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THE AUTHORITY OF SCIENCE - AND ITS ENEMIES - John R. Skoyles

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Successful scientists pick out one philosopher as having articulated the rationality of what they do as scientists. He is Sir Karl Popper FRS. But Popper's ideas play no part in contemporary philosophy. As Popper has said "Here I am being showered with honours as no professional philosopher before me; yet three generations of professional philosophers know nothing about my work" (Bartley, 1982).

How did this situation arise? I suggest, because philosophers use a false analogy to model the nature of authority held by ideas. It causes them to find intellectual problems where there are none and ignore achievements where they exist.

This analogy - which I call the "source" or geometry analogy started with Plato. It asserts that the authority possessed by empirical ideas in science is to be understood by analogy with that held by valid geometry theorems (more generally all valid theorems in axiomatisable systems). Geometrical ideas depend for their validity upon demonstration from a source of their truth - the axioms of their geometrical system. Both modern and ancient philosophy claim that something like this can be metaphorically applied to model the link between the authority of scientific conclusions about the external world and scientific reasoning. Plato's claim that knowledge is justified ideas is a simple analogy where knowledge itself corresponds to "geometrical theorem", justification to "proof" and truth to "geometrical axioms". This analogy takes for granted that the proper analysis of the authority of science must be in terms of a transmission of the authority of truth to ideas. Philosophers therefore search for the means to transmit truth to ideas to create "scientific knowledge" through justification or through some kind of dialectic. The history of philosophy is the history of the many imaginative attempts to model the nature of the source of science's authority: eternal forms, the logos, clear and distinct innate ideas, sense perceptions, a priori synthetic categories, socially defined meanings and epistemological contingencies.

Though sometimes creative, analogies can be destructive. Thus it is disturbing that philosophers have known nearly since its beginnings that the geometry analogy was an implausible guide to the authority of reason. That no empirical idea can be justified has been noted by every skeptic from Pyrrho of Elis (BC 365 - 270) to David Hume. There are obvious problems. If the authority of ideas is deduced from a source, how do we

know that this source has this authority except but by another source of authority? The authority of foundations must themselves have foundations. The geometry analogy leads either to an infinite regression to the ultimate source of authority, to an arbitrary dogmaticism that one authority is the authority, or to skepticism that is no such authority.

As a scientist I blame the geometry analogy for the present absurdities written by many philosophers (and sociologists) about science. Contemporary philosophers have been taught to expect science's authority to be transmitted from truth. They conclude rightly that truth cannot be its source. But they do not seek to replace the geometry analogy. Instead they twist it. Science manifestly has authority but truth cannot be its source; therefore, what is its source? Philosophers have readily filled the gap by attributing the "source" of science's authority to a wide variety of things. This process is most clear in Feyerabend. He first demands science to possess a "method" deductive from truth of its authority. Then, failing to find it, concludes the only alternative source of the scientist's authority must be political power, trickery and propaganda. Philosophers (and following them, social scientists) have selected other sources of authority, attributing it to "epistemology authority of speech communities" (Rorty and followers of Wittgenstein), and the ideology of the dominant social class (sociologists of science).

Do we need philosophers? Consider the following thought adventure. Imagine if scientists awoke one day with a collective amnesia as to every philosophical idea ancient and modern. Further, what if all trace of the prior existence of philosophers, their books and journals had disappeared. What kind of theory of scientific knowledge and authority might they invent?

Scientists might hypothesize that the authority of science was analogous to that held by valid theorems in mathematics. But they would quickly reject this. Theories in science are constantly replaced. Nothing like this happens within mathematical systems. Further, though the ancients knew axioms were created by us, they were aware of only one axiomatization and so perhaps could not ignore this; but we now know of non-Euclidean geometries and cannot. Moreover we know that axioms systems, for instance those of arithmetic, exist, possessing true theorems which cannot be proved. The transmission of authority from sources does not completely explain the authority of reasoned conclusions even in areas where it was thought to reign.

Scientists amnesic of philosophy would however appreciate the significance of authorities unknown in the ancient world. In the modern world, not all authorities originate in sources as some are created by goals and problem solving organised around them. Airworthiness is one example (discussed below). Scientists freed of philosophers would note close similarities with its authority and that of science.

People (including philosophers) want to fly safe aircraft. This creates a problem. Aircraft are innately dangerous - they are complex boxes which aerodynamically suspended accelerate to (and from) great speeds and heights. Not surprisingly, there is priority to make flight safe - we want to avoid accidents.

The problem of air safety is a problem about ideas. Though we do not fly ideas, how and what we fly depends upon ideas in the form of aircraft designs and protocols governing their operation. How and what we fly will therefore be determined by how their merits are argued, evaluated and debated. But what sort of problem intellectually is this? It is nothing like the reasoning done to demonstrate proofs - showing the transmission of authority from a source. Nevertheless reasoning over safety creates rational authority - airworthiness - to prefer one design over another. This is not reducible to its legal backing since this itself depends upon expert reasoning over safety.

How does this reasoning create authority? The authority of airworthiness lies in the combination of the goal of air safety with a non-geometric kind of problem solving. There are two kinds of problem solving. Before showing the connection between problem solving and authority I shall discuss them.

