment.

Some of Polanyi's late articles reflecting on his early scientific work on adsorption and crystals⁴ make clear that he sees his own research as shaped by the dynamics of authority within science and also, in some ways, by the vicissitudes of history in the period of World War I. About his work on adsorption, he remarks:

I would never have conceived my theory, let alone have made a great effort to verify it, if I had been more familiar with the major developments in physics that were taking place. Moreover, my initial ignorance of the powerful false objections that were raised against my ideas protected those ideas from being nipped in the bud. Later, by undertaking the labour, necessary to verify my theory, I became immune to these objections, but I remained powerless to refute them. My verification could make no impression on minds convinced that it was bound to be specious. (KB, 91).

Polanyi here and in other places uses his own scientific career illustratively. He acknowledges that his philosophical perspective in part grew

³ Michael Polanyi, *The Tacit Dimension*, (Garden City, NY: Doubleday and Company/Anchor Books Edition, 1967): 3. Citations to Polanyi's writing, after the initial citation, are in parentheses by title abbreviation and page number. *TD* is the abbreviation for *The Tacit Dimension*.

⁴ See, for example, Michael Polanyi, "The Potential Theory of Adsorptions" (originally published in 1963) and "My Time with X-rays and Crystals" (originally published in 1962); both are included in *Knowing and Being: Essays by Michael Polanyi*, Marjorie Grene (ed.). Chicago: University of Chicago Press, 1969. Citations to essays in this volume are hereafter in parentheses by the title abbreviation *KB* and page number(s).

out of his own research experience and the questions that this experience brought forth. It is a short step, for example, to link some of Polanyi's later reflections in the fifties on the work of Evans-Pritchard and his application of this to science as growing out of early puzzles that emerge from his experience in working on adsorption and crystals.⁵ But as I try to show below, questions and responses to questions Polanyi might have developed about the internal governance of science from his own experience are not, in the final analysis, separable from his questions and constructive claims about the relation of the scientific community to larger society.

Although Polanyi does draw on his first hand acquaintance with the internal dynamics of authority within science, his comment about his philosophical career coming as an afterthought primarily reflects his sense that his philosophical thought grew out of his role as an interpreter of science in the former Soviet Union. In *The Tacit Dimension*, he says he "first met questions of philosophy when I came up against the Soviet ideology under Stalin which denied justification to the pursuit of science" (*TD*, 3). An extensive discussion of his role as an interpreter of Soviet science and where this led his own career is included in the 1963 introduction (titled "Background and Prospect") to the University of Chicago Press reprint of *Science, Faith and Society* (1946).⁶ Here Polanyi discusses his visit to Communist theoretician N. I. Bukharin in Moscow in 1935 (two years after Polanyi came to England) where he confronted the notion that a distinction between pure and applied science is a capitalist illusion. Polanyi also reviews the emergence of the movement in Great Britain "to give social guidance to the progress of science" (*SFS*, 7), a movement against which, for a number of years and in a number of venues, Polanyi was an outspoken leader. In his new introduction, Polanyi suggests that efforts to plan science were the fruit of the Russian Revolution⁷; Marxist ideas thus opened for Polanyi larger questions about the nature and justification for science:

Their acceptance of Lysenko's authority was based on their philosophy of science. What philosophy of science had we in the West to pit against this? How was its general

⁵ See "The Stability of Beliefs," *British Journal for the Philosophy of Science* 3:11 (November, 1952): 217-232 which is incorporated in *Personal Knowledge* (Chicago: University of Chicago Press, 1958 [hereafter *PK*], 286-294.

⁶ Michael Polanyi, *Science, Faith and Society* (Chicago: University of Chicago Press, 1964 (hereafter *SFS*) which is, as noted, a reprint of the 1946 Oxford University Press text.

⁷ As I note in later discussion, Polanyi has quite a bit to say about Marxism. Sometimes he links it with utilitarianism. He also sometime connects Marxist approaches to science with positivism broadly understood. Neither positivism nor Marxism provides a satisfactory account of science Polanyi argues.

acceptance among us to be accounted for? Was this acceptance justified? On what grounds?

Marxism has challenged me to answer these questions: the essays republished here were written in reply to them. Like the Marxist theory, my account of the nature and justification of science includes the whole life of thought in society. In my later writings it is extended to a cosmic picture (*SFS*, 9)

As he understood almost twenty years after its original publication, *Science, Faith and Society* was his first extended constructive philosophical response to the set of large questions that he saw Stalin and Marxism raising.⁸ In succeeding later philosophical books (particularly *Personal Knowledge, The Study of Man, and The Tacit Dimension*), Polanyi amplified the constructive philosophy (i.e., the articulation of his vision of science and his broader vision of the human enterprise) that began in *Science, Faith and Society*. His early analysis of what he took the problems of western culture to be also is more clearly and fully developed in some of these later works. That is, Polanyi's critical philosophy is also refined in later writing. Certainly, by the time of *Personal Knowledge*, Polanyi not only analyzes and indicts Marxist social planning. In *Personal Knowledge* and later works, he critically discusses at length elements grounding the mindset of modernity that reach back to the Enlightenment (e.g., the emphasis upon doubt, tradition as suspect, the view of mind as separated from body, etc.).⁹

⁸ As I suggest here and in the rest of this paragraph, I find it helpful to describe Polanyi's philosophical thought in terms of its critical and constructive components. The distinction is somewhat artificial since these components are often woven together in the writings; nevertheless, it is a useful distinction. The critical components are concerned with Polanyi's analysis of prevailing philosophical accounts or cultural dispositions and their shortcomings. The constructive components are concerned with alternative accounts or visions, with the post-critical program alluded to in the subtitle of *Personal Knowledge*, "Towards A Post-Critical Philosophy." If Polanyi's writing is considered chronologically, it is relatively easy to see the development of critical components moving from concern with planned science to a broader critique of many elements of Enlightenment thought. The development of Polanyi's constructive thought moves from early concern with organization (spontaneous and corporate orders) to epistemology and a vision of human beings as responsible and curious citizens of the evolving cosmos.

