

## APPENDIX E.

The table on the next page has been drawn up on the universally accepted basis of the old navigators and geographers, viz., 8 stades equal to 1 Roman mile, and 4 Roman miles equal to 1 Italian league. To attempt mathematical exactness would fill it with confusing fractions and make it useless in reading the old authors. As an illustration of the near approximation of these equivalents let the last item be taken in the third column. If the 29,400 Italian miles be multiplied by 1,618 yards and divided by 2,029 yards and thus reduced into nautical miles, the result would be 16,263 nautical miles against the 16,320 nautical miles of the reckoning in the table by means of stades. The difference is thus only fifty-two miles in the whole circumference of the earth. This will give the measure of the discrepancy or non-equivalence of the quantities.

## NOTES TO APPENDIX E.

- a. Eratosthenes made the circumference to be 250,000 stades, and added 2,000 stades for convenience of division by 360 into degrees without fractions.
- b. Jaime Ferrer (see Appendix D) is reported, as the opinion is given in Navarrete, to have stated that a degree of the equator is  $21\frac{1}{2}$  leagues; but if the circumference of 7975 leagues, given also in the same opinion, be divided by 360, the result will be  $21\frac{1}{2}$  leagues. There is, therefore, an error in the text or in Ferrer's arithmetic.
- c. Posidonius.—I have followed Moit, D'Arvezac and Sir George Cornewall Lewis in giving 240,000 stades as the measure of the earth's circumference fixed upon by Posidonius. In most books it is given as 180,000, on the authority of Strabo. It is certain, however, that his first opinion was in favour of 240,000 stades. This statement is made by his admirer Cleomenes, who knew of no other figures. Historians reconcile the conflicting statements by assuming that he changed his opinion in later life.
- d. Pytheas of Massilia was a navigator [explorer or merchant], who about the time of Alexander the Great visited the north of Europe. He passed outside the Pillars of Hercules, and sailed in the British seas. Polybius and Strabo considered him to be an impostor, who palmed off his imaginary adventures for truth; but the great Greek geographers accepted his statements so far as to make up their maps on his information. Sir George Cornewall Lewis (*Astronomy of the Ancients*, p. 467), following his naturally sceptical temperament, is inclined to reject his voyages; while, on the other hand, the uncritical opinion of Lelewel accepts them fully. The truth lies, probably, between these extremes; for certain it is that Pytheas was a man of great enterprise and unusual powers of observation. He fixed the latitude of Massilia, by means of a gnomon, at  $43^{\circ} 2' 58''$ , and as it is in reality  $43^{\circ} 17' 30''$ , it is a very remarkable observation to have been made 2340 years ago, and there are very few latitudes so nearly correct in all the ancient authors. Hipparchus accepted the latitude of Massilia as fixed by Pytheas; but when he aimed at calculated by the gnomon the latitude of Byzantium he fixed it to be the same as Massilia, two degrees out of the truth. The "impostor" had made a more correct determination than the greatest of the Greek astronomers. Pytheas, when in the British seas, saw the tides which, on the west coast of Britain, are very high in the estuaries of the rivers, and are phenomena most striking to one from the tideless shores of the Mediterranean. He, moreover, correctly attributed them to the influence of the moon. The particular interest of Pytheas, in relation to the subject of this paper, is the belief of Lelewel that he estimated a degree to be 600 stades—almost the exact equivalent of 60 geographical miles. Pytheas does not, however, appear to have made any direct statement to that effect. It is an inference from his estimation of the distance between Oreas in 610 and Thule in 669, which was also given as six days' sail directly north, or 3000 stades. The figures are rounded out too much to be made the basis of serious calculation.
- e. Magellan gave this opinion to King Ferdinand just before sailing on his great voyage in A.D. 1519.
- f. Enciso.—See *ante*, p. 511, for a discussion of Enciso's opinions.
- g. This view is in fact, the opinion of both Spanish and Portuguese navigators and diplomatists whenever the leagues of the Treaty of Tordesillas came up for discussion subsequent to the convention of Madrid.