They can be of two broad types: closed or open. Closed problems have identifiable answers which end them. Solutions to open problems in contrast are always provisional and contingent. Finding a missing child is a closed problem: only the discovery of some specific child can end it. Another child, however similar, will not do. Finding the prettiest face in a baby competition, in contrast, is an open problem. Providing at least one child has been entered there is a prettiest baby. Which child wins is contingent upon individual judges' preferences (the criteria used) and those babies entered (the set of potential alternative solutions). Closed problems have the advantage of a definite solution at the cost of not having provisional ones. Unless the child is found the search can go on rewardless for ever. Open problems have the advantage over closed problems in always having solutions. If one candidate solution is not available another can take its place. If the winner of a baby competition is disqualified another baby can take its prize. The problem of creating airworthiness is of the open kind.

A subset of closed problems concern transmission. A successful transmission preserves the identity of its input in its output. A subset of this subset are problems concerning deduction which seek to transmit truth and falsity - truth from an antecedent idea to a consequent one and vice versa for falsity. Finding proofs about mathematical theorems are transmission problems, hence problems par excellence of a closed intellectual problem solving. Whether a theorem given certain axioms is valid or not has a definite solution. Thus in viewing rationally as analogous with geometry philosophers restrict their modelling of the problem solving of reason to closed problems.

There is an alternative - airworthiness shows authority can be created by goals. The authority of ideas can be created using open problem solving - a possibility denied historically by philosophers. Goals can do this because they can determine exhaustively the criteria and sets of candidate solutions used in open problems. We can use goals to restrict the ideas we hold. For any open problem there is a set of candidate solutions. This may be empty. But many sets are non-empty for instance the set of methods of reasoning. If there is a single member in the set, it is the solution by default - the set after all is made up of candidate solutions. Where more than one exists the solution is the one gaining by the criteria the highest merit. Which criteria should be used? This is determined by the

induction of further problems by our goal. (Open problem solving has similarities to mathematical induction - you start with a given and use a procedure to replace it. The main difference is that this procedure is another "given" in a higher level). If air safety is our goal, we will be concerned to use the best methods to select safe designs. At a higher level we want to use the best methods of selecting these methods. We would not want to use a method of selecting methods which was inferior to another - we might be less effective in choosing those methods good at selecting safe designs and so the pursuit of our goal. This ascent is made up of provisional solutions (ideas and methods of selection) - the only non-provisional thing is our goal. This makes our reasoning contingent upon the ideas methods and criteria we use. But the problem solving is constantly evolving in an unending quest towards something non-contingent - our goal.

The ascent to better methods is a better analysis of reasoning than the traditional analysis of the descent to its foundations. Successful problem solving does not transmit anything to their selected solutions. The reasoning and methods used to create air safety for instance do not give grounds for believing any flight is risk free. Instead of establishing the authority of the ideas methods in problem solving selects only the effectiveness of the problem solving used. In the case of air safety, effective methods reassure us we have done our best to search for potential causes of air disasters. Some may be missed but we know we have done our best to find them. Tomorrow, in our unending quest, we will do better.

Goal authorities radically differ from source authorities. Instead of foundations it is the exhaustiveness of our search and evaluation which give the ideas of goal authorities their authority. A source authority is challenged by showing that the privileged given an idea is not transmitted from an authorising source. Goal authority is challenged by finding an idea better than ones we have which meets our goal. Alternatively, it ceases as soon as we stop caring about the goal. If air safety was not a problem - if it did not matter whether aircraft crashed or not, then neither would those ideas selected as airworthy in terms of it. Given a different goal different ideas and problems would be selected.

A goal authority model of science explains three problems which philosophers fail to answer. First, the impossibility of finding foundations: goal authorities select ideas they do not justify them. Theories in science are privileged only because we care whether they are true or not. Their privilege has no foundation other than this.

Second, after Hume, we know that as no aircraft is known to be safe, no theory in logic can be known to be true - a few theory confirmations means as much for a theory being true as a few safe flights means an aircraft will not have a future accident. If scientific reasoning involves open problem solving this suggests the authority of any theory in science will be ephemeral awaiting a better one. But this ephemerality fits what Hume showed about the status of empirical logic.

Third, present philosophers cannot account for why scientists debate and criticise. However, as shown by the search for flight safety, the most efficient collective problem solving centred upon a goal involves a collective willingness to vigorously debate, test

and criticize ideas. Debate becomes central to understanding scientist's rationality if we are pursuing a goal.

In a world amnesic of philosophy, scientists would arrive at similar conclusions upon analogy with airworthiness as to Popper. First, science gains its authority from criticism. The authority of a theory rests upon the severity of the tests it has undergone (preproduction aircraft designs undergo vigorous testing; the more likely to uncover a design defect the better). Second, all theories are conjectures (no aircraft can be shown to be safe as accidents are always imaginable). Third, science aims not to show theories are true but to eliminate false theories (we cannot foresee the future, we only know the past; thus we can only eliminate designs and flights procedures known to have caused, or be likely, to cause accidents).

The history of the relationship between philosophy and science is not happy. Final causes motivated on philosophical grounds hindered mechanics for over a millennia. The philosophical assumption that we are the centre of the universe enabled the Ptolemaic model of the universe to sidetrack astronomy into the Renaissance. I suggest philosophers mislead non-scientists and scientists about the nature of science's authority. The ancient philosophers mixed ends and causes. They took the physical world as seeking goals and the authority of reason as transmitted from truth. In contrast, after Galileo, we know the physical world is based upon transmission from causes. After Popper, we know the authority of reason comes from how we seek truth.

Bartley, W.W. III. "A Popperian harvest". In P. Levinson (Ed.), *In pursuit of truth*, pp. 249-289 (Humanities Press. New York, 1982), p. 272.

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