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Science and epistemic values

J.D. Bernal on the value of science

J.D. Bernal was a convinced and eloquent supporter of the optimistic Enlightenment tradition. Science is a cultural value, he argued with Bacon and Marx, since it serves as an efficient and indispensable tool of social progress.

In his *Science in History* (1954), Bernal distinguished five different senses of science: 1) institution, 2) method, 3) cumulative tradition of knowledge, 4) a major factor in the maintenance and development of production, 5) one of the most powerful influences moulding beliefs and attitudes to the universe and man (p. 31).[1] The "progressive growth of science comes from its continually renewed interconnection with industry" (p. 1237): science solves problems that have primarily emerged from practical issues of "economic necessity" (p. 39), and it brings about "recipes" describing "how to do things" (p. 40) and rational means for the conscious planning of social production and order. "Science implies socialism", as Bernal wished to put his thesis (p. 11).

Especially in his later work in the late sixties, Bernal was painfully aware of the possibility that science, if not free and socially responsible, can also be "distorted for mean and destructive ends" (p. 1309). The danger, as he saw it, arises from "idealistic" theories of science (p. 497).

> "The ideal of pure science — the pursuit of Truth for its own sake — is the conscious statement of a social attitude which has done much to hinder the development of science and has helped to put it into obscurantist and reactionary hands" (p. 41).

But if able to avoid the refuge to a "cosmic pessimism" (p. 661), natural and social sciences together will remove both known and yet unrecognized "evils", cure diseases, "maintain life and happiness for all", discover "new good things" and "new and effective bases of organization for social action" (p. 1310), and transform society to "one free from exploitation" (p. 1309).

Bernal's Baconian optimism and Marxist rhetorics are not very fashionable today. We

simply know too much of the evils, oppression, and regress that has been brought about in the names of science and technology. But still we may and should admire the courage and strength of Bernal's personal visions and hopes.

We may also agree that science — in spite of its many present-day destructive associations — at least *has been* and still *may be* a "cultural value". The aim of this paper is to challenge Bernal's characterization of *how* and *why* science is a valuable form of activity in our culture. As my title suggests, I disagree with Bernal about the role of epistemic values (such as truth) in the mission of science.

Axiological systems

Cultural values may be expressed as an axiological system which tells what kinds of things or aims are regarded as possessing intrinsic and derived value.[2] In general, an *axiological system* A=<V,B,I> consists of three elements:

First, V is a hierarchical ordering of *intrinsic values* which are regarded as valuable in themselves, without relation to other aims. Intrinsic values may be, e.g.,

- hedonistic: happiness
- vitalistic: life, health
- economic: money, wealth
- political: power, liberty, equality, justice, peace
- social: love, friendship
- epistemic: knowledge, truth
- aesthetic: beauty
- religious: holiness, sanctity.

The dominant type of intrinsic value is a central characteristic of an axiological system — and of a culture where such a system is widely supported.

Secondly, B is a system of *beliefs* which tell how the intrinsic values in V may be pursued.

Thirdly, I is a set of *instrumental values* which serve, according to beliefs B, as effective tools or intermediate steps for reaching or promoting intrinsic values V.[3]

Instrumentalism vs. cognitivism

In what sense then could science be regarded as a cultural value? Bernal's position seems to be clear: his intrinsic values are primarily political and social (good social life, justice, liberty, freedom from exploitation) with hedonistic and vitalistic elements (happiness, health). Economic goals are for him instrumental values, since they help us to achieve good life free of misery. And science as a pursuit of knowledge is also an instrumental value in the service of industry and social organization. Bernal's conception of science is thus *instrumentalist* in the sense that he regards epistemic values to be means for ends that belong to the sphere of the social applications of scientific knowledge — and explicitly denies the idea that truth could be valued for its own sake.[4]

The instrumentalist view of science may exist in many variants, since it may be combined with many different value systems A=<V,B,I>. Science may be taken to be a tool for technological and economic progress (as many pragmatists think), for rational social life (as many Marxists think), or for Bildung as the education of rationally thinking human individuals (as the Enlightenment philosophers and many of their Romantic successors urged).

