ABSTRACT

The chart is obviously an excellent example of the genre, but it is also obviously an amalgam of two schools; Claudius Ptolemy and a LC de N derived Portolan Chart. The western section from Britannia southwards through France, Iberia to N. Africa is drawn to the Ptolemaic dictum as expressed in the prologue to Book 2 of “Geographia”, a simple proportion and rectangular graticule. But this only applies from 9W to 3E where the LC de N format then becomes apparent and the usual errors around 9E longitude skew the chart to fool some researchers into the magnetic declination school of thought. However the main problem can be observed at Bugea (Bejaia) on the N. African coast where the distortion is so apparent.

The eastern Mediterranean Sea is drawn quite accurately but expanded to agree with the LC de N Black Sea over length such that the chart is in proportion at this point.

The chart is an exceptionally well presented Portolan Chart which indicates a growing knowledge of the mathematics involved and the greater accuracy of measurement. Thus the cartographical draughtsman can experiment with the latest (although 100 years earlier) ideas as promulgated by Claudius Ptolemy in the then translated “Geographia.” But it should be borne in mind that the whole genre of Portolan Charts has always in its background had the Roman measurements and Ptolemaic proportion within the makeup of the chart. However, still after +200 years it is evident that the “Portolani” texts are obviously still being used.

Unfortunately, the Butterfly did flap its wings to cause enough Chaos in the finished chart to be noticeable, which is actually a sad occurrence for a thing of some beauty.

I have chosen to juxtapose this chart with a short text regarding two charts, Jorge de Aguiar, 1492, and Pedro Reinal, 1504, which show the partial development of the Iberian Peninsula as a rectangular graticule. The Pedro Reinal chart has the fully formed latitude scale in a similar position to the Jacobus Russus chart and thus they can be compared. This text was originally indexed as ChMES/1 and has 7, A4 pages and 6, A4 diagrams.

This text contains 6, A4 pages and 16, A4 diagrams which all interlink in their series.

Totally the text is 13 A4 pages and there are 22 A4 diagrams.

Michael J Ferrar; May 2016
ChJRS/1; JACOBUS RUSSUS, 1533 CHART; CHAOS THEORY, NO!

EXPERIMENTAL & EVOLVING DRAUGHTSMANSHIP, YES!

INTRODUCTION

The chart is inscribed “Jacobus Russus Mesina sulla nabis anilate isane anno dui 1533”, and has the visual appearance of a standard Portolan Chart. It has an excellent pair of scale bars situate north and south which can be easily evaluated for the distance measures utilized and thus the accuracy of the charts several parts.

The chart was subjected to an investigation in 2014 and had a partial cartometric study carried out, which if it had been properly analysed would have indicated to the researcher the underlying construction and opened the door to the research which is now included in this paper. Thus in this text I am trying to extract data and explain just how Jacobus Russus approached the draughting of the chart to incorporate the varying genres that are found within its form and construction. It is obviously not a standard Portolan Chart, although there are great similarities in particularly the eastern section. The hidden attributes place it in a different league to some earlier charts as will be fully explained and shown by the diagrams.

THE BASIC DESCRIPTION OF THE CHART

The chart I believe is held by the Biblioteca Fundacion Bartolome March, Palma de
Majorca, and is referenced Severa N. 3803, and given as 557 x 938mm. The dimension is questionable as will be explained later. It is drawn on vellum or parchment and illustrates Western Europe from Ireland to the Black Sea and from the Baltic Sea to N. Africa c17N, the Mauritanian coastline. Thus the geographical spread is from 17N to 59N and 31W to 42E; i.e. 42x73 degrees, but of a varying proportion.

The chart has obviously been reduced in size along its eastern edge and thus if the 557mm height is correct then the extant length would be c800mm not 938mm. This problem is unfortunately part of an ongoing discussion throughout the text, as the curtailment of the eastern section, cutting through some toponyms and the edge of the Black Sea may cause a frisson of doubt regarding the overall chart and what it may have shown.

There are five magnificent compass wind roses with the eight main winds designated by their initial letters except the easterly wind which is designated by a Cross, thus signifying times past! The initial letters are T, G, +, S, O, L, P & G; signifying the standard Tramontana, Greco, Levante, Sirocco, Ostro, Libeccio, Ponente and Garbino. The chart is adorned with a multitude of Flags, many now unfortunately lacking in detail, but they do indicate that they hark back to a bygone age when the towns were “Christian” and not by this date, “Ottoman”.

