WHY THE ARTIFICIAL SHAPES FOR THE SMALLER ISLANDS ON THE PORTOLAN CHARTS (1330-1600) HELP TO CLARIFY THEIR NAVIGATIONAL USE

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Portolan charts have been studied for more than a century and a half, and intensively so in recent years. Yet several basic questions remain unanswered; indeed, some have never been asked. A detailed investigation, focusing in particular on the place-names, and the shapes of the medium and small islands, has been carried out over the past few years. This has made possible a new understanding of the charts' development and a fresh explanation of both their purpose and longevity. Portolan charts contain an unexpected mixture of surprising geometric accuracy and apparently frivolous invention. Their toponymy was static enough to include in 1600 three-quarters of the names that can be seen 300 years earlier. Yet at the same time they were dynamic enough to introduce many hundreds of new, and subsequently repeated, names over that period, and to discard hundreds of others. It will be demonstrated that the portolan charts - leaving aside their land-based roles as decorative mercantile or prestige objects - were an essential tool for sailors. Their uneven 'accuracy' can be explained in terms of three distinct shipboard uses: first, when on a long sea passage out of sight of land, second, when working from headland to headland along a coast, and third, when picking a way through an archipelago - particularly those in the Aegean Sea. The strange, clearly unnatural shapes given to many of the small and medium-sized islands, especially in the Aegean, have been barely noticed by previous commentators. It is suggested that these should be seen as 'mnemonic substitutions', simplifying work for the chart copyist and providing the medieval helmsman with an easy way to memorise the position of scores of islands. That these shapes were neither random nor restricted to a single chartmaking family or production centre, but were instead standardised and widely repeated, sometimes for centuries, provides evidence, in the author's view, that the 14th-century chartmakers had the imagination to create a convention-defying cartographic device. This was apparently without precedent, and not imitated elsewhere. It is ironical that the charts' continued relevance for merchant shipping can be attributed to the reverence with which every small hydrographical detail of the original workshop model was faithfully copied through perhaps ten generations, rather than to any adaptability in response to what we might have supposed were evolutionary pressures. Only the vital, and ever-changing toponymy contradicts that statement.

Les cartes portulans sont un objet d'étude depuis plus d'un siècle et demi, et de manière plus soutenue ces dernières années. Certaines questions fondamentales restent toutefois sans réponse ; d'autres n'ont jamais été posées. Une investigation approfondie, centrée en particulier sur les noms de lieux et la forme des moyennes et petites îles, a été menée au cours des dernières années. Elle a permis une nouvelle compréhension du développement des cartes marines et une explication toute nouvelle de leur finalité comme de leur longévité. Les cartes marines sont un mélange inattendu d'exactitude géométrique surprenante et d'invention apparemment frivole. Leur toponymie est assez stable pour inclure en 1600 les trois quarts des noms déjà présents trois cents ans plus tôt. La nomenclature est toutefois, pendant la même période, suffisamment dynamique pour introduire plusieurs centaines de nouveaux noms, et les conserver sur la durée, et pour en détruire des centaines d'autres. On démontrera ici - laissant de côté leurs usages terrestres comme objets marchands décoratifs ou de prestige - que les cartes portulans étaient essentiellement un outil pour les marins. Leur inégale « exactitude » peut être expliquée en fonction de trois usages distincts à bord des navires : premièrement, lors d'une longue traversée hors de la vue des terres, deuxièmement en cas de cabotage le long d'une côte, et troisièmement, en traçant une route au

sein d'un archipel, en particulier dans la mer Égée.Les formes étranges, clairement artificielles, données à de nombreuses petites et moyennes îles, notamment en mer Égée, ont été rarement relevées jusqu'ici par les commentateurs. On suggère ici qu'elles peuvent être considérées comme des 'substituts mnémotechniques' , simplifiant le travail du copiste des cartes et procurant au timonier de l'époque médiévale un moyen aisé pour mémoriser la position de très nombreuses îles. Que ces formes ne soient ni le fruit du hasard ni limitées à une seule famille de cartes marines ou un seul centre de production, mais aient été au contraire standardisées et largement copiées, parfois pendant des siècles, constitue une preuve, de notre point de vue, que les hydrographes du XIV^e^ siècle ont eu l'imagination nécessaire pour concevoir une convention cartographique. Ceci fut apparemment sans précédent et ne fut jamais imité nulle part. Ironie des choses, il semble que la pertinence durable des cartes marines pour la navigation marchande puisse être attribuée au respect avec lequel chaque petit détail hydrographique du modèle cartographique était fidèlement copié en atelier à travers peut-être dix générations, plutôt qu'à une supposée capacité d'adaptation pour répondre aux pressions de l'évolution. Seule la toponymie – vitale et perpétuellement changeante- contredit cette affirmation.

