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Misappropriations and Convergences Between the Portuguese
Methods of Navigation and Those of the Indian Ocean in the late 15th Century

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The meeting in Malindi (April 1498)

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May I suggest turning our interest neither on the goods and the ideas carried along the Maritime Silk Roads nor on the ships involved in such exchanges. Many papers have already given an outstanding lighting on such aspects. My purpose is to compare the navigation methods along the Maritime Silk Roads, out of sight of the coastal references. Our maps of the maritime exchanges of the past ages suggest theoretical lines waving artistically from harbor to harbor. The problem is to discover which real ways were sailed through the open sea.

Improving the antic traditions of coastal navigation, the determination of true elements of the position of the ship by astronomic observations has been a major testimony of human creativity. Exploring a wide spectrum of ages and civilizations, we shall examine the Arabian, Persian, and Chinese methods up to the 15th Century, as well as the Portuguese methods used to open what European have named more exactly "The Spice Roads".

Most of the ships along the oriental trading roads did not need any astronomic earth references, either because they were coasting or just crossing straits from island to island, or because they found sufficient help in star heading references and magnetic needles to lead their way through the open sea. I would like to underline the close connection between the magnetic needle and the Pole Star. Before the discovery of the magnetic phenomenon the needle was supposed to indicate the Pole star by divine intervention. So, it was obviously used as an alternative of a more ancient practice involving a previous knowledge of the navigation of the Pole star.

Most of the ships along the silk roads did not need during their whole journeys any astronomic earth references, because estimated positions provided sufficient information through the whole early maritime history, all over the world. In medieval Europe, the

maritime trade was contained inside small areas: Mediterranean, North Sea and the Baltic. The Viking transatlantic migration along the average latitude 60° North crossed an area more or less at the same dimension as the Mediterranean. Viking ships did not use any method, on their east to west and west to east journeys, other than referring to the sun and the swell. Polynesians, by far the first transoceanic navigators in the world's history, knew by unwritten tradition which star was to be followed to reach an island from their own island. They had no capability of elaborating a universal method of navigation from this local and relative system. Their practice on the whole was not so far from an insubstantial star compass.

A not attested Arabian chronicle tells that the great Muslim pilot Ibn Majid was the pilot who led Vasco de Gama from Kenya to India. Anyway, the experienced pilot who came aboard Sao Gabriel, named by the chronicles Mu'allim Kanaka or "Master of Navigation" had been instructed in the spirit of Ibn Majid, born in 1430 in Oman, a writer of numerous navigation treaties. He deemed himself to be the heir of the so called "three lions": Muhammad bin Sada; Sahl bin Aban and Layth bin Kahlan, who had written navigation treaties between the 11th and the 12th Centuries. Their successors would be in the 16th Century Sulayman al Mahri born in South Arabia.

Records of Maritime navigations on the silk roads exist from the beginning of the Christian area. According to the Chinese monk Yijing, Ships bound in the 7th Century from Guanzhou or Vietnam for Sri Lanka and India, sailed straight across the Gulf of Siam and South China Sea and later the Bay of Bengal. They used a star compass referring to the pole star and if necessary, a magnetic needle floating on the surface of a water bowl.

This wide area of cosmopolitan navigation spread over 40° in latitude and some 80° in longitude from Kenya to China. Southwards, the area was limited by a line from Madagascar/Zanzibar, far south of the Equatorial line. At this time, European scholars affirmed that the boiling Equatorial waters were impassable. Due to the convexity of the Chinese shores, the coastal road was the shortest maritime way from a Chinese harbor to another. On the other hand, the Gulf of Siam, lengthened by the Malay Peninsula as well as the Bay of Bengal, shaped on both sides by concave coast, required to be crossed straight.

It was sufficient to follow the compass to reach the other side. More precisely, to arrive somewhere. Remember that, until the late 18th Century at least, ships set sails when they could

and arrived where they could, without any consideration of time or accuracy. The Monsoon was particularly remarkable for its regularity. But navigator had to wait several months for good winds. According to Yijing, and due to the geography of the Chinese area, I think that Chinese probably sailed systematically straight northwards and southwards.

They could start from selected departure points, reached by coastal road, on the meridian of the expected destination. We must never underestimate the pragmatism of the early navigators. The sailors anywhere around the World refrained from using sophisticated methods unless absolutely necessary. Chinese pilots were obviously drawn by the pole star, guiding straight ahead when sailing from Borneo to China, straight astern when sailing from Vietnam to Sriwijaya. The Chinese magnetic needle showing the south, by devotion to the Emperor, was of same pragmatic use. The departure points determined the landing point, exactly as it did for the Vikings during the westward journeys. The altitude of the Pole star was of no interest for determining and correcting the ship's heading, but could be a good indication of the distance from ship to shore ahead.

