

The Mathematical Junta

The University of Lisbon stood on a hill overlooking St. George's castle to the east and the majestic estuary of the Tagus to the south. Abraham gazed at the shimmering blue water and marveled at the wide inland expanse, almost three leagues across, and the narrow connection to the Atlantic. From the west, two caravels were running the nor'wester into the *Mar da Palha*, the straw sea. The large anchorage opposite the capital of Portugal was easily the best natural harbor between the Mediterranean and the North Sea, sheltered from the Atlantic by an twenty-fathom trench. Easy to navigate, easy to defend.

The astronomer was waiting for the other members of the Mathematical Junta. King John had brought them together to oversee the science of the sea voyages and to review expeditionary plans brought to him by adventurers from Venice, Genoa, and elsewhere.

Since its creation in 1290, the university had attracted eminent mathematicians from all over Europe. On the Junta sat Jewish exiles such as Ibn Verga of Seville, Vizinho, physician to the king, and Martin Behaim, known as the Bohemian. Together, they were a formidable group; Verga had written on astronomy and penned books on navigational science. He was an expert in the use of the astrolabe, the quadrant, and other wondrous instruments that held the key to steering by the heavens.

For the common sailor, it was close to magic; if you could read the stars to describe today, then surely they might be used to foretell tomorrow! No wonder these magicians, who juggled numbers like rabbits from a hat, were known as astrologers—for where is the difference between time and space when it comes to telling the future? But for the pilots and captains, the devices were a key element for positioning at sea, and the mathematicians were often sent to sail with the fleets; Vizinho himself had done so in Guinea in 1485 at the behest of the king.

By measuring the solar elevation, which the Portuguese sailors commonly termed weighing the sun, it was possible to determine the ship's latitude. This operation required great accuracy, both in timing, given the sun should be at its highest point in the sky, and in measurement, given the ship's roll. It demanded also not a little courage, or perhaps foolhardiness, since staring at the midday sun had devastating effects on the eyes, particularly near the equator.

The mathematicians had worked out a set of tables to be used according to the day and the year, and these were fiercely guarded according to the king's instructions. The Munich regiment, as it was known, calculated these declinations at

sixty points to the north of the equator. The Junta had also worked on the use of the North Star, and in particular the guards, as the two brothers of the Ursa Minor were called.

A tall bearded man walked into the room, looking approvingly at the shelves filled with scholarly volumes. “Shalom, Abraham, good morning.”

“My dear Vizinho, come, sit,” the teacher greeted him warmly. In the hallway, the booming voices of the Sevillian and the Bohemian could be heard. They were speaking in Latin—Behaim with the harsher tones of northern Germany, Verga in a rapid Andalucian staccato that brought a smile to the two men in the room.

The four sat at a long table, and Abraham poured each a cup of spice wine as he recounted his conversation with the pilots. “The king wishes to send his squire Dias on a voyage, with plans to sail further south than the Congo, perhaps even to the Cape of Storms.” He stood, stooping slightly, and took a few frail steps toward the map, wisps of white hair framing the almost childlike face. The astronomer traced a finger down the African coast.

“You are familiar with the hardships of Cão’s journey, the tales of woe, hunger, and suffering as the caravels battled south against currents and trade winds.” The teacher sipped the red wine pensively, then continued. “The pilot Escobar described how Cão sailed west off the Guineas to avoid the doldrums, and how they found a propitious westerly breeze. Of course, they did not know how far west they were, and feared that they might never return. So they turned around.”

He smiled sweetly, but his pink cheeks and embroidered skullcap were deceptive in their innocence. They concealed a sharp mind and a scientist’s intolerance of fools. “We know the theory of Ptolemy, that the seawater in warmer areas near the equator will expand and flow toward the poles. That theory is clearly wrong.”

He took a globe and slowly spun it. “We know about the ocean circulation in the North Atlantic, and we are certain that there is a rotation pattern. This is the reason for the preferred route to the Azores, southwest to Madeira, followed by a northerly route home.”

Vizinho nodded. “I appraised the plans of Columbus three years ago, at the command of the Perfect Prince. This is how the admiral proposes to go to the Indies, south using the trades via Madeira and the Canaries. We do not endorse his calculations and cannot support his conclusions, but I too believe there is a gyre, driven west by the trade winds and sent back by the roaring forties.”

Abraham smiled, but this time with the fever of science in his eyes. “We may postulate an Atlantic circulation in the south, a mirror of our patterns in the north.”

A quirky Prussian accent: “Zymmetry?” The Bohemian dipped a quill in the inkwell, and drew two vertical lines on a parchment, the top one for Europe and the bottom for Africa. No one knew how long that lower line might be. To the left, he carefully added two large circles, one above the other, two wheels spinning in opposite directions. Symmetry has always been part of the beauty of mathematics, and of nature itself.

“Yes, we see it in the winds north and south of the equator, in the ocean current, the temperatures both of water and air, and most importantly in the angle of the sun,” the Sevillian Bin Verga added. His quick mind had grasped the concept immediately. “Our clever Abraham is saying we can use the bottom circle like we use the top.”

The teacher’s blue eyes shone. “Indeed, if there is a passage to the east below the African continent, we can use the circle to get there, or perhaps part of the circle only.” Abraham felt pleased to share his theory with such distinguished scholars, men to whom ideas were the fuel of life, and knowledge the engine of progress.