The Evaluation of Columbus' 'India' Project by Portuguese and Spanish Cosmographers in the Light of the Geographical Science of the Period

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'. . . standosi [Colombo] in Portogallo cominciò a congietturare che, siccome quei Portoghesi camminavano tanto lontano al mezzo dì, medisimamente si potrebbe camminare alla volta dell' Occidente, e che di ragione si potrebbe trovare terra in quel cammino'. Fernando Colombo, *Le Historie della Vita e dei fatti di Cristoforo Colombo,* Venice, 1571 (ed. Rinaldo Caddeo, Milan, 1930) I, Chap. V, p. 39.

'While in Portugal, it began to occur to Columbus that, just as the Portuguese were sailing so far to the southward, one might in the same way, sail westward and that logically one should find land in that direction'.

Without resources of his own, Columbus was, in order to realize his project of sailing westwards to Asia, obliged to seek the aid of state powers, first that of Portugal, then later that of Spain.[1] Before finally obtaining the support of the Catholic sovereigns of Spain, Columbus had his project examined on three successive occasions, only to see it rejected, first in Portugal by a committee of cosmographers appointed in 1483–84[2] by the King D. João II[3] and then in Spain by a *Junta* of experts whose opinion was sought twice by the Catholic sovereigns in 1486–87 and in 1491.[4]

It is our intention here to analyse the validity of the arguments presented against the project and to show that far from being absurd, they reflected a respectable theory based on the writings of Aristotle. Columbus' own arguments, which were refuted in the name of the above theory, were, as we shall show, also based on Aristotle.

Several cosmographical parameters determined Columbus' project: (a) the distance across the Ocean separating Asia from Europe, a distance which depended on the east-west extent of the *oikumene,* or the Eurasian land-mass lying between Spain and China, (b) the circumference of the globe and the number of miles or nautical leagues in a degree and (c) that which it was possible to infer, regarding these distances, from the theory of the relations between the size of the surfaces of water and earth such as the followers of Aristotle held them to be in the Middle Ages.

Out of Aristotle's thought the scholastic thinkers of the Middle Ages had developed two doctrines, which in our context, can be seen to contradict each other. The first of these doctrines held that the *oikumene* was of large extent, and that therefore the distance between Europe and Asia was very small. The second doctrine held exactly the opposite to be the case.

Roger Bacon (*c.* 1219–1292), basing himself on a passage in Aristotle's *De Caelo,* held in his work *Opus Majus* (composed between 1266 and 1268), the first of these two doctrines. Where Aristotle had tentatively remarked that 'those who imagine that the region around the Pillars of Hercules joins the regions of India [. . .] are not suggesting anything utterly incredible.'[5] Bacon made him say that between Spain and India there was a *mare parvum* (a short sea distance).[6] Bacon seems to have been encouraged to allege this by the remark of Seneca, who, in his *Quaestiones Naturales,* had said that the sea between Spain and India could be crossed in 'a few days, if one had a good wind to drive the ship.'[7] Bacon further quoted Pliny and the prophet Esdras in support of his claim for a large *oikumene.* Esdras had declared that six parts of the earth formed dry land and a seventh part water,[8] and Pliny had written that one could readily sail from the Arabian gulf to the pillars of Hercules,[9] a voyage which Bacon seems to have interpreted as across the Atlantic.[10]

Bacon's words were closely repeated by the French cardinal Pierre d'Ailly (1350–1420) in his work *Imago Mundi,* Louvain (?), 1483 (?),[11] a work that Columbus copiously annotated, adopting Bacon's interpretation of Aristotle, Pliny and Esdras.[12]

Bacon and d'Ailly are among the few writers who held that Spain and India were not very far apart. Most of the scholastic writers of the fourteenth and fifteenth centuries seized on other passages in Aristotle's *De Caelo,* taking up the latter's doctrine of the four elements: earth, water, air and fire—arranged in concentric spheres round a common centre, the centre of the universe.[13] As we shall see, it was by logical deduction from this aspect of Aristotle's thought that they came to believe that the distance between India and Spain was indeed very large.

Aristotle, and his Greek commentators after him, had, in his doctrine of the elements, left unsolved the problem of how dry land could emerge (as it obviously did) from the concentric sphere of water, to enable men and animals to live and breathe air. Aristotle had allowed his rigorous logic relating to the elements to lead him into this absurd position, declaring specifically regarding their concentricity that an element could only be in its natural place if it were 'lodged' by the element in the sphere coming immediately after it. Thus his logic required that the earth be entirely covered by a uniform layer of water.[14]

Only in the Middle Ages did scholars begin to try to deal with this problem, proposing various solutions, most of them requiring the intervention of a divine miracle to maintain the dry land out of the water.[15]

The Spanish converted Jew, Paul de Burgos (c. 1350–1435)[16] in his *Additiones* to the *Postillae super totam Bibliam* of the Frenchman Nicolas de Lyra (1270–1349), held that on the first day of God's Creation, the elements were placed in a perfectly concentric order, but that on the third day, when according to Genesis[17] (Fig. 1) God commanded the waters to gather together so that the dry land should appear, he shifted the sphere of the water so that its centre no longer coincided with the centre of the earth and so that a part of its surface could emerge.[18]

The consequence of Paul de Burgos' doctrine was that the *oikumene* could not be of greater extent than half of the circumference of the sphere of the water (and was very probably much less), and thus, contrary to the position held by Roger Bacon and Pierre d'Ailly, the distance between India and Spain could only be very considerable.

It was this doctrine of Paul de Burgos that the cosmographers of the Catholic sovereigns defended at their *Junta* at Salamanca in 1486–87 and again at their *Junta* at Santa Fé, near Grenada in 1491, in order to deny the feasibility of Columbus' project. Columbus on each occasion repeatedly defended the doctrines of Roger Bacon and Pierre d'Ailly.

Las Casas describes in his *Historia de las Indias* how the cosmographers at Salamanca had declared, '. . . that of this lower sphere of water and earth, only a very small part lay uncovered, for all the rest was under water, and for this reason one could not navigate except along the shores and coasts [of the *oikumene*] as the Portuguese did along [the coast of] Guinea.'[19] Fernando Columbus who repeats, in his *Historie,* almost word for word Las Casas' description, adds something which Las Casas does not: 'When scholars might be agreed that one could reach [by land] the limit of the Orient [i.e. the eastern extremity of the *oikumene*], they would be ready to admit that one could travel [by sea], from the [western] limit of Spain to the western limit [of the Atlantic] (*dal fine della Spagna fino all'ultimo Occidente*).[20] In other words, the cosmographers very reasonably argued, Columbus project could be envisaged only when the exact east-west extent of the *oikumene* were known.

In response to Columbus' quotation of Seneca that a voyage across the Atlantic could be achieved in a few days with a fair wind, the cosmographers retorted with a quotation from another of Seneca's works, the *Suasoriae* that 'many had doubted that the Ocean [i.e. the Atlantic] could be navigated, as it was reputed to be infinite.'[21]

In rebuttal of the pseudo-aristotelian doctrine of Paul de Burgos, as expounded by the members of the Salamanca *Junta,* Columbus had, in the words of the Portuguese historian João de Barros already in 1483–84, replied to the cosmographers of the King of Portugal D. João II that since the Portuguese had discovered '. . . the islands of the Azores and a large part of the African continent, unknown to the Iberian peoples [. . .], by analogy, there might well exist other islands and lands to the west; for Nature could not have been so disorderly in the make-up of the whole orb, as to have intended that, for living beings to live and multiply, a greater share be assigned to the element of the water than to that of the earth uncovered [by the water]'.[22]

The members of the second Spanish *Junta* held at Santa Fé, continued to oppose Columbus'

