

# Galileo and the “theory-ladenness” of observations

- Galileo’s *Siderius Nuncius* (1610) announced four main “discoveries” resulting from his telescopic observations

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- 1. Jupiter has 4 moons
- 2. The Moon’s surface is ‘uneven, rough, etc’
- 3. Fixed stars appear no bigger when viewed through the telescope than to the naked eye
- 4. Milky way consists of lots of stars

# Galileo and the “theory-ladenness” of observations

- In 1613 Galileo also published the claim that he had observed the phases of Venus through his telescope.
- (Observations made in 1610.)

# Galileo and the “theory-ladenness” of observations

- Observation 1 seems to refute the Ptolemaic view that *everything* else in the universe moves around the fixed earth
- Observation 2 refutes (or at least clashes with) the Aristotelian view that the heavens are ‘perfect’ – quite distinct from the terrestrial realm of change, imperfection and decay

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- (Observation 4 is interesting, but so far as this theoretical dispute goes neither here nor there)

# Galileo and the “theory-ladenness” of observations

- Famously, various supporters of the Church and of the Aristotelian/Ptolemaic view contested the observations themselves
- Some even refused to look through Galileo’s telescope – regarding the instrument as impious

# Galileo and the “theory-ladenness” of observations

- This provides an interesting case against which to judge a thesis that has played a major role in “post-positivist” philosophy of science
- And hence a major role in the whole so-called postmodernist movement
- This is the thesis of the *inevitable “theory-ladenness of all observation statements”*

# Galileo and the “theory-ladenness” of observations

- Popper’s basic falsificationist model
- $T$  entails  $O$ , but not- $O$ ; therefore not- $T$
- (“Man proposes, Nature disposes”)

# Galileo and the “theory-ladenness” of observations

- But of course it is not ‘Nature’ that directly clashes with a theory
- The clash is logical – i.e. between assertions or sentences
- But observation sentences are just records of fact?? And involve no interpretation/theory??
- Some have argued that this is wrong and that therefore the basic testing model is compromised.

# Galileo and the “theory-ladenness” of observations

- Sources of this thesis are
- 1. N.R.Hanson’s famous imaginary discussion between Tycho and Kepler on the “sun rise”; and
- 2. Interesting results from the psychology of perception which suggest that even our introspectively available sense data is affected by theories that have become *hard-wired*

# Galileo and the “theory-ladenness” of observations

- Have always found Hanson discussion trite and pointless
- Of course if we accept certain theories then we will be happy to describe certain observable situations in terms of those theories
- (Cp the physicist looking into a cloud chamber)

# Galileo and the “theory-ladenness” of observations

- But it's easy to disentangle to two
- Especially when there is a dispute
- So Tycho and Kepler can easily agree on the observation and locate all the dispute as concerning what each acknowledges as a theory



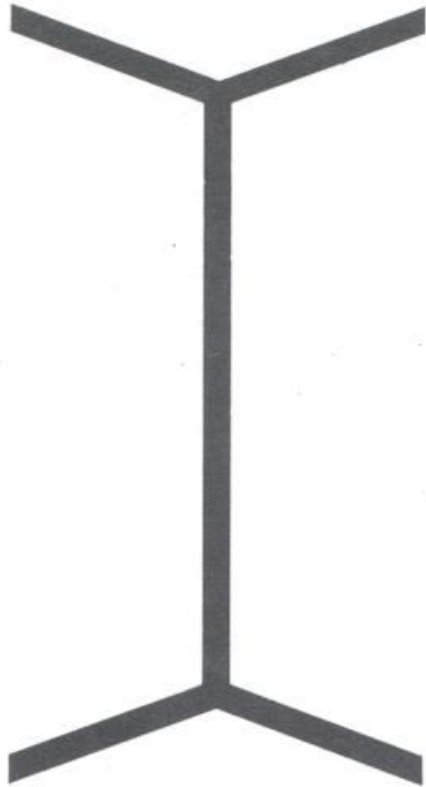
# Psychology of Perception

- Bringing results from psychology of perception to bear on this discussion is a lot more interesting.
- We tend to think that – at least in favourable conditions – we ‘see things as they are’
- (Though physics tells us very differently.)

