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Reply

A symposium on the role of the philosopher among the scientists: nuisance or necessity?

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'So what does all this have to do with science? In his delightful paper, Professor Agassi furnishes an answer to philosophers of science who are taken to task for making a secondary field their primary area of investigation. While he is prepared to admit that philosophers of science are backseat drivers (nuisances), Agassi argues that even the most irritating backseat driver can be useful now and then so long, that is, as we are prepared to adopt a heroic theory of inquiry (driving) which grants them a proper function. Agassi's answer will likely be rejected by many sociologically minded philosophers of science (even those who are besieged by perplexed students and colleagues), not because of misguided defence of the empirical canons that Professor Agassi assails, but because of the theory of driving espoused in his paper. Agassi's attempt to secure respectability for philosophers of science is laudable, but his alternative theory of inquiry is not the best way to secure the goal of gainful employment.

In this space, I will raise two objections in order to cajole Agassi to articulate his provocative suggestions. First, I will mount a mini historical case-study which indicates that Agassi's heroic account of scientific inquiry is flawed as an historical thesis; i.e. even staunch defenders of the *status quo* have made important contributions to the development of scientific ideas, and so I conclude that Agassi's advocacy of opportunism is not warranted. Secondly, I will invoke the body of work on laboratory science[1–3] as the basis for the claim that, even if science adopts a methodological stance which encourages heroic behavior, it does not follow that philosophers will have anything substantial to contribute. Indeed, the view which I will adopt here is that the advent of modern science ('big experimental science') effectively rules out the possibility of contributing to our philosophy of nature from an armchair or a podium. Creation may belong to all of us, but it is not an activity which these days can be performed with words. By way of closing, I will suggest that there is a better way of securing the goal of respectability, one which does not run the risk of irritating Nobel laureates.

Let me recount a few features of Agassi's paper as a preface to my historical digression. Agassi divides philosophers of science into two camps – those who are content to praise the performance of scientists (even when a bad review is deserved), and those who insist on getting involved in substantive questions. Both groups are

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backseat drivers, to be sure, but characterized by Agassi as cowards and nuisances, respectively. Let us assume for the sake of discussion that some philosophers are slavish in their love for science and that their philosophical research, by and large, is targeted at promulgating an enviable image of scientific practice; and that others pronounce on the performance of scientists, even to the point of suggesting better ways of doing things. Now, Agassi seems to hold that these approaches are mutually exclusive, but virtually any philosopher of distinction can be placed in both these camps.

Karl Popper's views, for example, have made a significant contribution to the supposition that science is the apex of human rationality; i.e. that science is different from metaphysics, the social sciences, and other endeavors because its views are not merely criticizable but refutable as well. In order to sustain this flattering portrait of science in the wake of a vocal lobby which objected that many scientists routinely treat 'Popperian' refutations as mere anomalies, Popper deeply offended many scientists by denigrating their education: 'in my view', he asserted, 'the "normal" scientist . . . is a person one ought to be sorry for . . . [He] has been badly taught'.[4] So Popper defends science, or at least those scientific practices that accord with his methodological outlook, but offends many scientists in the process. Where does this place Popper, in with the cowards or in with the nuisances? I leave it to your discretion. Kuhn (1962) can be situated in either camp as well. Only the natural sciences get on with the business of knowledge production because they are able to reach consensus about guiding assumptions. Kuhn also defends science, but alarms scientists by offering the mantle to any group which displays the tell-tale markings of 'normal' scientific bahavior, a lesson which has arguably exerted a negative influence on the social sciences. My point is that Agassi's distinction between the irritating backseat driver and the grateful passenger is not subtle enough to close the gap between the intentions and the consequences of our actions. A slavish lover of science can advance views that upset scientists; and conversely, a heroic stance can be a front for a genuinely conservative attitude. Even our folklore is filled with tales of the unlikely hero who brings about revolutionary change and of the rogue who only wants to be loved by the powers that be.