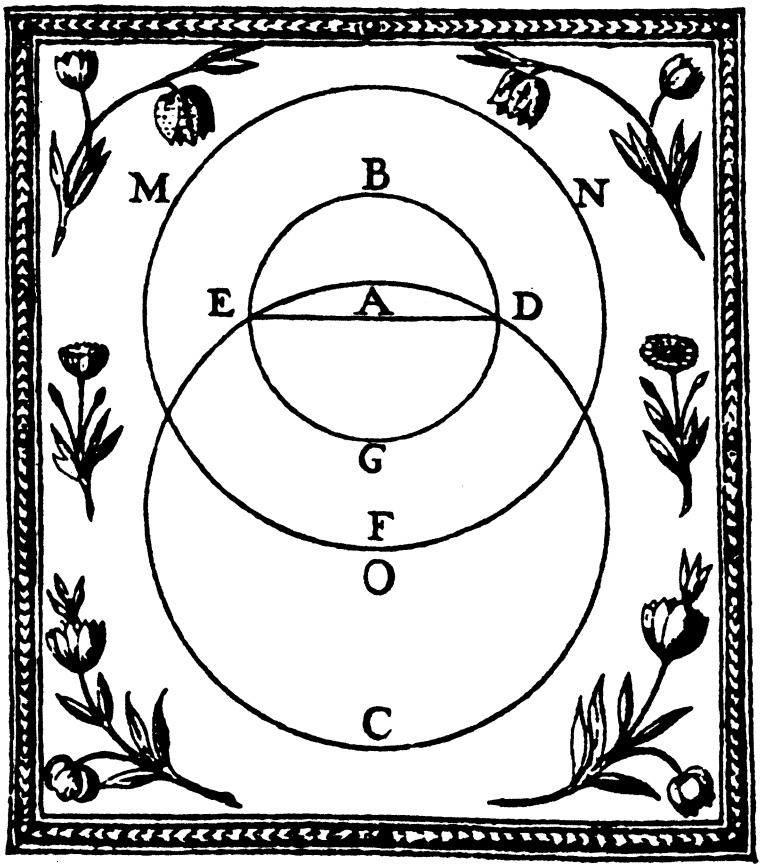

Fig. 1. Engraving of the spheres of earth and water before and after the *congregatio aquae* on the Third Day of the Creation, according to Paul de Burgos, *Additiones* [written in 1429] in Nicolas de Lyra, *Postillae Nicolai de Lyra super totam bibliam cum additionibus*, Nuremberg, 1481 (no pagination). 'In this figure let A be the centre of the earth, which is also the centre of the universe, and let B, D, G, E, be the sphere of the earth centred on A and let M, N, O, be the sphere of the waters centred on A before their being gathered together. For the waters, according to their primordial nature surrounded the earth in an equal manner, given that every part of the waters tends in like manner towards the centre of the earth, which is the centre of the universe. Now God [on the Third Day] commanded that this sphere of water be gathered together in one place in such a way that the dry land might appear. Thus let the second sphere of the water, which is that which was gathered together after this commandment, be where is now the sphere C, D, E, which is equal in size to the sphere M, N. O. Let the centre of the sphere of the water be F which is excentric, as has been said, since it is separated and removed from the centre A which is the centre of the universe.'

project with the same arguments drawn from the theory of Paul de Burgos, arguments which they erroneously attributed to Nicholas de Lyra, since the commentaries on the verses of the Bible by both writers were printed together.

An Italian, Alexandro Geraldini (1455–1525) present at the deliberations of the *Junta,* and who wrote between 1520 and 1521, related how the Spanish cosmographers, quoting Nicholas de Lyra (in reality Paul of Burgos), had '. . . said that the whole of man's habitat (*totam terrae humanae compaginem*) [in other words the *oikumene*] which extends across the sea from the Fortunate Islands [the Canary islands] as far as the East, had no edge bent down toward the lower part of the sphere (*nulla latere habere per inferiorem partem sphaera obtorta*)'.[23] Geraldini adds that he had remarked in public to the experts of the *Junta* that the experience of the Portuguese had disproved Paul de Burgos' theory, for their navigators had reached far into the southern hemisphere and had 'observed new stars under the sky of the Antipodes'.[24] This was doubtless an

allusion to the voyage of Bartolomeu Dias in 1488 during which he had discovered the Cape of Good Hope. Columbus himself had been present when Dias made his report to the King D. João II.[25]

The immense extension of the African continent into the southern hemisphere, had obviously given support to the theory of an *oikumene* of large size and would have given encouragement to those who maintained that the distance between Asia and Europe was quite small.

Columbus, in his letter of 7 July 1503, refers to Portuguese voyages far southward along the African coast beyond the equator, to justify his preference for Marinus of Tyre's east-west extension of the *oikumene* (225 degrees as against Ptolemy's 180 degrees), for 'Marinus', wrote Columbus, 'makes Africa extend to 24 degrees Lat S., a latitude which the Portuguese have confirmed'.[26] The Portuguese had actually gone further, for the Cape of Good Hope is in 34° 50′ Lat S.

If we accept that, from the medieval point of view, the *oikumene* was of circular shape, it can be seen that the smaller the size of the *oikumene* in comparison to the surface of the Ocean, the more feasible the project of reaching India by a circumnavigation of the African continent seemed over that of a voyage across the Atlantic. But this only held true until the discovery of the Cape of Good Hope and its deep extension into the southern hemisphere. On the other hand, if the *oikumene* were shown to be of large size in relation to the surface of the Ocean, the distance between Spain and Asia would necessarily be small, and this could but encourage those who, like Columbus, believed that the shortest route to Asia was that which led west, rather than round Africa.

Now in Portugal, well before the Spanish *Juntas,* how had, in the course of the fifteenth century, the position of D. João II's cosmographers evolved on the subject of the relationship between the surfaces of earth and water, and as a result, on the supposed size of the *oikumene* and of the extent of the Atlantic? Here we must bring in a third model concerning this relationship, that proposed by Claudius Ptolemy (*c.* 90–168 A.D.) in his *Geography* of which the Florentine patron of the arts Palla Strozzi had had a Greek manuscript brought from Constantinople in 1400, to have it translated in 1406 into Latin by Manuel Chrysoloras and Jacopo Angiolo della Scarperia.[27]

No work published during the Renaissance was to so revolutionize the science of mathematical geography. Known in Portugal from at least 1484,[28] and in all probability in Spain[29] at the time of the *Juntas,* Ptolemy's work was apparently ignored by the Spanish cosmographers, who do not seem to have been aware of the incompatibility between its basic theoretical tenets and the pseudo-aristotelian doctrine of Paul de Burgos, which they so obediently followed.

In contrast to the pseudo-aristotelian theory of late medieval scholastic science, according to which the earth-*oikumene* emerged like an island out of the water, Ptolemy declared that 'the continuous surface of the earth and of the seas forms one sphere, whose centre is the same as that of the celestial bodies.'[30] Columbus seems to have followed this view himself, for according to Las Casas, '. . . since all the water and the earth in the world made up one sphere [. . .] Columbus believed that it was possible to circumnavigate it from east to west'.[31]

Ptolemy, in his *Geography,* took the position that instead of the earth being immersed in the water, it had hollows in it, in which the oceans lay in the form of lakes isolated from one another. Such a view could only reinforce the idea of an *oikumene* of large size and thus reduce the extent of the Ocean.

A recognition of the clash between the two theories of the relationship between earth and water, the pseudo-aristotelian on the one hand, and the ptolemaic on the other, appears clearly in the work of a Spaniard, Jacob Perez de Valencia. In his Commentary on the Psalms, published in Valencia in 1484, he comes out resolutely in favour of the ptolemaic theory, as opposed to the pseudo-aristotelian. '. . . for some imagine', he wrote, 'that the earth lies in the water like a light ball, or like an apple in a basin full of water, of which only the summit appears above the water [. . .] (Fig. 2). This view is obviously irrational'.[32] '[In reality]', he continued, 'the seas are no more than gatherings together of the waters in the depths of valleys between the mountains [. . .] the Ocean does not surround the earth, as is commonly thought. Rather it is surrounded on all sides by mountains [. . .] From this it follows that the centre of the earth should

