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MAP II. *The World of Eratosthenes*, in E.H. Bunbury's *A History of Ancient Geography* (London, 1879).

SYMPOSIUM

# The Battle Against Ptolemy's Geography

by Salvador Lozano

When the sages gathered at the Council of Florence examined the viability of the project which came to life in the voyages of Christopher Columbus, they first had to settle various questions related to the form and composition of our planet which had been discussed for many decades.

For example, in the absence of precise geographic data, the distance to be navigated westward from Europe before finding land must be estimated from the size of the globe; the probable proportion between the surface area of land versus water; and so forth. On the other hand, to plan explorations, they had to resolve the double question: which part of the world is habitable, and which

part of this is actually inhabited. In essence, the scientists of the Renaissance were making the same kinds of conjectures that we do today when discussing the conquest of the solar system.

The geographical knowledge of Mediterranean civilization had arrived at a high level just prior to the beginning of the Christian era. Outstanding for their contributions were Eratosthenes, the astronomer Hipparchus of Rhodes (second century B.C.), and the historian Strabo (first century B.C.). Maps II and III are the maps derived from the work of Eratosthenes and Strabo, respectively, and illustrate, among other things, the fact that they were well aware that Africa came to an end at a southern cape that was circumnavigable. It is probable that they knew of the Phoenician expedition sent about 609-593 B.C. by the Egyptian Pharaoh Necho II to circumnavigate Africa by departing from the Arabian Sea, as reported in the famous account by Herodotus in *The Histories*.

*This article, translated by Rick Sanders, has been excerpted and adapted from "The Geography of Exploration and the Fraud of Ptolemy," which appeared in the Spanish-language magazine Benengeli, Vol. 2, No. 1 (First Quarter, 1987).*

It is worth noting that Hipparchus subjected the work of Eratosthenes to stringent criticism, for his lack of rigorous method in dividing the map into zones and in situating places with precision, a method which must be based in the exact placement of parallels and meridian lines from astronomical observation. Hipparchus, who compiled a catalogue of no less than 1,980 stars, followed this method to correct the location of a good number of places, using for the first time in cartography the division of the Earth's circumference into 360°.

It must be kept in mind, however, that the various volumes of the *Geographika* of Strabo constitute more a formidable descriptive encyclopedia, than a conceptual work Hipparchus-style. In fact, regarding astronomical or mathematical material, Strabo frequently refers his readers to Hipparchus.

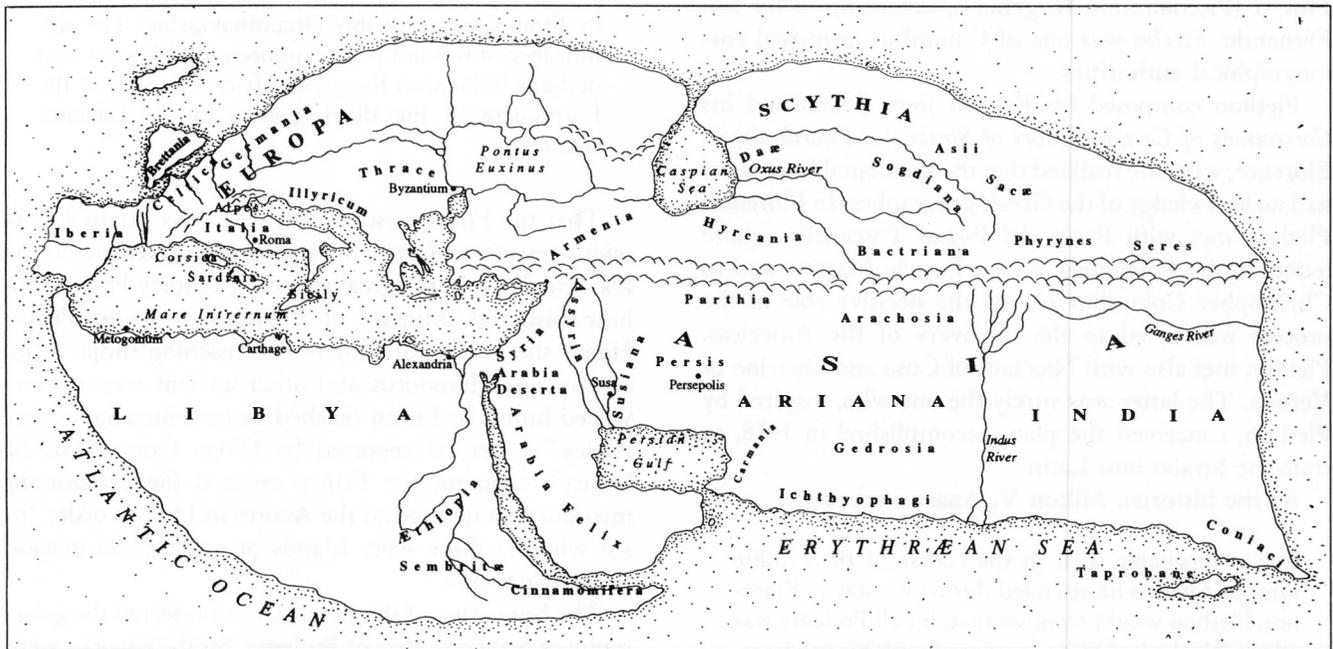
Some three hundred years after the death of Hipparchus, the fanatical Aristotelian Claudius Ptolemy (90-168 A.D.) became director of the library of the Alexandrian Museum. One of the biggest intellectual swindlers in history, who perpetrated frauds in astronomy, optics, and music, as well as geography, Ptolemy concocted a series of fables of which the most scandalous was that Africa is not circumnavigable because it is connected to an unknown land (*terra incognita*) which entirely surrounds the Indian Ocean (SEE Map IV). As for the distribution of land and water on the planet's surface, Ptolemy spread the discouraging idea that water covers upwards of five-sixths of the whole planet. Moreover, he placed rigorous limits on the habitable and the inhabited world.