The six Potentates of the Muslim areas are balanced by five Kings or Bishops of Christian areas, but all are subservient to the large Madonna and Child vignette. It is a highly decorated chart with what is normally a less crowded N. African hinterland, fully covered by various drawings which no doubt come from the research carried out by Jacobus Russus for his earlier chart of 1525 The Mansa Musa (the ruler of Mali) Map, BL Add. MS 31318. B.

Thus historians have a wealth of information there-on to evaluate but cartographically the storyline is hidden and requires uncovering to expose the developments taking place.

THE CHART BASICS; SCALE AND WIND ROSE

Firstly it must be made clear that I am working from three digitally enlarged versions
of the chart which itself is available at: [http://www.gahetna.nl](http://www.gahetna.nl). Go to Kaartcollectie, Binnenland Hingman, file No 3803. The primary chart I am using is 534 x 774mm measured on the centrelines of the wind rose. Thus the two scale bars, north and south can be assessed as having 78 visible units with only a 2mm discrepancy in their lengths, and thus a unit which is 50 millara is 7.39mm on my plot. It is a millara scale with each being equivalent of 1.233 Km and has been proven from internal measurements and explained in previous texts.

The first problem I encountered was when I tried to evaluate the size of the main Wind Rose graticule. On the southern scale bar the lines are taken through to the vellum edge, that is through the scale bar and thus it is quite simple to read off the fact that the Wind Rose is 60 scale bar units or 3000 Millara in overall width, that is the circle diameter if it had been drawn. Thus the internal measurements can be calculated prior to them being measured for not only an accuracy check, but to evaluate if Jacobus Russus understood the basic geometry of the Wind Rose. Thus the 3000 Millara is divided by 184 (2x92) and then the individual sections which are as a ratio, 35:30:27 calculated as my texts ChWR/1 and /2.

$$3000 \div 184 = 16.304 \text{ per unit and thus } 35 = 570.65; 30 = 489.13 \text{ and } 27 = 440.217.$$  
Thus the drawing should be 570/490/440, which if diagram [ChJRS/1/D02](#) is studied will be found to be correct. But, measure the whole Wind Rose graticule and we find that the actual draughting accuracy is quite poor in places with the putative square having 61, 59.2, 59 and 59.5, west to east measures. This of course immediately informs us that the Wind Rose was drawn by measurement and not formed from by a circle being inscribed, hidden or not, to locate the various points. But if you study the western most line, it is actually not part of the Wind Rose construction; it measures just over 60 units north/south and the east/west lines set top and bottom actually slope outwards from their short measurement to return to the correct distance of the Wind Rose construct, 3000 Millara. Thus Jacobus Russus understood his errors and endeavoured to correct them by this method and knew full well the mathematics and geometry required.
Barely visible, but very important, situate just inside of the western Windrose circle are a series of Dots, numbered Dots indicating they range from 26N to 62N and are thus the equivalent latitudes of the Claudius Ptolemy “Geographia”, who decreed that the northern most point for a chart was 63N. It is possible that the 63N dot is marked on the chart but the slight distress masks the final points. The 36 latitudinal degrees indicated measure 52 scale bar units or 2600 Millara, and are thus 72.22 Millara each. Claudius Ptolemy determined that the degree of latitude was 500 stadia, which is 75 Millara. If this was to be a perfect Ptolemaic scale then it should measure 2700 Millara and not 2600 Millara as drawn. The dimensional change is far greater than a distortional change and thus must be accepted. The overall chart, if the Ptolemaic scale had been completed to the south could have shown that it could have extended from 13N to 63N, a 50 degree latitudinal spread.

Therefore given the above evaluation, I have determined to accept the chart as drawn, ignore the Wind Rose graticule vagaries and concentrate upon the geographical details and the scale bar measurements.

However, at this point it is necessary to indicate that the centre latitude of the Ptolemaic scale bar from 26N to 62N is 44N, and that this is a particularly important finding.
In order to evaluate the chart I have set down some of the basic measurements on diagram ChJRS/1/D04 as found thereon from the scale bar. I have used two digital sizes for the investigation as large scale diagrams aid a better understanding of the whole chart and its measurement geometry. But what is immediately apparent is that the discrepancies within the chart indicate that the slewing to the north-east is not a magnetic phenomenon but purely a measurement distortion.
If the cartometric overlay produced in 2014 is studied, see diagram ChJRS/1/D05, the distortions can be readily observed and the four square Iberian Peninsula, with no deviation at all, is adjoined to a sudden rise in the 36N and 37N latitudes and the misplacement of Cape Bon, which should be set at 37N/11E and thus align latitudinally to Cape St Vincent.