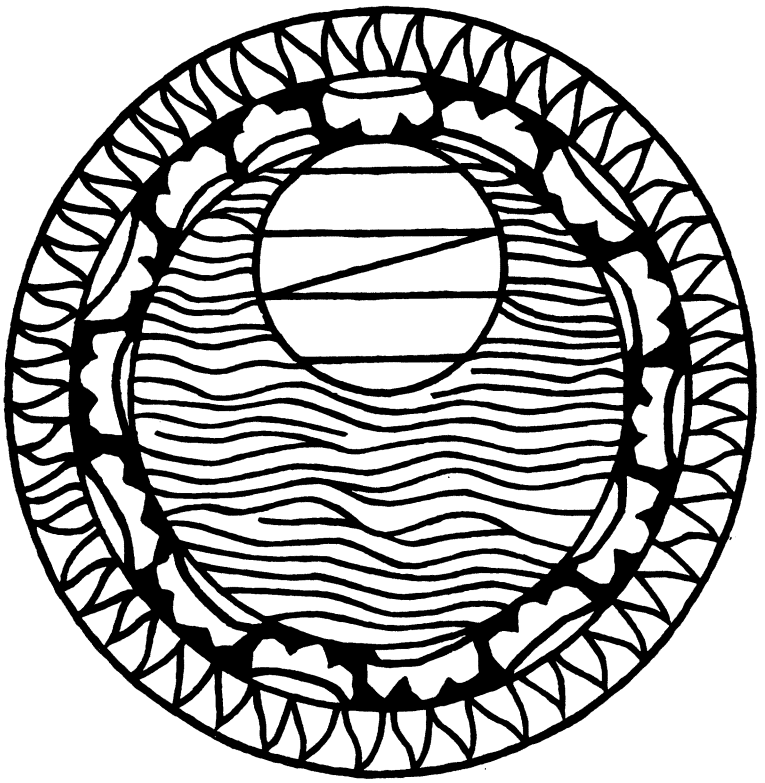

Fig. 2. Engraving showing the sphere of the earth just emerging from the sphere of the water, both being surrounded by the spheres of air and fire in the 1485 and 1490 Venice editions of Johannes de Sacrobosco, *Sphaera*. It is probably at such a representation of the four Aristotelian elements that Jacob Perez de Valencia directed his criticism when he wrote that 'some imagine that the earth lies in the water like a light ball or an apple in a basin full of water.'

not be shifted away from the centre of the universe; rather its centre should be at an equal distance from all the celestial orbs.'[33]

There is nothing to show that Perez' ptolemaic critique of the pseudo-aristotelian doctrine was known in Portugal in the fifteenth century,[34] nor did the Spanish cosmographers of the *Juntas* of 1486–7 and of 1491 seem to have been aware of it in view of their reiterated defense of Paul de Burgos, but the critique did indeed exist and it came from a thinker inside the Iberian peninsula. It is symptomatic of a changing climate of opinion.

There was however another aspect of the ptolemaic 'revolution', presented in quantitative rather than qualitative terms, which was to reach Portugal in 1474, more than a decade before Perez wrote.

In 1474, or just before, the King of Portugal, D. Afonso V, had solicited the advice of the most famous Italian cosmographer of the period, Paolo dal Pozzo Toscanelli (1397–1482), concerning the shortest route to the lands of the spices, in other words Asia.[35] That D. Afonso V took such a step is surprising, since he was known to have shown little interest in maritime discovery. Behind him no doubt, stood the figure of the Prince D. João, the future King D. João II, who from the very same year 1474 had been placed in charge of Atlantic exploration.[36] In response, Toscanelli forwarded to a personal friend of his, Fernão Martins, a Portuguese Canon, who had been mandated by the King to approach the Florentine cosmographer, a letter dated 25 June 1474 together with a map. In it he stated that to reach Asia the shortest route lay across the Atlantic, rather than round Africa.

On what did Toscanelli base his argument and why did the Portuguese not take any account of his advice? This is what we shall now try to analyse.

Toscanelli's map is lost,[37] but a copy of the letter has come down to us, copied by Columbus

on an empty page attached to his personal copy of Aeneas Silvius Piccolomini's work *Historia rerum ubique gestarum* published in Venice in 1477.[38]

The authenticity of the letter, once contested with great persistence by Henri Vignaud,[39] is today generally accepted.[40] Several scholars have sought, from the description of Toscanelli's map contained in the letter, to reconstruct it. The most convincing reconstruction still remains that of Hermann Wagner in 1894.[41] According to Wagner, the map was drawn on the projection of Marinus of Tyre, i.e. with the meridians parallel to one another, cutting rectilinear parallels at right angles.[42]

All that we know of Marinus of Tyre comes to us in the criticisms of his cartographical method given by Ptolemy in his *Geography*. Of all the cartographical projections described by Ptolemy, only Marinus' was capable of being used by sailors of the period and of this Toscanelli seems to have been fully aware. Thus did Toscanelli write of his map: '. . . the straight lines, therefore marked lengthwise in the chart [i.e. meridians] show the distances from east to west, but those which are transverse [i.e. parallels] show the spaces from south to north'.[43] He gave the distance in a straight line from Lisbon to China as almost a third of the circumference of the earth.[44]

From the data contained in the letter, Wagner deduced that the straight line from Lisbon to China is the same as the median parallel of the map (in terms of the Marinus projection) and he further deduced that Toscanelli, following Regiomontanus (1436–1476), had attributed a value of 41 degrees for the latitude of Lisbon[45] (the correct value being 38° 44′) (Fig. 3). On the parallel of Lisbon, each degree, according to Toscanelli, corresponds to 50 miles, which implies, at the latitude of 41 degrees, an equatorial degree of $66\frac{2}{3}$ miles or of $16\frac{2}{3}$ leagues (the nautical league being equal to four miles.[46]

For Wagner, the origin of the value of $66\frac{2}{3}$ miles to a degree is to be found in the *De Crepusculis*,[47] a work once attributed to Alhazen (ibn al-Haytham) (965–1039), though now attributed to Abu ibn Mu'adh of Seville (2nd half of the eleventh century).[48]

Three different values are commonly found among the Arabs for the value of a degree of the meridian: $56\frac{2}{3}$ miles, $66\frac{2}{3}$ miles and 75 miles, the miles being Arab miles, which the Latin translators had carelessly translated as Roman miles, considerably shorter.[49]

The Venetian cartographer Fra Mauro in his World Map of 1459, quotes various opinions on the value of the degree of the meridian: $56\frac{2}{3}$ miles, $66\frac{2}{3}$ miles and $62\frac{1}{2}$ miles.[50]

The latter value is attributed to Ptolemy by Martianus Capella (sixth century A.D.)[51] and was often repeated during the Middle Ages.

If the value of $56\frac{2}{3}$ miles to a degree was adopted by Columbus, who took it from Pierre d'Ailly,[52] who in turn took it from Alfraganus,[53] that of $66\frac{2}{3}$, or $16\frac{2}{3}$ leagues, was a value commonly used by Portuguese sailors in the fifteenth century and in particular by Bartolomeu Dias.[54] Thus the value used by the theoretically minded Toscanelli can be seen to have coincided with that used in practice by Portuguese sailors, though there is no way of knowing whether there may have been influence of the one on the other, either way.

Between Lisbon and Quinsay, a city which Marco Polo had placed on the coast of China (identified as the modern city of Hangzhou, Lat. 30° 18 W. and Long 120° 07′ E.), Toscanelli wrote that his map showed 26 'spaces', each measuring 250 miles. From these figures Wagner deduced that a 'space' is equal to 5 degrees and that the coast of Asia is situated at 130° from Lisbon, or 10 degrees more than 'almost a third of the circumference of the earth', as Toscanelli had said in his letter, the difference being, according to Wagner, explainable by Toscanelli's use of the Latin *fere* ('almost'). As a result, Toscanelli's *oikumene* stretched over 230 degrees, just 5 degrees more than that of the 225 degrees given it by Marinus of Tyre. Such a close correspondence led Wagner to call Toscanelli 'Marinus redivivus'.[55]

As Wagner noted, Toscanelli's letter and map constituted the first attempt to put at the disposition of sailors, a chart on which the circumference of the earth and the distance between Europe and Asia were expressed in units of distance which they were accustomed to use in practice.[56]

Was Toscanelli's advice to the Portuguese in favour of a route westward to Asia, advice that undoubtedly had its effect on Columbus (even if he did not follow it to the letter), ever at any