⁹ Michael Polanyi, *Personal Knowledge: Towards a Post-Critical Philosophy* (New York: Harper and Row, 1958). Some of these themes treated at length in *Personal Knowledge* and later books are also treated least in early publications.

POLANYI'S EARLY DISCUSSIONS OF SCIENCE AND SOCIETY

As Polanyi began to follow the Stalinist persecution of scientists and to think about the Marxist inspired rationalizations for planned science, his own alternative philosophical views slowly began to take shape in the thirties and forties. Below I review what can be regarded as Polanyi's early stage criticism of planned science, since his own ideas about science policy can be seen emerging in these criticisms.

In a 1936 review of J. D. Bernal's *The Social Function of Science*, Polanyi includes a lengthy discussion of what he dubs "the liberal view"¹⁰ that is his alternative to the views of Bernal. This view, Polanyi says, sets forth his stand "concerning the distinction between pure and applied science, and concerning the relation of science and society." ("RDS", 63). Polanyi argues that it is necessary and possible to distinguish theoretical and practical endeavors and theoretical and practical knowledge. He acknowledges that some kinds of practical knowledge are more empirical and some kinds are more rational. He admits that in the modern world there are "scientifically trained inventors" ("RDS", 65) responsible for many innovations in industrial practice. From this has come the notion of the "application of science to industry" and the term "applied science" which is distinguished from "pure science" ("RDS", 65). Polanyi affirms that there is a degree of cross-fertilization between theoretical and practical knowledge:

The discoveries made by the empirical crafts often prove later to be interesting objects of scientific investigation ('stimulation of science by industry'); and, on the other hand, knowledge gained and stored up by science is widely used by the modern inventory to contrive new processes and new apparatus ('application of science to industry') ("RDS", 65).

Nevertheless, Polanyi is quite convinced it is important and possible to distinguish the theoretical interests of science from any practical ends:

But it should also be clear from our description of science as an organism of ideas, that scientific research, which is the growth of the organism, cannot be deflected from its internal necessities by the prospects of useful application—any more than the empirical search for a practical advantage can turn aside to consider what interest science might take in the result ("RDS", 65-66).

¹⁰ Michael Polanyi, "Rights and Duties of Science", *Society, Economics and Philosophy: Selected Papers Michael Polanyi*. R. T. Allen (ed.). New Brunswick, NJ: Transaction Publishers, 1997: 63. This is a reprint of the review that originally was in *The Manchester School of Economic and Social Studies*, VII, 1936: 96-116. Parenthetical citation hereafter uses "RDS" and page number.

Polanyi grants that scientific method can be important in both theoretical and applied pursuits, but he contends that the purposes and results of theoretical endeavors have a striking character:

While the scientific method plays a part in both, the purpose pursued and the results achieved in the two cases are easily distinguishable. The intellectual events which start with Copernicus and end with Einstein form a process of continued penetration into the nature of things. It forms a series of discoveries into the laws of nature, ever widening in scope and delving ever further into greater depths.¹¹

Polanyi argues that the logical structure of pure and applied science is different:

The progress of mechanics, of which I have given an outline through four centuries, can be seen to go on continuing on the lines of the same basic ideas. Each new phase re-states that which was known before and reveals that its predecessor was the embryo of a truth wider and deeper than itself. We are faced with a persistent unfolding of thought by logical stages. Technology progresses differently. Lighting is constantly made cheaper and pleasanter. To that extent the development is also consistent and continuous. But logically each forward step represents a new departure. (*LL*, 74-75).

Finally, Polanyi contends also that economic criteria allow clear distinctions between pure and applied science. While pure science “cannot be affected in its validity by variations of supply or demand,” applied science is necessarily enmeshed in economic affairs: “No technology can remain valid in the face of a sharp drop in the demand for its produce or a steep fall in the supply of its raw materials” (*LL*, 74).

Polanyi’s “liberal” perspective is one that he summarizes by pointing to science as an intrinsically valuable enterprise because of its interest for human beings. But he also adds that expanding scientific knowledge opens up the fund of knowledge that can be used for practical ends:

Society cultivates science as an organism of ideas, which powerfully attracts the minds of intelligent people. Science as a whole, as well as the various branches of science, are valued for two combined reasons – the intrinsic appeal of the subject matter and the power of the theoretical interpretation. Society cultivates science also in order to increase the store of knowledge available for practical application. Whichever of these motives prevails, the resulting endowment should always be given freely, for science to pursue its own aim; namely, the further development of its several branches” (“RDS,” 67).

¹¹ Michael Polanyi, *The Logic of Liberty*. Routledge and Kegan Paul, 1951: 73. This discussion comes in Chapter 5 of *The Logic of Liberty* which is an expanded version of a 1945 essay. This discussion of the science planning movement and of pure and applied science is a more careful and cogent argument than some earlier ones. Parenthetical citations from *The Logic of Liberty* that follow use *LL* and page number.