But the slewing only occurs from the City of Bugea (Bejaia) and if the coast of N. Africa had been studied properly by previous researchers the sudden 45 degree misalignment would have been spotted and the reasons analysed. This sudden change does not occur geographically as the later diagrams illustrate and the idea that magnetic deviation accounted for the change would have never have been considered. Just why research is badly carried out by historians is anybody’s guess?

But more basic to the research is the fact that from 9W to 3E the Iberian Peninsula is set out from a longitudinal measurement commensurate with the Latitude at 44N, and is as illustrated the latitudinal scale indicated by Ptolemaic Scale for this section of the Iberian Peninsula. In other words, Jacobus Russus has amalgamated the geographical and the Ptolemaic ideas to form his latitudinal scale.

THE PUTATIVE GRATICULE

Diagrams ChJRS/1/D06, D07, D08 and D09

The first two diagrams, ChJRS/1/D06 and D07 are a complete latitudinal assessment of the western extremity of Europe from Britannia at 58.5N to the Canary Isles at 28N. The chart distance measures for the latitudes are noted there-on and indicate that from the 37N latitude, along the 9W longitude they measure 80 Millara.
But this changes as the latitudes move easterly when at the 7W line they start to slope slightly north easterly to become 90 Millara at the 2W longitude; that of course is the correct latitudinal spacing. At this point the latitudes are correct from 36N to 45N, a constant 90
millara. But at the 3E line the latitudes begin to vary and the longitudes start to meander until at the 5E line, the north coast of N. Africa near Bugea (Bejaia), the coastline makes a decidedly un-geographic slew to the north east. Further to the north, as can be seen on the diagrams the latitudes are horizontal across the isles of Corsica and Sardinia, and parallel to the Wind Rose graticule.

To the north, Ireland and Britannia are basically set out with an 81 Millara latitudinal measure and a continuation of the 44N longitudinal proportion measure of c65 Millara. Thus by 50N, Britannia, the longitudinal measure should have reduced to 58 Millara which tapers to c47 Millara along the north coast of Scotland. Therefore Diagram D07 has included there-
on a schedule of Latitude/Longitude proportional measurements, simplified such that they can be used for any Portolan Chart without its accuracy being compromised.

For the whole chart, as the putative graticule progresses easterly the distortion which commences at Bugea, 37N/5E causes cartographic mayhem (see diagram D08) as the near correct distance measures are now used to dictate the positions of the longitudes with the resultant twisting of the 9E longitude from Genoa southwards. But, Corsica and Sardinia are drawn correctly in relation to the 9E line and they indicate the precise problem which evolved from the idea of using the Ptolemaic dictum of choosing the centre line latitude/longitude proportion and projecting it over the whole chart. Claudius Ptolemy states, “In this way the opportunity will be given to anyone who desires it for drawing the parts of the earth in maps according to the particular prefectures and provinces, one or many, and the right relation of the places of each other on the maps will be preserved, together with the right size and the right shape. Nor will it make much difference if in these maps we use parallel meridian straight lines instead of curved lines, provided we keep the proper proportion of the meridian degrees to the degrees marked on the great circle, that is the equator, which is in the middle of every map.”

Therefore given the above evaluation, I have determined to take the Chart as drawn, ignore the vagaries of the Wind Rose Graticule and concentrate upon the geographical form as drawn using the scale bar for measurement.

Thus, if a geographical map of Italy, Corsica and Sardinia is aligned to the 9E longitude it will be so very apparent that there is a great deal of accuracy in this section, but as usual there
is an error south of Sardinia which can be shown to be the reason there is a sudden change of alignment in the N. African coastline at Bugea to place the land area around Bizerte and Tunis at the erroneous distance from Sardinia; L C de N rears its head again! Therefore at this point with the ratio of latitude to longitude approximating to geographical the slewing increases as if a conical projection was being used. It is not and this can be shown by the directional change of the 14E to 27E longitudes before they revert to a north easterly tilt parallel to the north easterly latitude slew.

