Bridgman and the Normative Independence of Science *

An Individual Physicist in the Shadow of the Bomb

Mahmoud Jalloh

March 11, 2024

Abstract

Physicist Percy Bridgman has been taken by Heather Douglas to be an exemplar defender of an untenable value-free ideal for science. This picture is complicated by a detailed study of Bridgman's philosophical views of the relation between science and society. The normative autonomy of science, a version of the value-free ideal, is defended. This restriction on the provenance of permissible values in science is given a basis in Bridgman's broader philosophical commitments, most importantly, his view that science is primarily an individual commitment to a set of epistemic norms and values. Considerations of external moral or social values are not, on this view, intrinsic to scientific practice, though they have a broader pragmatic significance. What Bridgman takes as the proper relation between science and society is shown through analysis of his many writings on the topic and consideration of his rarely remarked upon involvement in the most problematic example of "Big Science" of his day: the atomic bomb. A reevaluation of Bridgman's views provides a unique characterization of what is at stake in the values in science debate: the normative autonomy of science.

*My sincere thanks to the reviewers of this paper for extremely detailed and helpful comments that greatly improved the manuscript. I would like to thank Christian Damböck for raising this topic to my attention. I'd also like to thank Porter Williams, Matthew Wiseman, and Rachel Keith for general discussions about the value-free ideal debate. Thanks to Junjie Dong for his shared interest and enthusiasm in Bridgman's work and his relation to the Manhattan Project. Special thanks to Alex Wellerstein for providing me with some archival materials and for some hints on how to read between the lines of some formerly classified information. Thanks also to Maggie Boyd, the archivist at the American Academy of Arts and Sciences for providing me with some information and a photograph.

Contents

> No [scientist] can serve two masters: for either he will hate the one, and love the other; or else he will hold to the one, and despise the other. Ye cannot serve God and mammon. (Matthew 6:24)

> [The scientist] has found that it is not sufficient to trust the word of his neighbor, but that if he wants to be sure, he must be able to check a result for himself. Hence the scientist is the enemy of all authoritarianism. (Bridgman 1955, 82)

> Bridgman was a scientific puritan. When he defended science, he defended it as a true vocation, a voluntary dedication to a higher calling. Bridgman asserted that the scientist does not recognize the jurisdiction of any authority other than that dictated by science itself. The duty of science transcends mundane social or political interests. Therefore he felt impatient with contemporary debates about the responsibility of science to society. To many his views were, at best, irrelevant, at worst, simply wrong. (Walter 1990, 264)

1 Introduction: The Value-Free Ideal and Its Discontents

In recent decades much attention has turned to the interaction of values and science—much of it critical of "the value-free ideal".[1] This literature is large and quickly growing; my focus here will be limited to one particular and, I think, important criticism of the value-free ideal: Heather Douglas' (2009) criticism of physicist Percy Bridgman (1882-1961) as a representative supporter of the value-free ideal for science. Whereas Douglas argues that the scientist is not given an exception from considering the moral, social, and political consequences of their work, Bridgman held the view that the scientist can accept no responsibility which would limit their intellectual grappling with the world, "no holds barred". I will argue that a broader look at Bridgman's thinking regarding the proper relationship between the scientist and society and, especially, consideration of his conception of scientific practice provides a challenge to criticisms of the value-free ideal. This requires that I show that there is more to Bridgman's position than Douglas discusses and further that this fuller account of Bridgman's views results in a defense of some version of the value-free ideal that is immune to Douglas' criticism—I will argue that Bridgman's view is defensible and best understood on a *restriction* on values in science to values which can properly be said to be *from* science. While there will be much done in the way of rational reconstruction, I aim to present a view that faithfully represents the best in Bridgman's thinking on these matters across his career. In this introduction, I present Douglas' criticism of the value-free ideal in general and of Bridgman in particular.

Douglas's seminal book, *Science, Policy, and the Value-Free Ideal*, brought renewed focus on the relationship between science and public policy into the mainstream of philosophy of science; This relationship having been, Douglas argues, largely abandoned by philosophers of science in efforts

[1] See Elliott (2017), Elliott and Steel (2017), and references therein for a sense of growth of this area of philosophy.

to avoid scrutiny during the Cold War.[2] The supposed abandonment of deep consideration of the relationship between science and policy was made in tandem with the explicit development of a conception of science suspicious of values: the value-free ideal. According to those in favor of the value-free ideal, the evaluation of scientific theories and experiments ought to be done independently of the moral, political, or social consequences of those evaluations. For Douglas, the value-free ideal is an untenable commitment to the normative autonomy of science, both with regards to its feasibility and its desirability as an ideal. Douglas argues that an acceptance of the value-free ideal amounts to providing scientists with an undue moral exemption from consideration of the consequences of their actions—an insulation of scientists from the rest of society:

> [T]he current value-free ideal rests on the idea that scientists should act as though morally autonomous from society, in particular that they should not consider the broader consequences of their work. (Douglas 2009, 15)

Not only does Douglas argue that scientists are not allotted a moral exemption from charges of recklessness or negligence, but she also makes the case that scientists have special responsibilities *in virtue* of their being scientists:

> There are also the responsibilities that scientists must meet because they are scientists. Responsibilities special to science can be considered role responsibilities, which are those that assist scientists in achieving the central goals of science: improved explanations and predictions about the world around us. They include the precepts of basic research ethics, such as the honest reporting of data, the open discussion of scientific results, and the fair consideration and evaluation of the work of others. There is little or no debate about whether these kinds of role responsibilities should hold for science. For example, all fraudulent reporting of data is roundly condemned. (Douglas 2009, 72)

Douglas certainly has a *prima facie* argument for the role responsibilities of scientists here that is supposed to follow from what I agree is an unquestionable moral phenomenology: we recognize role responsibilities and we have some that we seem to assign to scientists in particular under the heading of "research ethics". Just as a parent has duties to their child that no stranger has, so does a scientist have to the social enterprise of science. Douglas' challenge, then, to the partisan of the value-free ideal is for the provision of reasons why such moral considerations do not apply the investigation and evaluation of scientific theories and experiments.

I argue that Bridgman provides a conception of science on which the responsibility of a scientist, *qua scientist*, excludes considerations of certain kinds of values in the investigation and evaluation of scientific theories and experiments. While this is a statement of (a version of) the value-free ideal, the roots of this claim are found deep in his conception of science as an epistemic project.

[2] An extended account of this can be found in Reisch (2005). I do not question this narrative here, but for a contrary account of this withdrawal see Dewulf (2021).

What makes Bridgman's position unique is that it is founded in a reconceptualization science as a individual practice as opposed to a large social institution—even defenders of the value-free ideal often take on the science-as-social-institution framing.[3] Bridgman was wary of the effects of the looming dominance of "Big Science" which would make each scientist dependent on the approval of the governmental or private funders. Douglas' argument for role-responsibilities—that scientists have particular moral responsibilities *in virtue* of being scientists—depends on a conception of a scientist as already being a socially defined role. If, on the other hand, the scientist is something like an individual epistemic agent, with *sui generis* values, then the core epistemic virtue of such an agent, intellectual integrity, crowds out moral, social and political considerations external to science from their scientific practice. Below I clarify Bridgman's idiosyncratic conception of science, the scientific values and responsibilities which do follow from being a scientist, and why they exclude the sorts of values Douglas and others believe ought to constrain a scientist *qua scientist*.

2 The Significance of the Bridgman Case

In this section I want to introduce some of Bridgman's thinking on the relationship between values and science by way of making clear the significance of his case. First, I will make clear the significance of Bridgman's position for critics of the value-free ideal. Second, I will establish the significance of Bridgman's views in political debates regarding "Big Science" and atomic weapons control. Thirdly, Bridgman's views on the proper relation between science and society will be contextualized with a brief discussion of what is known regarding his involvement in the Manhattan Project. The aim of this section is to establish that Bridgman's views matter, both philosophically and historically.