The key here is that science is what Polanyi regards as a community cultivating intrinsically valuable mental goods or ends. In the thirties and forties, he sometime puts this in terms of the pursuit of “spiritual aims” (“RDS”, 67) or “spiritual duties” (“RDS”, 68). He links the pursuit of such aims with the protection and exercise of principles of liberty:

Science, munificently showering gifts on all men, when allowed freely to pursue its own spiritual aims but collapsing into a barren torpor if required to serve the needs of society, makes a powerful argument for liberty (“RDS”, 67).

In an article in 1940, Polanyi makes similar points a bit less floridly in a constructive argument. He develops a rather elaborate comparison between what he regards as two “alternate methods of ordering human affairs.”¹² These fundamentally different schemes or approaches for human social endeavor he dubs “planning” and “supervision” or, alternatively, “comprehensive planning” and “supervisory authority” (“CP”, 129). The model for the first approach is hierarchical, military organization. Polanyi regards comprehensive planning as an appropriate strategy when action calls for a general plan in which “every further and further detail fits into it, and has significance only as its execution” (“CP”, 125). But Polanyi argues that many social endeavors cannot prosper as comprehensively planned activities. He affirms, “supervision is in the first place the method by which the cultivation of things of the mind is regulated.” (“CP”, 127). Polanyi points out that the presuppositions of supervisory authority are fundamentally different than those of comprehensive planning:

Supervision presupposes human activities which are initiated from a great multitude of centres, and it aims at regulating these manifold impulses in conformity with their inherent purpose. It achieves this by making generally available social machinery and other regulated opportunities for independent action, and by letting all the individual agents interact through a medium of freely circulating ideas and information. (“CP”, 127).

Clearly, Polanyi thinks science can prosper only when operating under “supervisory authority.” Science is an endeavor of creative thought and individuals attracted to this important endeavor must be fundamentally at liberty to devote themselves to interests:

¹² Michael Polanyi, “Collectivist Planning”, *Society, Economics and Philosophy: Selected Papers Michael Polanyi*. R. T. Allen (ed.). New Brunswick, NJ: Transaction Publishers, 1997: 129. Allen notes that this is reprinted from *The Contempt of Freedom*, London, Watts, 1940: 27-60. Parenthetical citation hereafter uses “CP” and page number.

The position of science in society is thus seen to be merely a special feature of the position of thought in society. Its consideration is so important because it strikingly points to the general fact that society must cultivate thought and not attempt to dominate it – for fear of seeing it drowned in the morass of some eternally stagnant orthodoxy – and also because it shows how society, in order to perform this spiritual duty, must grant its citizens freedom to devote themselves to the sphere of ideas, and must secure them the right to appeal from its own commands to the superior judgments of this realm. (“RDS”, 68).

Polanyi thinks of Marxism and Marxist-influenced calls for planned science (as well as Fascism) as fundamentally misguided because they do not affirm that thought is important in society; thought merely reflects society rather than shapes it. Polanyi was convinced in his early writing that a materialistic reading of the history of science had become dominant in culture:

The plea for the planning of science is reinforced further by a materialistic interpretation of the history of science. In its light the supposed independence of scientific progress appears as a mere illusion. Science, it would seem, has actually always advanced only in response to social needs. The representatives of this theory have given elaborate analyses of the history of science, purporting to show how each step forward was socially determined. Thus the planning of science, they urge, would merely bring into the open the existing position of science and there could be no question of any violence done thereby to its spirit (*LL*, 69)

Perspectives that do not affirm the key role of thought in shaping society do not protect the liberty to pursue thought:

The Marxist doctrine of social determinism and the kindred teachings of Fascism, claiming that thought is the product of society and ought, therefore, to serve the State, removes all ground on which to consolidate an authority, to which man could justifiably appeal against the commands of the State. If on the other hand it is admitted that the realm of thought possesses its own life, then freedom is not only made possible but its institution becomes a social necessity (“RDS”, 67).

Polanyi does grant that the motives and outlook of figures like Bernal and others who favor a planned science are not always merely a reflection of the conviction that intellectual processes are determined by the modes of production: “The major force behind this attitude is the passionate desire to put science into the consciously organised service of human welfare” (“RDS”, 71). But this passionate desire Polanyi regards as a manifestation of the enhanced moral passions found in modern society; such passions have become unrealistic and contorted. In the political forms and philosophy of the late nineteenth and twentieth century, Polanyi contends that enhanced moral passions have been undercut by skepticism imparted by impossible Enlightenment ideals for knowledge.

This combination, which Polanyi by the fifties and sixties dubs “moral inversion,”¹³ has led to contemporary violence and nihilism:

Marxism is a revolutionary utilitarianism, Nazism a revolutionary romanticism. But their seductivity is of a similar kind; it lies in offering paths of intense political action to men estranged by a moral rebellion armed with moral scepticism, a combination which I have equated – not without historical reasons – with nihilism (“AP”, 98).

Polanyi held that efforts to plan science to promote human welfare will fail to produce scientific progress and will ultimately corrupt the process of scientific inquiry. He argues that the growth of science occurs as a progressive, but always surprising, deepening of a framework of meaning:

To illustrate the growth of science we must imagine a statue which, while it is being pieced together, appears complete at every successive stage. And we may add that it would also appear to change its meaning on the addition of every successive fragment – to the great and ever renewed surprise of the bystanders (*LL*, 89).

Comprehensive planning can only hamper this pattern of growth:

No committee of scientists, however distinguished, could forecast the further progress of science except for the routine extension of the existing system. No important scientific advance could ever be foretold by such a committee (*LL*, 89).