Therefore when the chart is assessed concerning the Levante and Black Sea areas as diagram ChJRS/1/D09 illustrates, a more formal graticule appears with the Mediterranean Sea latitudes correct at 90 Millara and the longitudes varying from 72 to 80 Millara, which are correct at 37N and 27N. The whole eastern Mediterranean Sea has thus been expanded to align with the standard pattern for the Black Sea length which occurs when the details from
Lo Conpasso De Navegare are used to plot the Black Sea coastline. It is basically 100 Millara over length.

CORRECTING THE CHART TO ILLUSTRATE THE ERRORS
Diagrams ChJRS/1/D10, D11, D12 and ChJRS/1/ D13
The first diagram illustrates the problem of the short latitudinal degree for the west coast of Iberia and the fact that if it had been drawn correctly then the 43N latitude would have been quite precise and aligned across the south coast of France near the Isles Hyeres and thence to the tip of Corsica, Cape Corse. This small mistake is the start of a major headache for Jacobus Russus to control the form of the chart. The second diagram, and here I should add they all overlap to interlink to form a whole Portolan Chart copy, indicates the problem of the Black Sea over length with distance measures between Italy and the Black Sea being very reasonable indeed. The third diagram moves Bugea south to its correct position and then on the fourth diagram Cape Bon, is shown correctly also. Finally on this diagram the Levante coast of the Mediterranean Sea is correctly positioned.

THE 37TH PARALLEL EXPLAINED IN DETAIL   Diagrams ChJRS/1/D14, D15 & D16

Finally I have chosen to draw the 37th latitude from Cape St Vincent to Cape Bon (and
Sicily) to illustrate the actuality of its profile at a very large scale. The diagrams all link together to provide an overall picture of this N. African coastline.

The 37\textsuperscript{th} parallel is in fact drawn very accurately from Cape St Vincent across the south of Iberia to the N. African coast close to Algiers and thence onto Bejaia. But as the geographical map I have appended indicates the coastlines on the Portolan Chart then deviate wildly. I have already indicated the reason by the erroneous measures. But if the 37\textsuperscript{th} parallel is drawn to follow the erroneous coastline, a 45 degree angle, then it can be drawn again properly parallel through the residue of the N. African coast to Cape Bon.

I have already written two texts which show conclusively that the distortion caused by the Lo Conpasso De Navegare measurements is the raison d’être for the historians view that there is a magnetic declination, very variable from chart to chart, and this is fallacious. It takes little technical knowledge to ascertain that poor distance measures are to blame.
CONCLUSIONS

Jacobus Russus has cleverly endeavoured to amalgamate the rectangular graticule promulgated by Claudius Ptolemy with a standard Portolan Chart constructed from the texts
such as Lo Conpasso De Navegare, with all of its errors. Had he continued with the Iberian Peninsula format and been able to reduce the distance measures commensurate with the 44N longitudinal measure, then a plain chart would have evolved which would have been more accurate than the chart he has drawn. This chart however is a masterpiece in conception by the melding of the two genres. The Portolan Chart has always had the 9W longitude set due north/south matching the Wind Rose alignment, but to take this step forward and ensure the whole of Iberia was virtually geographical in construct was a move by a genius.

But, as the following text diagrams indicate, Jacobus Russus may have been following Pedro Reinal, whose chart indicates both a foursquare Iberian Peninsula and a special scale.

However, there was an obvious change in style from the Jacobus Russus 1511 chart which has the north coast of N. Africa slewing in one twist as most standard Portolan Charts exhibit. Why, who knows, but the change is so very significant.

Michael J Ferrar May 2016

ChMES/1. JORGE DE AGUIAR, 1492 AND PEDRO REINEL, 1504
CHARTS; THE MYTH OF THE LEAGUE DERIVATION, MPM AND C PTOLEMY!

ABSTRACT

The use of Cartometry has introduced a reliance on mathematics and formulae instead of the actual charts and their scale bars being used to inform us of the original measurements and their development over the centuries.

Perhaps based solely on national pride the chart of Jorge de Aguiar looms large in texts emanating from the Iberian Peninsula, Portugal in particular. The latest text published in the Cartographical Journal, 2015, discusses that chart and one by Pedro Reinel in a paper regarding the length of a degree of latitude, particularly the numbers of leagues per degree.