2.1 Bridgman as Counter to Value-Free Ideal Skepticism

Douglas (2009, 75–79) distinguishes two of Bridgman's arguments for the moral exemption of scientists. There is the strong version, under which the epistemic value of scientific inquiry trumps all other values, and so scientific discovery is worth any cost caused by a lack of control over the process by which it is made or the results that follow. The untenability of the strong version of this argument goes without saying. There is also the weaker version: Imposing moral responsibilities for the results of scientific inquiry on scientists is unacceptable. This places too high a burden for science to work properly, which is unacceptable given the value of scientific discovery. One way to understand this distinction is that the strong version holds that the value of scientific inquiry is incommensurable with but categorically or lexically prior to other values, while the weak version holds that the value of scientific inquiry is commensurable with other values, but just so happens to outweigh the probable costs of moral restrictions. We ought to consider Bridgman's own words:

[3]See, e.g., Betz (2013); Melo-Martín and Intemann (2016); Bright (2018).

> The challenge to the understanding of nature is a challenge to the utmost capacity in us. In accepting the challenge, man can dare to accept no handicaps. That is the reason that scientific freedom is essential and that artificial limitations of tools or subject matter are unthinkable. (Bridgman 1948, 72)

While Bridgman's claims seem to be an endorsement of a version of the strong argument—"scientific freedom is *essential*" and its limitation "*unthinkable*"—the weaker argument is much more plausible, and we might dismiss this language as mere bombast, as Douglas (implicitly) does by offering the weaker interpretation. However, Douglas rejects also the weaker version of the argument. She rightfully points out that there are occasions, like the Trinity test, that the consideration of further outcomes of our investigations—like Hans Bethe's worry that a rogue chain reaction could ignite the atmosphere—are essential to scientific practice itself. Knowledge of the effects of the Trinity bomb could not be known if its explosion resulted in the elimination of all observers! It is the case that the scientist can and *does* take into account various causal, moral, and political consequences of their work—the value of human survival finds its way into scientific decision making.

Examples like the existential risk of the Trinity test tend to serve value-free ideal skeptics as an initial foothold. They are taken to show that values *do* and *ought to* play a role in science, indeed they show that they must. A limited version of the inductive risk argument will not be countered here. What I take Bridgman to supply the conceptual apparatus for is a restriction on the sorts of values which are at play in science. Attempts at such a filter are well known: allowing in epistemic ("cognitive") values and excluding moral ("non-cognitive") values. The existence of such a distinction has been questioned (notably by Longino 1990, 1996). While I share the opinion of Lacey (2017, 17) that such arguments often trade on the well-known fallacy that if a distinction is vague or difficult to account for that it is nonexistent or useless, my aim here is not to enter into this dispute but is rather to provide an alternative or successor distinction between the values that are admissible in scientific practice and those which are not. Rooney (2017) shows that criticisms of distinction between epistemic and non-epistemic value need not be understood as committing a fallacy if we take into account what use such distinctions are meant to be used for: filtering the admissible from the non-admissible values in science. If such a filter is to be determinate, so should the distinction which grounds it. I take Bridgman's idiosyncratic conception of science to provide the basis for such a filter between properly scientific and non-scientific values—leaving behind distinctions of cognitive and non-cognitive or epistemic and non-epistemic as alternative (and evidently problematic) ways of accounting for this distinction that characterizes various forms of the value-free ideal. The value-free ideal has been and will be here understood and defended as a *restriction* on the *sorts* of values that play a role in the core functions of science. In the extreme case the value-free ideal means an elimination of all values from any part of science. Plausible forms of the ideal all allow *some* values into *some* aspects of science; determining which values and where they are admissible is the task before us. Supporters of the value-free ideal aim to minimize the space of admissible uses of values in science, while value-free ideal skeptics aim to grow the space of admissible uses of values in science.

Looking back at Douglas' different interpretations of Bridgman's argument for the necessity of the value-free ideal, we can get a better idea of the different grounds given for such a divide between scientific and non-scientific values. Given my characterizations above, we can understand the two interpretations of Bridgman's argument for the value-free ideal to indicate to general strategies. The strong argument privileges the scientific project over any moral or political project, i.e. scientific values are more important than moral and political values. The weak argument appeals to some absolute conception of value in a weaker way. Given the outcomes of the scientific project, moral and political projects take a backseat or at least should not constrain, the scientific project. These other projects may even be more important than the scientific project, but the benefits of unconstrained science (even by their lights) outweigh the costs. I will give a third interpretation of Bridgman's argument in §3: the values of science *to the scientist qua scientist* are the only values that are to be considered in science. This is in a sense a return to the stronger version of the argument, that scientific values are incommensurable with and prior to other values, but this claim is restricted to the perspective of the scientist. The scientist is one engaged in the scientific project, and so the values of that project are the only relevant ones to the scientist.

I show below that Bridgman's view is more complex than has been appreciated. Bridgman's concerns about the autonomy of science and the threat of moral and political obligations on scientists can only be properly understood in the context of his highly idiosyncratic and *individualistic* understanding of science. Freedom as conceived by Bridgman is a precondition for the scientific project; the scientist has a corresponding *scientific* responsibility and virtue of intellectual integrity. Other conceptions of responsibility, moral or political, are outside the normative realm of scientific rights and virtues. However, Bridgman's internal scientific norms can recapture much of what is right in what I described as Douglas' "moral phenomenology"—Bridgman also has the means to ground what Douglas describes as "role responsibilities" for scientists. The scientist does take up some normative commitments in their acceptance of science as a project, but these commitments are rooted in the nature of the scientific project itself, not from any other authority.

2.2 Bridgman as Critic of Socialized Science

Bridgman was concerned by the socialization of science—its increasing dependence on government monies and scientists' increasing sensitivity to moral and political concerns—well before the Second World War. Most of his principled views on these issues were established in the thirties (see §3). On this basis he became one of the leading critics of socialized, "big" science after the war and served as a foil for many commentators both inside and outside of the physics community. This fact and the less well known fact that Bridgman contributed to the Manhattan project, serve as essential, but complicating, background for understanding his views on the proper relationship between science and society. In this subsection I will discuss Bridgman's role in the postwar debate. In the following subsection, I will detail what is currently known regarding his involvement in the Manhattan Project.

In his 1947 Arthur D. Little Memorial Lecture at MIT, J. Robert Oppenheimer, the "father of the atomic bomb", expressed a widely shared feeling of responsibility towards the creation of nuclear weapons:

> [P]hysicists felt a peculiarly intimate responsibility for suggesting, for supporting, and in the end, in large measure, for achieving, the realization of atomic weapons. Nor can we forget that these weapons, as they were in fact used, dramatized so mercilessly the inhumanity and evil of modern war. In some sort of crude sense which no vulgarity, no humor, no over-statement can quite extinguish, the physicists have known sin; and this is a knowledge which they cannot lose. (Oppenheimer 1948, 66)

Whether or not this quote truly encapsulates Oppenheimer's complex feelings towards the creation of the bomb,[4] it still serves the purpose of a foil insofar as it represents the consensus among physicists at the time. Bridgman, Oppenheimer's former teacher at Harvard, was quoted in a 1948 *Time* story as having a different opinion:

> If anybody should feel guilty, it's God. He put the facts there. (Bridgman quoted in "The Eternal Apprentice" 1948, 77.)

In the very same issue of *Bulletin of the Atomic Scientists* in which Oppenheimer's Little Lecture was reprinted, Bridgman (1948) addressed the issue of "Scientists and Social Responsibility".[5] Bridgman's article expounds a view that he presses in multiple lectures and essays, both before and after the bomb: that the growth of science done under the auspices of government and the increasing pressure—internal and external—for scientists to "take responsibility" for the consequences of their discoveries threatens intellectual freedom. For Bridgman, intellectual freedom is a necessary condition for scientific practice; a threat to intellectual freedom is a threat to the possibility of science, which is nothing other than the free use of "intelligence".