The areas “at which the existing system of science can be effectively amended reveal themselves only to the individual investigator” (*LL*, 89):

The pursuit of science can be organized, therefore, in no other manner than by granting complete independence to all mature scientists. They will then distribute themselves over the whole field of possible discoveries, each applying his own special ability to the task that appears most profitable to him (*LL*, 89).

Against Bernal, Polanyi points out that his lengthy book never is able concretely to identify exactly how in fact scientific progress could be turned more directly toward enhancing human welfare:

However brilliant and instructive pages of the book have no answer to the question: how should the progress of science be directed in order that it may benefit human welfare. The process remains mysterious up to the end (“RDS”, 71).

¹³ Michael Polanyi, “A Postscript”, *Society, Economics and Philosophy: Selected Papers Michael Polanyi*. R. T. Allen (ed.). New Brunswick, NJ: Transaction Publishers, 1997: 98. Allen’s reprint is of the Polanyi essay of the same title that appeared at the end of the volume *History and Hope: Tradition, Scepticism, Fanaticism in Modern Society*, K. A. Jelenski (ed.). London: Routledge and Kegan Paul, 1962: 185-196. This volume included Polanyi’s “Beyond Nihilism” which treats similar themes as the opening essay. Parenthetical citations from “A Postscript” that follow use “AP” and page number.

In many of his writings, Polanyi discusses the ways in which Soviet genetic research, in the period of Stalin, was corrupted under external political pressures. He argues that control of research must be returned to scientists who believe in the importance of thought and who are free to make independent judgments. Science, Polanyi contends, must be governed by “scientific opinion” (LL, 66)¹⁴:

One thing only is necessary – but that is truly indispensable. All that is required is to restore the independence of scientific opinion – to restore fully its powers of maintaining scientific standards, through the selection of papers for publication, through the selection of candidates for scientific posts, through the granting of scientific distinctions and in the award of special research subsidies; to restore to scientific opinion the power of controlling by its influence the publication of textbooks and popularizations of science, and the teaching of science in universities and schools; to restore to it above all the power of protecting that most precious foothold of originality, the position of the independent scientist – who must again become sole master of his own research work (LL, 66).

Polanyi argues that there is a “cooperation of independent minds” (“CP”, 131) at work in science. He distinguishes what he terms “economic and intellectual systems of spontaneous order” (LL, 166) by pointing to the difference between competitive and consultative action:

I have analysed, side by side, economic and intellectual systems of spontaneous order and have shown that the individual actions by which the former operate are purely competitive, while those of the second are in the first place consultative, i.e., adjusted with reference to an established professional opinion (LL, 166).

Polanyi frequently links the cooperation found in science and other intellectual systems with the pursuit of truth¹⁵:

. . . in the case of science, the workers all intercommunicate by rapidly publishing the results achieved in cultivating different arts of the same major task. This is the co-operation of independent minds devoted to the pursuit of an aim which, though it is beyond the perception of any, yet is jointly guiding their several thoughts. It is the co-operation which arises by the pursuit of truth and other parts of human culture. In the Liberal State the cultivation of science is public concern, in the performance of which the community is guided by scientific public opinion. Recognised scientific ability forms a claim to official support, and new branches of knowledge are similarly taken up officially, once they are recognised by science. Thus science governs itself under the goodwill of Society. The State

¹⁴ The important term “scientific opinion” appears in the fourth chapter “Self-Government in Science,” and section V of this chapter is an extended discussion of Soviet genetics. Polanyi identifies his discussion as a “demonstration given here of the corruption of a branch of science, caused by placing its pursuit under the direction of the State. . .” (LL, 65).

¹⁵ There is an interesting, extended, and somewhat similar discussion of truth in connection with free discussion, fairness, tolerance and dedication in the final chapter of *Science, Faith and Society* (SFS, 63-84). Polanyi seems, from his earliest philosophical writings forward, to believe it is important to reintroduce straightforward discussions about truth in science and social life.

fulfils its supervisory duties by protecting and subsidising science as a whole, while letting the administration of scientific affairs operate under the control of scientific opinion. ("CP", 131).

Although in his later writing he is more apt to speak about the depth and significance of reality,¹⁶ in his earlier writing Polanyi seems to have the idea that scientific explorations and especially scientific discoveries inevitably are complementary because of the nature of truth. Discoveries necessarily fit together as part of the puzzle of truth:

The mutual consistence between discoveries simultaneously or in close succession to one another requires no explanation to those who recognise the existence of Truth. A statement which is part of Truth will always be consistent with another part of Truth; and both parts together will reveal a further, more comprehensive aspect of Truth. This is just as necessary as that two pieces which fit into neighbouring gaps of an unfinished jigsaw puzzle must also fit to one another ("CP", 131).

In one interesting early discussion, Polanyi contrasts the medieval and modern methods of investigation; the key to the success of the modern scientific method is its decentralization, but this approach is grounded in underlying convictions about the way in which elements of truth coalesce:

... it is the essence of science, in contrast to scholastic speculation, that it advances piecemeal, by extending knowledge wherever discoveries can be made and not with references to a central problem. Science has emerged from medieval scholasticism precisely by abandoning such comprehensive tasks as the search for the Philosopher's Stone and for the Elixir of Life, and by applying itself instead to specialised pieces of research, knowing that the parts of truth thus discovered must form a joint pattern in the end ("CP", 132-133).