This paper, ChMES/1 is a full examination of the two charts and their scale bars with regard to the nautical measurements used in the 14th and 15th centuries and continues with a critique of the CaJ paper. It examines many distance measures of the era and their origins, and concludes that most Leagues are spurious, unable to be replicated by normal measures and that in fact the oldest measures used in the “Portolan” system are in fact still correct.

The text is 7, A4 pages and contains 6, A4 diagrams.

ChMES/1; JORGE DE AGUIAR, 1492 AND PEDRO REINEL, 1504
CHARTS; THE MYTH OF THE LEAGUE DERIVATION, MPM AND C PTOLEMY!

INTRODUCTION

Having read the CaJ 2015 text I was struck by the lack of detail there-in to actually
determine the League length, regardless of the number per degree. If you wish to sail a number of Leagues then you have to have a measurement that can be assessed whether it be by time/distance log or from coastal features. Therefore the length of a league must actually relate to the real world and not be a designer distance, one just chosen for spurious reason. This text analyses the two charts noted and discusses the various Leagues of the period and negates the CaJ research by introducing a variety of Leagues and determining a positive answer to that which would actually have been used as it is land based and replicative.

HISTORY

The first set of maps to use a standard earth measurement, length of a degree of latitude and the corresponding reduction in the degree of longitude was Claudius Ptolemy. His actual text, “Geographike Hyphegesis”, written c150AD, is in 8 books and not only sets out the basis for the measurements but also indicates how to draw a map or maps, be they single countries or a whole continent, or the known world. There are clear explanations of the ratio between the latitudinal and longitudinal degrees as one proceeds north from the equator, and the main text, books 2 to 7 list country by country the places and coastal places using the “geographical” co-ordinate system of latitude and longitude we now freely use for our maps.

However, the whole basis for the world measurement he has utilized is flawed, severely flawed. He has accepted the length of a latitudinal degree promulgated by Marinus the Tyrian as being 500 stadia of c185 metres, when in fact it should be 600 stadia of c185 metres. Note, that if we accept the degree as 111.135Km then the stade is 600.73 per degree. Thus Claudius Ptolemy reduced the world circle from 360 x 600 = 216000 stadia to 360 x 500 = 180000 stadia, a 6:5 ratio reduction.

But we must bear in mind that whilst this happened the Roman Surveyors or Geometres had established that the world was in fact 75 Roman Miles or 600 stadia per degree of latitude. The Roman Mile is 1.4791Km consisting of 8 x 0.1849Km stadia.

PORTOLAN CHARTS AND THEIR BASIC DISTANCE MEASUREMENTS

Fast forward to the extant Portolan Charts and by using their scale bars we can determine the standard measurement there-on as being a Millara of c1.233Km and thus immediately understand the reasoning for that measurement;

Roman Mile = 1.4791Km and Millara = 1.2326 (c1.233) Km and they are in the perfect ratio of 6:5, the ratio of the Ptolemaic to the actual world measure.

The following is a summation of the measurements and how they interlink from the Roman Mile to the Marritimo Miglio of Genoa.

Roman Mile = 1.4791Km (1.48), of 8 stadia of 184.8875 metres (c185)
Millara = 1.23258Km, (1.233), of 6.667 stadia
Ratio; Roman Mile to Millara = 6:5

Roman World = 75 RM per degree of latitude = 600 stadia (300BCE-300AD)
Ptolemaic World = 62.5RM per degree of latitude = 500 stadia (c150AD)
Ratio; Roman World to Ptolemaic World = 6:5
Millara Geographical degree = 90millara. i.e. 90 x 1.233 = 111Km.
Millara short degree = 75millara. i.e. 75 x 1.233 = 92.5Km.
Ratio is 6:5, the Ptolemaic reduction.

Millara = 1.233Km or 6.667 stadia
Marritimo Miglio = 1.8495Km or 10 stadia
Ratio, 2:3

Marritimo Miglio per degree
Millara degree = 90 but as the Marritimo Miglio = 60 or 600 stadia
Short degree = 75 but as the Marritimo Miglio = 50 or 500 stadia

The natural ratio for all is obviously 6:5 as they are derived from the same basic unit.

The first and only time the ratio of 6:5 was introduced into world measure was by Marinus the Tyrian and expressly used by Claudius Ptolemy in his “Geographia” as he clearly states. It is therefore quite clear that the Portolan Chart standard measurement, also used in the “Portolani” texts, is actually derived from the Ptolemaic degree measure of 500 stadia, and is thus 75 Millara per degree and as such mimics the Roman World Measure and it then developed into the Marritimo Miglio of 10 stadia.

