ChPo/2 THE MAP WITHIN THE PORTOLAN

EXAMINATION BY REDRAWING

Occam's Razor Methodology; Lex Parsimoniae

ABSTRACT

The portolan's of Angelino Dulcert and Jorge de Aguiar are again examined but this time to establish the minutiae of the maps draughtsmanship, as opposed to the preceding text, "Portolan Charts; Construction and Copying", [ref. ChPo/1] which examined how the whole Portolan could have been drawn. The method of examination chosen is by a redrawing exercise as opposed to a cartometric programme. A paucity of node points and the tendency to produce curved lines which are not part of the Portolan repertoire are the basic reason for the non utilisation. This paucity leaves large areas of sea and tracts of land behind the littoral subject to an averaging of the distortion grids and a tendency therefore to perceive the plot as correct, when in fact it is not.

Thus from an initial visual appraisal of the map to a detailed point by point recognition of the maps form, how they were first conceived and then drawn, the process becomes apparent.

There are 13 A4 pages and 14 A4 diagrams.

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INTRODUCTION

The two Portolan's chosen have been well studied by researchers, but those same researchers have failed to determine a drafting method for the actual map and have merely concentrated upon the "Portolan effect." This is usually the determination of the magnetic variation across the Portolan's face and the distortion grid thereof. There is adequate data in other papers for a full comparison of the research already carried out. One such is that by Professor Alves Gaspar; "e-Perimetron, vol 3, No4, 2008", "*Dead reckoning and magnetic declination; unveiling the mystery of portolano charts."* It has several diagrams of note.

The Dulcert Portolan, 1339 and the Jorge de Aguiar Portolan, 1492 are studied sequentially. The first is held by BnF Paris and the second by the Beinecke Library, USA. The Dulcert Portolan comprises two parchment sheets joined to form a single sheet Portolan; 750 x 1020mm which was drawn in Palma, and is therefore one of the earliest Majorcan cartographic works available to us. The Jorge de Aguiar Portolan was drawn in Portugal and is 770 x 1030mm. Thus of similar size, they are separated by c150 years and any advancement in geographical knowledge of the Mediterranean Sea, or of methodology, or scientific work should be visible.

CARTOMETRIC ANALYSIS DISCUSSED

In his 2006 paper, Bernhard Jenny naturally makes a persuasive argument for the use of the 'MapAnalyst Programme' he is the joint developer of. It is a superb tool, but like all such tools must be used cautiously. He states, *"the cartometric analysis of historical maps is undoubtedly faster and more reliable with computer software than with the traditional manual method*s." This is a statement too far as will be shown within this text and diagrams.

However in his first paragraph there is a caution included, but the list of three reasons to use such a system is perhaps overstated, particularly as he has dismissed manual drawing, which after all is the manner in which they were produced.

One problem of the system is that large areas with few or no node points produce bland graticules, whereas areas of high density node points produce highly undulating grids when the contrary is possibly a more precise answer. There is also the problem of the computer programme producing the graph system of visualisation, that of all lines being curved to produce an even flow across the chart. This is actually a falsehood as the charts are plain flat earth maps with no curved lines whatsoever in their construction. Thus the visualisation of the deformation grid by neatly curving lines is neither the correct visualisation, nor could it have ever been drawn as such. (Note; there are papers which consider these Portolan charts to be drawn on a curved projection. These should be studied, but it must be recognised that not a single curved line appears on a Portolan chart.) Therefore the analyst must have a second methodology ready to counteract such discrepancies. This problem can be readily observed on the two plots in Professor Gaspar's paper referred to.

To understand this problem and perhaps overcome it an email was sent to Bernhard Jenny as follows;

"I find some old Portolano charts to have severe distortion due to age and tend to draw each and every line as a tracing overlay on these charts. Thus I think I can obviate the distortions by observing the intention of the cartographer and the use of the loxodromes or windrose etc. It is quite possible that my little knowledge has caused a blindness, but, I find that in drawing the actual lines on paper over the chart produces a detailed plot which when I compare the other research papers and their use of the system, their work appears to be rather superficial and does not have the detail. No criticism intended, I just do not know and suggest it is a lack of input detail which does not produce the same result. But just how many control points do you require to follow a line from Iberia to Turkey (say 40N) and reflect the true alignment."

