

The Politics of Scientific Conceptualization

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Regular readers of *Science for the People* are already familiar with some of the ways in which science is inescapably political. And yet there is a more fundamental, less familiar, intrinsic link between science and politics, the implications of which we have barely begun to discern. *In its most basic aspects, the concepts with which scientists organize data and formulate theories, science is inherently political.* Scientific concepts are not simply asymptotic approaches to underlying truth. They are products of a particular social structure and may in turn either reinforce or challenge the social status quo. Not only the daily practice and social use, but also the content of science would be different in a differently organized society. No one interested in building a more humane society can unquestioningly accept present-day science as if it were a given, unable to be radically different.

Origins of New Concepts

Together with many previous generations, we have grown up hearing a series of apocryphal legends from the history of science, myths which seem to indicate that scientific concepts simply follow from the raw data. Copernicus, so the story goes, came to his new understanding by being a better observer of the heavens, Galileo by comparing the rate of fall of objects dropped off the leaning tower of Pisa. Aristotle wrote that men have 32 teeth and women 28, supporting his notion of different female and male natures, whereas Renaissance scientists actually counted and discovered dental parity. Newton's insights presumably followed from his forced appreciation of a falling apple. All of these stories are historically spurious, as is their

underlying theme.¹ Science is not purely inductive. As Einstein noted,

There is no inductive method which could lead to the fundamental concepts of physics... We now realize with special clarity, how much in error are those theorists who believe that theory comes inductively from experience.²

Philosophers of science and even some science textbooks increasingly recognize that factors extrinsic to science influence the formulation of scientific concepts. I shall argue that these extrinsic factors are primarily social, though of course expressed by individuals, and that, far from detracting from science, they are the factors potentially most under human control. Thus there is the possibility of a science in which scientists can take responsibility for their concepts, as a product of and contributor toward a society which is controlled and intentionally shaped by all the people in it.

Scientists who recognize that concepts do not simply derive from raw data, and even that there may be social influences on the formation of concepts, nevertheless mainly continue to believe that their conclusions are responsive only to the correspondence test — whether or not predicted results are verified by experimentation, whether or not they correspond to external reality. No experiment can be designed, however, to test a proposition outside of a conceptual context or in isolation from all other propositions. Rather all experiments test complex theories with multiple components, many of them simply assumed as commonsensical by the experimenter. There is a large margin of choice in evaluating which component to regard as falsified by any experiment. In the history of science there are many instances of scientists from different historical periods observing the same phenomenon or conducting what would seem to an observer to be the same experiment, but interpreting the results quite differently.³ Scientists really use two different tests of any hypothesis: one is the correspondence test, the other is whether the hypothesis makes sense in terms of how the scientist is used to interpreting reality as a whole. This latter interpretive framework derives mainly from the scientist's existence in a particular society.

As a way of coping with external reality, all human beings develop an interpretive framework, a world-view, which explains our situation in that external reality to ourselves. In developing a world-view, the most important component of our

reality. the major part of what we need to explain, is social. Because each of our situations, our activities and social environment, is similar to that of other individuals and dissimilar to that of yet others, we develop an outlook and responses in common with some other people, defining us as a social group. Briefly and too simply, as our situation changes, as our society changes or as our position in the society changes, our explanation to ourself changes also.⁴

All our ideas, whether in science, politics or music, are conditioned by our world-view. They are thus indirectly shaped by our society and our position in it. We develop or accept ideas as they seem to make sense to us in terms of our general explanatory framework. Life in any particular society thus shapes the range of understandings and approaches in any particular realm of thought. As societies change, as world-views change, new ranges of conceptual possibility are opened in every sphere of thought.