An alternative to instrumentalism is to include *epistemic values* (such as truth and information) among the *intrinsic* values of our axiology. This conception of science may be called *cognitivism*, since it takes the essence of science to be the rational pursuit of knowledge, i.e., justified true information about reality, by the systematic methods of inquiry.[5]

Cognitivism may again exist in many variants. Bernal's criticism of the ideal of "intrinsic and pure knowledge" is directed at a special version of cognitivism which regards Truth (with a capital 'T') as the *only* basic value, and therefore remains indifferent or even hostile to the attempts to apply scientific knowledge to the needs of mankind in a socially responsible way. However, a cognitivist may quite well accept, besides truth, also other intrinsic values (such as beauty, health, justice, freedom etc.). Thereby he or she will also

accept that the best results of scientific inquiry, besides their intrinsic epistemic value, possess also instrumental value relative to the goals of good life.

The rhetoric opposition between instrumentalism and cognitivism becomes thus largely unnecessary, if we realize that an axiological system may attribute to the same goal (such as truth) *both intrinsic value and instrumental value* (relative to the other intrinsic values in the system) *at the same time.*

The contrast between cognitivism and instrumentalism does not become irrelevant or empty through this observation, however. It still has important consequences in science policy. First, in assessing the validity of a truth claim in science, a scientist may appeal only to its epistemic value or to indicators of such values, but not to its instrumental value. For example, it is not an argument in favour (or against) a scientific hypothesis that its truth would be nice and useful (or awkward and harmful) relative to our practical interests.

Secondly, while a cognitivist regards it valuable and rational to pursue "pure" basic science, or curiosity-oriented fundamental research, even if the obtained knowledge never leads to any "practical" applications, an instrumentalist has to justify the rationality of *all* scientific activity as some form of "strategic" or "applied" research.[6] This is one of the reasons why I prefer a *socially responsible form of cognitivism* to the kind of instrumentalism represented by Bernal.

Explaining the success of science

Another reason for preferring cognitivism to instrumentalism becomes evident, when we ask for an *explanation* of the success of science.

It cannot be denied that science has been extremely successful on two practical levels. First, the method of science provides a rational way of resolving cognitive disputes about the nature of our universe. The relative success of science over other ways of forming belief systems (such as myths, religions, pseudo-sciences, etc.) has to be explained by such epistemic virtues or ideals of science as its self-corrective methods of research, critical attitude, and public argumentation. This relative and historically progressive *cognitive success* is either denied or left unexplained by those sceptics and relativists who fail to find any distinguishing features in the procedural rationality of science.[7] It is over-explained by those dogmatists who falsely claim that science possesses an *infallible* method for finding certified truths.[8] Epistemic values thus have a fundamental role in any plausible account of the cognitive success of science.

Secondly, science has been practically successful also in the pragmatic sense (Greek *pragma* = action) that its theories have served as effective tools of human action. Reliable predictions and rules about means — ends-relation have enabled men to enhance their interaction with nature and to pursue their practical goals efficiently. This *pragmatic success* of science is a fact about which both instrumentalists and cognitivists agree. But they will typically disagree on the best way of explaining this fact.

Bernal himself wanted to use the practical success of science to explain its cognitive success: the "continually renewed interconnection with industry" explains the "progressive growth of science" (p. 1237).[9] Even though laboratory practice is an important element in the critical testing of theories in natural science, Bernal's thesis is clearly exaggerated. There are progressive areas of science which, at least for a long time, develop independently of industrial applications. Therefore, the connection to industry fails to explain the existence of theoretical revisions and revolutions which arise within a scientific tradition.

A *scientific realist* turns the table around and wishes to explain the pragmatic success of science by its cognitive success. As we know from classical logic, a true statement logically entails only true consequences. Hence, if a theory is true, all of its empirical predictions are true as well. Recent work on the concepts of truthlikeness and approximate truth — which a critical scientific realist uses for expressing the non-absolute degree of success of a theory in its description of reality — has also shown in which precise sense the

assumption that a theory is "close to truth" helps to explain the practical success of its observational predictions.[10]

In this sense, instead of being a dangerous "ideology", the pursuit of epistemic values (truth, information, truthlikeness) is an *indispensable and explanatory element in guaranteeing that science is able to serve also other cultural values.*