The answer given by Bernhard Jenny [with my thanks] is as follows;

"Your question, concerning the number of control points is difficult to answer. MapAnalyst uses pairs of control points to create distortion visualisations for an old map. The current version does not match lines, nor does it transform lines from one map to the other. MapAnalyst also does not convert the image of the old map onto the new map (or vice versa). But, MapAnalyst creates distortion visualisations, either for individual control points (displacement vectors and "displacement circles"), or for the entire map (distortion grids). Hence, MapAnalyst does not currently include specialized tools to compare coastlines between two maps.

A second aspect to consider is that often it is difficult to clearly identify pairs of control points on the old and the new map. Hence, the density of control points may be very *irregular over the map sheet. Local clusters of control points can influence the appearance of the computed distortion visualization. One way to deal with this is to locally remove points from clusters in order to achieve a more homogeneous distribution of control points."*

Hence, for this research paper the tried and tested drawing method will be used.

THE MEDITERRANEAN SEA FEATURES Diagram ChPo/2/D01

The Mediterranean Sea can be defined by a series of alignments which are useful to ascertain the veracity of a map or chart. The first and perhaps the most important, having been used for hundreds of years and known since antiquity is the 36N latitude which traverses the Mediterranean Sea from the west, The Pillars of Hercules, to Rhodes and thence Issus. But, at the eastern point, Issus, the Mediterranean is bounded by the 36E longitude, which obviously on a flat earth map will be a perpendicular alignment.

Centrally the defining longitude is 9E, which traverses the Sea from Africa, via Sardinia, Corsica and thence Genoa at 44.5N. Thus, this alignment gives significant points between 36N and 44.5N at 39, 40, 41, 42 and 43N to allow the chart to be studied.

The Pillars of Hercules are straddled by the 5 & 6W longitudes and the Sacred Promontory of Iberia set at 9W, 37N is also a defining point. A perpendicular from the Sacred Promontory along the 9W longitude defines the western coastline of Iberia for 6 degrees north and then defines Cape Finisterre at 43N, and then it is the northern littoral.

In the central portion of the Mediterranean Sea, Sicily is very useful as 15E defines its eastern littoral and the 37/38N latitudes define its shape. Rhodes at 28E/36N and Istanbul at 29E/41N are equally important markers. The diagram illustrates some of the defining lines.

Therefore, any map or chart of the Mediterranean Region can be analysed without recourse to extensive research, merely several lines drawn to match geographic reality.

MAGNETIC ALIGNMENT AND CARTOMETRY; EXAMPLES Diagram ChPo/2/D02

In his 2010 paper, Professor Gaspar states the following (pp94/95);

"Given the little precision of marine compasses of the time, which was certainly reflected in the accuracy of the directions represented on the charts, the difference between the historical values and the output of the model are not considered critical for the purpose of the present discussion. From the above results, one may then conclude that conditions were favourable during the 14th and 15th centuries for a cartographic representation of the Atlantic coasts of Europe and northern Africa, between the British Isles and the Canary islands, to consolidate. Because the average value of the magnetic declination affecting such representations was relatively small, the resulting charts could easily accommodate a scale of latitudes and be used for supporting astronomical navigation, as soon as it was introduced."

Professor Gaspar has used various charts and superimposed *"the geographic grid implicit there-on"* [by cartometric analysis], which indicates that the Iberian Peninsula, North Africa (Atlantic) and the British Isles are drawn foursquare, NSEW. There is no apparent magnetic deviation and thus any cartographer can draw them foursquare, NSEW.

From the preceding section of text quoted, if a simple analysis of the Iberian Peninsula had been carried out with reference to the background graticule, it would be shown to be drawn geographically correct to NSEW. Cartometric analysis merely confirms what is obvious if the windrose NSEW lines are used to ascertain the alignments.

The number of control points used must be questioned as they are tantamount to allowing, "*areas loosely populated and hence fewer anthropogenic objects with clearly identifiable locations"* to overshadow the few coastal node points identifiable and thus available. This is all too evident upon the following diagram.