To be fair to Agassi, however, he is concerned with the *consequences* of our actions and, particularly, in securing any potentially welcome consequences, even if the actions that produce both good and bad consequences are irritating. His distinction may not address the entire spectrum of psychological factors at work in backseat driving, but he is surely right that many philosophers have been dismissed as nuisances for giving advice to scientists and, furthermore, that fear of offending has no doubt dissuaded others from getting involved at all. Against my remarks about Popper and Kuhn, Agassi could argue that whether we intend to 'attack' or 'defend' science is beside the point. The issue is simply whether philosophers actively contribute to our philosophy of nature. His assessment, of course, is that philosophers by and large refuse to question the authority of scientists – an act of cowardice fostered by the presumption that to do so would be to violate empiricist canons that regulate scientific conduct. In order to encourage greater participation, therefore, Agassi argues that we need to repudiate existing standards that lead us (wrongly) to suppose that we can ascertain in advance of participation when an action is likely to have welcome consequences. Since these empiricist canons are frequently violated by scientists, Agassi maintains they can only serve to protect the interests of professional scientists and, in turn, to ensure that philosophers (and others) do not participate in the creation of our philosophy of nature.

This thesis is reminiscent of Feyerabend's *Against Method*: 'And is it not clear that participation in a process of this kind is possible only for a ruthless opportunist who is

not tied to any particular philosophy and who adopts whatever procedure seems to fit the occasion?[5] The pertinent difference, however, is Agassi's qualification to the effect that philosophers must show 'respect for empirical observations of the facts of nature'. This qualification is important for Agassi because it ensures that the *intentions* of philosophers are noble, so that even if philosophers are backseat drivers who participate in science ('a physical activity') 'by the use of words', they 'will have a proper and a recognizable job which they can perform without thereby offering drivers any cause for taking offense.' Scientists can rest assured that philosophers will not attempt to highjack science for their own purposes.

Well, even if we can provide assurances that the armchair philosopher is not going to dismiss matters of fact, and so seek to undermine all of science, we need not tolerate their presence. Even with the best of intentions, it does not follow that the philosopher in fact will have anything useful to say. While acknowledging the legitimacy of this worry, Agassi submits that we *never have a justification* for presuming that anyone will have anything useful to contribute, scientists included. Moreover, an examination of the historical development of science, Agassi contends, testifies that many eminent scientists were opportunists and adventurers – as I mentioned in passing, that scientists did not respect the very empirical canons that are effectively invoked to block philosophers from making contributions. On this point, Agassi is surely right. There are numerous historical cases where philosophers (or 'outsiders') had nuisance value for science.

Consider the case of Leibniz, a nuisance if ever one was. Leibniz had the audacity to accuse Newton and his disciples of subverting religion – as holding that 'God almighty wants to wind up his Watch from Time to Time . . . He had not, it seems, sufficient foresight to make it a perpetual Motion. Nay, the machine of God's making is so imperfect . . . that he is obliged to clean it now and then by an extraordinary Concourse, and even to mend it – ' (Leibniz to Princess Caroline, November 1715). Leibniz's accusations were raised against two or three passages of Newton's *Optiks*. In Query 28 (and in his third letter to Bentley), Newton invokes God to prevent the fixed stars from falling into one another. Query 31 assigns God the task of adjusting the solar system in order to counter irregularities occasioned by the mutual attraction of the planets. Finally, since motion is likely to be lost to the universe due to 'the history of fluids . . . and the weakness of elasticity in solids', God is invoked to conserve motion. To counter the 'running down' of the universe, Newton appealed to Divine Providence, an appeal wihch Leibniz regarded as involving a very imperfect conception of God.

In retrospect we can applaud Lebniz's brilliance, but to Newton and his cohorts Leibniz must have been an irritant. After reading a brief review of Newton's *Principa* published in the *Acta Eruditorum*, Leibniz[6] attempted to deduce the law of inverse squares from Kepler's ellipse, and not from Kepler's law of periodic times, the course taken by Wren, Halley, and Newton. Not only was it curious for the pre-eminent rationalist of the day to seek a basis for universal principles in the phenomena, Leibniz's forays into celestial dynamics testify that he was not a particularly astute astronomer. (Although, to be fair, Leibniz's blunder would be repeated by two prominent eighteenth century Newtonians, Colin Maclaurin and Henry Pemberton, a mistake which gave rise to the belief that Kepler's ellipse was the foundation for universal gravitation.) Firstly, Newton and his associates recognized that Kepler's third law of periodic times could be substituted for Huygens' law of centrifugal force (published in 1673), and that this substitution in turn yields the inverse square proportion. Leibniz did not. Second, Newton demonstrated in Book I of the *Principia* that, while the

inverse square proportion follows from the ellipse, any conical section is possible for the planetary orbit, depending on the initial velocity. It was this insight which enabled Newton to reconcile the very eccentric motion of the comets with the approximately circular motions of the planets.