1 Introduction

The findings described here, which are set out in full in an ongoing series of webpages[1] would not have been possible without the 2007 publication by Ramon Pujades - written in Catalan, with an English version of the text[2]. The accompanying DVD, containing images of almost all the surviving charts up to 1469, has opened up the subject in a way that could not have been imagined before. I may be the first to have used the Pujades DVD to make a range of systematic studies of the early charts - extended into the later period by means of freely available scans taken from the web.

Now that the early charts are available in legible form, it is possible to carry out intensive research into their place-names. My recent study, expanding on work done in the 1980s for volume 1 of *The History of Cartography*, considered the names along the continuous coastline from northern France round to Morocco. Altogether, about 1,800 recurring names were involved; those are set out in an online toponymic table[3].

About three-quarters of the names found on the earliest dated charts - Pietro Vesconte's of 1311-1313 - were still present three centuries later. However, a graph summarising the recent findings shows that a considerable number were added or removed (fig.1). Indeed, every one of the chartmakers working before 1440 introduced at least one new name[4]. Note how, after a steady decline in the number of fresh names, there was a sudden increase in the second half of the 16th century, as well as many deletions. This still needs to be explained. These brief comments on the dynamic nature of portolan chart toponymy are relevant for the later consideration of the more static aspects of their construction.

Much uncertainty still surrounds the charts' origins. When, where, by whom, how and why were they created? But it may be possible to propose an answer to a question that is surely of comparable interest: « why were traditional portolan charts made, sold and used by navigators for nearly 400 years after Vesconte ? ». The 1674 chart by Jean-François Roussin is an example of a very late production, part of the Bibliothèque nationale de France's marvellous collection and now available online (fig.2). Note the traditional structure, with a hidden circle defining the points where the compass lines meet, in this case often embellished with a compass rose.

The evidence that I offer here comes from a close observation of those surviving charts that are available in reproduction. It focuses on elements, often small details, that have been ignored by previous researchers. However, that is not so surprising because these new studies only became feasible with the Pujades DVD. Since we have no reliable information about the way the early portolan charts were made, my underlying contention is that portolan charts are a major, if not the primary, source for their own history.

It was only when I was analysing the different colours for the islands that I began to be aware that some had extraordinary, repeated shapes. The

1 Campbell, 2011 (a) ; 2011 (b).
2 Pujades, 2007.
3 Campbell, 1987 ; 2012 (a).
4 Campbell, 2012 (b).

remainder of this paper concentrates on those, and the implications that can be drawn from them.

2 Why do the smaller islands on the early charts have such strange shapes?

We can easily understand why the early chartmakers, when faced with islands that were either entirely imaginary or badly misplaced, gave them fictitious shapes, such as those to the north of the Canary Islands (in the left panel of fig.3)[5] Note the genuine Madeira, with to the north of it mythical islands such as St Brendan and 'Brazil'. In other words, while an attempt was made to give a realistic shape to Madeira, the non-existent islands were treated imaginatively.

And why not? The chartmakers had no proper information to work on. The alternative would have been to insert random island shapes. This way was more honest. It was quite impossible for any island to have Brazil's regular shape or that of the trefoil above it. And why not give those unvisited islands, supposedly either side of Scotland (the next panel to the right), the simple shape of a circle or oval, for the same reason? But Mediterranean trading ships certainly visited the Isle of Man. This is placed in approximately the right place, and it is roughly the correct size. So why is it shown as a cross? Likewise Paxos, one of the smaller Ionian Islands, is also given the shape of a cross, though of a somewhat different form. And, to the north of that, denoting Palagruza, can be seen what look like two pairs of eye glasses (of the pince-nez form) or, to a modern observer perhaps, headphones.

The three main early chartmaking centres, Palma in Majorca, Genoa and Venice, were also major trading states, with settlements along the Adriatic and in the Aegean. They knew the shapes of those islands very well. So how do we explain the outline given to the Ionian island of Zakynthos (on the lower row) - rather like a piece from a jigsaw puzzle? Or Skyros in the mid-Aegean with a shape that, to an imaginative mind, might suggest a space rocket. But the most extraordinary of all is Limnos, the large island in the north of the Aegean Sea, which has sprouted five projections. I call these 'lollipops' or *sucette*. Clearly, an explanation is needed.