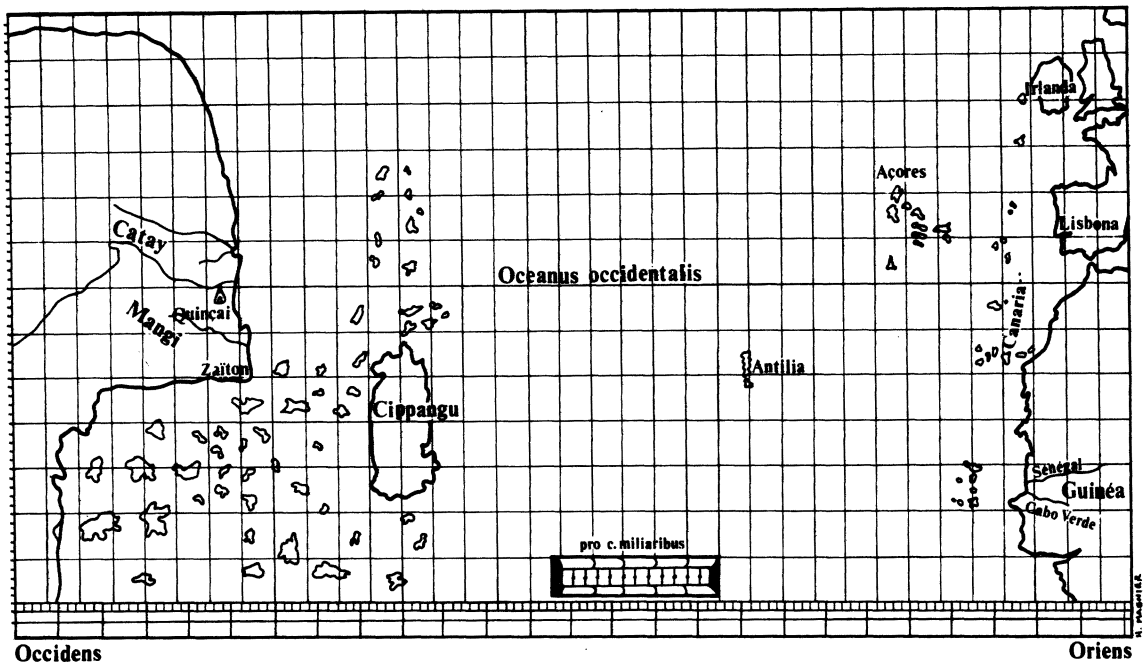

Fig. 3. Reconstruction of Toscanelli's map by Hermann Wagner, 'Die Rekonstruktion der Toscanelli-Karte vom Jahe 1474 . . .' in *Nachrichten der K. Gesellschaft der Wissenschaften zu Göttingen*, Phil.-Hist. Kl. (1894), p. 313. Within the framework of Marinus of Tyre's cylindrical projection, Toscanelli placed the European coastline and the Atlantic islands drawn from portulan charts and the coastline of Asia with Japan (Cypangu) taken from the account of Marco Polo's travels.

time taken seriously by the Portuguese authorities? This seems to us doubtful. According to the account of the Portuguese historian João de Barros, D. João II's cosmographers, when they examined Columbus' project in 1483–84, seem to have directed their criticisms less against a cartography based on Marinus of Tyre, than on what they regarded as the absurdities of Marco Polo, since all three agreed that Columbus' ideas were based on 'the imaginary things that Marco Polo recounted of the island of Cypango [Japan]'.[57]

The Portuguese thus put aside Toscanelli's proposal and concentrated all their attention on the route round Africa, but their progress in this direction was hampered by repeated setbacks, to the extent that there followed, after Diogo Cão's second voyage along the African coast (1486), a period of discouragement and uncertainty over whether the route round Africa was really practicable.

Up until then (1486), the Portuguese were persuaded that the shortest and the only route to Asia was round Africa, since their goal was neither China nor Cypango, but the shores of the Indian Ocean between Ethiopia and the coast of Malabar in India, a region where it was believed lay the Kingdom of Prester John. The historian João de Barros recalls the considerable outlay in expenses that the King D. João II had incurred in order to discover the King of the Abyssinians, identified as Prester John. In the instructions later given to Vasco da Gama, '. . . almost all consisted in learning of the political power of this Prince'.[58]

In Ptolemy's *Geography*, D. João II's cosmographers could have seen that the distance between the meridian of the Fortunate Islands (the Canaries) and the meridian passing through the northern tip of the island of Taprobana (Sri Lanka) was hardly more than 125 degrees,[59] five degrees less than the distance evaluated by Toscanelli between Lisbon and China.

Between 1460 and 1472, the discovery of the east-west extension of the Gulf of Guinea had considerably reduced Ptolemy's 125 degrees. At the end of 1485, or at the beginning of 1486, probably before the return of Diogo Cão from his second voyage (1486),[60] João Afonso de Aveiro returned to Lisbon with the news that at the bottom of the Gulf of Guinea he had discovered the Kingdom of Benin, where he had learnt that 250 leagues to the east, lay a potentate

named the Ogané. The historian João de Barros, who describes this discovery, tells how the King D. João II and his cosmographers examined Ptolemy's map of Africa and taking account of the way in which the discoverers had placed the *padrões* (stone pillars used to mark the limits of Portuguese discovery) along the coast, as well as the distance of 250 leagues to the east, where the inhabitants of Benin said lay the kingdom of Ogané, they considered that he must be Prester John,[61] since both lived hidden behind silk curtains (an allusion to a ritual of divine kingship) and held the Cross in great veneration. 'And it seemed to them that, if the King's ships continued to follow the coast that they had been discovering, they could not but reach the *Promontorium Prassum,* which lay at the extremity of the continent.[62]

Ptolemy had placed the *Promontorium Prassum* on the East Coast of Africa in 15 degrees Lat. S, and here it should be emphasized that in this period no one in Europe any longer believed the Ptolemaic doctrine of a closed Indian Ocean without communication with the Atlantic. Fra Mauro on his World Map of 1459 specifically stated that the Indian Ocean was not a *stagnon* (a closed sea).[63]

The optimistic calculations of the Portuguese cosmographers were to be belied by the failure of Diogo Cão to round the extremity of the continent on his second voyage (1486), which revealed that the African continent extended much further southward, and far beyond what had been expected, as far as the *Serra Parda* (Ponta dos Farilhões in 22° 10′ Lat. S.)[64] As a result, the distance to be sailed to reach India became considerably increased. This could only but encourage those who believed the route across the Atlantic to be shorter.

The result of the next Portuguese voyage south along the African coast, that of Bartolomeu Dias (1488) proved even more discouraging for D. João II and his cosmographers. Though it revealed that the Cape of Good Hope represented the southern extremity of the continent, (Dias turned back just beyond it), there still remained no proof that the continent did not continue to develop eastwards to end in a *Promontorium Prassum* as yet undiscovered, perhaps even more difficult to round than the Cape itself. This hypothetical undiscovered eastwards pointing cape, a relic of Ptolemy's *terra incognita* bordering the southern edge of the Indian Ocean, can be seen outlined on the map of Henricus Martellus c. 1490, and it was only with Vasco da Gama's voyage nine years later in 1497, that its non-existence was finally settled.

In an Oration given in Beja (Portugal) in 1489, the year after Dias' voyage, João Teixeira declared that '. . . each day we strive to reach the Promontories *Raptum* and *Prassum* [. . .] and from there to the approaches of the Indian Ocean,'[65] a proof that at that date, it was admitted that the promontories had not yet been discovered.

Dias had passed the Cape in a storm which had left terrible memories among his crew, and he himself had named it the *Cabo Tormentoso* (Cape of Storms), a name which according to Barros, the King D. João II changed to 'Cape of Good Hope', by reason of the promise it held for the discovery of India.[66]

Yet as Barros notes, such was '. . . the fury of the seas' round the Cape of Good Hope that in the opinion of the sailors, '. . . there arose a new myth of the dangers as there once had been concerning Cape Bojador.'[67]

Further evidence of the climate of discouragement and uncertainty, perhaps more among the sailors, than with the King himself, regarding the practicability of the sea route to India, appears in Fernando Columbus' ironic comment that D. João II, '. . . had not been able to go beyond the Cape of Good Hope and that it had been thus called because it marked the end and termination of his hopes of discovery and conquest (*per esser quello il capo e il fine della buona speranza della sua conquista e discoprimento*)'. Others, according to Fernando Columbus, did agree that the Cape had been given the name because of the hope it brought of 'pleasanter lands and of easier sailing'.[68]