It is worth paraphrasing the text by Bernhard Jenny (2006, p242) at this point. He is talking about mountainous areas, but it applies equally to all zones of zero control points. That unfortunately is what the Mediterranean Sea has in abundance and thus the Portolan's comprise large areas of seascape and non attributable hinterlands.

Paraphrase; "Additionally, the planimetric quality (in "desert areas") is lower and hence distortion grids show regularly shaped meshes in these areas, although the geomatic accuracy may be worse in the known landscape than the "desert areas". *"This problem is of course not limited to distortion grids, but affects any type of accuracy visualisation*".

Thus the figure numbers 4.1 to 4.5 within Diagram ChPo/2/D02, originally included within Professor Gaspar's chapter 4 "*Charts of the Atlantic and the Mediterranean Sea*" (2010) can be seen to exhibit just those problems as they consist mainly of large areas of open sea and hinterland with no reference points available and have thus regular distortion grids which are curved as if drawn for a graph, rather than straight lines of the cartographers maps. Perhaps if the graticules had been curtailed to the coastline as single crosses indicating the co-ordinates the apparent distortions would be avoided.

The two charts, 'Dulcert' and 'Aguiar' are therefore to be subjected to a rigorous analysis by comparison to a geographical layout to establish the veracity of their internal construction and the provenance of their layout and the methodology of drafting.

THE BASIC DRAWING OF A PORTOLAN Diagrams ChPo/2/D03 and ChPo/2/D04

The basic setting out of a Portolan is determined by the background rectangular graticule formed from the subdivision of a circle into 16 parts; i.e. 0, 22.5, 45, 67.5, 90 etc. And, as can be shown it is normally the 22.5 degree segment which details the scale of the Portolan; this segment being the largest when drawn against the circumference.

As has been shown in the preceding text [ChPo/1] a circle is not necessary to set out the windrose alignments, 16 parts, as the natural subdivisions of each quadrant evolve from the sine function of each angle. Thus we have a simple series of proportional squares and rectangles which can be drawn from the centre point, measured along NSEW axis lines. These subdivisions are in the ratio of 35; 30; 20; 7 or 35; 30; 27 and are a total of 92 units. At their most basic these subdivisions are 7; 6; 4; 1.4 or 7; 6; 5.4, and thus the actual windrose circle need never be drawn. (Multiply the second set of figures by 5 for the first set.)

The length of the 22.5 degree section of 35 units can be determined by the scale of the actual chart to be drawn.

The position of the windrose, or double windrose, upon the chart need not be a determining feature, as the actual charts position there-on is not crucial to the drafting. What is to be included upon the chart will determine its position apropos the windrose(s).

The first stage in the drafting is the location of the extreme west of the chart, and here we are discussing a full Mediterranean Sea chart, as individual sections may be set out to suit their format. This is determined by the foursquare setting out at NSEW.

By first plotting or using a template to draw the Iberian Peninsula, which tends to be drawn foursquare, NSEW, to the basic rectangular graticule, it is automatically a geographical plot. Although, it could be argued that there is a minor magnetic deviation which has been ignored by the original cartographer for this section, but the result is still a NSEW plot. However the cartographer has a basic parameter onto which the chart can be built once he has this section plotted.

But, if the chart is to be drawn with a skewed format to recognise a magnetic deviation of North from its geographical position, it can be set out via the windrose alignment graticule. The angle chosen, which can be from 5 to 11.25 degrees askew, and varies from Portolan to Portolan, can be achieved by twisting the template as required.

The Windrose wind direction lines can be drawn at any stage in the drafting process of the chart as they do not affect its construction; only the basic background graticule is required.

NOTA. It has been implied by various researchers that mariners in general were not mathematicians. That surely is to be refuted on the grounds that Andreas Biancho (1436) in his "Atlante Nautico" drew a "circle and square', the "tondo e quadro" with a list of mathematical units and the "Toleta de Marteloio" for the calculation of the return to a desired course when blown by adverse winds off course. Andreas Biancho not only drew his charts but could design a mathematical system based upon Right Angled and some Pythagorean Triangles to solve the sailing problem of course changes. See text Ch/Ab/1 for details.

