[Sir Thomas L. Heath, *The Thirteen Books of Euclid's Elements* (2nd edition), pp. 181–182 (1925).]

[Heath's commentary on Euclid, *Elements*, Book I, Definitions 10, 11, 12.]

Definitions 10, 11, 12.

10. Ὅταν δὲ εὐθεῖα ἐπ᾽ εὐθεῖαν σταθεῖσα τὰς ἐθεξῆς γωνίας ἴσας ἀλλήλαις ποιῇ, ὀρθὴ ἑκατέρα τῶν ἴσων γωνιῶν ἐστί, καὶ ἡ ἐφεστηκυῖα εὐθεῖα κάθετος καλεῖται, ἐφ᾽ ἣν ἐφέστηκεν.

11. Ἀμβλεῖα γωνία ἐστὶν ἡ μείζων ὀρθῆς.

12. Ὀξεῖα δὲ ἡ ἐλάσσων ὀρθῆς.

10. *When a straight line set up on a straight line makes the adjacent angles equal to one another, each of the equal angles is* right*, and the straight line standing on the other is called a* perpendicular *to that on which it stands.*

11. *An* obtuse *angle is an angle greater than a right angle.*

12. *An* acute *angle is an angle less than a right angle.*

ἐφεξῆς is the regular term for *adjacent* angles, meaning literally "(next) in order." I do not find the term used in Aristotle of *angles*, but he explains its meaning in such passages as *Physics* VI. 1, 231 b 8: "those things are (next) in order which have nothing of the same kind (συγγενές) between them."

κάθετος, *perpendicular*, means literally *let fall*: the full expression is *perpendicular straight line*, as we see from the enunciation of Eucl. I. 11, and the notion is that of a straight line let fall *upon the surface of the earth*, a *plumb-line*. Proclus (p. 283, 9) tells us that in ancient times the perpendicular was called *gnomon-wise* (κατὰ γνώμονα), because the gnomon (an upright stick) was set up at right angles to the horizon.

The three kinds of angles are among the things which according to the Platonic Socrates (*Republic*, VI. 510 C) the geometer assumes and argues from, declining to give any account of them because they are obvious. Aristotle discusses the *priority* of the right angle in comparison with the acute (*Metaph.* 1084 b 7): in one way the right angle is prior, i.e. *in being defined* (ὅτι ὥρισται) and by its *notion* (τῷ λόγῳ), in another way the acute is prior, as being a *part*, and because the right angle is divided into acute angles; the acute angle is prior as *matter*, the right angle in respect of *form*; cf. also *Metaph.* 1035 b 6, "the notion of the right angle is not divided into that of an acute angle, but the reverse; for, when defining an acute angle, you make use of the right angle." Proclus (p. 133, 15) observes that it is by reference to the right angle that we distinguish the other rectilineal angles, which are otherwise undistinguished the one from the other.

The Aristotelian *Problems* (16, 4, 913 b 36) contain an expression perhaps worth quoting. The question discussed is why things which fall on the ground and rebound make "similar" angles with the surface on both sides of the point of impact; and it is to be observed that "the right angle is the *limit* (ὅρος) of the opposite angles," where however "opposite" seems to mean, not "supplementary" (or acute and obtuse), but the equal angles made with the surface on opposite sides of the perpendicular.

Proclus, after his manner, remarks that the statement that an angle less than a right angle is acute is not true without qualification, for (1) the *horn-like* angle (betweeen the circumference of a circle and a tangent) is less than a right angle, since it is less than an *acute* angle, but is not an acute angle, while (2) the "angle of a semicircle" (between the arc and a diameter) is also less than a right angle, but is not an acute angle.

The *existence* of the right angle is of course proved in I. 11.