By the end of the war, Bridgman was already a well known commentator on the relationship between science, scientists, and society. In the final letter (in the Harvard archive at least) that Bridgman receives from New Mexico, his thoughts on matters of science and society are called for:

> Everyone here is naturally pleased at the outcome of our efforts, which undoubtedly shortened the war by many months, but are worried as to the future use of our monstrous child. I am looking forward to an opportunity to discuss this with you for I know that you have given much thought to the social implications of science. We have much to do to educate the public before we can expect proper use of technological developments. (Smith to Bridgman, September 20, 1945)

[4] Compare Bird and Sherwin (2005) and Monk (2014).

[5] Bridgman's speech which became "Scientists and Social Responsibility" was in fact given a year before Oppenheimer's Little Lecture. Oppenheimer alludes to a very similar lecture given by Bridgman the year prior at Princeton (see Wigner et al. 1947).

This note highlights an ambiguity in Bridgman's philosophy and actions: on the one hand Bridgman was involved with (and seemingly enthusiastically, see below) socialized science and was concerned with the possible results of scientific discovery and atomic weapons testing.[6] On the other hand, Bridgman repeatedly urged that these developments threatened the scientific project itself. A consideration of his involvement in government research may make for a reconciliation of his words and actions.

Bridgman's involvement in military research (radar) dates back to the First World War. In the aftermath of his service, Bridgman was asked by a certain Captain Defrees to sign a secrecy oath. Bridgman's unhappiness with the request is indicative of his general attitude towards the relationship between a organizations and individuals:

> In the first place, I dislike on principle to take any oath. You know and I know perfectly well what is required of a man who has been in the confidential relation to the Navy that I have. I do not like the imputation that my sense of the requirements of the situation is not sufficient to ensure the correctness of my behavior, and that any mere formality as going before a notary and holding up my right hand is any more likely to make me act in the way which I should.
>
> In the second place, I signed [...] last summer a pledge of secrecy. My position then was that the Navy had a right to ask such a pledge while I was in the service of the Navy, although I objected to such a proceeding in principle. This signed statement from me, which you now have, should be sufficient. A gentleman is not in the habit of being asked to give his word of honor twice.
>
> Finally, I do not understand the attitude of the Navy in asking a man who has left its empy [sic] to give a guaranteewhih [sic] should have been asked of him, if at all, before entering its employ [...] (as quoted in Walter 1990, 15–16)

While Bridgman was increasingly suspicious of government and social interventions on science, this episode shows that this did not mean that scientist should not involve themselves in government work of their own prerogative—and on their own terms.

Bridgman's government work continued with the Second World War. This is not new information, but this fact is not as widely known as one would expect. For instance, it is not mentioned in Maila Walter's (1990) otherwise exhaustive intellectual biography of Bridgman.[7] In fact, this time around,

[6] For example, Bridgman was one of the signatories of the 1955 Russell-Einstein maniefesto ("Russell-Einstein Manifesto" 1955), which urged peace in the face of hydrogen bombs.

[7] The relevant materials were declassified and made available to the Harvard Archive in 1974 (Kenneth Bainbridge to C. A. Elliott, May 6, 1974). Walter must have been familiar with all of the material therein, so, presumably, it was excluded due to a lack of space and its perceived lack of consequence for his physical and social thinking. I note that Bridgman's involvement *is* mentioned in Hoddeson et al. (1993) and Hawkins, Truslow, and Smith (1983), though neither source references the archival material that grounds the discussion here.

Bridgman appears to have volunteered to increase his contribution to the war effort by working on Oppenheimer's project—though his exact motivations are indeterminate.[8]

> After our luncheon I saw Bridgman in the laboratory. He told me that he was not satisfied with the work he was doing for the war, and wanted to find a more intensive job. I told him that we had had it in mind to ask for his help, but that it would be some months before we could profitably use [him]. (Oppenheimer to Conant, October 21 1942)[9]

Far from being aloof in his solitary experimental and philosophical work, Bridgman was a part of the paradigm case of Big Science—though he worked remotely. These working conditions are contrary to what appears to have been the first agreement between Oppenheimer and Bridgman:

> I told him [Bridgman] that this work would be full-time, would necessitate his abandoning his present obligations and his leaving Cambridge. He was delighted with the prospect, and assured me, that he would certainly accept if he were convinced that he could do the work and was needed for it. I in turn told him that I would like to discuss it with him and its technical details but could not do so for some time. He knows of course the general nature of the problems on which we are working." (Oppenheimer to Conant, October 21 1942)[10]

That Bridgman would be "delighted" at the prospects of leaving his work at Cambridge to work unspecified government work seems contrary to his both his general character and habit. However, Oppenheimer was a very charming recruiter in those days.

If the burden of "moral responsibility" on the scientist would interfere with the practice of science itself, as Bridgman seems to argue, then this must indicate something beyond (and so more onerous than) the ordinary considerations which the scientist may make voluntarily or by inner compulsion or in virtue of being a citizen, as some of the commentators on Bridgman's "Scientists and Social Responsibility" in *Bulletin of the Atomic Scientists* claim.[11] In fact, Bridgman seems to recognize that enlightened self-interest ought to lead the scientist to voluntarily take on social responsibility. The self-preserving motivation for scientific responsibility is made explicit in a letter regarding Operation Crossroads, a controversial set of nuclear bomb tests at Bikini Atoll in 1946:[12]

[8] Bridgman's motivations are clearer in light of his remarks on the necessity of universal war service in the face of the draft in his final book: "Perhaps the most important such limitation is that it is only the young men who are physically able to fight in the front line. This cannot be avoided. How, then, shall the rest of us conduct ourselves? It seems to me that the only decent way for the rest of the community to act is for everyone else to devote himself to to making such a contribution as he can to the common efort to ward off the common danger. This means universal compulsory service for everyone in wartime. The ideal would be for everyone to find the niche in which he could make the most effective contribution." (Bridgman 1959a, 302) Working for Oppenheimer allowed Bridgman to find his niche.

[9] BCF (1990), DSM Folder 54 Compton A. H. 1941-1942.

[10] BCF (1990), DSM Folder 54 Compton A. H. 1941-1942.

[11] See Urey et al. (1948), commentators included leading physicists I. I. Rabi and Lee DuBridge.

[12] For more on reactions to Operations Crossroads and a contextualization of Bridgman's remarks, see Wellerstein (2016).

> Suppose the bomb is dropped as at present planned, the ocean does not explode, and that later it should become known to the general public that the argument [that it wouldn't explode] had been weak and that the scientists had permitted the taking of a stupendous chance without doing everything in their power to safeguard all possibilities. *There might well be a reaction against science in general which would result in suppression of all scientific freedom and the destruction of science itself. This appears to me as cause for greater concern than the blowing up of the ocean, which after all would not very much affect a world of dead men.* (Bridgman to Bethe, March 13, 1946, my emphasis)[13]

As shown above, Bridgman is not against scientists considering the consequences of their own work and urging control over technological developments resultant from them *qua* members of the polity. Nor is Bridgman against such considerations in self-interest, lest the rest of society place a moratorium on research, etc. It seems then that Bridgman's actions can be explained by the idea that the non-voluntary socialization of science is to be resisted. Individual scientists may take on responsibility for their work or work at the pleasure of the government on a voluntary basis and in order to preserve a political situation in which science remains possible. The threat of socialized science is existential to the scientific project as Bridgman conceived it, but it may be embraced to the extent to which it eliminates other existential risks to science.

2.3 Bridgman as Manhattan Project Consultant

For the historical record, I here summarize all the major facts I know regarding Bridgman's involvement in the Manhattan Project.