Cosmology and World Order

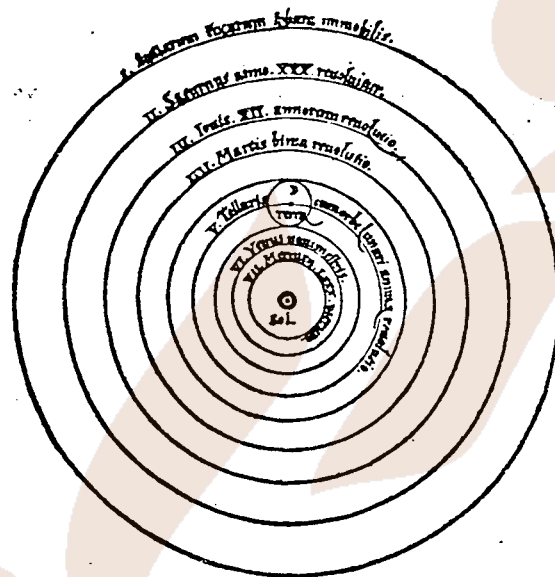
To compensate for the necessarily condensed and postulatory theoretical presentation, let me explore certain aspects of an example of a large-scale change in scientific conceptualization, the Copernican revolution. As might be expected from the preceding argument, the usual textbook accounts of the history are inadequate and significantly misleading. Prior to Copernicus' time, it seemed fairly obvious to people that the earth was the center of the universe and was stationary. Common sense held that, due to its weight, for the earth to move through space would require a continuous external driving force — something out there to keep shoving us. On the other hand the heavens, lacking substance, revolve of their own nature (or later, by their lack of resistance to an initial impetus). Being heavy, the earth would fall to the center of the universe in any case. Further, for the earth to revolve on its axis at the rate necessary to account for the visible movement of the stars rising in the East and setting in the West, centrifugal force would tear it apart, a consideration inapplicable to the even faster revolutions of the weightless heavens. This older, socially determined common sense was supported by empirical evidence. Contained in a finite universe the outermost limits of which were bounded by Heaven, any movement through space by the earth would have to be manifested in changes in the apparent positions of

planets and stars, whereas this parallax was not observable.

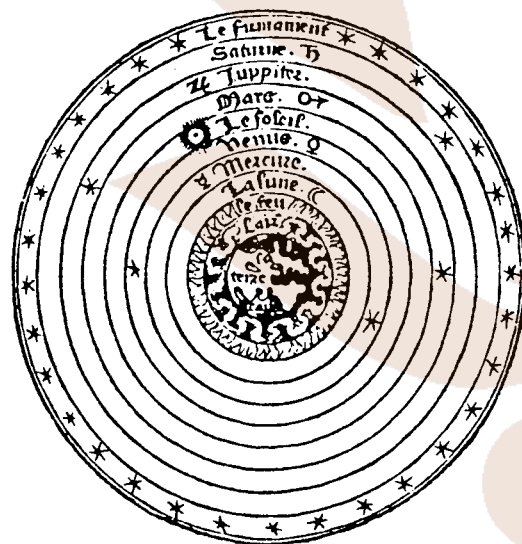
The older cosmology with its concentric crystalline spheres and its mathematical hypotheses to enable calculation of planetary positions, its epicycles major and minor, deferents, eccentrics and equants,⁵ embodied a series of presuppositions which were becoming less meaningful in the century or more before Copernicus. It premised strict limits on human knowledge and control, a rigid chain of being, and relative unimportance of human concerns. There was a split model of reality. Humans could know *a priori* the necessarily simple and perfect paths of the stars and planets, as distinct from human inability to understand the 'buzzing confusion' on earth, and as distinct from the complex mathematical devices necessary actually to calculate those heavenly paths. (Ptolemy and his successors explicitly denied that the planets could move epicyclically, etc., as it was necessary to imagine them doing in order to calculate.) The heavens, being of different material than the sub-lunar sphere, were thought to be subject to different laws. Change on earth, including social change, was caused primarily by the movement of the stars rather than human effort. There was a fixed hierarchy of value and authority in the universe, from Heaven, through the crystalline spheres, to Earth and below, a fixed position and code of conduct for each group, with man (my first impulse, to substitute 'people' for 'man,' would clearly be anachronistic) in a crucial intermediate position partaking of both soul and clay.

New World-Views and the Copernican Revolution

As the society changed in fundamental ways, new world-views developed, making possible new perceptions in all fields. The changes occurred first in northern Italy, which is where Copernicus studied. Renaissance society was still hierarchic, of course; however, its former rigidity had been shattered. Wealthy new urban strata had developed with the thirteenth century commercial boom. Growing state centralization and moves by monarchs against the landed feudal nobility created new jobs and possibilities of social mobility for commoners. Medieval criteria of hierarchy were now obscured by competing, though often intermingling, hierarchies, embodying different sets of values. A long economic slump and regression toward sharper class distinctions and obstacles to upward mobility in Copernicus' own lifetime only enhanced the widespread sense of