Science, in Polanyi's account, is modernity's highly successful, specialized community of inquiry. It should be governed by scientific opinion, but must be supported by the state and, as noted above, by the goodwill of the general public. The importance of the public's general interest in

¹⁶ See for example the discussion of reality in Polanyi's 1963 new introduction to the reprint of *Science, Faith and Society* (10) or the discussion in his 1964 essay "The Logic of Tacit Inference" (KB, 141). Some discussion below draws on this material, showing the way Polanyi dwells in later writing upon "reality" and links reality and truth. I recently made an attempt to sort out what kind of realist Polanyi is. See my essay "Polanyi's Participative Realism" (*Polanyiana*, 6:2 (1997): 5-21 which is an account that draws a number of parallels between Polanyi's realism and that of Charles Sanders Peirce (also on the *Polanyiana* web site at <http://www.kfki.hu/chemonet/polanyi/9702/mullins.html>).

A number of others have been interested in the issue including Ester L Meeks ("Contact with Reality: An Examination of Realism in the Work of Michael Polanyi" Diss. Temple University, 1985), Andy Sanders (*Michael Polanyi's Post-Critical Epistemology: A Reconstruction of Some Aspects of Tacit Knowing* [Amsterdam: Rodopi, 1988]) and John Puddefoot ("Resonance Realism", *Tradition and Discovery: The Polanyi Society Periodical* 20: 3, 29-39). A special issue of *Tradition and Discovery* focusing on Polanyi's realism (including these and other authors) was published in 2000 (26: 3).

cultivating scientific knowledge should not be overlooked, according to Polanyi. Science has gradually reshaped the worldview of cultures in which it is cultivated, although there remain “persistent centres of heterodoxy” which are a “constant challenge to science” and from which “may emerge in the future some element of truth inaccessible to the scientific method” (LL, 58). Polanyi is clear, however, that science has, for the most part, convinced the public that it offers a true explanation of nature; there is therefore a symbiotic relation between the scientific community and the interested public:

Men must form ideas about the material universe and must embrace definite convictions on the subject. No part of the human race has ever been known to exist without a system of such convictions and it is clear that their absence would mean intellectual annihilation. The public must choose, therefore, either to believe in science or else in some rival explanation of nature, such as that offered by Aristotle, the Bible, Astrology or Magic. Of all such alternatives the public of our times has in its majority chosen science (LL, 57-58).

Despite the public’s interest in science, Polanyi is careful to specify the kinds of satisfaction provided to the public as well as the level of understanding to be expected from the public. The cultivation of science or any system of thought cannot be evaluated in the terms appropriate for economic systems; in scientific research

... it is impossible to parcel up and hand out to individual consumers the results of such labours, which in fact cannot be consumed at all. The satisfaction which they give is of an inherently communal nature, as that given by beautiful public buildings or victories in war. And secondly, even if the results could somehow be individually consumed, the individual members of the public would not be competent to judge them, but would have to take their lead from the guardians of the professional standards who act as the public’s agents in supervising the various fields of mental cultivation and supplying an authoritative assessment of their fruits (LL, 167).

In sum, the several themes discussed above in Polanyi’s writing in the thirties, forties and early fifties emphasize that science is a growing “organism of ideas” (“RDS”, 65). Science as a community cultivating intrinsically valuable human interests must be organized in the appropriate manner, in a way that encourages individuals to pursue interests while adjusting to changes in the larger environment of ideas. Scientific work, Polanyi suggests, includes certain presuppositions about truth and the liberty of the individual to state conclusions taken to be true. Polanyi seems to think the state must play a largely non-directive role protecting and supporting science; the general public’s support is also of some importance. The public is and should be interested in and positively disposed toward scientific endeavor. But this is the case also for any other area in which mental excellence is cultivated; scientific work, however, Polanyi points out, has decisively influenced the worldview of most modern persons. Although

sometime Polanyi notes that science produces knowledge that can have utilitarian value, he does not argue that it is primarily the practical utility of science that justifies its support by society. He suggests that the public should take from scientific work a communal satisfaction, which is akin to the public's appreciation of beautiful public buildings. The actual administration of the scientific community must be left under the control of scientific opinion, Polanyi's emphasizes. The public must trust the "guardians of the professional standards" (LL, 167) to supervise and assess the value of scientific work.

POLANYI'S LATE DISCUSSIONS OF SCIENCE AND SOCIETY

Almost all of the themes that appear in Polanyi's early writing about science and society and, more narrowly, science policy, which I have discussed above, reappear in his later writings. Polanyi seems to rework ideas, sometimes expanding them and often pulling them together in interesting new configurations. Many of the themes discussed above are consolidated in an important 1962 essay "The Republic of Science: Its Political and Economic Theory" which was in the first issue of *Minerva*, edited by Polanyi's friend Edward Shils.¹⁷ Rather than comment upon several late discussions, I review below Polanyi's mature statement in this essay. Essentially, Polanyi's claim is that science is self-governing; it is a "dynamic orthodoxy" (KB, 70) whose members are "striving towards a hidden reality for the sake of intellectual satisfaction" (KB, 70). Science is "dynamic" because "it implicitly grants the right to opposition in the name of truth – truth being taken to comprise here, for brevity, all manner of excellence that we recognize as the ideal of self-improvement" (KB, 70). Polanyi implies that many people don't understand the internal dynamics and metaphysical foundations of science that he sets forth; further, he is quite clear that many of the ideals of contemporary culture if taken seriously will destabilize political communities and destroy science. In "The Republic of Science," Polanyi is not, as in some of his early writings,

¹⁷ In his obituary for Edward Shils, Stephen Turner notes that Polanyi's essay "in many respects set out the principal themes of the journal over the next twenty years" (*Tradition and Discovery: The Polanyi Society Periodical*, 22:2 (1995-96): 5). Turner discusses the influence of Polanyi on Shils. He comments on this essay that it "was one of Polanyi's best," which "synthesized and updated his writing on science and its governance and, in several ways, strikingly anticipated later work in 'science of technology studies' particularly with respect to the networks which check and sustain scientists' beliefs in their own results" (5).

preoccupied with the project of arguing against particular efforts to plan science.¹⁸ Here the operation of the scientific community is presented as a model of rationality and excellence that Polanyi seems to hope can be used to revitalize and reorient political and economic theory.