THE DULCERT PORTOLAN; 1339; EXAMINED   Diagram ChPo/2/D04

The background rectangles were first examined and minor discrepancies noted. These are not only due to shrinkage of the vellum, but also to a slight inaccuracy of draughtsmanship, no doubt caused by the drawing of two sheets which are joined together. Thus the western portion is slightly larger than the eastern section and could be therefore the actions of two cartographers. This is shown in the measured alignments from the centrelines drawn for the graticule. That statement is made as it was found impractical to draw a circle on each windrose, even allowing for a modicum of discrepancy in the drawing. Thus it is reasonable to opine that the circles were never drawn and the chart is of two separate sections joined after drawing, which are slightly mis-scaled. The script however could be by one scribe.

THE SUBDIVISIONS OF THE WINDROSE AS DRAWN

The average radius for the two windrose was determined as 92 units, with a natural subdivision therefore of 35; 30; 20; 7 or 35; 30; 27. But using the calculated subsection figures for complete accuracy (35.21; 29.85; 19.94; 7) it is possible to calculate the scale of the chart and confirm the scale bars as drawn.

The putative circles are in fact 14 degrees radius; that is from Iberia (Cape Reus) to Italy (Gulf of Taranto) to Turkey (Antalya), as shown on the actual chart itself.

The 35.21 units represent 8 scale divisions and thus each is 4.4 units. The second square, 29.85 units would thus have 6.782 scale divisions by calculation, which is in fact as drawn. But the overall 92 units by calculation would have 20.91 scale divisions, that is to say 21 actual scale divisions as drawn. That is, 92 divided by the 4.4units equals 20.91.

At 41N, 14 degrees equals the 21 scale divisions and thus the calculation by stadia is as follows; 14 x (604cos41) = 456 x 14 = 6384/21 = 304 and in all probability each scale bar section is therefore 300 stadia of 185m.

That is 55.5Km or ½ degree of latitude of 111Km which is the Geographic World.

SECTION BY SECTION INVESTIGATION Diagrams ChPo/2/D05, D06 & D07

The Iberian peninsula as shown on diagram ChPo/2/D05, was examined by placing a tracing sheet as overlay and both longitudinal and latitudinal markers were noted. This indicated that the whole peninsula was in fact geographical and that the grid extended to encompass the Balearic Isles of Ibiza and Mallorca. The Isle of Menorca was found to be slightly east of its geographic position. Thus this plot provided the impetus for the examination of the whole chart.

The NSEW grid was extended south and west to the Canary Islands which are shown situated between the 28N and 29N latitudes and then northwards to the British Isles, locating Lands End at 50N, with to the south the Bretagne peninsula at 48/49N. This positioning is to be considered quite accurate.

The longitudinal setting out is from the windrose centre line which coincides with the 3E longitude and thus appears to give a series of longitudes westwards which coincide with the background graticules of the windrose.

But longitudinally there are distinct errors. The Iberian peninsula however is quite accurate from the Sacred Promontory at 9W to Cape Creus at 3E (an alignment which passes south through Mallorca), but when the northern area, that of France is examined the westerly distance from Cape Creus to the Bay of Biscay has been exaggerated by 1 ½ degrees. That is it should be 1W but is shown 2 ½ W. This has moved the Bretagne peninsula westwards and therefore the British Isles also. However a simple adjustment of this error does not position the British Isles correctly as there is a total of 3 degrees longitudinal error.

But the basic parameters have been established to investigate further.

The next significant alignment, as shown on diagram ChPo/2/D06, which can be used to test the skew of the chart, is the geographical 9E, which commences at Genoa in the north and passes through both Corsica and Sardinia, and thence to the North African coast west of Cape Serrat. The angle of alignment here is c6 ½ degrees west of North and from the charts form appears to commence at the centre point of the western windrose which has already marked the 3E longitude as the setting out for the Iberian Peninsula graticule. But the crucial facts are that Corsica and Sardinia are easily marked with the correct latitudes even unto Genoa at 44 ½ N. Cape Serrat is at 37 $^{1/}$3N. Thus we have a longitudinal alignment with latitudes that can be accurately plotted and can be aligned to the Iberian Peninsula graticule via the Balearic Islands. Therefore the Mediterranean Sea between Iberia, Corsica/Sardinia and France/Africa can be evaluated and the graticule established to ascertain the departure from a geographical plot to a ‘magnetic’ plot.