The initial focus here will be on two of the Aegean islands, Limnos and Skyros. The sequence of details for Limnos (*stalimene* to medieval sailors) (fig.4) starts with the modern outline, which reveals its very complicated coastline. One can well understand why the chartmakers might have preferred a simple alternative. To the upper right is a pair of unsigned works that come, apparently, from the very early 14th century, or conceivably even earlier (though Ramon Pujades's contrary opinion on their dating appears elsewhere in this volume). Although it is always possible to see, in the simplest outline, an attempt at realism, these two would have been of no help to anyone trying to find their way around Limnos.

The chart by Pietro Vesconte, on the next row, appears to be more realistic, but comparison with the true outline shows that it is still highly misleading. But then, starting with Angelino Dalorto (or Dulceti) in 1330, the 'lollipops' outline appears for the first time. Even if there were minor variations that basic design was to continue, on some charts, for at least a further 250 years (ending with the 1598 Vincenzo Volcio version in the bottom right corner. Finally (in the lower left), examples of Venetian work from the first half of the 15th century demonstrate an attempt at realism. It was not particularly effective and was never able to displace the imaginary version.

We turn now to look at the portrayal of Skyros (fig.5). The earliest charts along the top are, again, formulaic but Pietro Vesconte in 1313 had already recognised the island's true elongated shape, which, a century and a half later, has thickened into the characteristic 'space-rocket' form seen on the work of Grazioso Benincasa. Again, the Volcio detail demonstrates the longevity of that outline. The final pair in the lower left show how the head of what looks somewhat like a dinosaur could point either way. Perhaps this was part of the chartmaker's personal stylistic signature.

Two of the Ionian Islands, Paxos and Zakynthos were shown in an earlier illustration, but here they are in context, with enlargements of Corfu in addition (fig.6). As can be seen, despite their artificial shapes, each island has roughly the correct size and is placed in relation to the others with some accuracy. Once again, these imaginary shapes survived up to 1600.

To see how artificial shapes could be applied more generally it is instructive to consider the smaller islands of the Cyclades and Dodecanese - those between Euboea (*negroponte*) and Rhodes, with its cross of the Knights. A side-by-side comparison can be made of the strange, artificial shapes found on two different atlases from the 1460s by the prolific

5 For detailed information, sea the table identification of the illustrations at the end of the article.

Grazioso Benincasa (fig.7). By examining closely the long red island in the centre, Nicharia, and the little rocks or islets to its east, it becomes apparent that they are not absolutely identical. This is because these details were probably not traced but rather copied by hand very carefully, including, in most cases, their standard colour.

They must have been taken from a workshop model. But, when drawing an island for the 100th time - and chartmakers probably produced a new chart every two weeks or so - they must have drawn them from memory. And memory, I suggest, is the key that allows us to understand this internal contradiction at the heart of the portolan charts: unprecedented overall accuracy on the one hand, and clearly invented shapes for the smaller islands, on the other. Where most true island shapes are un-memorably irregular, my claim is that what you are seeing here are aids to memory. They are, in other words, 'mnemonic substitutions'. Comparative details from three charts drawn over a period of two centuries show how long the chartmakers persevered with these cartographic fictions (fig.8). Was it because they were ignorant and had no direct experience of the Aegean themselves? Certainly not.

The Venetians had been established in the Aegean from the early 13th century. They held Limnos from 1208, using its harbours for their convoys en route to Constantinople. Then again, a number of the chartmakers, among them Benincasa and several Venetian practitioners, were, or had been, sailors, who must have known the sea very well[6]. Indeed, Benincasa, whose fantastic shapes are the most elaborate, had previously compiled a written sailing guide, which included the Aegean Sea[7]. It is surely safe to assume that these simple, and intentionally distinctive shapes, many of which can be seen already on early 14th-century Venetian and Majorcan work, must have served some practical purpose.

3 A better understanding of the charts' purposes and longevity

We now need to look at the question of the charts' function. Who were they made for, and what did their users do with them?

Of course, the ornate variety of chart - the kind that would be carefully preserved over the ages - was not made to be taken to sea. However, some researchers contend that portolan charts were not navigational tools at all. They have suggested that the charts were designed for merchants and other landsmen, who only needed to know the location of faraway places[8]. Therefore, the concerns of sailors would be irrelevant.

Archival documentation proves, though, that functional charts were certainly carried on board. Indeed, they were clearly thought to be an essential item of a sailor's equipment - which is why a number were found in the private chests of those who died abroad[9]. A 15th-century commentator, Benedetto Cotrugli, described how,

« After the ship-boy had served for some time in his apprenticeship, and had become an expert in life on board, in manoeuvres and navigation, he was to learn the use of the portolan chart and become conversant with calculating the ship route »[10].