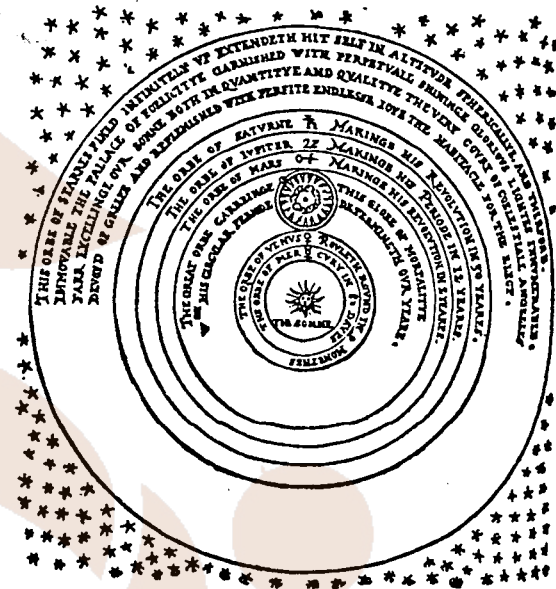


The universe of Copernicus
(from *De Revolutionibus...*, 1543)



The medieval universe: Ptolemy's celestial spheres
(from O. Finé, *La Theorique des Cielz, Mouvements, et Termes Practiques des Sept Planetes, nouvellement et tres clerement redigee en langage francois*, 1528)

30 A perfit description of the Caelestiall Orbes,
according to the most auncient doctrine of the
Pythagoreans. etc.



The infinite universe of Thomas Digges
(from *A Perfit Description of the Caelestiall Orbes, according to the most auncient doctrine of the Pythagoreans, lately revived by Copernicus and by Geometricall Demonstrations Approved* [Based on Book I of Copernicus' *De Revolutionibus Orbium Coelestium*], 1576, folio 43)

'THIS ORBE OF STARRES FIXED INFINITELY VP EXTENDETH HIT SELF IN ALTITUDE SPHERICALLYE, AND THEREFORE IMMOVABLE THE PALLACE OF FOELICITYE GARNISHED WITH PERPETUALL SHININGE GLORIOUS LIGHTES INNUMERABLE, FARR EXCELLINGE OUR SONNE BOTH IN QUANTITYE AND QUALITYE THE VERY COURT OF COELESTIALL ANGELES DEVOYD OF GREEFE AND REPLENISHED WITH PERFITE ENDLESSE JOYE THE HABITACLE FOR THE ELECT... THE GREAT ORBE CARREINGE THIS GLOBE OF MORTALITYE WTH HIS CIRCULAR PERIODE DETERMINETH OUR YEARE.'

In the first English-language version of Copernicus, Thomas Digges depicts a scattering of stars, illustrating his novel concept of infinity. In Copernicus' original diagram, we see a finite outer shell of 'immobile spheres' bounding a heliocentric system composed of mercury, venus, earth, mars, jupiter and saturn. In Finé's diagram of the Ptolemaic system, we see the four elements (earth, water, air, fire) at the centre, with orbits of the moon, mercury, venus, the sun, mars, jupiter, saturn and 'the firmament'.

individual self-fulfillment possible to those already of relatively high status. Much more of one's life and environment was seen to be within human control and understanding. Common sense was undergoing a change. In removing the earth from the center, in rotating it around the sun as one of many planets, the Copernican revolution raised human and mundane concerns to the level of the heavens. It is the manifestation in astronomy of a new interpretative framework corresponding to the new social ambient.

Early adherents were won to the new theory through sympathy with its underlying world-view, not through factors internal to science. As mentioned above, there were no new data or new technology to attract them. The new interpretation was not significantly simpler — in some respects it was more complicated — nor more accurate than the Ptolemaic model (in spite of assertions to the contrary by many textbooks, which distort the content of science as they misunderstand the factors which shape it). It denied the empirical evidence not only that the sun 'rises' and 'sets' but also that observable parallax was absent. Only decades later was the telescope adopted and what was taken to be empirical confirmation provided. Far from being based on new data, Copernicus' theory enabled the perception of new data. Other cultures, not precluded by their socially conditioned general perspectives from seeing celestial change, had observed sunspots and new stars for centuries. After Copernicus, using the same instruments as before, European astronomers began to see these phenomena and to interpret comets as wandering through what before had seemed 'immutable space'. The same premises which enabled the new astronomy and made sense to those of Copernicus' contemporaries whom his argument persuaded, are also to be found in other spheres of thought undergoing decisive transformation at this time. Copernicus' own writing on subjects far from astronomy manifests the same new world-view.