Thus it is quite open to opine that the “Portolani” and its “Portolan Chart” were originally conceived in the period following the Roman Empire, from Roman Itineraries, normally given in Stadia, and the Roman World Map of the Mediterranean Sea basin but using the conversion factor of 6:5 derived from the text of Claudius Ptolemy. However, the map derived from the text of Claudius Ptolemy’s “Geographia” was certainly not used.

FURTHER DEVELOPMENTS IN THE MEASUREMENTS

As the maritime republics/city states expanded and various countries formed mercantile fleets and navies, they tended, for mainly nationalistic reasons, to develop and prefer their own nautical measurements. Genoa was one of the first and as shown above their Marritimo Miglio which was 1 ½ times the standard Millara, i.e. 1.8495 to 1.233 = 3:2 ratio with a basic units being, 10 and 6.667 stadia.

Spain meanwhile developed the Mile and League using the basic Roman unit numbers;
Roman Mile (mpm) = 1000 Passum = 5000 pedes or feet, and the ancient mile in Spain is divided into 8 stadia, 1000 pasos or geometers feet which equals 5000 feet, but has a length of 1.3917Km, which is very nearly 1/7th part greater than the Millara of 1.233Km.

However the Spanish League or Legal League (actually abolished by Philippe II in 1568) was formed from 3 miles, 24 stadia, 3000 pasos; 5000 vares or 15000 feet, equalling 4.175Km and therefore 26.62 per degree, and a rather unwieldy measurement to use.

The Spanish Marine League (SML) developed as 20 per degree, was also the ancient common league of 4000 pasos; 6666 2/3 vares; 20000 feet which calculates at a length of 5.5667Km.

The SML or common league morphed into a length of 5.511Km, being 800 cordes; 6600 vares; 19800 feet and 20.166 per degree. That is a change of merely 1%, but it reflects the simplifying of the unit measures for calculations and usage.
Portugal, meanwhile had a mile of 8 stadia and was 2.058Km and thus there were 54 per degree. The league was 3 miles, 6.174Km and of course 18 per degree.
Please note that the 54 miles per degree is echoed numerically later in the text.

Having explored some of the nautical distance measures, I now intend to examine the two charts mentioned via their scale bars and thus inferred distances there-on.

JORGE DE AGUIAR, 1492, PORTOLAN CHART

Diagram ChMES/1/D01

The chart is held by the Beinecke Library, Yale University, is signed and one of the first by a Portuguese cartographer. It is very similar to its predecessors by showing the Mediterranean Sea basin and the north western European coastline. However it also includes the Island of Madeira, the Canary isles, the Cape Verde Isles and the west coast of Africa to the Gulf of Guinea. Thus it extends from c59N to c4N, a spread of 55 degrees latitudinally and the scale bar can be appraised to gain the unit utilized on the chart.

There are two diagrams which explain the scale bar measurement and thus the length of the putative chart degree. A third diagram follows in the text critique section.

Thus on diagram ChMES/1/D02, which illustrates the Atlantic coastline from N Africa to the UK as per the actual chart, I have appended the putative latitudes. Thus it can be clearly shown that 10 scale bar units (SBU) are the equivalent of 6 putative geographical degrees and thus the SBU’s are as follows;

10 SBU = 666.8Km and therefore 1 SBU = 66.681Km.
66.681Km = 54 millara of 1.233Km
= 36 Marritimo Miglio of 1.8495Km and thus 360 Stadia
= 12 Spanish maritime leagues of 5.5667Km (11.98)
= 16 Spanish legal leagues of 4.175Km (15.97)

and therefore, 1 Genoese millara = 3/5ths Portuguese mile or 1 P M = 1.667 millara.

Thus the Geographical Degree of 111.135Km becomes;
1 degree latitude = 90 millara; 60 Marritimo Miglio; 20 Spanish Maritime Leagues and 54 Portuguese Miles.
But note well; 1 scale bar unit = 54 millara of 1.233Km
1 degree latitude = 54 Portuguese Miles.