Correspondence between agents of the Italian merchant Datini in 1408 include two telling statements: first, that if the sole chartmaker then active on Majorca should die, « we shall no longer be able to sail», and, second, the clear distinction that was drawn between a sumptuous chart and one « made only for sailors»[11] . Incidentally, it is important to emphasise that the atlas made for presentation and the chart destined for shipboard use are exactly the same in their basic construction and underlying hydrographic information.

4 What was the charts' function?

I propose that portolan charts had three quite distinct navigational functions: first, when out of sight of land, second, when sailing along a coastline, and lastly, when finding a way through a complicated archipelago. Before embarking on a long voyage, sailors would work out the direction to their destination (using the appropriately coloured compass direction) as well as the measured distance (fig.9). Then, once they were underway, they could use the chart to

6 Falchetta, 1995 ; Pujades, 2007, p. 486-7.
7 Kretschmer, 1909.
8 Sheehan, 2013.
9 Pujades, 2007, p. 425 et seq.
10 Falcheta, 2008.
11 Pujades, 2007, p.459-60.

calculate how far they had actually travelled in the correct direction.

Once they sighted land - which they might well recognise - the second function would come into play. A sailor worked from one headland to the next, and the charts' considerable overall accuracy extends to the placement of those capes, but not the coastline in between. Bays are usually shown by a series of scoops - perhaps with two short parallel lines at their head, to indicate a river mouth. The place-names would help the navigators to identify the sequence of ports and estuaries they were passing, even if not their precise location.

What happened when the ship entered the Aegean? A detail of the islands between Euboea/Negroponte and Rhodes (fig.10) sets the scene. For a small island, the seaman needed to know the approximate size and position, but the shape was not important to him as he would be sailing past, not round it. So the smaller Aegean islands are in broadly the right place, and true to scale, despite their artificial outlines. And even the smallest islet is carefully named, providing a comprehensive toponymic catalogue of the archipelago, to go with the visual catalogue of their 'signature' island shapes. For a visiting ship, this would be a valuable aide-mémoire, even if a local pilot or past experience was needed to find a safe way through the labyrinth.

Although some shapes can be found repeated in a different archipelago (and indeed in those of 16th-century discoveries in the Atlantic and Indian oceans, on which more below), each outline was obviously intended to be different from the islands nearby. So that they could be easily memorised - by both chartmaker and sailor - some needed to be quite elaborate, while at the same time broadly symmetrical. The only scholar I am aware of who has noted this aspect of portolan charts, Guillén y Tato, catalogued a selection of these shapes more than half a century ago[12]. However, he was interested in classifying the standard outlines, for example those which suggested to him letters of the alphabet, rather than seeking an explanation of their purpose.

It might be asked then why were Crete, Cyprus and the other large islands treated realistically (fig.11). Well, because they fitted into the second category: coastlines along which a ship would run, noting the successive headlands, ports and estuaries. It seems probable that those large islands were directly copied, in the same way as the continuous continental coastlines, whereas the smaller ones were drawn in freehand. You can see from these comparisons for Crete and Cyprus that the remarkable degree of overall accuracy disposes of the argument that the inexact outlines might be the result of the chartmakers' ignorance.

My mnemonic interpretation depends on an acceptance that the elaborate, and long-lived geographical fictions I have illustrated were intended to be so fantastic that their non-realistic purpose would be immediately evident. However, some commentators have tried to show that what I call 'lollipops' conveyed some kind of practical navigational information. Might they not refer to a line of rocks reaching out from shore: in other words a navigational danger to be avoided? Or, alternatively, could they denote a large harbour, which, on the contrary, might save their life in bad weather? In my view, none of these attempts is convincing[13]. Their use was selective and short-lived, and most sailors could not have known what they meant.

Now it is certainly true that headlands, while being, on the whole, correctly placed, were not given their realistic outlines. Instead, the coastline was simplified into a series of formalised promontories, separated by non-specific bays. The rounded headlands might be shown as mini-peninsulas, attached by a small stalk to the mainland, rather like a round-headed pin. Sometimes, the capes were shown as arrow-heads. But there is a big difference between a real headland conveyed by means of a repeated symbol, such as the trio along the north Istrian coast, and lollipops, where no such headland existed (fig.12).

Limnos is the most extreme imaginary example, but there were others. Most surprising are those in the Balearics and, particularly the pair projecting from the south-west coast of Majorca, very close to the chartmaking centre of Palma. The illustration here is by the Genoese, Francesco Beccari, but he worked closely with the Catalans. And those protuberances are first seen on Catalan charts of the late-14th century. I can think of no rational explanation for those on Majorca, whose outlines are otherwise reasonably realistic.