How we organize data in science as in every sphere of consciousness embodies an over-all outlook which derives from our social existence. Underlying and structuring all our thoughts is our understanding of our society and our reactions and adaptations to it. Scientific concepts are thus inherently political, continuing to express and reaffirm socially based world-views. Einstein's reluctance to accept probabilistic quantum theory, to take one modern realization, stemmed explicitly from his

rejection of the discordant outlook of which he saw it a product. An excellent recent study (of sexism in the history of biology) in *Science for the People* provides a further illustration of how scientific concepts, in part socially based, in turn reinforce the social status quo.⁶ To 'serve the people' with existing science is insufficient.

Practising Politics and Science

For a worker in science who recognizes the need for fundamental social change, the more familiar respects in which science is political lead to relatively limited ways of combining jobs with political activity. Many indeed choose to separate professional from political lives, working with other people after job hours and outside job roles. Others publicize political abuses in connection with science or take advantage of respected positions based on work in science to speak out on social issues. Some scientists or science workers who are radicals organize their co-workers to rearrange or diminish hierarchies in the work situation. And yet all of these approaches leave the science itself, the content of research and formulation of results, untouched. Considered in those terms, science seems to offer fulfillment mainly in ways that are apolitical. For someone who is politically committed, there are constant qualms about whether and how much even to be working on science. Some people become science dropouts to expend energy on efforts more directly political. For others who need to hold a job in science and yet are unable to reconcile science and politics, the tension may result in lessening political commitment.

There is another important political option which derives from the above discussion. It is possible to use one's scientific knowledge to oppose specialization or overcome some of its deleterious effects. Often what pass for narrow technical decisions really contain disguised political decisions which can be extricated and pointed out. *Science for the People* has been full of examples.⁷ The aura of technical expertise shelters what are political decisions from question and criticism. There is a political point too in attempting to enhance not only the scientific understanding of non-scientists but also their sense of their own ability to understand. Effective 'popularization' has negative connotations only to people who accept the elitist premises of modern science. And yet, integrating the concepts with which scientists work for presentation to a lay audience, still accepts

those concepts as given. *It is through recognizing that scientific concepts themselves are political that it is primarily possible not only to be a radical and a scientist, but to be a radical scientist.*

Every society rests on the consciousness of its members. Their adherence to, or at least acceptance of, its structure is ultimately what holds the society together. The major obstacles we face in doing political organizing in our own society are a widespread lack of ability to conceive of a better society, or more commonly a sense that it is impossible fundamentally to change what we've got. Corporations, the state, etc., all of them clearly opponents, are obstacles primarily because too many people continue to believe them legitimate.

As a large part of this essay has attempted to show, consciousness is not autonomous. There is much about our society that encourages people's cynicism, apathy and low regard for themselves. In political organizing toward social change, it is not possible to work at the level of consciousness alone. There are severe limits on the extent to which people's sense of social alternatives and sense of their own capabilities to help shape those alternatives can be altered without some alteration in their lives. A revolutionary movement, aiming at a society in which all the people will run the society, must engage people increasingly in conscious and active participation toward changing social conditions now. This is distinct from models of revolutionary action which postulate a revolutionary elite as the sole active force, or ones which include an uncomprehending or merely sloganistic mass participation, or ones which would require waiting until after a seizure of power for the entirety of the social change. This is distinct also from any one-way conception of the relationship between social conditions and consciousness, either one that expects capitalism inevitably to fall from its own contradictions, exclusive of human effort, or one that approaches people without careful consideration of the concrete factors that shape and limit their receptivity. The very fact of being part of political struggle is itself a changed social condition which makes possible changes in perspective and attitude, especially if the political struggle is well chosen and well organized.

A crucial objective of organizing is the fundamental transformation of outlook. Through their struggles, people must learn to understand our society, what maintains it and what will be required to change it. There are important answers that will

elude us until we have a mass movement with the capacity to shake and test the society. People must see themselves as capable, if united, of effecting basic change and increasingly able themselves to decide which tactics will further our growing knowledge and ability to transform. It is insufficient to be only anti-capitalist, anti-ruling class, anti-racist, etc. More than an abstract idea of the kind of egalitarian, genuinely democratic society toward which we aim is necessary. That society must be seen as a real prospect and legitimate objective. Unfortunately even many radicals deep down do not believe that a better society is anything more than a theoretical possibility. Their actions and the ways they work with others manifest their acceptance of the prevailing order.