At this juncture, and even before Dias' return in December 1488,[69] D. João II seems to have turned anew to Columbus, for he wrote him an affectionate letter dated 20 March 1488, guaranteeing him a safe conduct back to Portugal, since he had left secretly for Spain without the King's authorization. D. João II added that 'he needed his energy and intelligence' and that 'it would give great pleasure if he were to come and in that which concerned him, dispositions would be taken which would make him content'.[70] It is unlikely that in thus encour-

aging Columbus, D. João II was preparing to help him realize his dream of sailing westward to Asia. It is probable that he was thinking more explicitly of the discovery of unknown lands in the Atlantic. Columbus, on his third voyage (1498), was to write that he wanted to sail southwards (into the southwestern Atlantic) to see 'what had been the intention of D. João II of Portugal, who had said that to the south there was mainland'.[71]

Columbus accepted the invitation to return to Portugal and was present in Lisbon when Dias made the report of his voyage to the King. In a marginal note in his copy of Pierre d'Ailly's *Imago Mundi*, Columbus described how Dias had reached a cape named by him Cape of Good Hope, 'and that by the astrolabe he had found himself in that place to be 45 degrees beyond the equator'.[72] The Cape of Good Hope being in Lat S. 34° 50′, the figure of 45 degrees is a manifest error and has given rise to much discussion.[73] It is however quite possible that the error was in fact Dias' and that at this date the Portuguese had still not thoroughly mastered the art of measuring latitude from the height of the sun.[74]

Columbus, at the news that the African landmass extended 45 degrees into the southern hemisphere, would have seen in this a proof of his conviction that the distance between Europe and Asia across the Atlantic was small, for if the *oikumene* had such a large north/south extension, it must necessarily have the same east/west extension, given that in the cartography of the time it was assumed to be circular in shape.

It may then have been the figure of 45 degrees, discouraging for the Portuguese, but encouraging for Columbus, that made him hurry off again to Spain, where his project was examined once more at the *Junta* of Santa Fé in 1491. He was to hear again brought out against him the arguments based on Paul de Burgos, which the Italian Geraldini, who was present, relates. Then when all seemed lost, suddenly the Spaniards became completely won over to Columbus' ideas. The Cardinal Pedro Gonzalez de Mendoza, to whom Geraldini at the *Junta* had remarked that the Portuguese in their voyages into the southern hemisphere had invalidated the doctrine of Paul de Burgos, now 'accepted', according to Gonzalo Fernandez de Oviedo, 'to give audience to Columbus and he saw that he was knowledgeable and spoke well and that he supported his ideas with sound reasoning. The Cardinal judged that he was a man of intelligence and very clever, and having reached this opinion, he held him in high esteem and chose to support him [. . .] As a consequence of this he was listened to by the King and the Queen who began to accord credit to his memoranda and petitions'.[76]

What new factor in the situation had emerged for the Spaniards to become so suddenly persuaded that Columbus' project was feasible and that he should be given men and ships to accomplish it? This point is crucial and obscure, and in the absence of documents, we can but make conjectures.

Nothing in the geographical science of the time could justify to the Spaniards Columbus' choice of $56\frac{2}{3}$ miles to a degree, rather than that of $66\frac{2}{3}$, adopted by the Portuguese and by Toscanelli.[77] Nothing in contemporary knowledge of Atlantic navigation could justify to the Spaniards his conviction that he would find mainland between 700 and 750 leagues west of the Canary islands.[78]

No direct information has reached us concerning the kind of world map that Columbus used.[79] Robert Almagià suggested in 1940 in a clever article, that a map similar to Henricus Martellus' World map of *c.* 1490 is likely to have circulated at the end of the fifteenth century and that it probably served as a model for Columbus.[80] Almagià wrote before the discovery and acquisition in 1961 by the Yale University Library, of a hitherto unknown world map by Henricus Martellus (Fig. 4), which, unlike the other known copies, is graduated in latitude and longitude (Fig. 5). R. A. Skelton, the only expert to have examined this map carefully, described it as representing an *oikumene* of 270 degrees in extent, leaving a distance of 135 degrees between Quinsay and Lisbon and a distance of 90 degrees from the base meridian in the Canary islands to Cypango (Japan). These distances, according to Skelton, 'coincide almost exactly with the distances which Toscanelli deduced from Marinus of Tyre and from Ptolemy'.[81] There is no direct proof that Columbus ever saw a copy of the Martellus map, but when he reached Cuba, he became convinced that the Caribbean island was in fact Cypango,[82] and he estimated that he had sailed 1142 leagues from the Canaries to Cuba.[83] On the Marinus projection of Toscanelli's

Fig. 4. World Map (*c* 1490) of Henricus Martellus. *By courtesy of Yale University Library New Haven.*

map, on which the median parallel contains 50 miles to a degree, a distance of 1142 leagues becomes equivalent to 91⅓ degrees, just one degree and a third more than the distance between the Canaries and Cypango on the Yale Martellus Map.

This would all fit together very well, were it not that the Yale Martellus map is drawn on Ptolemy's second projection, quite unsuitable for sailors and that Toscanelli's map, according to Wagner, was based on a module of 66⅔ miles to a degree, and not 56⅔, which was Columbus' choice. Yet it remains possible that Columbus only repeated his preference for the figure of 56⅔ miles/degree to emphasize his conviction of a small globe and of a short distance between Europe and Asia. It is exceedingly doubtful if he ever applied the module in practical cartography, probably contenting himself with using, in traditional Mediterranean fashion, the kind of chart that Toscanelli had prepared. He may not even have realized that its module was different from his.

Whatever kind of chart Columbus had with him, when he faced the Salamanca and Santa Fé *Juntas,* it is doubtful if the Spanish cosmographers would have found in it anything sufficient to shake their scholastic prejudices.

With Bartholomeu Dias' voyage there emerged however new empirical evidence concerning the size of the *oikumene* with experimental proof that it covered a very large surface of the globe and that as a consequence the distance between Europe and Asia was conceivably much smaller than the scholastic philosophers had been claiming it to be. It is this fact that may have swung the minds of the Spanish authorities and led them to give their support to Columbus, support all the more readily given in view of the increasing discouragement of the Portuguese that they would ever achieve their hope of reaching India by circumnavigating the African continent.

Neither the Portuguese nor the Spanish cosmographers were ignorant or stupid men.[84] They were aware of the principal currents of scientific thought in Europe, even if some were slower than others in embracing new trends. They could not know, even when they were disposed to follow their theories, that Ptolemy and *a fortiori* Marinus of Tyre had extended the *oikumene* some 50 degrees too far to the east and that even without the interposition of the American continent, unforeseen and unforeseeable, the voyage across the Atlantic from Europe to Asia would have proved too long for any ship of the time.

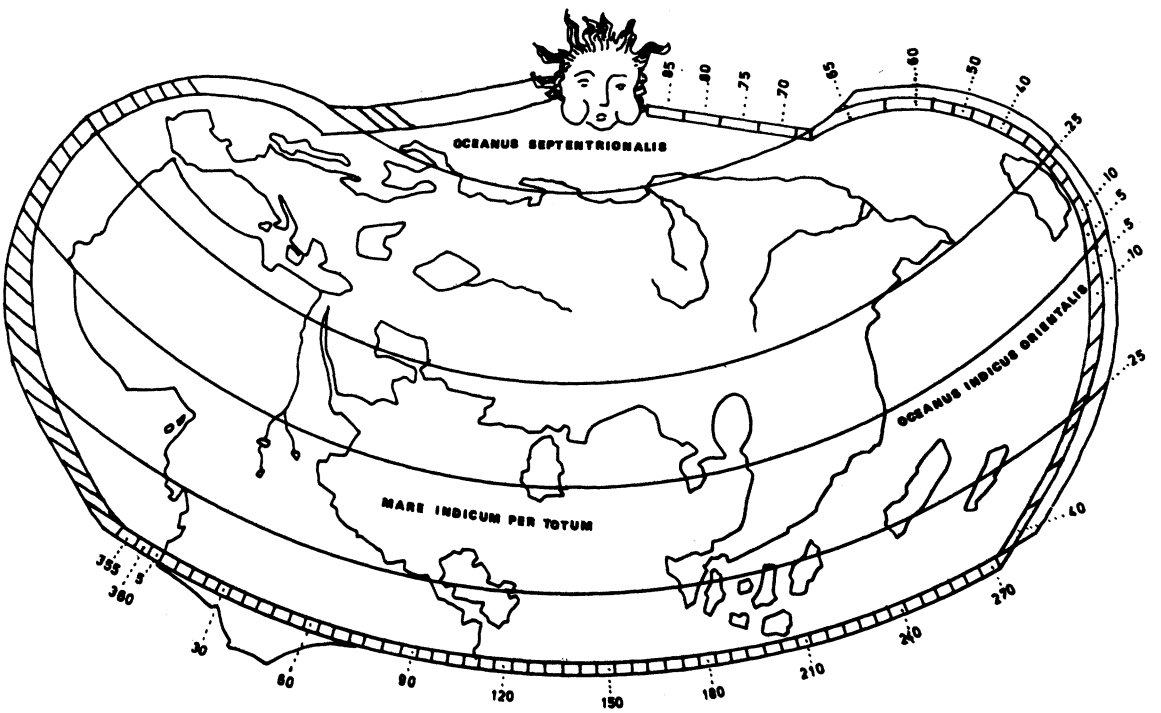

Fig. 5. A simplified reconstruction of the Yale Martellus Map to show scales of latitude and longitude.