We can perhaps pause here and attempt to deconstruct what the chartmakers have done. I will try to show that these strange shapes represent no less than a revolution in cartographic thinking.

Most cartographic mnemonic aids - and there are many types of these - seek to simplify: to reduce what is shown to its essentials. Strabo had suggested that it was sufficient to note an island's length and breadth and then give it a memorable geometric form - for

12 Guillén y Tato, 1955.
13 Campbell, 2011 (c).

example Sardinia as a human foot and Sicily as a triangle. Thus a real shape is reduced, like a caricature, to its most obvious elements, for the convenience of those who have no need of the exact outline. In the same way, modern France is often described as 'the hexagon'

It may seem surprising to compare the mnemonic insular shapes on the portolan charts to the London Underground Map (fig.13). But I hope to persuade you that the imaginative leap taken by Harry Beck in 1931 has interesting parallels with the charts, even if the two approaches were very different. In each case the originator of the device - not identified in the portolan chart instance - went back to first principles: what will work best? In each case they turned their back on cartographic orthodoxy. Each was concerned with the practicalities of a navigation network, even if in very different circumstances.

After each had reconsidered the fundamental purpose of the tool they were re-designing they realised it could be massively simplified, once existing assumptions had been challenged and, in some cases, rejected. Starting from the users' needs, Beck appreciated that none of the cartographic staples of scale, direction or distance was sacrosanct or indeed necessary. His diagrammatic solution provided the sequence of Underground stations, with their names, and highlighted the interchanges. How the network related to the world above was largely irrelevant.

Likewise, the different unknown portolan chart innovators - because the process did not happen all at once - must have realised that what an Aegean sailor required was a sequence of named islands, shown in their approximate position and relative size. Beck's iconic map sacrificed absolute scale and direction; on the charts, real shapes were substituted by imaginary ones.

Beck essentially reduced what was already there; he removed and distorted, but added nothing, besides comprehensibility. His is a topological map. By contrast, it could be said of the early chartmakers that their contribution to cartography was to add a new dimension - a series of imaginary and readily memorised island shapes, substituted for the real ones, whose practical convenience allowed them to become, like Beck's map, an accepted shared language. Had only a few of the chartmakers adopted those signature shapes, or applied them promiscuously to different islands, they would have served no purpose and would soon have been abandoned.

Instead they made a few of the insular shapes more complex - not, perhaps, than their true forms (if they had known them) but more complex than the simple rudimentary insular shapes that can be seen on the earliest charts.

Occasionally, the artificial shapes they created seem to be extrapolations from the true outlines (for example, Zakynthos in the Ionian Islands, see again (fig.6) but most were pure invention and took the form of simple geometric designs, usually formed of straight lines or simple curves. By employing those imaginary forms, they saved themselves and their successors valuable drafting time, and provided nautical users with a simple device for memorising their route through a complicated archipelago.

So my claim is that the mnemonic alternative shapes represent a uniquely successful experiment - initially by a few specialist medieval chartmakers - for which, apparently, there was no precedent, nor subsequent imitation beyond the world of the nautical chart.

Beck's inspiration produced what is probably the best-known map ever created. It will no doubt survive for a long time, but, at 80 years, it has some way to go to match the almost 300-year longevity of the charts' mnemonic shapes.

5 Why did portolan charts of the core, traditional area continue to be produced for hundreds of years?

Surprisingly, it seems that the reason the charts continued to be relevant so long for merchant shipping in the Mediterranean was precisely because they changed so little. Leaving aside toponymy, which was constantly being reviewed, the charts' hydrographical details remained broadly constant. And this was presumably a result of the chartmakers' working methods. Apprentices must have been taught to follow the workshop model exactly, down to the smallest detail, without thinking. Most other craftsmen would have created a wide range of different products during their career. But an early portolan chartmaker would probably have made much the same chart or atlas for his entire working life. He was trained to imitate, not innovate.

This reverence for the authority of the workshop model ensured that the main risks of such a reproductive process were avoided. The coastlines were not carelessly distorted; the names not (usually) mis-transcribed. There are signs of this happening, however, from the mid-16th century onwards, which presumably reflects a loosening of the medieval workshop discipline.

The mnemonic device would also have speeded up

chart production and thus been of advantage to the chartmakers. When a modern viewer examines a portolan chart he or she is likely to notice the overall coastal outlines, place-names, compass lines and, above all, illustrations. But each chart or atlas produced, for example by Benincasa, also contained an estimated 3,500 very small details off the coast. As can be seen here in the Sea of Azov, these warned about rocks and shoals, in the form of red or black dots and black crosses (fig.14). Each symbol had a distinct message and most can be found already on the earliest reliably dated charts. Their meaning is not explained but must have been universally understood. It is natural for a modern student to overlook these minute details and the labour involved in inserting them.