The clash between Newton and Leibniz can be interpreted purely as an in-house dispute. As scientist against scientist. Leibniz had been granted membership in the Royal Society and was among the best mathematicians of his age. But on the important questions (i.e. the astronomical ones), he was an outsider. While Newton and his associates were working out the stubborn mathematical details of an inertial physics conceived roughly in Keplerian terms, Leibniz was still enamored with Copernician perfect circles. Although Leibniz was enthusiastic about the experiments of others, he did not contribute to the cause of an experimental physics through the development of instruments, measuring devices and the like. He left no 'Leibniz telescope' or its equivalent to posterity. On any measure, then, he fulfills Agassi's definition of 'the idle spectator' who participates through the use of words alone. In any case, little rides on whether we classify Leibniz as a scientist or not. Agassi's thesis is that anyone who occupies the backseat functions as a *de facto* philosopher; even the best of scientists can find themselves in this position and so serve as a nuisance to the driver.

I have already suggested that the distinction between the coward and the hero is difficult to maintain. Agassi's presupposition is that cowards – i.e. those who simply rehearse the official story – can be of no benefit to the heroic scientist; the effects of their actions cannot be useful. This is Agassi's rationale for inciting philosophers to participate directly in science: they need not worry about being pests so long, that is, as they respect the facts of nature. Put otherwise, their suggestions can be useful only if they do not defend empirical canons that the truly heroic scientist does not follow. Philosophers of science can be heroes too.

There are many ways to participate in science – our options are not restricted to ruthless opportunism or a defence of repressive conceptions of scientific inquiry. First, science is more than facts, theories, and spurious empirical standards that seek to institutionalize a given set of interests. A comprehensive account of science would also include background knowledge about the subject matter, ranging from non-systematized metaphysical presumptions to high-level systematized principles that have no empirical consequences, and to assorted bridge principles that relate systematic theory to the phenomena. Scientific inquiry also has a down-to-earth component, which includes various instruments and detectors, and theoretical claims about these instruments and detectors. Finally, there are data generators (individuals like Brahe and Flamsteed but machines as well), data processing, data assessment, analysis, and integration. All these components have been with us since the revolution of the seventeenth century. Additional factors could be mentioned, but this list is sufficiently long to suggest that science is somewhat more complex than Agassi indicates.

These additional layers seem to be neither here nor there unless we recognize that they tend to be quite autonomous. What is innovative in one domain may be quite staid in another. A heroic theory of instrumentation, for instance, may be conservative as it impacts on another area of science. Kepler, for example, argued (wrongly) that his optics furnished a theoretical foundation for Galileo's telescopic discoveries. Kepler, of course, was in the process of destroying the myth of circular orbits and he was pleased that Galileo's discoveries appeared to support the physical theory propounded in his *New Astronomy* of 1609. Galileo was grateful for an endorsement from the Imperial

Mathematician at Prague, but he treated Kepler as an outsider, as someone who had nothing useful to contribute. Despite Kepler's pleas for one of Galileo's telescopes as a means for vindicating his reputation, Galileo sent his precious inventions to patrons as gifts.

The case of Leibniz is rather more complex. He was opposing Newton's systematized principles that, in conjunction with certain auxiliary assumptions, implied that the world was 'running down'. Leibniz's defence of perfectionism – or the notion that the world must be perfect (i.e. stable, immutable), if not at the level of direct experience, then at least at the more fundamental level expressed by natural law – reflected a deeply embedded metaphysical commitment, one which was arguably the driving force behind the dominant outlook of the seventeenth century, the mechanical philosophy. I will not go into details here, but it seems fair to say that on this question Leibniz was firmly planted on the side of science, or at least on the side of the underlying principles governing scientific explanation in this period. It is true that Newton may have resisted the imperfectionist implications of this cosmology, but they were plain for all to see. By forcing this issue out into the light of day, Leibniz proved to be a nuisance and it is not surprising that Newton and his disciples did their utmost to discredit him. On this score, therefore, Leibniz was both a defender of science and a nuisance, a combination which Agassi seems to rule out in principle. Moreover, whereas Agassi holds that nuisances or outsiders such as Leibniz can only be heroes if they set aside empiricist canons, Leibniz's success in having his worries accommodated by Newton's successors (e.g. LaPlace) testifies that even 'cowards' (i.e. defenders of the status quo) can be useful.