However it is quite obvious that the primary determinant for the Mediterranean Sea, the 36N latitude does not agree with the putative c6 ½ degree askew plot perpendicular to the 9E longitude. Thus there is perhaps an intermediate stage in the skewing of the chart to form the total Portolan. This of course would accord with the variation in the magnetic reading for North as the Sea is traversed eastwards, and can be shown to be from 0 degrees in Iberia, 6 ½ degrees in the western Mediterranean and up to 11.25 degrees in the eastern Mediterranean. However given the doubtful accuracy of the Magnetic compasses in the era of the Dulcert Portolan, it could also be poor draughtsmanship. But the last section, the eastern Mediterranean should answer the queries posited.

Following on from the 36N discrepancy noted, the final section as diagram ChPo/2/D07 indicates was treated in a similar manner to the others and the skew angle determined. This did in fact prove to be 11.25 degrees. It in fact encompasses the whole area from the Gulf of Taranto to the eastern extremity of the Black Sea. But more surprising was the origination point of this new graticule. It is the central point of the whole Portolan, which is also the finial point for the central section c6.5 degree layout. But it also indicates that another very significant ancient alignment, the longitude through Rhodes has been set precisely along the western 11.25 windrose alignment. This indicates that the historical knowledge of the medieval cartographers may have been far greater than previously thought.

THE SETTING OUT OF THE THREE GRATICULES Diagram ChPo/2/D08

To explain the setting out that has been evaluated in the three foregoing diagrams D05, D06 and D07, a separate diagram ChPo/2/D08 has been drawn with just the background graticule of the windrose there-on.

From this simple plot the setting out can be shown and the control points noted. The angles chosen for the three portions of the Portolan can be assessed and shown to be a construct of the squares and rectangles of the background graticule.

Thus it is quite obvious that the windrose graticule is the arbiter of the Portolan.

THE PORTOLAN OF ANGELINO DULCERT, 1339 Diagram ChPo/2/D09

The final diagram of this section of text is the chart or Portolan of Angelino Dulcert with the construction graticules drawn there-on. The distortion of the chart caused by the two sections drawn separately and slightly out of scale, with the natural shrinkage there-of has lead to a slight frisson of in-exactitude. Would that full size true to scale copies were readily available to be laid out on the parallel motion drawing board for a forensic examination in minute detail of the chart(s).

THE PORTOLAN OF JORGE DE AGUIAR, 1492 Diagrams ChPo/2/D10 and D11

The methodology adopted and explained in the previous section has been applied to the Portolan of Jorge de Aguiar. The resultant plot is as diagram ChPo/2/D10 and comprises only two major alignments. The Iberian Peninsula and the West African coast along with the British Isles are drawn foursquare NSEW. There is a minor error in the setting out of France which has set the Bay of Biscay coast 1 to 1 ½ degrees west, and this has led to the mis-positioning of the British Isles. This is much the same as observed on the Angelino Dulcert Portolan.

The joint line between the two graticules is again at the Corsica/Sardinia alignment, but this time the major alignment of 36N has been maintained across the whole map from Issus to the Pillars of Hercules. There are minor confusions in the plot which are basically caused by slight misplacement of sites, but they do not affect the overall plot of the map.

If diagram ChPo/2/D02 is studied, (figure 4.3 from the Prof Gaspar paper), the closeness of the two plots will be seen, but the Cartometric analysis has the gracious curves of a graph plot instead of the natural straight lines of these charts.

To understand the angle chosen for the "magnetic" deviation and thus to be able to control the drawing of the map, diagram ChPo/2/D11 illustrates its origination from the background rectangular graticule which forms the basis of the Portolan. It is an angle formed by the 20/130 units tangent as shown. The 36N and 9E lines are then set out from this line and its perpendicular.