6 The world beyond the Mediterranean after 1500

When first encountered by the Portuguese, the numerous coral islands in the complicated and dangerous Maldives chain presented a major challenge to chartmakers. Here, in turn, are three different approaches to that problem (fig.15). The Cantino Map of 1502, one of the earliest attempts to represent the group, employs artificial shapes like those we have already seen in the Aegean. The depiction on the 'Miller Atlas' of 1519 by Lopo Homem might look like a bag of sweets emptied out but, if this is interpreted as an impressionistic warning to 'keep away', it can be seen as an appropriate cartographic response rather than just ignorance. Likewise the Vaz Dourado's *pointiliste* arrangement of 50 years later must surely have served a similar purpose.

Should we see the substituted shapes I showed earlier as just a medieval convenience, and something that applies only to charts produced in the Mediterranean and covering the seas of the Old World? Why would we expect that to be the case? After all, the mnemonic tradition was still active in the Mediterranean in the 16th century, and some of those who charted the new discoveries were the same people.

What of other charts that included archipelagos found in the Atlantic or the Indian Ocean and beyond? This illustration, featuring islands off Equatorial Guinea, shows that 'signature' shapes could be applied, just as easily, to new discoveries (fig.16). Neither of the two larger islands has its correct outline but these two, apparently unconnected charts are clearly based on the same artificial model, which can be seen again on Pierre de Vaulx's 1613 chart of the Atlantic in the BnF, Ge SH ARCH 6 (RES)[14].

You can recognise some of those imaginary shapes from the earlier illustrations on another example, showing Madagascar, again from the very lavish 'Miller Atlas' of 1519 (fig.17). Moving west, details from two Portuguese charts (the 'Dauphin Atlas' of c.1538 and a chart of c.1550 by Jorge Reinel) show a reasonable understanding of the complex Bahama Islands (fig.18).Yet you can see a number of recurring fictitious shapes, some of which were still present in the West Indische Paskaert by Willem Blaeu of c. 1630[15]. To determine if these are *truly* mnemonic, rather than just the result of localised copying, more research would need to be done. Is a particular island given the same outline repeatedly, so that it must have become standardised and generally recognised?

The long survival of these imaginary outlines serves to confirm their essential navigational purpose.

Conclusion

If there are just three aspects that need to be stressed they would be these. First, the significance of apparently trivial details. The hierarchy of value and importance that historians have imposed on portolan chart content is sometimes anachronistic. Every reproduced feature, whether large or small, real or invented, was usually placed in the new chart with the same care. Second, we must try to see these charts through the eyes of their makers and users.

My final concluding points would be these. Portolan charts combine a level of overall geometric accuracy and elaborate geographical fictions - what I call 'mnemonic substitutions'. Clearly these were not just accepted by their users but actually preferred.

Map historians' focus on cartographic accuracy needs to be enlarged - for early maritime charts at least - to make room for unscientific, pragmatic, alternative approaches. Instead of seeing ignorance or carelessness, we should value the repeated instances of ingenuity and inventiveness on the part of those early chartmakers. If, as claimed here, the imaginary mnemonic island shapes are both unprecedented and unrepeated in medieval and early modern cartography, the creativity of their inventors needs to be recognised. It was, in intellectual terms, an astonishing major innovation.

14 Hofmann, et al., 2012.
15 Burden, 1996.

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Sheehan K., 2013, « Aesthetic cartography: the cultural function of portolan charts from 1300 to 1700 », *Imago Mundi*, 65:1, p. 133.

Identification of the manuscript sources

Figure 1 :

[from : http ://www.maphistory.info/ToponymyInnovationsSevenRegions.doc]

Figure 2 :

Jean-François Roussin, Portulan chart of the Mediterranean sea, 1674. Bibliothèque nationale de France, Ge SH Archive 44.