My dispute with Professor Agassi thus far concerns the interpretation of *the historical development of ideas*. I think that there has been plenty of room for the defender of empiricist canons to make a real contribution; he apparently does not. Where Agassi wants to say that only heroes (i.e. individuals who demand no more of science than that it respect the facts of the matter) make their mark, my view is that existing norms often exerted a positive influence on scientific practice. In principle, then, we need not be heroes in order to participate in science. Leibniz was no hero but he certainly made a difference.

In this second stage of my argument, I claim that even if we are heroes, the evolutionary development of science testifies that it is impossible to participate with words alone. I reserve the issue about gainful employment for philosophers for the time being, but to make the claim that Agassi's recommendations are not practical, I want to look more carefully at his notion that inquiry must be regulated by respect for the facts of the matter. Once again, let me preface my remarks with a brief story.

The Scientific Revolution represents a fusion of two approaches to nature: the purely mathematical expression of natural law, initiated by Kepler's *New Astronomy* of 1609, and the experimental tradition developed by Bacon, Boyle, Newton *et al.* Newton's *Principia* of 1687, a work which was overtly 'experimental' but purely formal in its treatment of the phenomena, firmly unified these approaches. Perhaps because of the intrinsic difficulty of Newton's mathematical demonstrations, Newtonian science was touted in the eighteenth century as an experimental science – and no doubt the driving force behind the efforts of Hume and others to extend 'the experimental method of reasoning' to other disciplines. Even so, by the nineteenth century philosophers of science had begun to regard science in formal terms as an axiomatic structure or as a cluster of propositions related in various ways; i.e. they started to worry about the foundations of scientific theories and the inferential relationship between the

propositions of science. In order to highlight the patterns of reasoning that demarcate good and bad ideas, philosophers became embroiled with the studies of language and logic.

Kuhn's description of the scientist as a skillful technician changed much of this. The merits of Kuhn's views can be debated, endlessly it would appear, but one thing is non-controversial: his characterization of the scientist as a skillful technician (rather than as a theoretician) drew our attention to a side of Newton's achievement overlooked by philosophers, viz. experimental science and, particularly, its twentieth century development, what Bruno Latour[1] appropriately calls technoscience. Our contemporary fusion of technology and science represents an evolutionary advance because it enables the scientist to investigate nature in controlled environments and to *generate artificially phenomena that do not readily occur in a pure state of nature.* In my view, the strength of sociological accounts of knowledge is that they highlight the practices of scientists who are engaged in the *production* of phenomena, and are not geared merely toward predicting or otherwise speculating about phenomena in their pure state. Science represents, in modern times, a powerful force for *intervening* in the world (see Hacking[7]).

When Hegel speculated that there could only be seven planets, he was advancing a claim that simply was false in view of the facts. One could easily distinguish Hegel's claim from the reasons advanced in support of it. A mild embarrassment but at least a statement which could be investigated. Hegel could participate with words, even if his contribution was uneventful. However, contemporary science is less forgiving of those who participate through the use of words alone. Indeed, what can usefully be said of the world is largely a function of what can be done with the world; i.e. the distinction between the propositions of science and the way scientists work toward these propositions is no longer clear and distinct. Whereas experiment was traditionally pursued as a *check* on the sentences that can be accepted as true, experimental science seems to suggest that the kinds of assertions that can be considered as true or false ride piggyback on experimental design, laboratory equipment, and a host of other factors that contribute to the production of phenomena (see Hacking[8] for a thorough discussion of this view).

