

The influence exercised by Arabian civilization through the astronomical schools of Cordova, Seville, and Granada, on the

tion of the journey" in hours. A much more perfect way-measurer, used both on the water and on land, has been described by Hero of Alexandria, the pupil of Ctesibius, in his still inedited Greek manuscript on the Dioptra. (See Venturi, *Comment supra la Storia dell' Ottica*, Bologna, 1814, t. i., p. 134-139.) There is nothing to be found on the subject we are considering in the literature of the Middle Ages until we come to the period of several "books of Nautical Instruction," written or printed in quick succession by Antonio Pigafetta (*Trattato di Navigazione*, probably before 1530); Francisco Falero (1535, a brother of the astronomer Ruy Falero, who was to have accompanied Magellan on his voyage round the world, and left behind him a "Regimiento para observar la longitud en la mar"); Pedro de Medina of Seville (*Arte de Navegar*, 1545); Martin Cortes of Bujalaroz (*Breve Compendio de la esfera, y de la arte de Navegar*, 1551); and Andres Garcia de Cespedes (*Regimiento de Navigacion y Hidrografia*, 1606). From almost all these works, some of which have become extremely rare, as well as from the *Suma de Geografia*, which Martin Fernandez de Enciso had published in 1519, we learn, most distinctly, that the "distance sailed over" is learned, in Spanish and Portuguese ships, not by any distinct measurement, but only by estimation by the eye, according to certain established principles. Medina says (libro iii., cap. 11 and 12), "in order to know the course of the ship, as to the length of distance passed over, the pilot must set down in his register how much distance the vessel has made according to hours (*i. e.*, guided by the hour-glass, *ampolleta*); and for this he must know that the most a ship advances in an hour is four miles, and with feebler breezes, three, or only two." Cespedes (*Regimiento*, p. 99 and 156) calls this mode of proceeding "echar punto por fantasia." This fantasia, as Enciso justly remarks, depends, if great errors are to be avoided, on the pilot's knowledge of the qualities of his ship: on the whole, however, every one who has been long at sea will have remarked, with surprise, when the waves are not very high, how nearly the mere estimation of the ship's velocity accords with the subsequent result obtained by the log. Some Spanish pilots call the old, and, it must be admitted, hazardous method of mere estimation (*cuenta de estima*) sarcastically, and certainly very incorrectly, "la corredera de los Holandeses, corredera de los perezosos." In Columbus's ship's journal, reference is frequently made to the dispute with Alonso Pinzon as to the distance passed over since their departure from Palos. The hour or sand glasses, *ampolletas*, which they made use of, ran out in half an hour, so that the interval of a day and night was reckoned at 48 *ampolletas*. We find in this important journal of Columbus (as, for example, on the 22d of January, 1493): "andaba 8 millas por hora hasta pasadas 5 *ampolletas*, y 3 antes que comenzase la guardia, que eran 8 *ampolletas*." (Navarrete, t. i., p. 143.) No mention is ever made of the log (*la corredera*). Are we to assume that Columbus was acquainted with and employed it, and that he did not think it necessary to name it, owing to its being already in very general use, in the same way that Marco Polo has not mentioned tea, or the great wall of China? Such an assumption appears to me very improbable, because I find in the proposals made by the pilot, Don Jayme Ferrer, 1495, for the exact determination of the position of the papal line of demarkation, that when there is a question regarding the