The text, "*Portolan Charts; Construction and Copying*" [ChPo/1] which preceded this has an explanation of the scale bars and the background Graticule of this Portolan.

MARINE CHART OR LIBRARY ADORNMENT Diagram ChPo/2/D12

Researching these two Portolan charts has led to the conclusion that they were in all probability drawn for sale to wealthy clients and not marine skippers. There are a plethora of unwanted, unnecessary and thus adornment lines upon these charts which enable an opinion to be stated that they were probably sold by the number of lines squeezed onto each chart to form the windrose(s).They have been aggrandised for a visual spectacular, a feast for the eyes and this could also apply to those sold in Alexandria for pepper.

Another text, "*Leather; Vellum; Parchment, Drawing and Copying Maps and Charts*" fully explains the historical basis of these Portolan's from their Monastic beginnings in NW Italy to the start of Ateliers copying and producing perhaps the possible marine charts.

Diagram ChPo/2/D12 has there-on the simplest chart (D12A), windrose and magnetic alignment required by a mariner. It is devoid of the luxurious detail upon the two charts under investigation and is thus more suitable for clear vision and usage onboard a vessel. There is only a simple windrose with the 16 points extended across the charts face. Any magnetic deviation would be countered by aligning the compass to the north point and then for the course to be sailed a straight edge is laid from port to port and the ships heading is thus given to the pilot. Keep the compass aligned and sail the straight edge course and then the wind deviation is natural and can be countered; a simple and precise methodology.

Diagram D12B, has the Dulcert chart with its three magnetic deviations there-on. BUT, there is not one line on the Dulcert Chart which allows the pilot to align the magnetic deviation as drawn to the magnetic compass on the western and eastern sections of the Mediterranean Sea. Did this chart require three compasses? Diagram D12B has these appended for illustrative purposes only. Naturally with the Iberian Peninsula being foursquare NSEW, the background graticule is the alignment.

Diagram D12C, the Jorge de Aguiar chart is simpler having only a single deviation, but again there is no alignment upon the chart to allow the pilot to reconcile the magnetic compass to the NSEW windrose. No doubt he would have purchased a matching fly paper!

Thus perhaps on mariner's charts there was a single line(s) which indicated the angle of deviation of the charts construction. The cartographer would have known this angle.

COMPASS/MAGNET/DEVIATION

There is a considerable amount of text which states that the pilots/cartographers did not understand declination and blamed the needle's variation on careless shipboard use or manufacture via a lodestone.

This must now be dismissed as incorrect analysis of the situation as the chart of

Angelino Dulcert clearly indicates. How can a cartographer draw three different magnetic deviation angles upon a Portolan without recognising that they are part of the same system particularly when the background Windrose is set foursquare, NSEW.

It has been surmised that pilots of ships sailing for one "family" would naturally share their experiences of the deviations, having noted them in their logs. This would lead to an analysis of the magnetic deviations and a cataloguing of those deviations to be shared.

But, why has one comment from the 'Diary of Columbus, 1492', been taken to mean the recognition of the deviation for the first time? Certainly it may be the first written record.

The first mention of the use of a compass at sea is in Alexander Neckam's *'De Utensilibus*', where he refers to mariners finding their course when sun or stars were invisible by means of a north pointing needle, and in his '*De Naturisrerum'* describes the needle being placed on a pivot. These date from c1200AD. However in 1269 a complete treatise upon the manufacture and usage of the magnetic compass was written in Amalfi, by Petrus Peregrinus.

It has been suggested that the problems encountered by Columbus in using his compasses may have arisen because the Genoese compass makers may have placed the magnetic needle under the fly, aligned with true north, whereas the Flemish makers allowed for the declination.

Thus with a growing awareness of variation, it had become the practice for navigators to set the needle beneath the card slightly askew to compensate for the amount of variation that occurred. Magnetic variation was known prior to 1500AD and with compasses being made in Flanders from the 14th century it is believed that by the middle of the 15th century, compasses were corrected for variations observed. Genoese compasses would have progressed as well and those fabricated in both Sicily and Venice which tended to have their needles set ¾ of a point eastward whilst those in Spain and Portugal were ½ point eastward.