In March 1974, Kenneth T. Bainbridge, Harvard physicist and director of the Trinity test, wrote to the Atomic Energy Commission stating that he found some records of Bridgman's experiments done for the Manhattan Project during the war. The documents were promptly declassified and filed in the Harvard Archive, with Bridgman's other papers.[14] Bridgman's contribution to the war effort began at least as early as 1942 and his contribution to Oppenheimer's project began in late 1943.[15] Bridgman's primary task was to determine the behavior of substances (varieties of uranium) under high pressures reaching as high as 100,000 atmospheres. Bainbridge mentions plutonium in his letter to the Harvard archives, but I find no mention of it in Bridgman's correspondence in the Harvard archives, which mostly concerns uranium hydride. However, apparent allusions to plutonium (e.g. Bridgman to Smith, December 10, 1945) are confirmed by other sources declassified in 1973 or 1980[16] as well as his last published experimental paper, which "reports the results of various

[13] NNSA/NSO Nuclear Testing Archive, NV0128609.

[14] These records can all be found in the Bridgman papers at the Harvard Archive HUB4234.17, quotes courtesy of Harvard library. All uncited quotations in this section are from these files.

[15] "It is almost a year since you and I discussed the possibility of your helping us in the project on which I am now engaged." Oppenheimer to Bridgman, November 8, 1943. See also the letters between Oppenheimer and Conant cited in the above subsection.

[16] NNSA/NSO Nuclear Testing Archive: NV0309126 (Allison to C. S. Smith, CC Openheimer 1945); NV0309137

measurements of the effect of static hydrostatic pressures on plutonium made during the spring of 1945" (Bridgman 1959b, 214). This makes sense of Bainbridge's otherwise confusing mention of plutonium in his introduction to the Harvard materials. He would have known that Bridgman worked on plutonium, though he may have forgotten whether that information was contained in the material he made available to Harvard.

The evidence is clear that the *kind* of experimental work for which Bridgman won the 1946 Nobel Prize in physics directly contributed to the design of implosion-style atomic bombs, like the Fat Man bomb used in Nagasaki.[17] The full extent of Bridgman's involvement in the war effort is not yet clear.[18] In this connection, it is worth mentioning that Bridgman, upon learning about his Nobel Prize, denied any direct involvement in the Manhattan Project, though this has been questioned—and ought to be—in light of his lack of candor regarding the matter.[19] This is not an idle historical curiosity. Bridgman's willingness to engage in "socialized science" and submit his intelligence to government authority may seem to be a great betrayal of his defense of the normative autonomy of science. However, properly understood, this is not at all the case. The normative autonomy of science is to be understood as a thesis regarding which values are intrinsic or internal to science, which is not to say that an individual cannot or should not subordinate parts of—or the whole of—the scientific project to some other project, in this case, the war project. The difficulty of disentangling this view from other versions of the "value-free ideal" goes some way towards explaining why our received understanding of Bridgman's views on science and society have been flattened. I now go on to attempt to give an account of the normative autonomy of science that emerges from Bridgman's various (and sometimes divergent) statements on the topic—this is a project of rational reconstruction, though not (I hope) one that is historically insensitive.

3 The Scientist as Individual

Bridgman was at the center of Oppenheimer's intellectual life at Harvard. In a 1963 interview, Oppenheimer describes his relationship to Bridgman so:

> I found Bridgman a wonderful teacher because he never really was quite reconciled to

(Jette to Bridgman, CC Openheimer, Allison, Smith 1945); NV0309138 (Smith to Oppenheimer, CC Allison, Peierls, Bacher, Holloway, Morrison, Bethe, Smith 1945); NV0309140 (Smith to Oppenheimer, CC Allison Peierls, Bacher, Holloway, Morrison, Bethe, Metropolis, Smith 1945).

[17] See Oppenheimer to Conant, November 8, 1943 in BCF (1990), DSM Folder 141 Oppenheimer.

[18] Evidence of Bridgman's acting in an advisory or negotiating role in the transfer of a cyclotron from Harvard to Los Alamos can be found in "Interview of Robert R. Wilson by Lillian Hoddeson on 1980 November 18", Niels Bohr Library & Archives, American Institute of Physics, College Park, MD USA, www.aip.org/history-programs/niels-bohr-library/oral-histories/30094-5.

[19] "[Bridgman] stated, however, that the award could have nothing whatever to do with the work he did for the Government, and dampened rumors that he had been one of the 'silent' men behind the creation of the atom bomb by disclosing that his war work had consisted of experiments testing the effects of high pressure on steel used in armor plating. Bridgman deprecated the value of this work and said that it had been discontinued even before the end of the war." ("Percy w. Bridgman Chosen for Nobel Prize in Physics" 1946)

> things being the way they were and he always thought them out; his exercises were a very good way to learn where the bones were in these two beautiful parts of physics.[20] I think as far as science goes they were the great point of my time at Harvard... [Bridgman] didn't articulate a philosophic point of view, but he lived it, both in the way he worked in the laboratory, which, as you know, was very special, and in the way he taught. He was a man to whom one wanted to be an apprentice. (Oppenheimer 1981, 69, as quoted by Smith and Weiner)

We will find that Bridgman *did* articulate a philosophic point of view; he would not live an unexamined life. Bridgman's intense drive to intellectual understanding of his own life in evident in his *cri de coeur* of an introduction to *The Intelligent Individual and Society*:

> As I grow older a note of intellectual dissatisfaction becomes an increasingly insistent overtone in my life. I am becoming more and more conscious that my life will not stand intelligent scrutiny, and at the same time my desire to lead an intelligently well ordered life grows to an almost physical intensity. (Bridgman 1938, 1)

Bridgman's drive to fully thinking things out to *his* own satisfaction is central to his conception of science and of the relationship between science and society. For Bridgman, the scientific life is one form of intellectual life, and living the intellectual life means grappling with the world using all the powers of one's mind "no holds barred". Bridgman always describes the actions of a scientist in personal terms: the scientist is essentially an individual.

Far from Bridgman's concerns regarding the imposition of social responsibility on scientists reflecting a lack of concern with society or the effect of science on society, Bridgman frequently (and quite repetitively) lectured and published essays on the subject of science and society in the 30s, 40s, and 50s. Throughout these materials is an emphasis on the individual as the locus of intellectual and moral significance. This becomes clearest in the best of these essays, "New Vistas for Intelligence":[21]

> The participation of the individual is necessary in every process of intelligence, not merely in the processes of science. Intelligence can be given a meaning only in terms of the individual. [...] I believe here is to be found perhaps the most compelling justification for democracy. Intelligence is based on the individual. An authoritarian society in which the individual is suppressed cannot, by the nature of intelligence, be characterized by *general* intelligence. (Bridgman 1955)

[20] Thermodynamics and probably electromagentism, the latter of which Bridgman took over from B.O. Peirce, leading to his great concern with the foundations of special relativity.

[21] This essay is the source of the "no holds barred" phrasing referenced by Oppenheimer (1948) and was presented at a Princeton's Bicentennial Conference in a session on "Physical Science and Human Values" in 1946—Perhaps the incoming director of the Institute of Advance Studies was in attendance. Originally in Wigner et al. (1947) and republished with his other writings on science, technology, and society in Bridgman (1955).

This quote brings out two significant aspects of Bridgman's thinking about science which are essential to understanding his views on the relationship between science and social values:

(1) The individual is *fundamental* to the epistemic practice of science (or intelligence more broadly).
(2) This, (1), has major implications for the values—the duties and virtues—to which a scientist is committed.

These two aspects of Bridgman's thinking mark a large departure from most thinking about the epistemology and normative status of scientific practice, both in his time and in ours. By expositing his views, I will problematize characterizations of Bridgman as merely another adherent of the value-free ideal, fungible with any others, and reveal a position in logical space, which, though radical in its conclusions, serves at least as a tool in conceptualizing the question of the proper relations between science and values.

3.1 Individualist Science as an Epistemic Thesis

Bridgman is a transitional character in the history of science in a number of respects. Both in his scientific work and in his work on the relationship between science and values he can be seen as a bridge between the attitudes and approaches of Victorian scientists and those of modern physicists, so changed by relativity, quantum mechanics, and two World Wars. In particular, Bridgman's insulation of science from worldly values and his focus on the (epistemic) virtue of individual scientists may be understood as a continuation of the secularization of scientific moral virtue which occurred from the Victorian period onward.[22] While these forerunners are important to note, much of Bridgman's idiosyncratic approach to values in science is best understood in terms of his idiosyncratic epistemology of science: operationalism.