The longitudinal measurement for the 1492 chart is shown to be a slightly variable feast as diagram ChMES/1/D03 illustrates. If the measurement from Gibraltar to the putative 36E longitude is measured, both overall and sectionally varying distance measures are obtained. But it is reasonable to opine that the latitudinal degree is either 16 or 12 leagues and the longitudinal degree is either 15 or 11 degrees dependent upon the base unit.
Thus we can readily observe the simplicity of the measurements used by Jorge de Aguiar.
PEDRO REINEL, 1504 CHART

The chart is held by the Bayerische Staatsbibliothek, Munchen, as reference Kuntsman 1, and is 90x 62cms. It has a latitudinal spread of 16N to 62N along the Atlantic coastline and covers the western Mediterranean Sea as far east as Sicily. On diagram ChMES/1/D05 I have appended the putative latitudinal lines and thus it can be clearly seen...
that the chart positions of the Cape Verde Isles and the Canary Isles are quite correct. The chart has what is considered a latitudinal scale bar set along the first wind rose sub-division line to the west. This would appear to be a later addition to the chart and is poorly drawn. In the North West corner of the chart another landmass is shown with a separate scale bar appended but it is not subject to investigation in this paper.

The scale bar has 11 SBU matching the 7 degrees from 36N to 43N along the Iberian coastline and thus each SBU = 17 leagues (16.97 at 4.175Km), and thus would give 26 2/3rd leagues per degree. From Gibraltar to Cape Bon the evaluation of the distance measure to the SBU longitudinally gives a figure of 15 leagues (14.99).

The ratio 17:15 SBU can be calculated as the Cosine for 28N, the Canary Isles.

The later latitudinal scale bar is harder to evaluate, as it is not aligned to putative latitudes or even to a known point precisely. Thus using the scale bar all we can show is that 48SBU equals 33 Latitudinal Degrees as drawn. Therefore the calculation is simply; 48 x 17 = 816 leagues and thus divided by 33 we have 24.73 leagues per degree. It is 4.494Km per league, and as such has no immediate recognition. This therefore is unsatisfactory research as the scale is indecisive, and perhaps as a later addition is not as accurate as the original, or even by the original cartographer.

Thus having analysed the two charts, I can now question the CaJ 2015 text.
Diagram ChMES/1/D06
The abstract of the text clearly states that 16th and 17th century Portuguese and Spanish Charts are presented and that from the analysis the adoption of various standards echoes traditional models of the earth and of political disputes between Portugal and Spain.
In fact the text is no more than a discussion of the basic measurement of a degree of Latitude as it affects or is, or maybe derived from the Iberian Peninsula. The introduction is actually concerned with the latitudes of the west coast of Africa from a Portuguese viewpoint. Immediately the author decides that any scale of latitudes upon a chart is given in Leagues and states that 17 ½ leagues per degree became the *de facto* standard in Iberian Nautical cartography without a single provable measure being discussed. All we read is;”assuming the length of 5573 metres for a league, the earth radius is discussed”. Although this is only a mere 6.3 metres difference to the SML of 5566.7 it is 19.94 to the degree and not the more accurate 19.965. As shown, a perfect distance would have been 5.55675.

The text pre-supposes that the length of a possible league was calculated from the earth radius prior to the charts being drawn. A calculation is made to show how, using PI, a ratio not then known with accuracy being generally fractions such as 22/7 and 25/8 etc. could be used and the length of the degree is therefore given as 111.135Km. Perhaps too accurate!

The next statement is that the Italian Mile gave way to the Castilian League of 4 miles, and the only proof given is the Scale Bar on the Pedro Reinel 1504 chart, which my research has clearly indicated is not the case.

The text continues; “When astronomical navigation was introduced and a scale of latitudes started to be added to the charts, a standard value had to be chosen for the length of the degree of latitude, expressed in leagues. Three different standards, or modules, are known to have been adopted in the Iberian nautical cartography of the Atlantic: 16+2/3, 17 +1/2 and 18 leagues per degree. It is consensually accepted that the first module to be adopted in Portugal was 16+2/3 leagues per degree. The modules of 18 and 17+1/2 leagues, used in most Iberian charts from the beginning of the 16th century on, would have followed (Costa, 1983, pp213-215)”.

From my research, discussed prior to this critique it can be clearly shown that the Iberian Nautical measures derived from the Roman Mile via the Genoese Millara and Marritimo Miglio. However it is worth analysing the measures the author considers to be the historical standards, 16+2/3, 17+1/2 and 18 leagues per degree.