## The Council of Florence

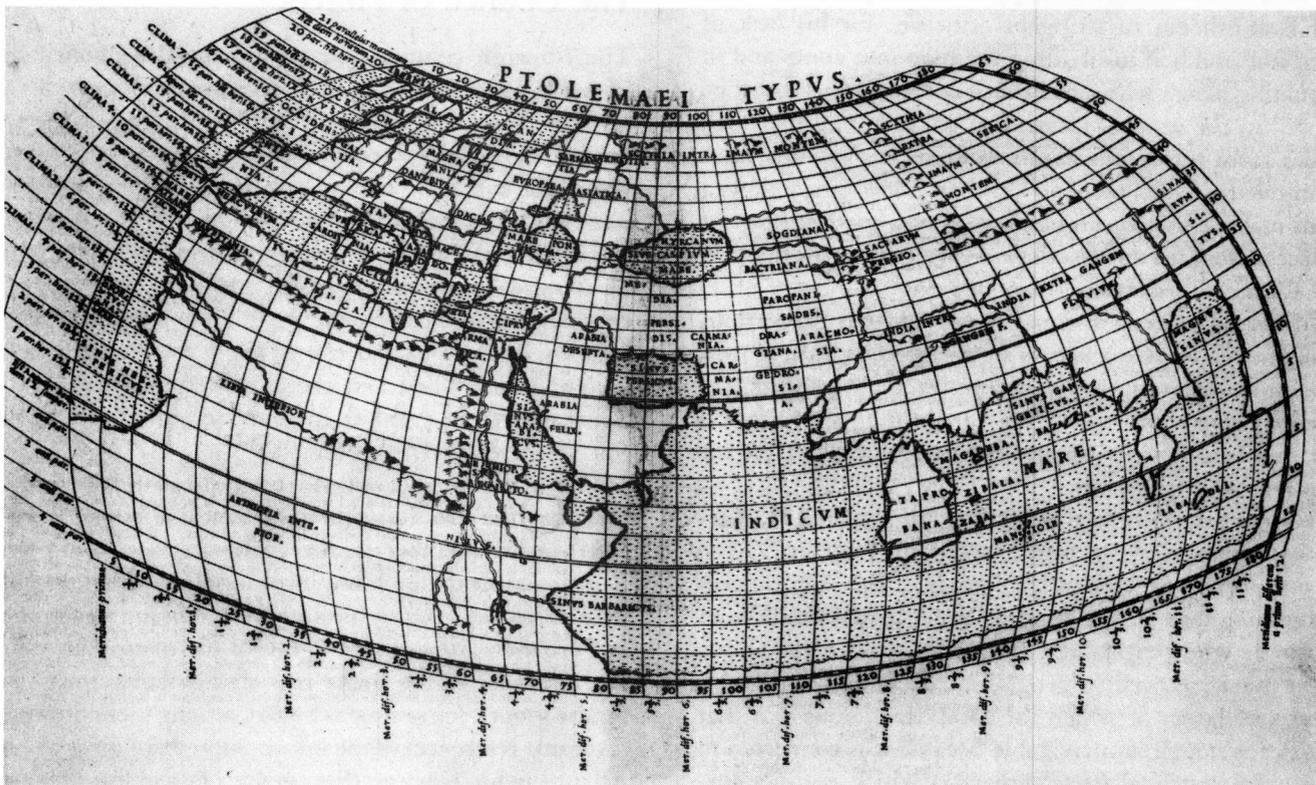
The fifteenth century, the century of the Council of Florence and the discovery of the Americas, provides a vista of bitter conflict: the efforts of the humanists to resolve the geographical questions posed by the great project of exploring the western route to the East, collided with the attempts to obscure all this through the charlatantry of Ptolemy and his promoters—especially as his treatise *Geographika Syntaxis*, which had been almost completely forgotten during the Middle Ages, had only recently been translated from Greek into Latin, a task accomplished, aided and abetted by strenuous promotional efforts, by Jacobus Angelus de Scarparia a mere thirty years before the Council.