At the Fifth International Congress for the Unity of Science in 1939, Bridgman announced a break with the epistemological framework constructed by his erstwhile fellow travelers, the logical positivists, in "Science: Public or Private":

> The process that I want to call scientific is a process that involves the continual apprehension of meaning, the constant appraisal of significance, accompanied by a running act of checking to be sure that I am doing what I want to do, and of judging correctness or incorrectness. This checking and judging and accepting, that together constitute understanding, are done by me and can be done for me by no one else. They are as private as my toothache, and without them science is dead. (Bridgman 1955, 50)

[22] For an account of the secularization of the moral virtues associated with scientific practice in Victorian England see Bellon (2014). For a look at this process focused on the American context and the interwar period, see Shapin (2008, chap. 5). A somewhat different accounting for Bridgman's account of scientific virtue in terms of Puritanism can be found in part 5 of Walter's (1990) biography.

It is through the operational analysis that Bridgman famously first applied to the new physics in *The Logic of Modern Physics* (1927) that Bridgman comes to the standpoint of the "isolation of the individual". Bridgman distinguishes his acknowledgment of the ego-centric standpoint from solipsism: for Bridgman the isolation of the individual is the farthest end of an analysis of experience, for the solipsist it is the basis for the construction of the world.[23] For Bridgman, the solipsist's position amounts to a denial of the facts of experience and is hence self-undermining.[24] I will not attempt to further distinguish Bridgman's view from that of the solipsist (however, see §3.3).[25] Sufficient to understand Bridgman's position is to understand how it contrasts with the public notion of science popular in the Unity of Science movement and popular today.

On the public notion of science, scientific epistemology is essentially social epistemology. That is to say, whatever one's theory of justification, verification, falsification, or testing may be, the standard for scientific truth or scientific belief requires *publicly accessibility*. Let's take, for ease of exposition, a simple verificationist epistemology of science: scientific theories are true if their predictions are verified by experience. What is it for some prediction to be verified? A simple answer would be that the predicted proposition entailed by the theory is believed by some observer upon their observation of some (apparent or experimentally solicited) fact.[26] The public conception of science is not, however, satisfied with the belief of *some* observer upon observation as the verification standard—rather, it is belief of *any* appropriate observer *if* they were to face the relevant fact that serves as a standard. Core to the public conception of science is that the objectivity of scientific fact requires that verification be *invariant* between *any* such observers, actual and possible. This is the reason why replication is thought to strengthen claims of scientific truth: replication shows that the verification of some fact is in fact invariant between the original observer and the replicator.

Bridgman's private conception of science flips this epistemological framework on its head. One of the "great limitations" of life that Bridgman takes as datum is the essential isolation of the individual. Epistemically this means that our epistemic standards are ultimately internal. Rather than hold public accessibility (of evidence) as a condition on the acceptability of a scientific theory or experimental result, individual understanding becomes the ultimate arbiter of what is to be accepted and what is to be rejected. Justification is a normative status that is given internally. This first-personal perspective applies to even the most abstract of logical matters:

> The syllogism is a piece of dead formalism until it has become alive by an act of creative

[23] See, for example, Carnap's *Aufbau* (1967).

[24] "[A]lthough I have often been accused of solipsism, nothing could be further from what I am trying to get across[...] [I]t does seem to me that the solipsist position does indeed not make sense[...] [I]t does not follow that the solipsist has not caught sight of a fundamental problem[...]" (Bridgman 1938, 153).

[25] See Bridgman (1959a) for more discussion, a sample: "[C]riticisms of my writing have frequently accused me of solipsism. These criticisms have always puzzled me. However, it is only recently that I have come to appreciate that use of the first person, which is all that I am urging, need involve no commitment whatever with regard to a solipsistic 'ego' or 'self,' the implied existence of which is what I suppose has principally disturbed the critics. My use of the first person in reporting has the neutrality of grammar. That it can have such neutrality I regard as an important observation."(1959a, 4)

[26] With the usual caveats: under standard conditions, etc.

> insight on my part; I cannot use the syllogism as a tool in any practical application until it has this become alive by passing through an act of understanding and of acceptance by me. (Bridgman 1938, 155)

The essentially private nature of science—and of reasoning in general—comes from the fact that our ultimate criteria of judgment are internal.[27] This does not mean that intersubjective agreement is not of epistemic significance, but its role is non-fundamental:

> Now I have found as a matter of experience that I am usually least likely to be making mistakes when my own conclusions agree with those of my fellows, so that in practise it may be that the first step which I take in verification is to find what my fellows do and think. But securing the consensus of opinion of my fellows in this way is something that *I* do for reasons that *I* have accepted. [...] I could even formulate circumstances under which I should be impelled to make the judgment that all my fellows had gone insane. The criteria are this ultimately my own private criteria, and in this sense physics or mathematics or any other science is my private science. (Bridgman 1938, 157–58)

This internalist standard of justification extends for Bridgman to ethical and aesthetic concerns,[28] but most importantly here is that the normative constraints a scientist is beholden to ultimately answer to this internalist standard as well. This must be the case if these role responsibilities are to be somehow intrinsic to the practice of science itself, as the intuitive examples given by Douglas seem to be.[29] I will show that the values intrinsic to the individualist conception of science can recapture much of what is intuitive in Douglas' picture while rejecting that they are socially determined or that they constrain what a scientist *qua* scientist ought to investigate or accept. The intellectual freedom from which science comes binds the scientist to an ideal of intellectual integrity, the only value that is internally justified.

3.2 Scientific Values and Non-Scientific Values: An Entelechic Filter

The evidence as to whether Bridgman endorsed the value-free ideal is mixed. In *The Intelligent Individual and Society*, Bridgman describes the scientific approach as "irrelevant" to "questions of value" yet also rejects a clear-cut division of epistemic and moral values or "the rational and

[27] See "Freedom and the Individual" from Bridgman (1955) and Bridgman (1959a), 129.

[28] "As a matter of observation I report that the mere statement by another that a certain line of conduct is desirable or good is powerless to affect me to action unless i to see that it is desirable or good. At the very least, I myself must want my own conduct to be 'good'. The springs of my conduct are *my* springs; unless some motive appeals to *me* it is not a motive." (Bridgman 1938, 155)

[29] Douglas sometimes has a somewhat different argument for role responsibilities: no one is better suited (or maybe even capable at all) of evaluating the consequences of scientific developments other than scientists, so they have a duty *qua* scientists to take into account the consequences of their work. This does not seem to me to generate a role responsibility in the manner with which I am concerned. I do not have a special role responsibility to save a drowning child because I am the only person close enough to do it. There is a general responsibility to save the child and I happen to be best placed to meet it, but the responsibility is not in virtue of my role as closest-to-the-child.

the emotional". (Bridgman 1938, 10, 74) This confusion becomes all the worse when we consider that in the volume in which these contradictory claims appear Bridgman subjects moral, social, and political values and concepts to the scrutiny of operational analysis—the ultimate form of "the scientific approach", according to Bridgman.[30]

If we can agree to forgive Bridgman his apparent inconsistency, we can attempt to rationally reconstruct a position on the relationship between science and values that may avoid the criticism of Douglas and others. Ward (2021) makes a number of useful distinctions regarding the possible relations between science and values upon which I will depend here. While her taxonomy is rich, we will make do here with on a couple of the distinctions she makes. One is the distinction between values as standing in causal (including motivational) relations with scientific reasoning and their standing in justificatory relations with scientific reasoning. Another is her fourway distinction of what claims of the "value-ladenness" of science may mean:[31]

> (Descriptive Do) Scientists do involve values in their scientific decision making.
>
> (Descriptive Must) Scientists must involve values in their scientific decision making.
>
> (Normative Can) Scientists can (permissibly) involve values in their scientific decision making.
>
> (Normative Should) Scientists should (ought to) involve values in their scientific decision making.