In the end it was the Portuguese cosmographers who made the most careful and prudent evaluation of the geographical situation and it was the Portuguese who, after nine years of persistent preparation first reached, round Africa, the India they had so long sought, while the Spaniards came upon what they were to call New Spain.[85]

Acknowledgement

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3. Their evaluation of Columbus' project is described by João de Barros, *Ásia,* Déc. I, Lisbon, 1552, Liv. III, Cap. XI (modern edition, Coimbra, 1932), p. 112.
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11. Pierre d'Ailly, *Imago Mundi,* Louvain, (?) 1483 (?) (ed. E. Buron, Paris, 1930), I, Chap. VIII, p. 211.
12. Columbus' annotations are reproduced in Buron's edition of Pierre d'Ailly, *ed. cit.,* I, p. 208.
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14. *Idem. ed. cit.* Bk IV, Chap. III, 310b *cf* also Duhem, Pierre, *Le Système du Monde,* Paris, 1958, Vol. 9, pp. 88–91.
15. On this considerable and complex question which much occupied Medieval scholars, *cf* the thorough studies by Giuseppe Boffito, 'Intorno alla "Quaestio de Terra et Aqua" attributa a Dante', in *Memorie della Reale Accademia delle Scienze di Torino,* Second Series, 52 (1903), pp. 257–342; Duhem, Pierre, *Les origines de la Statique* (Paris, 1906), I, pp. 93–97 and Idem, *Le Système du Monde,* IX (Paris, 1958), Chapters XVI and XVII.
16. On Paul de Burgos, *cf* Martinez Añibarro y Rives, Manuel, *Intento de un diccionario biografico y bibliografico de autores de la provincia de Burgos* (Madrid, 1889–90), pp. 470–479, and Labrosse, Henri, in *Etudes Franciscaines,* Vol. 19 (1908), pp. 370–71. Labrosse notes that there were 27 editions of Nicolas de Lyra's work with Paul de Burgos' 'Additiones' printed before 1500. On Paul de Burgos' life, *cf* Serrano, Luciano, *Los conversos don Pablo de Santa Maria y don Alonso de Cartagena* (Madrid, 1942).
17. Genesis, 1, 9.
18. de Burgos, Paul, 'Additiones' in *Postillae Nicolai de Lyra super totam bibliam cum additionibus* (Nuremberg, 1481) (no pagination).
19. De las Casas, Bartolomé, *Historia de las Indias,* Lib. I, Cap. XXIX (éd. B.A.E., Tome XCV, Madrid, 1957), p. 111.
20. Columbus, Fernando, *Le Historie della Vita e dei fatti di Cristoforo Colombo* (Venice, 1571, ed. Rinaldo Caddeo, Milan, 1930), I, Cap. XII, pp. 106–107.
21. Las Casas, *op. cit. loc. cit.* Seneca, *Suasoriae,* I (translated by M. Winterbottom, Loeb edition, London 1974), p. 485.
22. João de Barros, *op. cit.* Déc. I, Liv. III, Cap. XI *ed. cit.* p. 112. The three cosmographers were José [Vizinho], Master Rodrigo and Diogo Ortiz de Calçadilha, a Castillian who had taken political refuge in Portugal in 1475 from Salamanca, where he had held the chair of Astrology at the University since 1469. *Cf* Beaujouan, Guy, 'L'astronomie nautique dans la péninsule ibérique à la fin du Moyen Age' *Agrupamento de Estudos de Cartografia Antiga, Secção de Coimbra,* XXIV (Coimbra, 1969), *XXIV,* p. 15.
23. Geraldini, Alexandro, *Itinerarium ad regiones sub aequinoctiali plaga constitutas* (Rome, 1631), pp. 204–205.
24. Idem. *loc. cit.*
25. *Cf* Columbus' marginal note in his copy of Pierre d'Ailly's *Imago Mundi,* reproduced by Nunn, George E., *The Geographical Conceptions of Columbus* (American Geographical Society Research Series, No. 14, New York, 1924, reprint Octagon Books 1977), pp. 7–8. (Latin text and English translation).
26. Columbus' letter of 7/7/1503 ('Marino en Ethiopia escrive aliende la linea equinocial mas de 24 grados, i ahora que los Portugueses la navegan le fallan cierto') in *Select Documents illustrating the Four Voyages of Columbus,* ed. and trans. by Cecil Jane

(Hakluyt Society, Second Series, No. LXX, Vol. II, London, 1933; Reprint Kraus, 1967), pp. 83–84. George Nunn claims that Marinus of Tyre had no influence on Columbus' ideas until his fourth voyage. *Cf* Nunn, George E., 'The Three Maplets attributed to Bartholomew Columbus', in *Imago Mundi,* IX (1952), p. 18 and Idem, 'Marinus of Tyre's Place in Columbus' concepts' in *Imago Mundi,* II (1937), p. 35. Nunn gives no satisfactory proof to support his claim.