Polanyi begins his discussion in "The Republic of Science" by pointing out that scientists "freely making their own choice of problems and pursuing them in light of their own personal judgment, are in fact co-operating as members of a closely knit organization." (KB, 49). He contends that "the principle of spontaneous co-ordination of independent initiatives" (KB, 50) is at work in science. This means "independent initiatives are organized to a joint achievement by mutually adjusting themselves at every successive stage to the situation created by all the others who are acting likewise" (KB, 50-51). Polanyi argues that the pursuit of science through this "process of self-coordination" (KB, 51) is "the most efficient possible organization of scientific progress" (KB, 51). He suggests that the market system is merely a special case of mutual adjustment mediated by a price system. Scientists, of course, pay attention to current research and are motivated by emerging intellectual challenges and current professional standards. Professional standards are developed and reinforced in the practices of the scientific community.

Polanyi discusses "scientific merit" (KB, 53) in terms of three criteria, plausibility, scientific value and originality, which are in some tension. Work must, Polanyi contends, have a sufficient degree of plausibility to receive a hearing in the scientific community. Plausibility is absolutely fundamental since it determines whether people will pay any attention to findings; in Polanyi's view, because there is always an operative (but dynamic) framework of scientific plausibility¹⁹ journals are able to dismiss out of hand the abundant contributions of "cranks, frauds and bunglers" (KB, 53). Polanyi does recognize that the framework of plausibility evolves in science and good work sometimes is dismissed prematurely. The second criterion of merit is the assessment of scientific value. Polanyi holds that there are three distinguishable "coefficients" (KB, 54) of value that are always mixed together in scientific contributions, but mixed in different proportions in different contributions. The coefficients of value are accuracy, systematic importance and intrinsic interest of subject matter. The particular mix of coefficients explains differences in contributions found

¹⁸ He does, however, discuss efforts to plan science.

¹⁹ Polanyi implies that those properly socialized in the community of science pick up this framework in their socialization but those not properly socialized won't and cannot acquire it.

in the different areas—the “overlapping neighbourhoods” (KB, 55)—of science:

You can see these three gradings entering jointly into the value of a paper in physics compared with one in biology. The inanimate things studied by physics are much less interesting than the living beings which are the subject of biology. But physics makes up by its great accuracy and wide theoretical scope for the dullness of its subject, while biology compensates for its lack of accuracy and theoretical beauty by its exciting matter (KB, 54).²⁰

Finally, Polanyi argues that originality can be an important aspect of scientific merit:

. . . the originality of a discovery is assessed by the degree of surprise which its communication should arouse among scientists. The unexpectedness of a discovery will overlap with its systematic importance, yet the surprise caused by a discovery, which causes us to admire its daring and ingenuity, is something different from this (KB, 54).

Polanyi claims that there is a creative tension between the first two criteria of scientific merit, plausibility and scientific value, and the third criterion of merit, originality. This tension yields a “dynamic orthodoxy” (KB, 70). In essence, the “authority of scientific opinion enforces the teachings of science in general, for the very purpose of fostering their subversion in particular points” (KB, 55):

²⁰ This comment appears a bit strange in the context of “The Republic of Science.” This is an essay whose main objectives are to outline broadly the overall internal governance structure of science and to criticize notions of freedom in modernity. The discussion of “scientific value” is but one small component of the larger account. There are richer discussions in *Personal Knowledge* and *The Study of Man* (Chicago: University of Chicago Press, 1959) of differences among different areas of human inquiry. Charting the territory of human inquiry was a matter of significant interest to Polanyi. *The Study of Man* is a small book (originally the Lindsey Memorial Lectures of 1958) in which Polanyi tries to set forth what he regards as the spectrum of inquiry running from the so-called hard sciences to history. Polanyi notes in the “Preface” (9) that the first two chapters might be regarded as an introduction to *Personal Knowledge*. The third and final chapter is titled “Understanding History.” As I have discussed elsewhere (“Michael Polanyi and J. H. Oldham: In Praise of Friendship,” *Appraisal*, 1:4 (October, 1997): 179-189), it is of significance that this short book on the spectrum of inquiry and the study of history is dedicated to J. H. Oldham. Oldham was an ecumenical leader and an influential friend for twenty-five years; Oldham involved Polanyi in his intellectual discussion groups (The Moot and other later groups convened by Oldham) beginning in 1944. The people and ideas Polanyi met through Oldham importantly shaped Polanyi’s developing thought. Questions about history, culture and religion were central to Oldham’s discussion groups. Polanyi told Richard Gelwick in a 1962 interview that his involvement in Oldham’s discussion groups was more influential upon his thought than anything other than his experience in science (see Richard Gelwick, *Michael Polanyi: Credere Aude—His Theory of Knowledge and Its Implications of Christian Theology*. Th. D. Dissertation. Pacific School of Religion, 1965: p. 11, note 8). Finally, I also note that it is also easy enough to see that most of the material in Polanyi and Harry Prosch’s *Meaning* (Chicago: University of Chicago, 1975) is really an effort to extend this map of the territory of human inquiry to cover not only the sciences but what we conventionally call the “humanities.”