I will follow Ward in characterizing the essential issue at hand being a version of the descriptive must thesis with respect to a *justificatory* role for values in science. The question at the center of the debate is then: Must values be used in justifying our judgments regarding scientific theories or experiments?

How then to understand Bridgman? The ambiguity described above is a consistent trait of Bridgman's writings on science and society. Let's take this passage as a starting point for interpretation:

> The role of intelligence in questions of value is primarily a neutral one—that of a tool by which values may be effectively realized. It is true that intelligence also has a role to play in education which is back of the system of values. The values which one accepts may be altered by a visualization of all the consequences, and this act of vision requires intelligence. But except for this, intelligence accepts the values without question, as one of the conditions of the problem, and applies itself to the task of realizing these values

[30] For Bridgman there is no singular scientific approach. Science is distinguished by its subject matter rather than its method; it is a specific form of the more general practice of intelligence. Operational analysis is the application of intelligence to itself.

[31] See Ward (2021), 58.

> as effectively as possible. By its neutrality, intelligence acquires universality; it is the one common denominator of mankind, independent of creed or culture, spanning the hemispheres and the centuries. (Bridgman 1955, 531)

Intelligence being Bridgman's general term for science and other forms of reasoning, we can understand this passage as making the claim that values can be both causes and effects of scientific decisions and that values can be motivators for scientific decisions insofar as the application of intelligence to the realization of values involves a scientist accepting a hypothesis due to their motivation to realize some value. What is not clear is whether Bridgman believes that values play a role in the internal functioning of intelligence, justifying judgments of theories and experiments.

For Bridgman, the adoption of a scientific form of life appears to exclude the use of *social* values in the methodology of science. In "Science, Materialism, and the Human Spirit", Bridgman writes:

> Acceptance of the commitment to exclusive use of the methods of intelligence is itself an act of intelligence. For we are not here concerned with the acceptance of arbitrary limitations for their own sake, as when one composes a crossword puzzle on a pattern of his own creation. We accept the commitment to the use of the methods of intelligence because that seems to us from all the evidence at present in hand to be the only method which has any prospect of successfully accomplishing the purpose of the scientist, which may be broadly described as understanding. [...] In reaching this conclusion we have not allowed ourselves to be influenced by what it might be pleasant to believe, but have subjected ourselves voluntarily to a single supreme control, the control of agreements with the facts. In the face of a fact there is only one possible course of action for the scientist, namely acceptance, no matter how much the fact may be at variance with his anticipations, and no mater what havoc it may wreak on his carefully thought out theories. (Bridgman 1955, 455–56)

The purpose of the scientist is to understand the world. By adopting the scientific project as one's own, one is holding understanding as the highest commitment. This commitment entails a radical subjection of oneself to the facts and brings along with it some values, or "spiritual elements", internal to scientific life: integrity, honesty, and freedom. Of these three values, freedom is most fundamental, it makes possible intellectual integrity and honesty. This freedom is in the first instance an inner freedom, which society is "powerless to touch".

For Bridgman the responsibilities of scientists are *not* responsibilities in virtue of socially determined roles. Rather, scientists are scientists in virtue of their own volition, a voluntary commitment to the truth (or at least empirical adequacy). So, Douglas' examples of role responsibilities, like honest reporting of research or responding to criticisms, are not to be understood in the first place as responsibilities to a scientific community, but rather are derived from responsibilities that each scientist has reflexively. This recaptures some of Douglas' moral phenomenology but also comes

apart from it (i.e. the view has some bite): In some situations internal self-honesty (including honesty about what is likely to aid in the reaching of one's aims) may come apart from external honesty, though in practice external honesty generally seems more conducive to the achievement of understanding the facts.[32] For the scientist, self-honesty is non-negotiable, while other-honesty is a matter of pragmatic calculus.

The disagreement between Bridgman and Douglas is not a matter of whether or not values are involved in science, but a matter rather of *which* values, *whose* values, and *how* those values affect the scientific project. We ought not confuse Bridgman's accounting of the values of science as the commonplace, and oft questioned, distinction between moral (and political, etc.) values and epistemic values—Bridgman recognizes no ultimate values but prudential values.[33] Both Bridgman and Douglas hold that the integrity of the scientific process is an essential value, but they differ as to what this integrity requires. Douglas (2009) spends multiple chapters explaining how it is that the permissible, indirect use of values in science preserves its integrity; for Bridgman, integrity requires a thoroughgoing internal intellectual honesty that requires a freedom, which would be undermined by the use, direct or indirect, of the values of *others*.

It is essential to understanding Bridgman's position to take into account the centrality of the individual in his conception of science. The individualist conception of science allows for a distinction between scientific and non-scientific values of a different kind from other attempts to distinguish "cognitive" and "non-cognitive" values (see discussion in §2.1). I will borrow Driesch's borrowing of Aristotle's language and describe Bridgman's view as a *entelechic* restriction on values in science. Much like Driesch had hoped to ground the autonomy of biology in the intrinsic and irreducible principles of life, I believe the autonomy of science can be grounded in its intrinsic and fundamental aims and values. Entelechic values are those values which "bear the end in themselves", that is, these values are intrinsically linked to the end of the practice from which they arise.[34] Since the fundamental aim of science, understanding, is understood individualistically, no values not aligned with the aim of an individuals understanding may play a fundamental role in scientific practice.[35] An analogy: when one decides to play chess, to be a chess player, a particular state of the board affords normative restrictions on what moves may be made. *Qua* chess player, some moves are better than others and some are verboten. Other values, sourced in projects other than playing chess (to

[32] See Bridgman (1938), 261.

[33] This bottoms out in a sort of emotivism—"oughts" and other moral "objects" are (more or less useful) societal fictions that serve to align the interests of diverse actors in a society, see Bridgman (1938), 250-257, 281.

[34] For more on the etymology: "Let us then borrow our terminology from Aristotle, and let that factor in life phenomena which we have shown to be a factor of true autonomy be called Entelechy, though without identifying our doctrine with what Aristotle meant by the word ἐρελέξελα. We shall use this word only as a sign of our admiration for his great genius; his word is to be a mould which we have filled and shall fill with new contents. The etymology of the word évrελéxeia allows us such liberties, for indeed we have shown that there is at work a something in life phenomena 'which bears the end in itself,' ὃ ἔχει ἐν ἑαυτῷ τὸ τέλος." (Driesch 1908, 1:144)

[35] This distinction is similar to Longino's (Longino 1990) distinction between constitutive and contextual values. The main difference between Bridgman and Longino being that Longino sees science as essentially a social enterprise, which makes room for the scientific role of contextual values.

win), like teaching one's opponents, may tell against the optimal move. This would be to (partially) fail as a chess player, while succeeding at pedagogy. To the chess player, *qua* chess player, no such consideration of pedagogy can be allowed to justify one move rather than another. So it is with science and other projects that an individual may choose to commit themselves to (e.g. morality, social justice, financial gain).

3.3 Is an Individualist Science Possible? A Spectre of Trust

Whatever the results of my reconstruction of Bridgman's position, one may think I am underestimating the robustness of the social conception of science. Even if Douglas was wrong in her reconstruction of Bridgman, isn't it the case that the reconstructed Bridgman is simply wrong about the nature of science?[36] There is a large literature defending and analyzing the claim that scientific practice essentially depends on epistemic (Rolin 2008; Wilholt 2013; Gerken 2015) and moral (Hardwig 1985, 1991; Shapin 1994; Frost-Arnold 2013) trust (and the combination thereof, these are complementary, not contradictory, claims). Indeed, hasn't one of the greatest lesson of the "practice-turn" in philosophy of science been that science *is* social knowledge (locus classicus: Longino 1990)?