27. *Cf* Da Bisticci, Vespasiano, *Vite di Uomini illustri* (ed. Bologna, 1893) 3, pp. 9–10 and pp. 216–217.
28. Fernandes de Lucena, Vasco, *Valasci ferdinandi utriusque iuris consulti Illustrissimi regis Portugalliae oratoris ad Innocentium VIII, pontificem maximum de obedientia Oratio* (Rome, 1485); reproduced in facsimilé in Fontoura da Costa, A. *Às Portas da India em 1484* (Lisbon, 1936), p. 80.
29. Guy Beaujouan mentions the existence, among the scientific manuscripts at the University of Salamanca, of two manuscripts of Ptolemy's *Geography* of which one was copied in 1456. *Cf* Beaujouan, Guy, *Manuscrits scientifiques médiévaux de l'Université de Salamanque* (Bordeaux, 1962), p. 159 and pp. 161–162.
30. Claudius Ptolemy, *Géographie,* French translation by the Abbé Halma (Paris, 1828), p. 11. It is true that a much less precise version of Ptolemy's definition was to reach the Latin West as early as the twelfth century, through the work of Alfraganus (al-Farghānī) (died *c.* 861) translated into Latin by John of Seville (1135) and by Gerard of Cremona (*c.* 1175). Alfraganus wrote that 'the earth together with all its parts, both terrestrial and marine resembles a sphere.' *Cf* Alfraganus, *Differentie scientie astrorum* (edited by Frank J. Carmody, Berkeley, Calif. 1943), p. 6. Alfraganus' definition does not seem in any way to have shaken the Aristotelian scholastics before the appearance of Ptolemy's *Geography* at the beginning of the fifteenth century.
31. De las Casas, Bartolomé, *Historia de las Indias* (ed. cit.) I, Cap. V, p. 27, Fernando Columbus' text is almost identical. *Cf* Columbus, F., *Historie* (ed. cit.) Cap. VI, p. 41. It is true that during his third voyage, Columbus had doubts on the subject and returned for a moment to the pseudo-aristotelian doctrine, even admitting that the earth might be pear shaped. *Cf* Columbus' letter of 18 Oct 1498, in *Select Documents illustrating the Four Voyages of Columbus,* pp. 29–31 (English and Spanish texts).
32. De Valencia, Jacob Perez, *[Commentaria in psalmos],* Valencia, 1484, sign. ii f. ii (v.)
33. *Idem.* sign. ii f. iv (r.-v.)
34. The Portuguese soldier-sailor-scientist, Duarte Pacheco Pereira does expound it, but at the beginning of the sixteenth century. *Cf* Pereira, Duarte Pacheco, *Esmeraldo de Situ Orbis (c.* 1508), translated and edited by G. H. T. Kimble, Hakluyt Society, 2nd series, No. LXXIX, London, 1937, reprint Kraus, 1967, Bk I, Chap. 2, p. 13.
35. Toscanelli in his reply stated: 'Whereas I have spoken [. . .] elsewhere concerning a shorter way of going by sea to the lands of the spices, than that which you are making by Guinea, the most Serene King [D. Afonso V] now wishes that I should give some explanation thereof, or rather that I should so set it before the eyes of all'. Text in Vignaud, H., *Toscanelli and Columbus* (London, 1902), Appendix A, pp. 276–278.
36. *Cf* Peres, Damião, *História dos Descobrimentos Portugueses* (3rd. ed., Oporto, 1983), pp. 118, 193 and for the official document appointing the prince, Bensaude, J., *L'astronomie nautique au Portugal* (Berne, 1912–1917. Reprint Amsterdam, 1967) pp. 271–274 and Brásio, A., *Monumenta Missionária Africana* (Lisbon, 1954), IV, pp. 12–15.
37. Sebastiano Crinò's alleged identification of Toscanelli's map with the so-called Genoese planisphere of 1447 has been vigorously refuted by a number of scholars. *Cf* Crinò, Sebastiano, *La Scoperta della Carta originale di Paolo dal Pozzo Toscanelli* (Florence, 1941). His identification has been refuted by R. Biasutti, 'Il mappamondo del 1457 [sic] non è la carta navigatoria di Paolo dal Pozzo Toscanelli', in *Rivista Geografiche Italiano,* 49 (1942), pp. 44–54; by H. Winter, 'Die angebliche Toscanelli Karte', in *Koloniale Rundschau,* 33 (1942), pp. 228–38; and by A. Magnaghi, *Tutto è chiaro finalmente* (Turin, 1941).
38. The letter is reproduced with an English translation in Vignaud, H., *Toscanelli and Columbus* (London 1902), pp. 275–292.
39. Vignaud, *op. cit.,* pp. 36–51.
40. *Cf* the criticisms of Vignaud's thesis by Hermann Wagner, in the *Göttingische gelehrter Anzeiger,* 2 (Berlin, 1902) pp. 108–131; by Lucien Gallois, 'Toscanelli et Christophe Colomb', in *Annales de Géographie,* 11e Année, No. 56 (1902), pp. 97–110; *Idem.* in *Annales de Géographie,* XXXVII (1928), pp. 207–8; S. Ruge, 'Die Echtheit des Toscanelli-Briefs', in *Zeitschrift des Ges. für Erdkunde zu Berlin* (1902), pp. 498–511. The only writers who persist in defending Vignaud are Th. Simart, 'Le crépuscule d'une légende, in *Bulletin de la Société Royale de Géographie* (Antwerp, 1914), xxxviii, pp. 5–62 and A. Cioranescu, 'Portugal y las cartas de Toscanelli', in *Estudios Americanos,* XIV (1954), pp. 1–17. Neither is convincing and the latter's claim that the Toscanelli correspondence was fabricated by the Portuguese carries not a shred of evidence.
41. Wagner, Hermann, 'Die Rekonstruktion der Toscanelli Karte von Jahre 1474 . . .', in *Nachrichten der K. Gesellschaft der Wissenschaften zu Göttingen* (Phil.-Hist. Kl., 1894), pp. 208–312. The first to attempt to reconstruct the map (with converging linear meridians) was O. Peschuel in 1867 (*Cf* [O. Peschuel], 'Die Schiffbuch des Entdeckers von America bei seiner uberfahrt über das atlantische Meer" in *Das Ausland,* 40 (1867), pp. 1–4. Peschuel's same reconstruction was adopted by K. Kretschmer, *Die Entdeckung Amerikas-Atlas* (Berlin, 1892), Tafel, 1.
42. Wagner, H., *art. cit.,* pp. 238–242.
43. Toscanelli's letter in Vignaud, H., *op. cit.* p. 280.
44. Idem, *op. cit.* pp. 287 and 289.
45. Wagner, H., *art. cit.* pp. 250–251; Regiomontanus, *Ephemerides sive Almanach perpetuum* (Venice, 1496). We have not been able to consult the earlier editions of Regiomontanus' work.
46. Wagner, H., *art. cit.,* pp. 257–258.
47. *Cf* the edition of Alhazen's *De Crepusculis* in Nunes,

Pedro, *Obras* (Lisbon, 1943, II, p. 131. *Quantitas circuli magni continentis [terram] secundum quod dixerunt sapientes [. . .] est vigenti quatuor mille milliaria)* (24,000 divided by 360 = 66⅔).