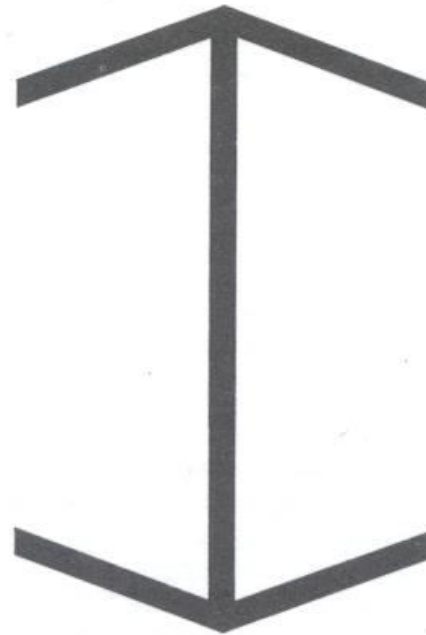
# Psychology of Perception

- Moreover, fairly recent results in psychology of perception seem to show directly that theories can become hardwired and affect the very way that we see things
- “Size Constancy” (the ‘Theatre Audience Effect’)
- Various other optical illusions
- Daddy of them all: the Muller-Lyer illusion

# Psychology of Perception

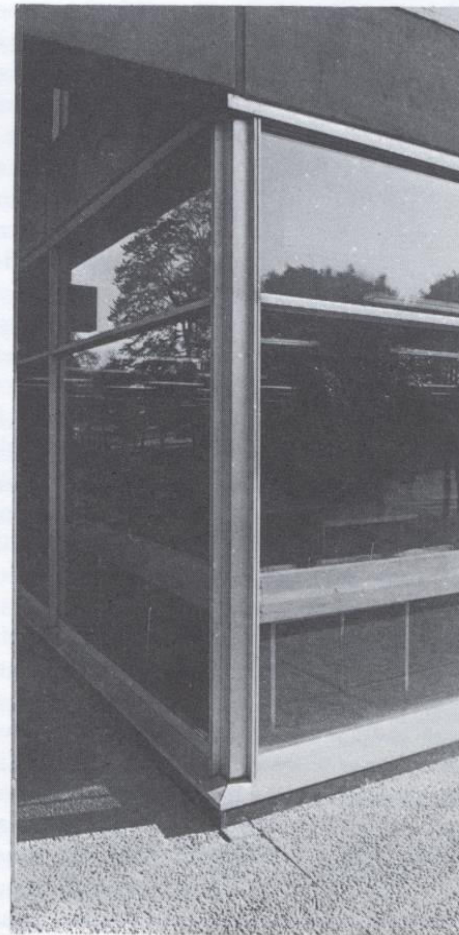
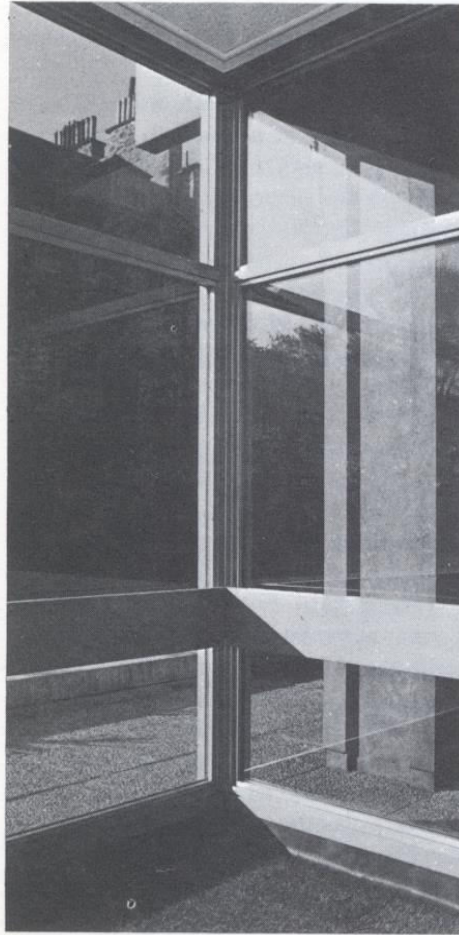