Going Beyond: Doing Radical Science

Knowing that science concepts would and will be different in a qualitatively different society⁸ enables science workers in their daily practice now to call into question this society and the consciousness that sustains it. This can be done in two basic ways. The first is by learning to identify the hidden, seemingly commonsensical and thus hard to see, premises that underlie accepted concepts, and by learning to recognize how these premises reflect a world-view which is socially based and socially restricted. Showing their connection to the structure of our society, teaching others to understand all ideas and cultural products in social terms, aids people in recognizing that this society is not eternal and cannot be simply accepted as a given.

This first possibility for political practice within science leads to a second. Having discerned the kinds of premises and perspectives promoted by life in this society, radical scientists may begin to be able to develop alternative science concepts based on empathy with a qualitatively better society; to attempt the new possibilities for organizing data which arise out of a different world-view. The difficulties in undertaking this science/political option are formidable, for it requires identifying with a society not yet existent. We are of course fortunate in the availability of socialist societies to present us with alternative models. These can serve, however, to indicate only the barest outlines, the most abstract hopes, for what we could create here. Undoubtedly it is impossible to put oneself entirely outside of one's society. To step back from it, to delegitimize it at its roots within oneself and others is immensely difficult. Yet this is a

fundamental goal of radical practice and the precondition of radical science.

A word is necessary regarding validity in science. Concepts are not arbitrary, nor are they plastic. There is an external reality to which they must correspond. Most of the concepts in present-day science have a definite operational validity (this is not the place to explore other possible tests for validity); they are not, however, the exclusive ways to organize data. Modern science recognizes the tentativeness and incompleteness of any particular concept, the possibility that it will be transformed through further discovery. What is not readily acknowledged is that its supersession, at the level of fundamental conceptual change, is tied to social developments. In addition, scientific concepts are partial not only because they correspond to a particular social structure, as we have seen, but also because most scientists, as a relatively privileged social group, have a stake in only a partial view of their social reality. The world-view which the concepts manifest is thus that of a group barred from an over-all perspective. As partial, the concepts in present-day science have been functional both in controlling natural reality (the operational test) and in not questioning social reality.

To the extent to which it is possible to transcend the dominant world-views based on adaptation to this society, alternative science concepts may be developed now, resulting in a more creative science. This in itself, however, is not a political accomplishment. Without making explicit the political underpinnings, the alternative concepts will become simply creative reinforcements for the status quo. Radical scientists need to be self-conscious of and to show others how their concepts arise, how their ideas relate to their society and how to understand their society. Alternative concepts should be used to raise social alternatives. In science as elsewhere, the theoretical possibility and attainability of a qualitatively better society must be constantly stressed.

There has been a tendency among radicals to reject the usual posing of issues in terms of the scientist's personal or social responsibility, and rightly so.⁹ Abuses of science are endemic to an oppressive social order. There is, however, a higher level of individual responsibility which comes with the awareness that concepts do not automatically derive from raw data and are socially influenced. Recognizing that there are choices behind concepts and that these choices have political implications,

radical scientists are able to take responsibility for the concepts they use. By doing so they act as precursors of a society in which consciousness is no longer subordinate to social conditions. Through their science now, they can contribute to fundamental social change.

This essay has gone nearly as far as it can. The next step would have to be a start on social analysis and restructuring of current science concepts. This should be read as a challenge to politically committed science workers to undertake that effort.¹⁰

This example of labour shows strikingly how even the most abstract categories — despite their validity for all epochs (precisely because of their abstractness) — are nevertheless, in the specific character of this abstraction, themselves likewise a product of historic relations, and possess their full validity only for and within these relations . . .

In the succession of the economic categories, as in any other historical, social science, it must not be forgotten that their subject — here, modern bourgeois society — is always what is given, in the head as well as in reality, and that these categories therefore express the forms of being, the characteristics of existence, and often only individual sides of this specific society, this subject and that therefore this society by no means begins only at the point where one can speak of it *as such*; this holds *for science as well*.

— Karl Marx, *Grundrisse*