48. *Cf* Sabra, A. I., 'The Authorship of the *Liber de Crepusculis'*, in *Isis,* LVIII (1967), pp. 77–85.
49. Nallino, C. A., 'Il valore metrico del grado di meridiano secondo i geografi arabi', in Idem, *Raccolta di scritti editi ed inediti* (Rome, 1944), I, pp. 409–59.
50. Fra Mauro, *Il Mappamondo di Fra Mauro* (facsimilé edition by T. G. Leporace and R. Almagià, Rome, 1956), pp. 19 and 62.
51. *Cf* Martianus Capella, 'The Marriage of Philology and Mercury,' in Stahl, W. H., and Johnson, R., *Martianus Capella and the Seven Liberal Arts,* II (New York, 1977), p. 228.
52. *Cf* the marginal notes of Columbus reproduced by George E. Nunn *The Geographical Conceptions of Columbus* (New York, 1924, Reprint 1977), pp. 9–10 and Pierre d'Ailly, *Imago Mundi,* ed. E. Buron (Paris, 1930) II, p. 531 (*Epilogus Mappe Mundi*).
53. Alfraganus (al-Farghānī) (d. after 861), *Differentie scientie astrorum,* ed. Frank C. Carmody, Berkeley (California, 1943), Cap. pp. 13–14. A degree of 56⅔ miles corresponds to 83·87 kms. *Cf* J. Keuning, 'Anschauungen über die Grösse der Erde im Zeitalter der Entdeckungen und ihre Beziehungen zu den älteren Gradmessungen', in *Comptes rendus du Congrès International de Géographie* (Amsterdam, 1938), II, p. 31.
54. *Cf O Livro de Marinharia de André Pires* (*c.* 1530), ed. Luís de Albuquerque (Lisbon, 1963), pp. 218–19, and A. Teixeira da Mota, 'Bartolomeu Dias e o valor do grau terrestre' in *Congresso Internacional de História dos Descobrimentos* (Lisbon, 1961) II, pp. 299–309. The degree of 16⅔ leagues is equal to 96·666 kms, whereas the true value of the degree is 111·111 kms (*Cf* Fontoura da Costa, A., 'La lieue marine des Portugais aux XVe et XVIe siècles', in *Comptes rendus du Congrès Internacional de Géographie* (Amsterdam, 1938), II, p. 7.
55. H. Wagner, *art. cit.* pp. 225–30 and pp. 236–42.
56. H. Wagner, *art. cit.* p. 226.
57. João de Barros, *Ásia,* Lisbon, 1552, Déc. I, Liv. III, Cap. IX, ed. (Coimbra, 1932), p. 113.
58. João de Barros, *Terceira Década* (Lisbon, 1562), Liv. IV, Cap. I (éd. Lisbon, 1946), III, p. 165.
59. Claudius Ptolemy, *Géographie,* Bk. 1, Chap. XIV, French translation by the Abbé Halma (Paris, 1828), p. 40.
60. Fontoura da Costa, A., *Às Portas da Índia em 1484,* Lisbon, 1936, p. 10 and p. 29.
61. Prester John had been placed in Ethiopia from 1306 onward. *Cf* R. A. Skelton, 'An Ethiopian Embassy to Western Europe in 1306', Appendix III in O. G. S. Crawford, *Ethiopian Itineraries, c.* 1400–1524, Hakluyt Society, 2nd series, 109 (London, 1958), pp. 212–15.
62. João de Barros, *Ásia,* Lisbon, 1552, Déc. 1, Liv. III, Cap. IV (ed. Coimbra, 1932), p. 84.
63. Fra Mauro, *Il Mappamondo di Fra Mauro,* Facsimilé ed T. G. Leporace and R. Almagià (Rome, 1956) XI, p. 27.
64. Fontoura da Costa, A., *op. cit.,* p. 20.
65. João Teixeira, *Oratio habita ab insigni viro Joanne Teyxeira* (1489), Coimbra, 1562, sign. A. viii (r). It is true that Duarte Pacheco Pereira wrote *c.* 1508, that after having passed the Cape of Good Hope, Dias saw that '. . . the coast here turned northwards and northeastwards towards Ethiopia [. . .] giving great hope of the discovery of India' (*Cf* Duarte Pacheco Pereira, *Esmeraldo de Situ Orbis,* Bk III, Chap. VII, translated by G. H. T. Kimble, Hakluyt Society, 2nd series, 79 (London, 1937) p. 154. But Pereira wrote after Vasco da Gama's voyage which had proved that the Cape was the only cape of importance. For Dias the way to India was still not so clearly established.
66. Barros, João de, *Ásia,* Déc. 1, Liv. III, Cap. IV, ed. cit. p. 87.
67. Barros, João de, *op. cit.,* Déc. 1, Liv. III, Cap. I *ed. cit.* p. 112. Gaspar Correa and Fernão Lopes de Castanheda confirm Barros on this point. Gaspar Correa, *Lendas da Índia* (Lisbon, 1858), I, p. 8 and Fernão Lopes de Castanheda, *História do Descobrimento & Conquista da India pelos Portugueses* (Lisbon, 1555) Liv I, Cap. I, p. 2. (Copy of the 1st edition consulted on a microfilm from the British Library).
68. Columbus, Fernando, *Historie, ed. cit.,* I, pp. 92–93.
69. Fontoura da Costa, A., *Às Portas da Índia en 1484* (Lisbon, 1936) p. 37.
70. Letter from D. João II to Christopher Columbus, 20 March 1488 in Martins da Silva Marques, João, *Descobrimentos Portugueses,* III (1461–1500), Lisbon, 1971, p. 371.
71. De las Casas, Bartolomé, *Historia de las Indias, ed. cit.* Liv. I, Cap. CXXX, p. 350.
72. *Cf* the reproduction of the note in Pierre d'Ailly, *Imago Mundi,* reproduced by Nunn, George E., *The Geographical Conceptions of Columbus,* pp. 7–8. The authenticity of this marginal note has been the object of much polemic. Las Casas claimed that it had not been written by Columbus, but by his brother Bartolomé. (Las Casas, *Historia de las Indias, ed. cit.* Liv. I, Cap. XXIX, p. 110). Las Casas' opinion is judged to be groundless by A. Magnaghi, in *Questioni colombiane* (Naples, 1939), pp. 18–19), and by S. E. Morison, in *Admiral of the Ocean Sea* (Boston, 1942), I p. 106, note 29). Rinaldo Caddeo takes, without reason in our opinion, the opposite view claiming that not only did Bartolomé Columbus write the note, but even sailed with Dias on his voyage! Cf Caddeo, Rinaldo, Appendix H in Colombus, Fernando, *Historie, ed. cit.* II pp. 366–72.
73. Ravenstein accepted the figure of 45 degrees as a latitude observed at sea beyond the Cape (Ravenstein, E. G., 'The voyages of Diogo Cão and Bartolomeu Dias (1482–1488) in *Geographical Journal,* 1900 (off print of 31 pages). Bensaude and Fontoura da Costa held the figure to be a gross error imputable to Columbus. (*Cf.* Bensaude, J., *L'astronomie nautique au Portugal* (Bern, 1912/17. Reprint Amsterdam, 1967) p. 109 and Fontoura da Costa, A., *A. Marinharia dos Descobrimentos,* 2nd ed. (Lisbon, 1939), p. 37 n. 48). Jaime Cortesão claimed that the figure was deliberately invented by D. João II to mislead Columbus into believing that the Cape route was really much longer than it

was! *Cf* Cortesão, Jaime, *A Política do Sigilo* (Lisbon, 1960), pp. 50–51. That the Cape of Good Hope stood in a latitude of 45 degrees was a notion that spread into European cartography. The Cape is thus shown on the gores of Waldseemüller's globe in his *Cosmographiae Introductio* (St Dié, 1507). The Polish cosmographer Matthaeus Shamotuly read this very figure off the map and placed it in the text of his commentary on Sacrobosco (Shamotuly, Matthaeus, *Ioannis de Sacrobosco astronomi celeberrimi sphericum opusculum* ... (Cracow, 1521) f. 54 (r).) Only known copy in the Huntingdon Library, San Marino, California.

74. The first clear proof of their mastery of the technique of measuring latitude comes in the figures given by Duarte Pacheco Pereira (*c.* 1508). Pereira, Duarte Pacheco, *op. cit. passim.*
75. Geraldini, Alexandro, *op. cit. loc. cit.* (see note No. 23).
76. Fernandez de Oviedo, Gonzalo, *Historia General y Natural de las Indias* (Seville, 1535), Liv. II, Cap. IV (ed. B. A. E., Madrid, 1959), 117, p. 22).
77. Columbus in one of his marginal notes reproduced by George Nunn claims to have checked experimentally that the degree of the meridian corresponded to $56\frac{2}{3}$ miles and that Master Joseph [Vizinho] whom the King D. João II had sent to Guinea to make astronomical observations of latitudes in the region, had also confirmed this figure. See Nunn, George E., *Geographical Conceptions of Columbus* (New York, 1924, Reprint, New York, 1977) pp. 9-10. Nunn's demonstration of how Columbus had performed the verification of the figure is vitiated by his misreading of the latitude of the Los Idolos islands referred to in one of Columbus' notes: '1° 5′ N', instead of '5° ... minutes N'. His mistake was pointed out by A. Magnaghi 'I presunti errori che vengono attributi a Colombo nella determinazione delle latitudini', in *Bollettino Soc. Geog. Ital.* (1928), pp. 462–65. We do not necessarily follow Magnaghi in the other conclusions of his article. R. A. Laguarda Trias, in *El enigma de las latitudes de Colón* (Valladolid, 1974), p. 37, is also of the opinion that Columbus could not have confirmed experimentally the figure of $56\frac{2}{3}$ milles/degree.
78. Columbus, Fernando, *Historie,* ed. cit. I, Cap. XXI, p. 159, (700 leagues) and De las Casas, Bartolomé, *Historia de las Indias,* Liv. I, Cap. XXXIX, ed. B.A.E. Tome XCV, p. 139 (750 leagues). A repetition of this 'mysterious' distance can be found in a Portuguese rutter dated to *c.* 1495: 'Este livro he de rotear', reproduced in *O Manuscrito de Valentim Fernandes* (Lisbon, 1940), p. 230. *(Sabe q̃ jazẽ as Antilhas com o Ferro leste e hoeste E ha na rota vijc leguas largas).*
79. Morison and Nunn's attempts to analyse the cartographical bases of Columbus' conviction of the short distance he had to sail are not entirely convincing, especially Morison's, and lead to differing conclusions (*Cf* Morison, S. E., *op. cit. ed. cit.* pp. 86–91 and pp. 103–104 and Nunn, George E., *op. cit. ed. cit.* pp. 25–30). Much depends on the estimation of the number of degrees of longitude by which interpreters of Marco Polo's travels are said to have extended Asia eastwards beyond the limits assigned by Ptolemy.
80. Almagià, Roberto, 'I mappamondi di Enrico Martello e alcuni concetti geografiche di Cristoforo Colombo', in *La Bibliofila,* XLII (1940), pp. 228–311.
81. Skelton, R. A., note in Destombes, Marcel, *Mappemondes A. D. 1200–1500* (Amsterdam, 1964), pp. 229–33.
82. *The Journal of Christopher Columbus,* translated by Cecil Jane, revised and annotated by L. A. Vigneras, with an appendix by R. A. Skelton (London, 1960), pp. 42–43.
83. *Ibid.* p. 51.
84. Such as Washington Irving, described them. *Cf* Irving, Washington, *A History of the voyages of Christopher Columbus* (London, 1828), pp. 119–126.
85. The term 'America' was not used by the Spaniards until the eighteenth century.