

Realism and Instrumentalism: the case of the Copernican revolution

- General issue:
- **What does “realism” assert??**
- Useful to break it down to 3 components
- 1. “Metaphysical realism” – often taken to assert that there is a reality independent of the human mind.

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- However, much better, is:
- Meta-R = There is a structured and undivided reality of which the mind is a part and that, far from imposing their own order on things, our mental operations are themselves governed by the laws which describe the workings of Nature.

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- 2. “Methodological realism” = 1 + the structure of reality is, at least to some extent, intelligible to the mind

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- 3 Scientific Realism = 1 + 2 + successful theories in the mature sciences are approximately true (ie genuinely, if only partially, reflect the structure of the reality postulated in 1)

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- Instrumentalism is uncommitted re 1 but insists:
- A. contrary to 2, the human mind is capable only of real knowledge of the observable part of reality (“phenomena”)
- B. contrary to 3, even our most successful theories should be regarded as merely attempts to codify the phenomena in an efficient way

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- How did this play out historically in the case of Copernicus?
- Usual story is that the scientists (at least the good ones) were realists about Copernican theory
- While the Church insisted on an instrumentalist interpretation in order to preserve Aristotle and scripture

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- One of the chief villains of the piece - on this story - was Osiander (who wrote an anonymous preface to *De Revolutionibus*)
- Certainly Osiander provided a classic statement of the instrumentalist view of scientific theories

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- “Since the novelty of the hypothesis here proposed, according to which the earth moves and the sun stays fixed at the centre of the universe, has already received a great deal of publicity, I have no doubt but that certain savants have taken great offence and think it wrong to upset the liberal disciplines which have been so firmly established.”

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- “If however they are willing to weigh the matter scrupulously, they will find that the author of this book has done nothing deserving of censure. For the astronomer’s job consists of the following:

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- “To gather together the history of the celestial movements by means of painstakingly and skillfully made observations and then – since he cannot by any line of reasoning reach the causes of these movements – to think up or construct whatever hypotheses he pleases ...

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- .. such that, on their assumption, the self-same movements, past and future both, can be calculated by means of the principles of geometry ... It is not necessary that these hypotheses be true. They may not even be likely. This one thing suffices that the calculations to which they lead agree with the result of observation.”

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- And he later added:
- Astronomy ‘thinks up fictive causes’
- And:
- “Sometimes alternative hypotheses are available with which to account for one and the same movement; the eccentric and the epicycle in the theory of solar motion are a case in point.

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- “In such a case, the astronomer will by preference choose the hypothesis that is easier to grasp while the philosopher tends to seek out likelihood. Neither one nor the other can, however, conceive or enunciate the least certainty, unless he be the recipient of some divine revelation.

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- Let no one then expect from astronomy [anything] about these hypotheses that is certain. Astronomy can give him nothing of the sort. Let him take care not to take as true assumptions which were fabricated for a quite different purpose, lest, far from gaining access to astronomical science, he be turned away from it, and leave it more stupid than he was before.”

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- And the other chief villain was the Church (or rather churches):
- Luther:
- “People give ear to an upstart astrologer who strove to show that the earth revolves, not the heavens or the firmament, the sun and the moon.

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- “... This fool wishes to reverse the entire science of astronomy; but sacred scripture tells us [Joshua 10:13] that Joshua commanded the sun to stand still, and not the earth”

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- Or, Melancthon:
- “The eyes are witnesses that the heavens revolve in the space of 24 hours. But certain men, either from love of novelty, or to make a display of ingenuity, have concluded that the earth moves; and they maintain that neither the 8th sphere nor the sun revolves.”

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- “.. Now, it is a want of honesty and decency to assert such notions publicly, and the example is pernicious. It is the part of a good mind to accept the truth as revealed by God and to acquiesce in it.”
- And of course the Catholic Church eventually followed suit

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- So let's do some analysis here
- First, was Copernicus himself a realist about his own theory?
- Answer is clearly yes

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- Copernicus: “ I hesitated long whether ... I should give to the light these my Commentaries written to prove the Earth’s motion”

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- Also clear that he didn't think that one needed to go instrumentalist to solve the problem of the apparent clash with mechanics
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- “ How I came to dare to conceive such motion of the Earth, contrary to the received opinion of the Mathematicians and indeed contrary to the impression of the senses ..”

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- It is but as the saying of Aeneas in Virgil – “We sail forth from the harbour, and lands and cities retire.” As the ship floats along in the calm, all external things seem to have the motion that is really that of the ship, while those within the ship feel that they and all its contents are at rest.”

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- “We must admit the possibility of a double motion of objects which fall and rise in the Universe, namely the resultant of rectilinear and circular motion. Thus heavy falling bodies, being especially earthy, must doubtless retain the nature of the whole to which they belong..”

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- Notice that what was often cited as a reason not to be a realist can in fact be turned into an argument in favour of realism
- The clash with accepted mechanics is only a problem for a realist and it provides scientific problems that may prove fruitful
- The “heuristic argument” for realism

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- So as usual the situation is rather more subtle than later commentaries suggest
- There certainly were scientific as well as theological (and other) grounds for concern:

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- 1. No effect of motion
- 2. No dynamics to underwrite the assumption of the earth's motion
- 3. Various ad hoc moves – e.g. concerning stellar parallax and the 'third motion'
- 4. Complexity of the 'full theory'

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- Alongside a number of major predictive successes

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- But in any event no one should be fully realist about any fundamental scientific theory
- Cp current situation with GTR and QM
- Rather the sensible view is that the theory's 'theoretical part' reflects *to a certain extent* the underlying nature of reality

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- This again was the basic attitude of Copernicus's successors
- Kepler, Galileo and Newton all 'accepted' Copernican theory in this attenuated sense
- But went on to modify it significantly

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- Kepler eliminated the circles
- Galileo worked toward a better account of inertia
- Newton fully articulated a mechanics that could underwrite the Copernican hypothesis
- But at the same time importantly modified it