Figure 3 :

- Grazioso Benincasa, Portulan atlas, 1466. Bibliothèque nationale de France, Ge DD 2779
- Grazioso Benincasa, Portulan atlas, 1467. Bibliothèque nationale de France, Ge DD 1988

Figure 4 :

- Carte Pisane. Portulan chart, undated. Bibliothèque nationale de France, Ge B 1118
- Cortona Chart, Portulan chart, undated. Cortona, Biblioteca Accademia Etrusca, Port. 105
- Pietro Vesconte, Portulan atlas, 1318. Vienna, Österreichische Nationalbibliothek, Ms. 594
- [Angelino Dulceti], Portulan chart [1339+]. London, British Library, Add. MS 25691
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Figure 5 :

- Carte Pisane. Portulan chart, undated. Bibliothèque nationale de France, Ge B 1118
- Cortona Chart, Portulan chart, undated. Cortona, Biblioteca Accademia Etrusca, Port. 105
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    - Francesco Beccari, Portulan chart, 1403. Yale University, Beinecke Library, Art Object 1980.158
    - Grazioso Benincasa, Portulan atlas, 1466. Bibliothèque nationale de France, Ge DD 2779
    - Vincenzo Volcio, Portulan chart, Bibliothèque nationale de France, Ge C 5095
    - Pizzigani brothers, Portulan atlas, 1373. Milan, Biblioteca Ambrosiana, SP10, 29 [SP II.2]
    - G. da Napoli, Portulan chart, undated. London, British Library, Egerton MS 73, ff.4-6

Figure 6 :

Grazioso Benincasa, Portulan atlas, 1467. Bibliothèque nationale de France, Ge DD 1988

Figure 7 :

- Grazioso Benincasa, Portulan atlas, 1466. Bibliothèque nationale de France, Ge DD 2779
- Grazioso Benincasa, Portulan atlas, 1467. Bibliothèque nationale de France, Ge DD 1988

Figure 8 :

- Francesco Beccari, Portulan chart, 1403. Yale University, Beinecke Library, Art Object 1980.158
- Grazioso Benincasa, Portulan atlas, 1467. Bibliothèque nationale de France, Ge DD 1988

Vincenzo Volcio, Portulan chart, 1598. Bibliothèque nationale de France, Ge C 5095

Figure 9 :

Diogo Homem, Portulan atlas, 1574. Bibliothèque nationale de France, Ge DD 2006

Figure 10 :

Grazioso Benincasa, Portulan atlas, 1467. Bibliothèque nationale de France, Ge DD 1988

Figure 11 : Early outlines for Cyprus and Crete

Pietro Vesconte, Portulan atlas, 1318. Venice, Museo Correr, Port.28

Figure 12 : Other examples of 'lollipops'

- Grazioso Benincasa, Portulan atlas, 1466. Bibliothèque nationale de France, Ge DD 2779
- Francesco Beccari, Portulan chart, 1403. Yale Univeresity, Beinecke Library, Art Object 1980.158

Figure 13 :

- F.H. Stingemore, Underground Railways of London, Printed, c.1930
- Harry Beck, Underground, Printed, 1933

Figure 14 :

Grazioso Benincasa, Portulan atlas, 1466. Bibliothèque nationale de France, Ge DD 2779

Figure 15 :

- Cantino Map, 1502. Modena, Biblioteca Estense Universitaria
- 'Miller Atlas', Portulan atlas, 1519. Bibliothèque nationale de France, Ge AA 640
- Fernão Vaz Dourado Atlas, c. 1570. San Marino, Huntington Library, HM 41

Figure 16 :

- Valentim Fernandes, 1506-10. Munich, Bayerische Staatsbibliothek, Cod. hisp.27 (via Portugaliae Monumenta Cartographica, Vol.5, 127)
- Gaspar Viegas, Portulan atlas, 1534. Bibliothèque nationale de France, Ge B 1132

Figure 17 :

'Miller Atlas', Portulan atlas, 1519. Bibliothèque nationale de France, Ge AA 640

Figure 18 :

- Jorge Reinel, Portulan chart, c.1550. Bibliothèque nationale de France, Ge B 1148
- 'Dauphin Atlas', Portulan atlas, c.1538. The Hague, Koninklijke Bibliotheek, Atlas ms. 129.A.24