Both the criteria of plausibility and of scientific value tend to enforce conformity, while the value attached to originality encourages dissent. This internal tension is essential in guiding and motivating scientific work. The professional standards of science must impose a framework of discipline and at the same time encourage rebellion against it (KB, 54).

Professional standards in science as they are embodied in the practices of scientists and in scientific institutions (in journals, appointments, etc.), in Polanyi's account, provide the essential structure for the governance of science. Standards embodied in practices and institutions generate scientific opinion that stretches across the overlapping neighborhoods of science. Standards enforce discipline and also promote progress in science. But such standards are in a strong sense rooted in certain metaphysical convictions. Polanyi makes this clear by pointing out how the functioning of standards to encourage both conformity and originality entails certain broader presuppositions about the nature of the things:

This dual function of professional standards in science is but the logical outcome of the belief that scientific truth is an aspect of reality and that the orthodoxy of science is taught as a guide that should enable the novice eventually to make his own contacts with this reality. The authority of scientific standards is thus exercised for the very purpose of providing those guided by it with independent grounds for opposing it. The capacity to renew itself by evoking and assimilating opposition to itself appears to be logically inherent in the sources of the authority wielded by scientific orthodoxy (KB, 55).

This passage in "The Republic of Science" suggests that Polanyi was particularly concerned to clarify the link between "reality," scientific discovery and questions about the governance of science. It is true that in the earlier discussions of the forties, Polanyi sometimes identified science as a "spiritual reality" and explained scientific research in terms of making contact with "reality" (e.g., *SFS*, 24, *SFS*, 35, *LL*, 39, *LL*, 40).²¹ However, it appears that in the sixties, Polanyi rediscovered his own earlier emphasis upon "reality" and focused new attention to this topic as a way succinctly to convey a perspective that binds together the metaphysics of science and the governance of science. In the 1963 new introduction to the reprint of *Science, Faith and Society*, Polanyi comments that

²¹ Some sections of earlier writing about science and reality are confusing because Polanyi will speak of the "spiritual reality of science" (*LL*, 40 italics mine) as well as the efforts of the discoverer to "reach out for contact with a reality in which all other scientists participate with him" (*LL*, 40). The "spiritual reality of science" seems to be an expression Polanyi uses to point to his conviction that scientists accept transcendent ideals such as truth and affirm that they must be at liberty to pursue such ideals. The reality that the discoverer contacts is a reality that is there for other as well as a reality that remains partially hidden.

to hold a natural law to be true is to believe that its presence will manifest itself in an indeterminate range of yet unknown and perhaps yet unthinkable consequences. It is to regard the law as a real feature of nature which, as such, exists beyond our control (SFS, 10).

He identifies this view as “a new definition of reality” (SFS, 10):

Real is that which is expected to reveal itself indeterminately in the future. Hence an explicit statement can bear on reality only by virtue of the tacit coefficient associated with it. *This conception of reality and of the tacit knowing of reality underlies all my writing* (SFS, 10, italics mine).

In a 1967 essay titled “Science and Reality,”²² Polanyi forthrightly announces that

The purpose of this essay is to reintroduce a conception which, having served for two millennia as a guide to the understanding of nature, has been repudiated by the modern interpretation of science. I am speaking of the conception of reality (“SR”, 225).

Clearly, Polanyi believes that Marxist, positivist, and other interpretations of science have dropped the connection between science and “reality.” Even those who oppose positivism, Polanyi says, provide “no statement on the true metaphysical foundations of science” (“SR”, 227). Science and philosophy of science are thereby “left today without any accepted theory of the nature and justification of natural science” (“SR”, 227); reintroducing “reality” is an important corrective:

Rarely will you find it taught today, that the purpose of science is to discover the hidden reality underlying the facts of nature. The modern ideal of science is to establish a precise mathematical relationship between the data without acknowledging that if such relationships are of interest to science, it is because they tell us that we have hit upon a feature of reality. My purpose is to bring back the idea of reality and place it at the centre of a theory of scientific enquiry (“SR”, 226).

Polanyi acknowledges that his effort to reintroduce “reality” is effectively an effort to reintroduce into accounts of science a notion that differs somewhat from earlier conceptions of reality in philosophy:

The resurrected idea of reality will, admittedly, look different from its departed ancestor. Instead of being the clear and firm ground underlying all appearances, it will turn out to be known only vaguely, with an unlimited range of unspecifiable expectations attached to it (“SR”, 226).

²² Michael Polanyi, “Science and Reality”, *Society, Economics and Philosophy: Selected Papers Michael Polanyi*. R. T. Allen (ed.). New Brunswick, NJ: Transaction Publishers, 1997: 225-247. The original article was in *The British Journal for the Philosophy of Science*, XVIII, 1967: 177-196. Parenthetical citations to Allen’s reprint use “SR” and page number.

Polanyi argues that his conception of truth necessarily is intimately bound to his resurrected idea of reality:

If anything is believed to be capable of a largely indeterminate range of future manifestations, it is thus believed to be real. A statement about nature is believed to be true if it is believed to disclose an aspect of something real in nature ("SR", 240).