One of the decisive events at the Council in this respect was that the erudite Greek, Gemistos Plethon (1389-1464), a lay member in the group accompanying the Paleologue Emperor John, introduced the Western humanists to the geographical encyclopedia of Strabo.

Fernando Columbus, the son of the discoverer, calls our attention to the many reasons his father found in Strabo's work for sailing as he did, among them Strabo's favorable references to the information Plato gives about Atlantis in his *Timaeus*. (For, in the *Timaeus*, based upon very ancient oral traditions, Plato speaks of "terra firma situated on the other side of this true ocean," which could be reached by sailing "from one island to another.") Columbus must have cited this and other observations directly from Strabo's text, since none of these quotes are given in other works by other authors whom Colum-



MAP III. *The World of Strabo. Reconstruction based on E.H. Bunbury's A History of Ancient Geography (London, 1879).*



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MAP IV. *The World of Ptolemy, in Girolamo Ruscelli's La Geografia di Claudio Tolomeo (Venice, 1561). Note the strip of land which connects Africa to Asia and encloses the Indian Ocean—making the circumnavigation of Africa impossible.*

bus had studied or annotated. Columbus referred to Strabo to support the notion that there exist habitable regions as yet unknown; and he frequently referred to Strabo in his comments on the *Historia Rerum* of Pope Pius II (Piccolomini). In general, according to his son Fernando, Strabo was one of Columbus' principal cosmographical authorities.

Plethon composed his *Extracts from Strabo* and his *Corrections of Certain Errors of Strabo* (or *Diorthosis*) in Florence, when he realized that the occidental humanists had no knowledge of the Greek geographer. In Florence, Plethon met with Paolo dal Pozzo Toscanelli, whose letters to the Portuguese canon Fernão Martins and to Christopher Columbus played the decisive role in the process which led to the discovery of the Americas. Plethon met also with Nicolaus of Cusa and Guarino of Verona. The latter was surely the one who, inspired by Plethon, conceived the plan, accomplished in 1458, to translate Strabo into Latin.

As the historian Milton V. Anastos reports:

It was inevitable that, in the course of the erudite symposia which he attended during his stay in Florence, Plethon would mention that, for all Ptolemy was admirable, he had to be compared with his predecessor, Strabo, whose *Geographika* corrected and aug-

mented in many points the work of Ptolemy on the same subject. Among other things, he will have drawn people's attention to, as he does in the *Diorthosis*, Ptolemy's idea that the Indian ocean is landlocked being very questionable; and that Africa, as taught by Strabo, was probably circumnavigable. The significance of this last point had been lost hitherto, and perhaps influenced the great African voyages of the Portuguese in the third quarter of the fifteenth century.