Thus the cartographers with their variations of magnetic deviation set against a NSEW wind rose must have been very aware of the different declinations.

THE USE OF PORTOLAN CHARTS

The following is a direct copy of the paper by Piero Falchetta;

"The use of portolan charts in European navigation- that is, within the Mediterranean and along the coasts of northern Europe- has been disputed for a long time on the grounds of relatively little written evidence. The matter was brilliantly summarized and discussed by Tony Campbell (1987) in his well-known study on portolan charts, but his conclusions are far from definitive. Even though there remain few doubts on the presence of nautical charts on board medieval ships, their function and usefulness in calculating routes is unclear. Ten years later (1997), Patrick Gautier Dalche analysed several medieval texts where mention of the portolan charts and their use on board can be traced. His conclusions tend to rule out an exclusive relationship between navigation, calculation of routes, compass and other instruments on one side, and charts on the other. His position is that the medieval chart is probably an "object" that "sert seulement pour aider a retrouver la route perdue ou pour confirmer la localisation effectuee par des moyens empiriques [---] En un mot, elle sert, parmi d'autres moyens, a localiser, non a diriger la navigation" and, "La carte marine, dans la majorite des cas, ne procure aucun indice de la localisation precise d'un lieu".

Such a conclusion seems to clash with the idea that it is generally considered to be *self-evident, the idea that portolan charts were instruments that were absolutely essential for navigation".* (end of copy).

Thus when the Dulcert Portolan is studied with its three magnetic sections, perhaps we can see that these are not in fact an aid to navigation as at worst they would rely on three compasses with different fly inserts, or in the east if set at 11.25 degree the declination would be fine, but, by the time the ship reached the Iberian Peninsula there would be an error of 11.25 degrees which surely is unacceptable.

"THE AUTUMN OF MEDIEVAL PORTOLAN CHARTS; CARTOMETRIC ISSUES"

The above titled paper was published by e-Perimetron in 2012 whilst this text and its predecessor were in preparation. It is therefore necessary to include its findings within this text as they closely relate to the research here-in.

The text is an analysis of the Francesco Beccari chart, 1403, and discusses the work of Angelino de Dalorta (Dulcert) and others (see diagram ChPo/2/D13 of this paper).

Within the text the authors constantly refer to the north/south parallels and at one point state that' he', the cartographer, draws six horizontal lines. It is worth quoting the section concerning the drafting of the Beccari chart;

"Turning now to an analysis of the procedures employed in the making of the chart, it appears probable that the scale of latitude was drawn after Beccari had identified the western (Tenerife, L'insula de l'Inferno) and eastern (Batuni?, Vati in a Black Sea surprisingly close to reality) limits of his representation, calculating the distance as if these were arranged on the same axis (figure 6, phase 1). [See ChPo/2/D14 of this paper.]

Having identified the mid-point of this distance, he draws a vertical line: the first axis of the main windrose (2). At this point the scale of latitude comes into play (3) which serves Beccari for identifying the centre of the main windrose on the first vertical partition. He takes as reference the latitudes of the Atlantic extremities------. The next step is the construction of a circumference (4) the radius of which is calculated on the distance from the centre of the extreme points indicated above.------After this the circumference is divided into 16 parts (5).

Starting from the northern and southern extremities of the circumference and from the sixteenths aligned on the two hemispheres, he draws six lines (6) that cross the scale of latitude: this forms a partition of as many parallel lines with distances that decrease identically on either side of the central pseudo meridian corresponding to around 5^0 20", 4^0 40" and 4^0 00" (leaving the northern and southern borders to the aforementioned secondary partitions).