In "The Republic of Science," Polanyi suggests that governing through scientific opinion does not mean, in a simple sense, that authority is evenly distributed in the scientific community. Clearly, some scientists are distinguished figures and their ideas carry special weight in scientific affairs. Nevertheless, Polanyi claims, the authority of scientific opinion is in important ways a mutual authority between scientists; that is, "scientists exercise their authority over each other" (KB, 56). Every mature scientist (i.e., those who have assimilated professional standards and other requisite skills) is recognized as capable of making independent contact with reality. Such contact joins all scientists in a rational enterprise which Polanyi dubs an exploration striving towards "a hidden reality, for the sake of intellectual satisfaction" (KB, 70). Once the novice becomes a mature scientist, he joins a "chain of mutual appreciations" and bears an "equal share of responsibility for the authority to which he submits" (KB, 56). It is the mature scientist's contact with reality that provides the "independent grounds" (KB, 55) for opposing and reforming prevailing scientific opinion.

To summarize, Polanyi claims that professional standards in science are "the logical outcome of the belief that scientific truth is an aspect of reality" (KB, 55). He is arguing that the metaphysical foundations of science have led to the governance structure found in science. That is, belief that scientific truth is an aspect of reality leads logically to governance through scientific opinion generated by the teaching and enforcement of professional standards.

In "The Republic of Science," Polanyi forthrightly states, as he does in some of his earlier work, that the transmission of scientific standards and scientific opinion relies upon tradition.²³ Tradition is the necessary vehicle for an ongoing community of inquiry such as science. He argues that the

²³ Discussions of tradition in early material are interesting and important. For example, the following passage in *The Logic of Liberty* is about as eloquent as anything that is found in "The Republic of Science":

An intellectual system of spontaneous order can arise only within an existing system of thought. Such a system, transmitted by tradition, may absorb new entrants and guide their contributions in accordance with the traditional standards inherent in it (LL, 166).

era in which science must challenge traditional authorities like the Roman Catholic Church is now long past. Science has and relies upon its own tradition:

We may conclude, therefore, that the appreciation of scientific merit too is based on a tradition which succeeding generations accept and develop as their own scientific opinion. This conclusion gains important support from the fact that the methods of scientific inquiry cannot be explicitly formulated and hence can be transmitted only in the same way as an art, by the affiliation of apprentices to a master. The authority of science is essentially traditional (*KB*, 66).

It is, however, the case that the tradition of science is a tradition that always invites revolution:

But this tradition upholds an authority which cultivates originality. Scientific opinion imposes an immense range of authoritative pronouncements on the student of science, but at the same time it grants the highest encouragement to dissent from them in some particular... Scientific tradition enforces its teaching in general, for the very purpose of cultivating their subversion in the particular (*KB*, 66-67).

Polanyi argues that the intellectual traditions of modernity, ironically, “leave us no grounds for accepting any tradition” (*KB*, 68). His post-critical philosophy is, of course, an attempt to reform Western intellectual traditions in such a way that appreciation for traditional beliefs and values become central. He suggests that late modernity has been a dangerous and unstable period. Although they have usually been ignored in the practices of most working scientists, our intellectual traditions have undercut endeavors like science that are reliant upon living traditions. Modernity, Polanyi argues, developed an understanding of freedom as the individual’s right to self-determination. Such an understanding, Polanyi contends, is misguided. Freedom of the individual “has no bearing on the right of men to do as they please; but assures them the right to speak the truth as they know it” (*KB*, 70). Polanyi distinguishes “private freedoms” from “public liberties” (*KB*, 70), arguing that the latter mark a free society. He suggests that a free society can cultivate excellence in endeavors like science. A free society has the opportunity to be a “society of explorers” (*KB*, 71):

In this view of a free society, both its liberties and its servitudes are determined by its striving for self-improvement, which in its turn is determined by the intimations of truths yet to be revealed, calling on men to reveal them (*KB*, 70-71).

Polanyi’s late essay “The Republic of Science,” like much of his writing in the thirties, forties and early fifties, weaves together questions about the fundamental nature of science and the governance of science. Such matters are inseparable in his view. As I have tried to show, Polanyi argues

that scientific investigations presume certain metaphysical assumptions and such assumptions have led to particular organizational and operational patterns in science. By the time "The Republic of Science" was written (1962), Polanyi certainly recognized that the early debate about "planning" science had ended. Polanyi renews and somewhat broadens this old discussion in his late essay in order to weave together questions about the nature of science and the conditions for its success with larger questions about the prospects for broader political culture. Polanyi suggests that society, like science, should be engaged in cultivating radical progress. To do so requires respect for excellence and recognition that the public interest can be "known only fragmentarily and is left to be achieved as the outcome of individual initiatives aiming at fragmentary problems" (KB, 71).

Those, like the writers in *Physics Today* quoted at the beginning of this discussion, who earnestly seek in contemporary culture to redirect science policy to assure that science serves the public welfare, should consider carefully Polanyi's arguments. Polanyi was not tempted by the slippery slope of a utilitarian rationale, whether in Marxist influenced or right wing dress. Science is primarily an intellectual endeavor, a growing "organism of ideas" ("RDS", 65); cultivating mental excellence in science is significant in human affairs. It produces, in both the scientific community and secondarily, in the broader public, communal satisfaction that is akin to our appreciation of beautiful public works. Although much undoubtedly has changed in science since Polanyi was considering questions about the health and welfare of science, it seems likely some things have not changed. Polanyi's reflections are thus worth the scrutiny of those engaged in the conversation about science policy.