Sailors and Astronomy

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Sailors are neither professional nor amateur astronomers, but people who have to observe the sky in the course of following their professional calling. As soon as sailors ventured far from the coast they required some guide and even in antiquity (as shown by mentions in Homer's *Odyssey* and, considerably later, by Aratus) they used Ursa Minor and Ursa Major. With journeys farther afield, they gained some insight into latitude from the changes of the altitude of the circumpolar constellations above the horizon.

Although the very last Viking voyagers knew of the magnetic compass, earlier ones still relied on the Sun and the stars. Describing the methods used, Harald Akerlund says "One saga mentions a man, Oddi Heldagon, who was known as "Oddi the Star" and who served as long-distance pilot for an Icelandic magnate towards the end of the 900s. He left notes that included a complete table of the changes in declination of the Sun throughout the year, expressed as the height of the Sun on the meridian in semi-diameters. There is also a small table of azimuths giving the direction at different times of the year, of dawn twilight, defined as being a faint band of light on the horizon, visible before sunrise. We know nothing of the instrument used to measure the altitude of the Sun."

Such methods fell into disuse with the discovery of the compass, after which positions were estimated from the known point of departure and the distance covered. Such methods sufficed for navigation in the Mediterranean and around the coast of Europe, but when Henry the Navigator instigated longer voyages of exploration around Africa, estimation of position on the high seas and at low latitudes required new techniques. The solar declinations given in the Alfonsine Tables, prepared between 1248 and 1252, were insufficiently accurate to be used with determination of the altitude of the Sun at local noon for position-finding. Abraham Zacuto of Salamanca published his more accurate *Almanach Perpetuum Celestiam Radix* in 1473 and Regiomontanus his *Ephemerides Astronomicae* in 1475. The Portuguese appear to have used accurate tables after 1449, but these remained a "trade secret" until their publication in Lisbon in 1509.

Although latitude could thus be determined, longitude either required a suitable chronometer or the knowledge of the precise times, at a standard meridian, of phenomena such as the eclipses of Jupiter's satellites, or else tables of lunar distances. The observatories of Paris and Greenwich were set up specically to provide accurate

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astronomical tables. The work of such observatories was wide-ranging and so cannot be described in any detail. However, the career of Admiral Mouchez is interesting, in that after having served at sea he became Director of the Paris Observatory.

In the middle of the 19th century, Lieutenant Ernest Mouchez found errors in both charts and in the astronomical methods and equipment used by navigators. In particular, a sextant used with a mercury artifical horizon did not give sufficient accuracy to check chronometers. Mouchez felt that sailors required the sort of techniques and instrumentation available at a land observatory. At his own expense he had a portable transit telescope built by Brünner, and this was tested on the voyage around the world that he made on the "La Capricieuse" between 1850 and 1854. On his return, his report about observations made with the instrument, its drawbacks and possible improvements, was sent on to Le Verrier at Paris Observatory, who then invited Mouchez to develop the instrument at the observatory. This perfected design of portable transit telescope remained in use until the development of the prismatic astrolabe.

Mouchez also designed an altazimuth telescope, which again he had built at his own expense by Brünner. Both instruments were used by Mouchez to determine the longitude of the observatory at Rio de Janeiro in Brazil. His value disagreed by at least 21 seconds – equivalent to a distance of more than 8 km – from the value determined by the director, Emmanuel Liais, who was seconded from Paris Observatory. A commission of enquiry essentially agreed with the value found by Mouchez, who was appointed to the Bureau des Longitudes in 1873.

Naval officers took part in the expeditions to observe the transit of Venus in 1874. Bouquet de la Grye led that on Campbell Island and Mouchez the one on Saint Paul. On his return to France, Mouchez suggested that the scientific equipment that had been brought back should be used for instructing naval officers and explorers. The Navy, particularly its Chart Office, the Institut, the Académie des Sciences and the Bureau des Longitudes were all interested and the City of Paris donated land, where the Montouris Observatory was established. This was directed by its founder until his death, and then passed to the central hydrographic service and later the Bureau des Longitudes, until the Navy ceased to send its officers there for training.

Mouchez was elected to the astronomical section of the Académie des Sciences in 1875. In 1878 he became Director of the Paris Observatory after Le Verrier's death and after Henri Faye, who was proposed by the Académie des Sciences, had been rejected for unknown reasons. He was seconded by the Navy to take up this post and appointed Rear-Admiral at the same time.

The second transit of Venus, in 1882, saw Bouquet de la Grye and Hatt leading expeditions to Puebla in Mexico and to Chubut in Patagonia. The former was the third President of the S.A.F., after Flammarion and Hervé Faye.

Two other hydrographic surveyors, Caspari and Fichot, became Presidents of the S.A.F., and both are better known for their theoretical work than for their observations. Caspari, who wrote a manual on astronomy, worked on improving time-keeping, and published a large number of papers about chronometers. He was President of the International Commission on Time-keeping that met at the time of

the Paris Exhibition in 1900. Finally, Fichot, apart from numerous scientific papers, edited one of the volumes of Henri Pioncaré's manual on celestial mechanics.

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