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# Psychology of Perception



# Psychology of Perception



# Psychology of Perception



# Galileo and the “theory-ladenness” of observations

- As for the psychological results – note that observation of a sort is still taken as ‘foundational’ here
- How do we know that the Muller-Lyer is an illusion?
- So although these results show that often what we think we see is infused with theory
- This either doesn’t arise or is eliminable in scientific theory-testing

# Galileo and the “theory-ladenness” of observations

- As for the psychological results – note that observation of a sort is still taken as ‘foundational’ here
- How do we know that the Muller-Lyer is an illusion?
- Ans: we *measure* the two lines



# Galileo and the “theory-ladenness” of observations

- Obviously the issues raised by the Galileo case *do* arise within science
- Everyone accepted that there was good evidence that the telescope was “reliable” in terrestrial observations
- Notice 1. the multi-level nature of this and
- 2. the fact that – as so often – this can be analysed in terms of independent testability

# Galileo and the “theory-ladenness” of observations

- Aristotelians like Horke however claimed that while the telescope was reliable terrestrially, it was unreliable celestially
- Was this an unacceptable *ad hoc* manoeuvre?

# Galileo and the “theory-ladenness” of observations

- In fact, as Feyerabend points out, there was some evidence for this move
- For example, while terrestrially the telescope made things appear bigger, the stars appeared no bigger (in fact, with good telescopes, smaller)
- And, stars that appeared single to the naked eye, appeared double in the telescope
- Obviously two interpretations of this
- 1. They really are double stars (telescope is right)
- 2. This is an illusion (naked eye is right)

# Galileo and the “theory-ladenness” of observations

- So what are we to make of all this?
- 1. Obviously Galileo no more ‘saw’ the moons of Jupiter than Kepler ‘saw’ the earth revolving to reveal the sun
- 2. But we can identify the ‘appearances’ (or raw data) on which everyone can agree: e.g. the regular appearance, disappearance and re- appearance of certain characteristic spots of light on the crosswires of the telescope at recorded times
- 3. There are various different interpretations of this raw data that everyone should regard as theoretical; in particular

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- (a) that these are images of a moon of Jupiter which is periodically obscured by Jupiter and visible at other times as it orbits around Jupiter
- (b) that the spots of light are simply artefacts of the telescope
- 4. So we can find an observational level – raw data - on which all parties to the dispute agree (infallible? incorrigible?)
- 5. And then there are rival theories to account for this raw data –and once we recognise them as theories it is very easy to differentiate between them
- (What Feyerabend sees as ‘rhetoric’ and Kitcher as ‘exhibiting certain skills’ is in fact just our old friend independent testability)

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- In sum:
- 1. Easy to ‘laden’ any talk about what we are observing with theory
- 2. But also easy to articulate and separate out the theory and get down to incorrigible (or at any rate neutral and not corrected) stuff
- 3. Then the situation is seen clearly as a dispute over which theory is better supported by this neutral, generally agreed data
- 4. And the answer is provided by the fact that one does and the other does not pass independent tests

# Galileo and the “theory-ladenness” of observations

- Instructive to compare this with the Newton/Flamsteed dispute
- Exactly the same conclusions follow
- (except that in that case Newton’s suggestion was not directly testable at the time; but of course the overall theory was)