In the Indian Ocean, the roads were established on the same principle, but westwards or eastwards through the Bay of Bengal and the Arabian Sea. In this situation, the altitude of the Pole star indicated the position of the ship, in comparison with ideal road. If the pilot knew the altitude of the Pole Star in a harbour, at a specific moment of its daily circumpolar rotation, he could determine whether its ship was at the same latitude or not. If so, ordering to steer westwards or eastwards he drove the ship straight to the harbor, as far as the measure was accurate. Arab and Persian pilots practiced first this method by adding their horizontally stretched fingers between the horizon and the Pole Star. They deduced later from their finger the angle unit so called "isbah". Their instruments were the nautical quadrant, derived from the quadrant astrolab, and the Kamaal or "Perfection", directly derived from the fingers method. The pilot moved a small wooden horn board until it covered the exact distance between the Pole star and the horizon. Knots along the string fixed in the middle of the board translated the distance from the eye into altitude. Pointing first to the altitude of the star in selected harbours, some more sophisticated kamaal could later measure the increasing standard angles from isbah to isbah. The first instrument was sufficient but it was of local use. The second called for either an associated sea chart, or at least a table of recorded harbour's latitude. It was universal. The muslim pilot of Vasco de Gama in Malindi produced a map of the Indian coast, squared with parallels and meridians, suggesting the tradition in the area to sail following cardinal directions.

During the Middle Ages, Europeans had not the least knowledge of the oriental maritime adventure. Under the tyrannical rule of the Christian church, the scholars proposed a circular world (Terrarum Orbis) surrounded by the Ocean river, as the limit assigned to men.

Venice was the last dispatching market of the silk roads. Her merchant galleys collected cargos from Alexandria, Beyrouth or Tana, and spread all over the Mediterranean area and up to Flanders. Overseas began for them not out of the Mediterranean, but already out of the Adriatic. Sea charts appeared in the last years of the 13th century, relying on the use of magnetic compass, but exceptionally used in this area.

Some travelers, at the end of the 13th Century, narrated the astonishing Asiatic passengers' liners and the efficiency of the maritime roads of the Far East. They unfortunately gave no information on the improvement of the oriental nautical science. Anyway, everybody dreamed essentially of the Cathay and Cipango's golden places described from hearsay by Marco Polo. Europe began to dream of the Far East when Portugese assault fleet invested Ceuta (North of Morocco) on 21st August 1415, and discovered Africa and fascinating eastern ware.

Under the spiritual leadership of Infante Henry, so called the "Navigator", Portugese explorers began to sail around Africa. They hesitated for 13 years before being courageous enough as to go round Cape Bojador, which was the limit of the European navigations and was regarded as a point of no return. A small occidental boat entered for the first time the gloomy ocean in 1434, presenting finally Europeans with the high sea.

Reaching India required 64 more years, and the whole Portugese maritime adventure lasted 79 years. This delay reveals the intellectual and technical difficulties faced in elaborating nautical science from nothing. At the beginning of their circumnavigation, Portugese supposed they were going to coast along Africa, following the Mediterranean tradition. The first novelty occurred in the middle of the 15th Century, when they sailed into the Gulf of Guinea. This area was unfavourable indeed for return, due to prevailing north-east trade-winds. So, the Portugese were obliged to invent a new method of navigation. First they used Caravellas, a latin or triangular rigged ship, good for tacking wind direction. Second, they conceived the most important process of the occidental history of navigation: the "volta ", a wide detour across the Atlantic, towards the Azores archipelago, using at best the prevailing winds. For the first time in history, sailors deliberately followed a longer way in order to save time. And then, the Portugese were obliged to invent a method of finding their way in an unknown open sea. Scholars, Astronomers, Hydrographers, from Portugal, Spain and Germany were called

for help. By 1460, the method used by the Arabs in the Indian Ocean was discovered again from nothing. The first instruments were built for this purpose. First the quadrant, and later by 1530 the Cross-Staff, similar to the Kamaal.

Equator was reached and sailed across by Lopo Goncales in 1468. With the Pole Star having disappeared behind the northern horizon, a new method using the sun was elaborated during the last decades of the 15th Century. The nautical astrolabe was invented for the purpose of measuring the altitude of the sun, and tables gave the necessary correction for the astronomic declination of the sun depending on its location between the tropics from the mid-summer solstice to the midwinter solstice.

In conclusion, the rising of a real astronomic navigation based upon positions and not only headings established the transformation of the linear notion of point-to-point maritime journeys into a bi-dimensional space, developed in a system including the memory of the whole geography of the area, thanks to maps or recorded information of ground coordinates. This universal method could be extended to any area to be explored. It is remarkable that this universal method never appeared in any maritime civilization without a technical necessity due to an imperative reason to sail in the open sea for a long time to have confidence in the estimate method of dead-reckoning from heading and appreciated speed.

Developed and improved first in the area of the maritime silk roads, on both sides of the Malay Peninsula and Indonesia, this method was discovered again about 8 centuries later in the Atlantic, when a new need appeared. It is strange to record that Portugese had no knowledge of the Arabian and Persian methods until the meeting in Malindi in April 1498 between Vasco de Gama and the muslim pilots. Mu'allim Kanaka, the experienced pilot described by Portugese chroniclers, spoke the same scientific language as the Portugese pilots. They could exchange their similar instruments, and Kamaal became fashionable on board the Portugese Caraks. Their enthusiastic discussion constituted the first international seminar on the scientific navigation. Our seminar today could be the commemoration of the 493rd anniversary of this event.