16.667 Leagues per Degree
111.135Km equals 16.667 leagues of 6.668KM
6.668Km = 1.597 x 4.175 (Spain Legal)
   = 1.2099 x 5.511 (Common League)
   = 1.1978 x 5.5667 (Spain Maritime)
   = 1.08 x 6.174 (Portuguese League)
   = 5.4079 Millara
   = 4.5135 Roman Miles
   = 3.6123 Marritimo Miglio

17 Leagues per Degree
111.135Km equals 17 leagues of 6.53735 Km
6.5373 Km = 1.5658 x 4.175
   = 1.1862 x 5.511
= 1.1744 x 5.5667
= 1.059 x 6.174
= 5.302 Millara
= 4.417 Roman Miles
= 3.5346 Marritimo Miglio

17+1/2 Leagues per Degree
111.135Km equals 17+1/2 leagues of 6.3508Km
6.3508Km = 1.5211 x 4.175
= 1.1523 x 5.511
= 1.1408 x 5.5667
= 1.0286 x 6.174
= 5.1505 Millara
= 4.2909 Roman Miles
= 3.434 Marritimo Miglio

18 Leagues per Degree
111.135Km equals 18 leagues of 6.174Km
6,174Km = 1.4788 x 4.175
= 1.1203 x 5.511
= 1.1091 x 5.5667
= 1 Portuguese League
= 5.007 Millara (i.e. 1.2348 not 1.233 for 5 millara, and 90 for the degree)
= 3.338 M M (i.e. 1.8524 not 1.8495 for 3+1/3 MM and 60 for the degree)
= 4.1716 roman Miles (i.e. not 4.1667 and 75 for the degree)

Thus the Portuguese League of 18 per degree is the natural continuation of the Genoese chart measurements and can be expressed in a variety of measures thus making it very usable.

Therefore we must ask the questions: “how did a mariner measure a league of 17+1/2 units per degree of latitude?” What is its basis in distance measure? How does a cartographer know its length set against a coastal length?
If they did not know its actual distance by comparison to land based measurements which are normally used for coastlines and particularly the “Portolani”, is it just an adopted figure based upon an empirical calculation, or a unit used by one country to thwart another’s idea of distance in the rivalry for world domination which was prevalent at this period.

The 18 leagues per degree is a very acceptable unit for the mariner and cartographer being part of the larger overall distance measure compendium available. From the list of Iberian sources of the 16th century with references to the length of the degree as provided in “Table 2” of the CaJ text, it would appear that only Duarte Pacheco Pereira c1505; Valentim Fernandes c1518 and Joao de Castro c1545, actually provided their readers with the logical unit of 18 leagues per degree, but my own research has clearly shown that the Spanish Marine League, 20 per degree was equitable to the Millara, 5.56675Km being 4.5 Millara and thus there are 90 per degree, as well as equitable to the MM and 60 or 600 stadia per degree.

This clearly suggests that the textual references quoted in “Table 2” should be
considered similar to many other texts of the age, such as the “Tavoletta da Navigare” written by such authors as, Ramon Lull, Andreas Bianco, Michael of Rhodes and A N Other as analysed in my text ChMa/1:Four Marteloio sailing Directions, 1295/1436AD. It was clearly shown that within these texts the simple mathematics led to spurious conclusions, although the overall schema was correct. It also showed quite clearly that these writers did not fully understand the subject and thus inappropriate units were used.

Thus the author of the CaJ text in suggesting that the League per degree was derived from a series of nautical observations requires explaining the method of estimation and measurement and how the 17+1/2 League module was found in the five charts he utilised.

Thus I consider the use of a league as a distance measure is no doubt from spurious mathematics and wrong observations which cartographers such as Jorge de Aguiar and Pedro Reinel appear to have ignored, choosing instead to rely on recognised distance measures which are capable of being converted into other measures at will.

They are of course; Roman Mile, Millara, Marritimo Miglio, the 18 units League, as well as the 20 unit league and various Mile measures I have indicated at the beginning of this text.

Michael J Ferrar April 2016.

The last text was written first and was only meant to be a riposte to the CaJ text mentioned. But it became very apparent that the Pedro Reinal Chart was in many ways a predecessor of the Jacobus Russus chart as the research progressed. Thus both texts, perhaps with different emphasis are co-joined to become one paper as the diagrams tell the story far better than a text can. It remains to be seen if the two charts are fully compared in a later paper.

Update, M J Ferrar, May 2016.