

The Caravel

Captain Bartolomeu Dias was the superintendent of the royal warehouses, and had been a naval commander in the expedition to the Gold Coast in 1481, led by Diogo d’Azambuja. Like Azambuja, he had been both a corsair and commander of merchant vessels in the Mediterranean Sea, two faces of the same coin. Now he was master of the *São Cristovão*, appointed by the king in October 1486. For this, the crown granted him an annuity of six thousand reals “in consideration of services to be received.”

Nine months hence, the last preparations for his great trip south were nearing completion, a fleet of three caravels with a mission of extending the discoveries of Cão to the very ends of Africa. On that journey, Cão and his officers had been playing a card game aboard, which the captain trumped with the manille of spades. Tossing the ace in the air, he laughed. “That promontory shall be christened Montenegro!” It was his last landmark, past the thirteenth southern parallel. By tradition, and by devotion, the name was unusual. Although some places were named after events, the majority was christened after saints. South of Catumbela, the Swamp River, Cão had passed a bay on March 25 and promptly named it Angra Santa Maria. Because keeping time at sea was all important, such toponyms accurately recorded the progress of an expedition; since place names matched saints’ days, this added to the reliability of the captain’s log.

The last part of the astronomical preparations would take place on board the *São Cristovão*, docked at Belém on the western approach to Lisbon. The captain and pilot welcomed Abraham and Vizinho and assisted them with the scientific tomes and astronomical instruments. The caravel was a new type of ship, invented by the Portuguese, drawing on knowledge acquired from the Arabs, and had been little used prior to Dias’s journey. The captain showed the astronomers the three masts, each bearing a huge triangular sail.

“She displaces about fifty tons and has a lateen both on the mizzen and main,” Alenquer said. “And as you see, she has only one deck. This is the stern castle, from whence the vessel is governed and where all astronomical observations are made.”

“Cão sailed in a barque, but these new vessels are much more maneuverable, especially sailing to windward,” the captain said.

How small these ships are, thought Abraham. One ton was the size of a barrel, six feet tall and four feet across, nothing! What courage, to put to sea in a walnut shell like this one and brave the wild Atlantic.

It was late Sunday afternoon, with the sky above bright and clear. The date was August 12, two weeks before the expedition was due to leave, and after the tide turned at half past five the caravel sailed west on the ebb, the astronomers aboard. Provisioning and stowage below decks was almost complete: spare sails, anchors, sheets and instruments, foodstuffs—sacks of flour, barrels of biscuit and salt pork, fish, wine, oil and vinegar—for the long journey. There was a gibbous moon, but a spring tide, a good choice both for sailing and observing the stars.

“Before we set sail today, let us discuss the route,” Abraham said. They spread charts of the South Atlantic on the table. “You may recall some close questioning on my part when pilot Escobar described Cão’s journey south from Guinea.”

Alenquer interrupted. “Indeed, you asked about the western route.”

Now it was Vizinho who spoke. “We have discussed this at length in the Mathematical Junta, and performed some calculations. We believe that the journey south must be carried out as a mirror image of the journey north, as a great circle, arcing against the hands of the clock. This will allow you to head south in the mid-longitudes, perhaps two hours west.”

Dias looked at him with suspicion. “If you’re wrong, this poses a great risk: we will all perish.”

Alenquer, more adventurous, said, “When we navigate the Azores leg home, we’re sailing from the bulge of equatorial Africa, and because of the span of the nine islands, an error of five degrees in longitude still allows us to sight the archipelago. If we overshoot, the winds and currents carry us there, and if we fall short, it’s clear from the flotsam on the water. Also, there is the anomaly in the Genovese needle.” He was referring to the shift in true north known to occur in the Azores area, which did not allow the measurement of longitude, contrary to many beliefs, but did indicate the proximity of the volcanic islands. “But in the South Atlantic, where will be the islands to guide us? How will we know how far west to go?”

Abraham again spoke. “We have devised a method, but it requires a most skilled pilot, such as yourself.” Alenquer looked down, for like many great men, he was modest about his achievements and uneasy with compliments. “We have called it the sawtooth. You agree that sailing a straight course west along the South Equatorial Counter Current, you may only use the hourglass, correct?” The sailors nodded dubiously.

“The hourglass is as fickle as a woman,” Dias scoffed. “What it says is not what it means—it can be as misleading to a sailorman as the siren’s song.”

“Of course,” said Abraham, “there are only two instruments that may be trusted on board, the compass and astrolabe.”

“And the pumps,” said Dias, for all vessels shipped water no matter how well caulked they might be, and particularly after a storm, all hands often manned the pumps until damage could be repaired. The astronomer felt that the captain was anxious to shift the conversation and move on from the consideration of an alternative route. After all, Cão had used a far less maneuverable vessel and made it halfway down the Angolan coast. Why should Dias risk this expedition on such whimsical notions?

Abraham looked at his colleague, and both turned to Alenquer, who seemed to be the more serious of the pair. “We believe you can significantly improve your accuracy in sailing the parallel by zigzagging a sawtooth. Do you remember Behaim’s hour rose? Each quadrant has eight divisions, spanning eleven and one-quarter degrees. To know how far west you go, sail along one of these, and if you can keep a true course you will know how far you went from the latitude.” The mariners looked at him quizzically.

Abraham drew some lines and angles on a paper. “Geometry is the secret. Imagine you are at the equator. If you sail southwest for seventy leagues, you will have completed a right-angled triangle of about fifty leagues south followed by fifty west. You will know how far south you are by weighing the sun. If you measure your latitude position at the end of the leg as three degrees south, you will be three degrees further west.” He smiled. “The beauty of it is, as long as your course was true southwest, it doesn’t matter that you do not know the distance you traveled. You then head north, or better still, if wind permits, you make your heading one of the six bearings between north and west until you again reach the equator, completing one full tooth of the saw!”

After a pause, Alenquer nodded. “Yes, this can be done. We avoid the errors of measuring speed, since we know latitude and bearing.”

Vizinho had brought with him a precious gift, a partial translation of the *Almanach Perpetuum*, written by his teacher Zacuto in 1478. In the book were tables of the declination of the sun, together with the ephemerides—the paths of the planets and stars. The combined power of the two elements meant a huge improvement in navigational accuracy; certainly the difference between success and failure, probably the difference between life and death. The group spent part of the night and all the next day using navigational instruments to take readings of the stars and the sun, and performing calculations using the tables in the almanach.

As the astronomers disembarked, Abraham was under no illusion that their mission had been only a partial success. It seemed unlikely that Dias would follow their proposed southern route, but their contribution to improving navigational skills for the expedition might contribute to its success. "I will recommend this pilot to King John," he said, "as a most competent and learned man."

Vizinho nodded. "And when it is time for the eastern adventure, tell His Majesty that he will need a commander worthy of his pilot's skills."