The question of Agassi, i.e. for the individual who wishes to participate with words, is just what kind of contribution can be made in the face of technoscience? Leibniz could forecast from his isolated library in Hanover, but his usefulness was contingent on a science geared toward describing phenomena in their pure state. The distribution of truth values was readily apparent to anyone willing to write to Flamsteed, the Royal Astronomer, or to read the latest set of astronomical tables. The facts to be explained were readily available; with a little luck, one could even predict novelties and so add a fact to the existing stockpile. Agassi's rider that we must respect the facts of nature makes perfect sense in this context; it ensures that the armchair philosopher plays the scientific game with honor. Indeed, it is just the kind of rule that allows the philosopher to give advice at all. To be sure, since science is moonlighting for most philosophers, it ensures that philosophers will not sleep on the job or due to bad advice prevent scientists from putting in an honest day's work.

In the seventeenth century, it was relatively easy to ascertain the facts – to be able to state with some confidence that one is honorable in one's view of the facts. Descartes could develop a conceptual scheme for planetary behavior in the absence of any real knowledge of the finer, mathematical details of planetary motion, advanced by Kepler, Horrox, and others. He could give useful advice, sufficiently compelling so as to induce

an astronomer as skilled as Giovanni Cassini to reinterpret Kepler's ellipse as a Copernican circle. But in the twentieth century, facts are not merely interpreted in the light of theories. This overlooked cliche presumes that there are facts waiting to be interpreted. It is rather the case that the 'facts', in many respects, are artificial constructions produced in artificial environments; i.e. 'working out' an interpretation in many respects is synonymous with 'working toward' the phenomena.

Now, I do not want to press this point, but it strikes me that Agassi's policies are based on a conception of science as essentially an act of representing the world. (In order to 'respect' the empirical observations of the 'facts of nature', presumably one has to be in a position to know what they are.) Agassi envisages a situation where the philosopher can scan for stop signs, lights, pedestrians and other obstacles from his position in the rumbleseat, and give advice about how best to negotiate these obstructions. Latour, Woolgar, Pickering and others have argued fairly persuasively that the phenomena are artificial constructions. (I leave the question open as to whether this view augurs for or against realism.) In today's science, it is the signs and the like which are produced by the act of driving – by the doings of scientists. Can one participate in such an activity with mere words? In the seventeenth century, the style of reasoning in vogue basically emulated logic and mathematics, styles of inference readily available to anyone with a formal education. But today's styles of reasoning are based on laboratory skills. Whether it is true that '*x* is a fact' depends, in the first instance, on how scientists work toward *x* but, more fundamentally, on whether scientists have the technical know-how to work toward *x* at all.

I think that there is a great deal of merit in Agassi's contention that science is conducive to heroic behavior. Despite my reservations about the universality of his thesis, I believe that modern technoscience particularly favors opportunism. It is not clear to me, however, just how words alone can contribute to the production of phenomena. Or course, it may still be the case that philosophers can make useful contributions to technoscience. Perhaps Agassi need not abandon his alternative guideline, but it will be instructive to see just how he will bring it to bear on a slightly less sanitized account of scientific practice.

Although I am not convinced by Professor Agassi's argument, I strongly support his contention that philosophy of science should be more than an exercise in public relations. The traditional mandate of philosophers has been to provide instructions for driving, and I can discern nothing in the advent of technoscience to preclude their fulfilling this function. However, the philosophy of science is standing at a crossroads. Philosophers have traditionally issued advice to scientists, an occupation which modern science has rendered obsolete. Fortunately, however, the other road leads to gainful employment. In order to realize this opportunity, what philosophers need to repudiate is not empiricist canons (which, by and large, are textbook fabrications), but the notion that it is the scientist who is driving the vehicle of knowledge. It is this notion which infuses Agassi's recommendations and which, ultimately, undermines them.

While it may be true that in the past scientists effected many of the decisions regulating the deployment of scarce resources, the administration of science has itself evolved into a fairly specialized discipline with ties to numerous private and public sources of funding. In view of the enormous financial commitment involved in 'big experimental science' it is the science policy administrator who now pilots the vehicle of knowledge, and it is here that the philosopher can issue useful instructions from the backseat. Philosophers can be gainfully employed if they advance normative accounts of knowledge production and direct these accounts at the individuals, agencies and

institutions that regulate scientific research. Of course, they will forfeit the opportunity to repeat Hegel's hubris, but at least they will not risk the ire of Nobel Laureates in turn.

Notes

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