Here it is necessary to state quite plainly that those author's assumptions regarding the circle and method of construction are probably misguided. Firstly they state that" *there are one or two circumferences on the chart regularly divided into 16 arcs which give rise to the dense network of rhumb lines characteristic of the nautical production*". Surely it is clear on the chart if there is one major windrose with subordinate lines either side, but, if there is no circle upon the chart it was not drawn. As has been shown it is un-necessary and the lines they call partitions are all that is required, drawn to the correct ratio as has been previously explained. Thus items 4 and 5 in fact are produced from item 6, the rectangular graticule of the chart. We can then understand the scale bar and its measurements which will be in the ratio of 35; 30; 20 (or 27 for the full circle). Thus the degrees are more likely to total 14^0 10", not 14^0 00" and each division is therefore 50", with a subdivision of 5^0 50", 5^0 00" and 4^0 00" being precise to the 16 points of the compass subdivision. In fact the two halves are not equal.

Two other sections of the text are worthy of note;
"The above considerations not only appear to establish a link between Beccari's chart and the geographical drawing of the early sixteenth-century charts, which has been seen to be based on a plane projection (that does not consider the convergence of the meridians and practically equalises the degrees of latitude and longitude)(Crone, 1953), but also make deflate the significance of the considerations regarding the contemporary nature of the drawing and the scale (sic).

"In this sense, Beccari's chart would appear to be early evidence of a map that brought together a traditional drawing technique (in the Mediterranean) with the astronomical method of the new cartography that was to become consolidated in the following century."

Returning briefly to figure 6 of the paper which has the "Fase" numbers appended, it would be a more useful diagram if the whole graticule had been appended with the correspondence of the rectangles/squares outside of the circle noted. An attempt to draw them is appended below the original diagram in explanation, as diagram D14B. It also indicates a change in the background graticule to give 30 division units to the eastern section whilst maintaining 22 divisions for the actual circle. The latitude spacing has been recalculated from the figures in '6' and they are shown to vary again. Thus particular detailed work is required using the geometry of the circle divided into 22 ½ degree segments.

CONCLUSION

The charts, well drawn and presented as they are do not lend themselves to simple usage by a pilot at sea. Thus it would be quite plausible to consider them library editions and not representative of an actual mariner's chart, although they could be one and the same.

If that is accepted then it is the simplest of presentations which would be applicable to the mariner's chart as has been shown, diagram D12A, and there need only be a single windrose with the 22 ½ degree lines extended to cover the whole map. If the cartographer desired he could include a single line to indicate the magnetic deviation at the home port, but by simply rotating the map to place the windrose North along the Compass north would suffice. Of course, the attachment of a card to the fly set to the declination angle is more likely.

The scales, both latitudinal and measurements can be part of the background graticule as has already been shown. These can be ratio lat/long or a square map format.

The following questions are perhaps pertinent:

Would a mariner pay for unnecessary information in the form of aggrandisement, when it is the simplest of chart that is required?

Would a mariner require a plethora of lines upon the chart which serve only to confuse, especially in poor light?

Would a mariner accept three declinations on one map?

Would a mariner accept that the wind line at the South East should join across to a wind which blows from the South West when two wind roses are used?

These and other questions which can be posited must surely lead to the questioning of the presentations we have as Portolan Charts. Thus they are in all probability Library Editions, which emanate from the scriptoria of monasteries in NW Italy c1275AD.

Unfortunately, charts of the Mediterranean Sea used solely for navigating elude us, but as posited they may in fact be one and the same.

But it is perhaps pertinent to finish this text with a quotation from a respected historian, Piero Falchetta. From his 2007 paper this is his conclusion;

"*To conclude, I would say that the nautical treatises of the Middle Ages do not describe the use of portolan charts in navigation at all because the whole matter was entirely determined by the practice of navigation. In other words, portolan charts could be wrong in so many details that it was almost impossible to prescribe rules for their actual use before knowing the level of their relative exactness."*

"In conclusion, we can say that the image of Europe that we receive from these portolan charts reflects the anachronistic symbol of medieval nautical practice more than the image of a geographical space."

Michael J Ferrar, 2013.

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Lex Parsimoniae
Occam's Razor is a principle of parsimony, economy or succinctness used in logic and problem solving. It states that among competing hypotheses, the hypothesis with the fewest assumptions should be selected. Plainly put, the simpler the explanation the better.
Leonardo da Vinci stated,' Simplicity is the ultimate sophistication'.