This conclusion of scientific realism has been challenged by two different counter-arguments of philosophers with instrumentalist leanings. The first is the *pragmatist* strategy of denying that the concept of truth could be defined independently of practical success: the classical idea of truth as correspondence with reality should be replaced by the view that 'true' and 'useful' have the same meaning, i.e., truth is defined in terms of pragmatic success.[11] This strategy leads, however, to the undesirable consequence that the pragmatist has no explanation for the practical success of science any more: the explanatory schemata

(1) Science is pragmatically successful, since its theories are sufficiently truthlike
(2) Theory T_1 is pragmatically more successful than theory T_2, since T_1 is more truthlike than T_2

are transformed into trivial tautologies:

(3) Science is pragmatically successful, since its theories are pragmatically successful
(4) Theory T_1 is pragmatically more successful than theory T_2, since T_1 is pragmatically more successful than T_2.[12]

The second strategy has been supported by methodological antirealists like Bas van Fraassen (1980) and Larry Laudan (1984b), who retain the classical concept of truth even for theories, but find it altogether irrelevant in the analysis of scientific progress. They suggest that science is practically successful (in making true observational predictions, or in solving empirical problems), but this is not a fact in need of any explanation. van Fraassen points out that it is no wonder our theories "work", since we *choose* those theories which "survive" in the "fierce competition". Laudan remarks that the problem-solving capacity of our theories, or their reliability in predicting nature and intervening in the natural order, needs no explanation in terms of their truth or truthlikeness, since we use testing procedures and strategies of experimental design which select more reliable theories than other techniques.

I find these excuses insufficient. Consider an analogy: why are our cars faster than cars 50 years ago? It is not sufficient to say that we buy faster cars now than earlier (cf. van Fraassen), or that we produce in our factories faster cars than earlier (cf. Laudan). Our explanatory question demands an account of the relatively permanent ability of a car to perform successfully in terms of its speed. We need to identify some property (such as the structure of its engine), which relates the behaviour of this artefact to its functioning in its natural environment.

Similarly, an explanation of the ability of a scientific theory to yield successful predictions, not only in cases it was originally designed or selected to handle but in novel and surprising types of cases as well, has to refer to some permanent property of the theory, which describes its relation to the world. Truthlikeness is the best — even the only — property I know that could serve this function. Hence, relative success in the pursuit of epistemic values is the best explanation for the practical success of science.

NOTES

1. *Science in History* appeared first in 1954. The third edition was published in 1965. All the references are to the illustrated edition (Bernal, 1969).
2. For value theory, see von Wright (1963) and Rescher (1969).
3. For an interesting "reticulational" account of the interplay between values, methods, and theories in science, see Laudan (1984a).
4. For a criticism of instrumentalism, see Niiniluoto (1984: Ch. 12).
5. A classical formulation of cognitivism, with truth and information content as the intrinsic values, is Levi (1967). Cf. Niiniluoto (1987).
6. For the conception of "strategic" basic research, see Irvine and Martin (1984).
7. Here the views of "epistemological anarchism" (Feyerabend, 1987) and "strong programmes" in the

sociology of science meet each other. According to Feyerabend, there are no objective reasons for preferring "science and Western Civilization" to other traditions: science has gained its position by deceit, military force, and political pressure. For a critical evaluation, see Niiniluoto (1990).

8. For arguments against dogmatic cognitivism or naive realism, see Popper (1963) and Niiniluoto (1984). Instead of absolute concepts of Knowledge and Truth, we need "softer" concepts which allow for a distance from certainty and perfect truth.
9. For an interesting analysis of Marxist views on practice as a criterion of truth, see Roll-Hansen (1989).
10. For details, and for replies to Laudan's (1984a) challenge, see Niiniluoto (1986, 1987).
11. Classical pragmatists defined truth as the "cash-value" of a belief (William James) or as the "warranted assertability" of an assertion (John Dewey). Nicholas Rescher's (1977) "methodological pragmatism" defines scientific progress as "increasing success of applications in problem solving and control".
12. This observation falsifies Arthur Fine's (1986) thesis that each realist explanation for the success of science can be replaced by an equally good instrumentalist explanation, where the realist notion of truth as correspondence is substituted by a pragmatist one.

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