Much cannot be done here. What I can do is provide a defense of Bridgman's individualistic conception of science on the basis of practice. Indeed, there is no philosophy more concerned with practice than operationalism. What to be understood is that the individual-centered practices which figure so much in operational analysis—a first personal analysis—underlies any intersubjective practices, which ultimately answer to the individual epistemically.

Let me first more concretely describe the phenomenon whose necessity in science is taken to refute Bridgman's basic conception of science and so his defense of science's normative autonomy: trust. There are varying aspects of accounts of trust in this literature (and beyond it), but I take there to be two major aspects in all such accounts: reliance and alignment. Reliance is purely an inferential matter: when I rely on my fellows' testimony, report, argument, or claim (let's use statement as neutral between these versions), I take that statement-act as evidence or justification for belief in the statement-content and other propositions which inferentially follow from (in either a deductive or inductive sense) the statement-content. What is necessary to change this mere reliance into a trust is that me and my fellow have aligned values or standards. I believe that my fellow will only supply with me with statements that they have a sufficient degree of confidence in, relative to the risks of false positives and false negatives. So then, if trust is essential to scientific practice, Bridgman's account fails on two fronts: (1) it fails because reliance makes *the cognitive states of others* essential to scientific practice eliminating the possibility of an individualistic science on the basis of which a entelechic filter between scientific and non-scientific values can be grounded; (2) it fails because alignment makes *the values of others* essential to scientific practice, falsifying an

[36] I thank a referee for raising this objection.

individualistic account of science which does not allow such values a role in scientific judgment.

Bridgman's defense relies on an operationalist point of view. We must ask the question: What do *I do* when my fellow supplies me with a statement and I use it in my scientific judgment? Two extremes are to be avoided here. One the one hand, I do not go through every bit of mathematical reasoning which my fellow used in reaching their statement, nor do I replicate the experiments they the state the results of. I take it as given that the necessity of trust to science means that I cannot recreate all the inferential moves made externally, internally. On the other hand, I cannot be said to accept these claims uncritically and without judgment, I do not allow others to think or value for me in a robust sense. Both aspects of trust, reliance and alignment, are a result of my judgment. As judgment is essentially the act of an individual, trust can be made sense of in an individualistic conception of science.

Bridgman's response to the two objections from the necessity of trust would be as follows:

(1) Reliance does not undermine the individualist basis for the scientific project—this view is not solipsistic—just as the formation of beliefs on an empirical basis may require belief in external objects, belief formed on the basis of testimony require belief in the reliability of my fellows. The aim of the scientific project is the same: the agreement between *my* beliefs and experience, not just with the beliefs of my fellows, though their statements are a part of experience.

(2) Alignment does not undermine the entelechic filter between scientific and extra-scientific values. The values of my fellows or of society writ large do not substitute for my own or come into consideration *qua* values in my judgments. I do not take in my fellows' risk tolerance in as a value, but as evidence regarding the truth-aptness of their statements.

For Bridgman, intellectual integrity means at all times depending on one's own judgment, even when one is deferring to others. The beliefs and values of others are thus encapsulated and only their evidential residue plays a role in scientific judgment. Trust and the epistemic division of labor is not contrary to Bridgman's conception of science, which has its basis in the fundamental nature of individual experience rather than the superstructure of society.

4 Conclusion: Society for Science, Not Science for Society

Bridgman's defense of a version of the value-free ideal relies on a contentious and unfashionable philosophy of science (operationalism) and radically individualist point of view. For these, and perhaps other, reasons, the position is unlikely to garner much acceptance at present. However, in closing, I'd like to suggest one further way that Bridgman's position calls for us to rethink the relationship between science and society, a way in which I hope will have more immediate effect. One should not leave with an impression that Bridgman's view allows for no checks on scientific

development, no responsibility whatsoever: the point is in a way a modest one, such responsibility lies beyond the ken of science proper.

As stated above, Bridgman believes that the scientist, *qua individual committed to the scientific project*, has no obligation to consider the societal effects of their work:

> Since the central position of the individual has been one of our cardinal points, society will have be such that each individual is accorded his own central position. The primary demand must therefore be that society be so constructed that it serves the individual, not that the individual serve society. This principle will guide me as an individual, both in determining what demands I shall allow society to exact of me, and in my capacity as a member of society in the demands which I allow society to exact of my fellow. (Bridgman 1938, 283)

Bridgman's individualistic stance brings with it a recognizable libertarian ethos. If the libertarian creed, that society has only the legitimate function of protecting the rights of individuals, is true, then the demands of society on an individual are largely illegitimate. Calls for scientific responsibility are demands that society imposes on individual scientists.

In "Scientists and Social Responsibility", Bridgman distinguishes a number of senses of "responsibility" and hones in on a notion of moral as opposed to merely causal responsibility. This responsibility would be "a moral obligation to see to it that the uses society makes of scientific discoveries are beneficent." (Bridgman 1948, 69) Bridgman notes that a moral obligation has two faces: scientists have a *duty* to control their discoveries and society has a *right* to demand this of them—a duality recognized by most moral philosophers. It is this latter aspect, the *right* of society to certain demands on scientists—and in case of a failure to meet these demands, the right to *punish*—is incompatible with Bridgman's conception of a free society. Wary of the Marxist slogan, "From each according to his ability, to each according to his need", Bridgman denies the moral and political legitimacy of such rights.[37] This illegitimacy is due to the fact that "society" does not truly exist but only do individuals, and the tolerance required for a free society, according to Bridgman, precludes any such demands for the labor of ones neighbor. Bridgman's picture of society is of an arrangement of individuals, each entitled with negative rights against undue interference, and without positive rights to make claims on others (except by mutual agreement, presumably).

However, Bridgman does still have a proposal for who should be morally responsible for the control of scientific discoveries like atomic energy. Society should use the tools already available to it—meaning that the individuals responsible for the political arrangement of things, politicians and policymakers, ought to decide on what research to fund and what industries to regulate in light of what scientific inquiry may yield. This is not, however, to demand that the scientists, in virtue of being scientists, limit themselves in their grappling with the world.

[37] There is no implication that the existence of claims on an individual by society is essentially Marxist, nor that Bridgman makes such an error—for him it is indicative of a broader trend.

Beyond this run of the mill libertarianism, Bridgman presents a radical proposal. Insofar as science is individualist, we ought to expect society to be for science, rather than the other way around. But further, we ought to have a society built for science, for scientific value provides an example of intrinsic, non-instrumental value. Indeed this provides a way of evaluating different societies:

> The scientist thus having discovered a new kind of good, he, and through him others, will henceforth impose a new kind of criterion as to whether a society is good or not. The criterion is whether society is a place in which there is opportunity for acquiring understanding and whether such understanding is prized. (Bridgman 1959a, 288)

For Bridgman, a man with no religion, science not only provides a way to understand the world, but further provides a purpose to life, a source of human dignity:

> After we have scavenged the world of the blight of totalitarianism, what are our long-range objectives? Have we nothing eventually in view more admirable than the abolition of want and the securing of comfort for everyone, ends which at present bulk so large in our programs? Will we be permanently satisfied with these, or will something more be necessary to give dignity and worth to human activity?[38]

Here we are left with a very different framing of the relationship between science and society. Rather claim that science is in service to society, as many value-free ideal skeptics would have it, Bridgman presents a picture in which society is in service to science. Bridgman proposes that science—intelligent activity—is the answer to some of the deepest questions regarding the value and aim of human society. We might take Bridgman's conception of science, then, as a way of preserving a very fragile thing, a world of intrinsic value.

[38] From "Science and its Changing Social Environment" republished in Bridgman (1955), 409.

References

BCF. 1990. *Bush-Conant File Relating to the Development of the Atomic Bomb, 1940-1945*. National Archives Microfilm Publications. Washington D.C.: Records of the Office of Scientific Research and Development, Record Group 227, microfilm publication M1392, National Archives and Records Administration (circa 1990).