That the Portuguese project was based upon a conscious rejection of Ptolemy's geography is clear. For as Damiao de Gois, the great sixteenth-century Portuguese humanist and intimate of Erasmus wrote of Prince Henry the Navigator's interest in reaching India: "The accounts of Herodotus and other ancient writers convinced him it had been reached by circumnavigation of Africa." Later, as reported by Diogo Gomes, one of Henry's captains, the Prince ordered the exploratory missions that first found the Azores in 1432, in order "to see whether there were islands or a mainland outside Ptolemy's world."

The humanists of the Renaissance preferred the geography of Strabo to that of Ptolemy. Strabo's works were printed various times between 1469 and 1473, before the

work of Ptolemy was even printed for the first time, in 1475. Pope Pius II definitively rejected the Ptolemaic description of Africa and adopted that of Strabo—which was that of all the classical Greek geographers.

This illustrious Pope says, in his *Asiae Europaeque Elegantissima Descriptio*:

Asia is joined to Africa by the nape of Arabia which separates our sea [the Mediterranean] from the Arabian Gulf. No one denies this; but he [Ptolemy] adds that at a certain point, they are connected by an unknown land mass which encloses the Indian Ocean. In this opinion he is almost alone. Because all the ones we know who wrote about the features of the Earth, place the Indian Ocean south and east,

without ascribing to it any limit, hence they are of the opinion that it is a part of the *ocean-sea*, as recorded by those who navigated from the Arabian Gulf to the Atlantic Ocean and the Pillars of Hercules.<sup>1</sup>

For this reason, when Bartolomeo Diaz circumnavigated the Cape of Good Hope, Christopher Columbus judged the event, and rightly so, as the practical refutation of the Ptolemaic description of the limits of the inhabited world, and a powerful argument in favor of the project in which he played such an outstanding part.

#### NOTES

1. A clear reference to the expedition of Pharaoh Necho II.

## SYMPOSIUM

# The Science Behind Columbus

by Rick Sanders

For the modern reader, the attempt to discover the scientific and technological significance of Columbus' 1492 voyage is probably almost as difficult as it was for him to do what he did in the first place. Even leaving aside the politically motivated detractors of Columbus and his exploit, his admirers are not always helpful. Admiral Samuel Eliot Morison, for example, tries to have it both ways. First, he says that Columbus was barely capable of using the astrolabe and the quadrant, and that he underestimated the size of the Earth by twenty-five percent; later, he goes on to say that Columbus was among the world's best navigators, and that "no man alive, limited to the instruments and means at Columbus's disposal, could obtain anything near the accuracy of his results."<sup>1</sup>

To understand the outlines of how the science of Renaissance navigation positioned Columbus to undertake his great voyages, we have to answer the following questions:

- What general cosmological and navigational knowledge, other than the astronomical sciences, was required to carry out the 1492 exploit?

And, as to the astronomical sciences, we must know:

- With what kind of accuracy could Columbus determine latitude? Did he use the stars, the sun, or both?
- How close was Columbus in his estimate of the Earth's circumference?

- If Columbus knew the Earth's circumference, did he know the size of the "hole" between Spain and "Cipango" (Japan); that is, did he know to what longitude Asia stretched, so that he might calculate the actual distance between East Asia and Spain?
- Did Columbus have any reliable way of finding longitude?

## Cosmology and General Seamanship

### Cosmology

The "politically correct" cosmological view at the beginning of 1492—despite the counter-tradition of Nicolaus of Cusa and the Council of Florence—was that of Aristotle and Ptolemy, that the known world was an island in the midst of a chaotic, untraversable ocean. Columbus had the courage to accept instead the conclusions of Pierre d'Ailly, Cardinal of Cambrai, who in his 1410 *Imago Mundi* said:

The length of the land toward the Orient is much greater than Ptolemy admits. . . . For, according to the philosophers and Pliny, the ocean which stretches between the extremity of further Spain [Morocco] and the eastern edge of India, is of no great width. For it is evident that this sea is navigable in a very few days if the wind be fair. [This part is heavily underscored by Columbus in his copy of the book.]<sup>2</sup>