

Glossary for Newton's Studies on Light and Color

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This is a glossary of terms that appear in Newton's work on light, color and optics, and in the responses of his contemporaries to that work, that a modern reader may have difficulty with. (The relevant works are, especially: Newton *Opticks*, *Principia*, *Arithmetica Universalis*, *Methodus Serierum et Differentiarum*; and Huygens *De Lumine*, and Pardies *De Lumine*.) I also include definitions and discussions of some terms that, while not archaic or otherwise unusual, may not be familiar to those without a passing knowledge of this branch of physics, and yet other terms that may not appear in Newton's work but which I need in order to define and discuss some of the terms that do.

N.b.: the way that Newton uses some of these terms *does not* always accord with the way that several of his contemporaries use the same terms, especially in the works cited in the previous paragraph. It often seems to be the case, moreover, that Newton is aware of the discrepancy in usage whereas his interlocutors are not. I note in their respective entries the terms for which this may hold, and what the differences in usage may be.

connate see the entry for 'original and connate property'

difform as in "Light ... consists of *difform* rays" (? , p. 53): see the entry for 'similar'

Experimentum Crucis The term has its origins in the *Novum Organum* of Francis Bacon, where he uses '*instantia crucis*' to mean a determining circumstance that would show that one hypothesis or theory holds true while all rivals do not. I am told (but cannot find the reference) that the term '*experimentum crucis*' was then coined by Robert Hooke, to mean the deliberate construction of a controlled situation whose observed result would provide an *instantia crucis*.

homogeneal as in "Light is not ... homogeneal" (? , p. 53): see the entry for 'similar'

in specie in appearance; thus, beams of light that are the same *in specie* are those disposed to induce the same color sensation under the same circumstances

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index of refraction a quantitative measure of the amount a ray of light suffers refraction (*q.v.*), depending on the two media the light passes through; thus, there is a fixed index of refraction for air and glass, for glass and water, for air and water, and so on

original and connate property a property of a kind of physical system that cannot be altered by any manipulation of or intervention on it, nor by any interaction it may have with any other kind of system (as used, *e.g.*, at (? , p. 53)); such properties are definitive of the kind of system; see Rule III of Newton's Rules of Reasoning in Philosophy (? , Bk. III, p. 398–399); it seems clear that Newton's contemporaries did not understand his usage

Phænomena of Colours The iridescent display of colors produced when sunlight (or any heterogeneous mixture of light) enters a glass prism and exits, appearing as a rainbow



Figure 1: The Phænomena of Colours, courtesy of Pink Floyd

proof a test of a proposition, to see whether it is false, *not* (as in modern usage) a demonstration of its truth; thus, the maxim (due to Bacon) “the exception proves the rule” means that a seeming exception to a general rule *serves as a test* of whether the rule is in fact general (*i.e.*, is in fact a rule)—either it really is an exception, and the putative rule is shown to be no rule at all, or it is explained why it is not in fact an exception, with a concomitant gain (one hopes) in understanding of the content and meaning of the rule by clarification of the rule's scope and of the conditions under which it holds; the modern sense of ‘proof’ is sometimes also used, as in, *e.g.*, the first paragraph of ?, but context should disambiguate which sense is intended

prove see the entry for ‘proof’

qualification of light a change made by an external agency to the constitution or dynamical behavior or properties of whatever constitutes light (as used, *e.g.*, at (? , p. 53)); it was universally held at the time that white light (canonically, sun light) is the “natural state” of light, and that different colors are produced by disturbances (“qualifications”) of some kind to white light

received laws of refraction (in particular as it appears at the end of the first paragraph of ?) Snell's Law, a formula that quantitatively describes the relationship between the angle of

incidence and the angle of refraction (see glossary entries above) of a ray of light as it passes the boundary between two different transparent media. According to the understanding of the phenomenon at the time Newton began his investigations, the relevant aspect for Newton's work, and in particular for the observation that initiated the work described in ?, is that all rays of light passing the boundary between two given transparent media always have the same ratio of the angle of incidence to that of refraction. This is what Newton refers to as "the Hypothesis of the proportionality of the Sines of Incidence and Refraction" (?, p. 49).

In a modern formulation, which exhibits the relevant point, the law is

$$\frac{\theta_{\text{ref}}}{\theta_{\text{inc}}} = \frac{n_1}{n_2}$$

where θ_{inc} is the angle of incidence, θ_{ref} is the angle of refraction, n_1 is the index of refraction (*q.v.*) of the medium the light is leaving, and n_2 is that of the medium the light is entering.

refract the act of refraction (*q.v.*)

refraction the change in the direction of propagation of a ray of light when it passes from one medium to another (*e.g.*, passing from air into the glass of a prism, or back out again); sometimes it is meant qualitatively, merely as the general phenomenon of the bending of light in the circumstance; at other times it is meant quantitatively, as a numerical measure of the bending, usually given as an angle

refrangibility the disposition of a ray of light to refract (*q.v.*)

similar as in "Light is not similar" (?, p. 53): consisting entirely of parts all of the same sort; in this case, that light is not (generally) similar means that it (generally) consists of different sorts of simple rays, *i.e.*, of rays all having different fixed refrangibilities (and so different fixed colorificities)

specie see the entry for '*in specie*'