Bellon, Richard. 2014. "There Is Grandeur in This View of Newton: Charles Darwin, Isaac Newton and Victorian Conceptions of Scientific Virtue." *Endeavour* 38 (3): 222–34. https://doi.org/10.1016/j.endeavour.2014.10.008.

Betz, Gregor. 2013. "In Defence of the Value Free Ideal." *European Journal for Philosophy of Science* 3 (2): 207–20. https://doi.org/10.1007/s13194-012-0062-x.

Bird, Kai, and Martin J. Sherwin. 2005. *American Prometheus: The Triumph and Tragedy of j. Robert Oppenheimer*. 1st ed. New York: A.A. Knopf.

Bridgman, Percy W. 1927. *The Logic of Modern Physics*. New York: The Macmillan Company.

———. 1938. *The Intelligent Individual and Society*. Macmillan.

———. 1948. "Scientists and Social Responsibility." *Bulletin of the Atomic Scientists* 4 (3): 69–72. https://doi.org/10.1080/00963402.1948.11460173.

———. 1955. *Reflections of a Physicist*. New York: Philosophical Library.

———. 1959a. *The Way Things Are*. Cambridge: Harvard University Press.

———. 1959b. "Compression and the α-β Phase Transition of Plutonium." *Journal of Applied Physics* 30 (2): 214–17. https://doi.org/10.1063/1.1735135.

Bright, Liam Kofi. 2018. "Du Bois' Democratic Defence of the Value Free Ideal." *Synthese* 195 (5): 2227–45. https://doi.org/10.1007/s11229-017-1333-z.

Carnap, Rudolf. 1967. *The Logical Structure of the World and Pseudoproblems in Philosophy*. Chicago: Open Court.

Dewulf, Fons. 2021. "The Institutional Stabilization of Philosophy of Science and Its Withdrawal from Social Concerns After the Second World War." *British Journal for the History of Philosophy* 29 (5): 935–53. https://doi.org/10.1080/09608788.2020.1848794.

Douglas, Heather. 2009. *Science, Policy, and the Value-Free Ideal*. University of Pittsburgh Press.

Driesch, Hans. 1908. *The Science and Philosophy of the Organism*. Vol. 1. London: Adam and Charles Black.

Elliott, Kevin Christopher. 2017. *A Tapestry of Values: An Introduction to Values in Science*. New York, NY: Oxford University Press.

Elliott, Kevin Christopher, and Daniel Steel, eds. 2017. *Current Controversies in Values and Science*. Current Controversies in Philosophy. New York: Routledge, Taylor & Francis Group.

Frost-Arnold, Karen. 2013. "Moral Trust & Scientific Collaboration." *Studies in History and Philosophy of Science Part A* 44 (3): 301–10. https://doi.org/10.1016/j.shpsa.2013.04.002.

Gerken, Mikkel. 2015. "The Epistemic Norms of Intra-Scientific Testimony." *Philosophy of the Social*

Sciences 45 (6): 568–95. https://doi.org/10.1177/0048393115600527.

Hardwig, John. 1985. "Epistemic Dependence." *The Journal of Philosophy* 82 (7): 335–49. https://doi.org/10.2307/2026523.

———. 1991. "The Role of Trust in Knowledge." *The Journal of Philosophy* 88 (12): 693–708. https://doi.org/10.2307/2027007.

Hawkins, David, Edith C. Truslow, and Ralph Carlisle Smith. 1983. *Project y, the Los Alamos Story*. Edited by Los Alamos Scientific Laboratory. History of Modern Physics, 1800-1950, v. 2. Los Angeles: Tomash Publishers.

Hoddeson, Lillian, Gordon Baym, Roger A. Meade, and Catherine Westfall. 1993. *Critical Assembly: A Technical History of Los Alamos During the Oppenheimer Years, 1943-1945*. Cambridge [England] ; New York: Cambridge University Press.

Lacey, Hugh. 2017. "Distinguishing Between Cognitive and Social Values." In *Current Controversies in Values and Science*, edited by Kevin Christopher Elliott and Daniel Steel, 15–30. Current Controversies in Philosophy. New York: Routledge, Taylor & Francis Group.

Longino, Helen E. 1990. *Science as Social Knowledge: Values and Objectivity in Scientific Inquiry*. Princeton, N.J: Princeton University Press.

———. 1996. "Cognitive and Non-Cognitive Values in Science: Rethinking the Dichotomy." In *Feminism, Science, and the Philosophy of Science*, edited by Lynn Hankinson Nelson and Jack Nelson, 39–58. Synthese Library. Dordrecht: Springer Netherlands. https://doi.org/10.1007/978-94-009-1742-2_3.

Melo-Martín, Inmaculada de, and Kristen Intemann. 2016. "The Risk of Using Inductive Risk to Challenge the Value-Free Ideal." *Philosophy of Science* 83 (4): 500–520. https://doi.org/10.1086/687259.

Monk, Ray. 2014. *Robert Oppenheimer: A Life Inside the Center*. New York: Anchor Books.

Oppenheimer, J. Robert. 1948. "Physics in the Contemporary World." *Bulletin of the Atomic Scientists* 4 (3): 65–86. https://doi.org/10.1080/00963402.1948.11460172.

———. 1981. *Robert Oppenheimer: Letters and Recollections*. Edited by Alice Kimball Smith and Charles Weiner. 2nd printing. Cambridge, Massachusetts London, England: Harvard University Press.

"Percy w. Bridgman Chosen for Nobel Prize in Physics." 1946. *The Harvard Crimson*, November.

Reisch, George A. 2005. *How the Cold War Transformed Philosophy of Science: To the Icy Slopes of Logic*. Cambridge ; New York: Cambridge University Press.

Rolin, Kristina. 2008. "Science as Collective Knowledge." *Cognitive Systems Research*, Perspectives on social cognition, 9 (1): 115–24. https://doi.org/10.1016/j.cogsys.2007.07.007.

Rooney, Phyllis. 2017. "The Borderlands Between Epistemic and Non-Epistemic Values." In *Current Controversies in Values and Science*, edited by Kevin Christopher Elliott and Daniel Steel, 31–46. Current Controversies in Philosophy. New York: Routledge, Taylor & Francis Group.

"Russell-Einstein Manifesto." 1955. *Nuclear Musuem*.

Shapin, Steven. 1994. *A Social History of Truth: Civility and Science in Seventeenth-Century England*. Science and Its Conceptual Foundations. Chicago: University of Chicago Press.

———. 2008. *The Scientific Life: A Moral History of a Late Modern Vocation*. Chicago: University of Chicago press.

"The Eternal Apprentice." 1948. *TIME Magazine* 52 (19): 70–81.

Urey, Harold C., I. I. Rabi, Herbert Goldhamer, Lee A. Dubridge, William F. Ogburn, and Eugene Rabinowitch. 1948. "Comments on Dr. Bridgman's Article." *Bulletin of the Atomic Scientists* 4 (3): 72–75. https://doi.org/10.1080/00963402.1948.11460174.

Walter, Maila L. 1990. *Science and Cultural Crisis: An Intellectual Biography of Percy Williams Bridgman (1882-1961)*. Stanford: Stanford University Press.

Ward, Zina B. 2021. "On Value-Laden Science." *Studies in History and Philosophy of Science Part A* 85 (February): 54–62. https://doi.org/10.1016/j.shpsa.2020.09.006.

Wellerstein, Alex. 2016. "America at the Atomic Crossroads." *The New Yorker*, July.

Wigner, Eugene P., F. T. Spaudling, I. I. Rabi, Lee A. Dubridge, H. Shapley, F. S. C. Northrop, M. Polanyi, Percy Williams Bridgman, and H. N. Russell. 1947. *Physical Science and Human Values*. Princeton: Princeton University Press.

Wilholt, Torsten. 2013. "Epistemic Trust in Science." *The British Journal for the Philosophy of Science* 64 (2): 233–53. https://doi.org/10.1093/bjps/axs007.