1. **Totals of new and abandoned names compared, 1318-1600**

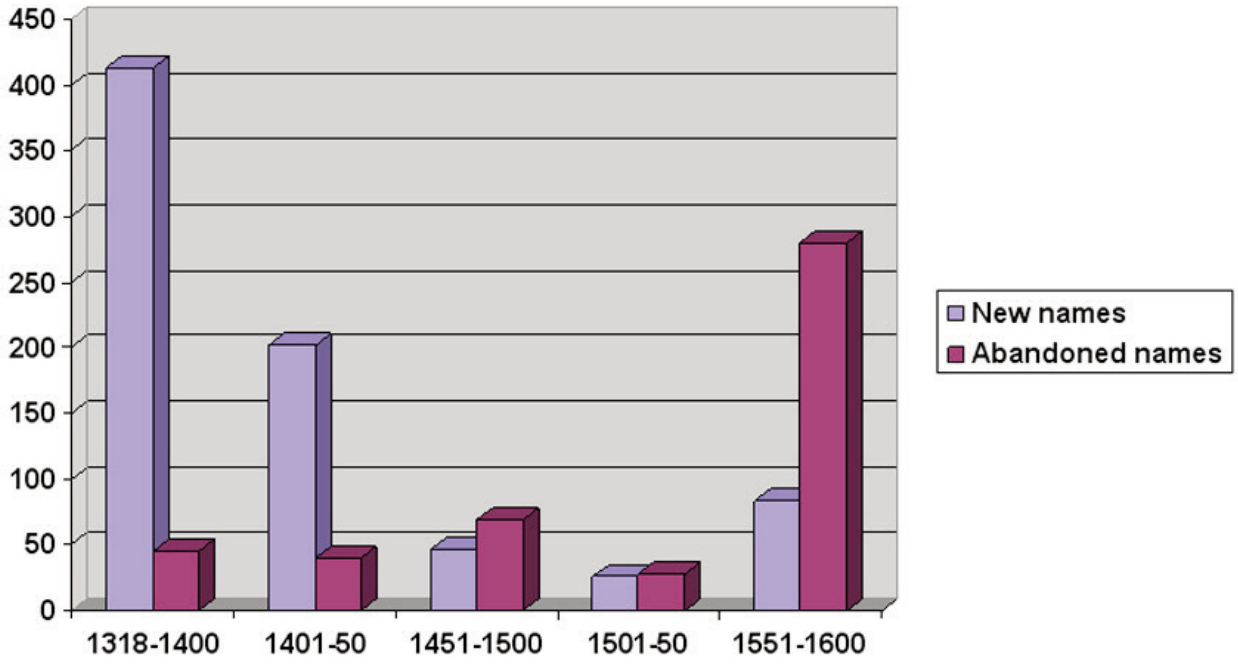


Figure 1 : The toponymic analysis summarized.

Figure 2 : A very late traditional chart

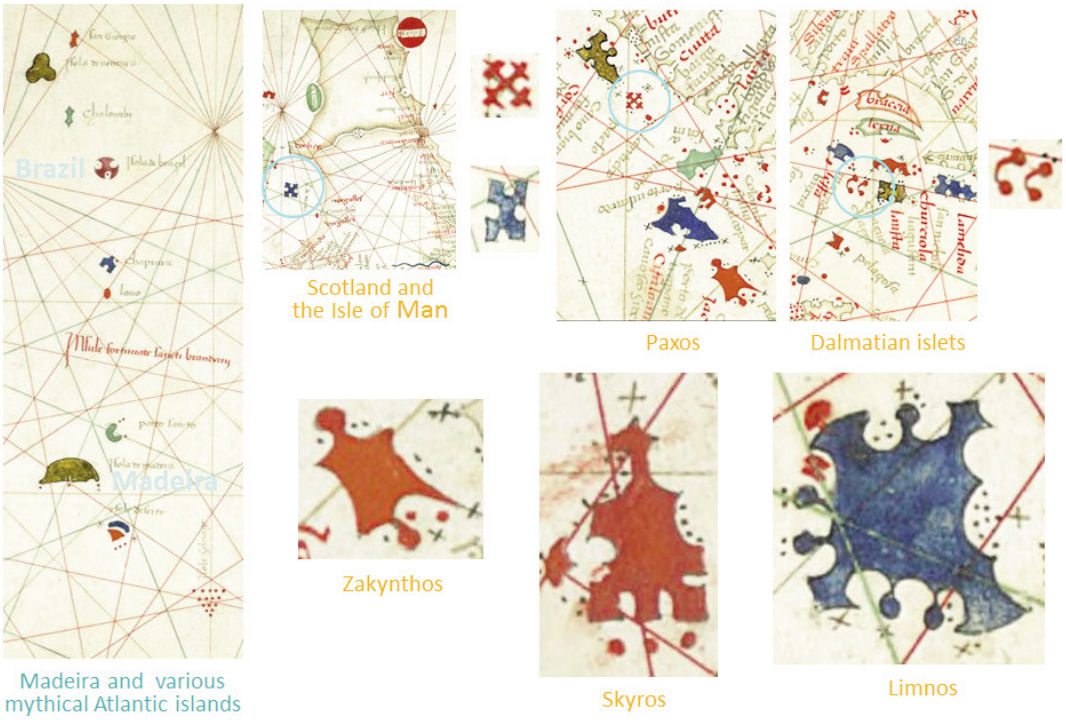


Figure 3 : The strange shapes of selected islands.

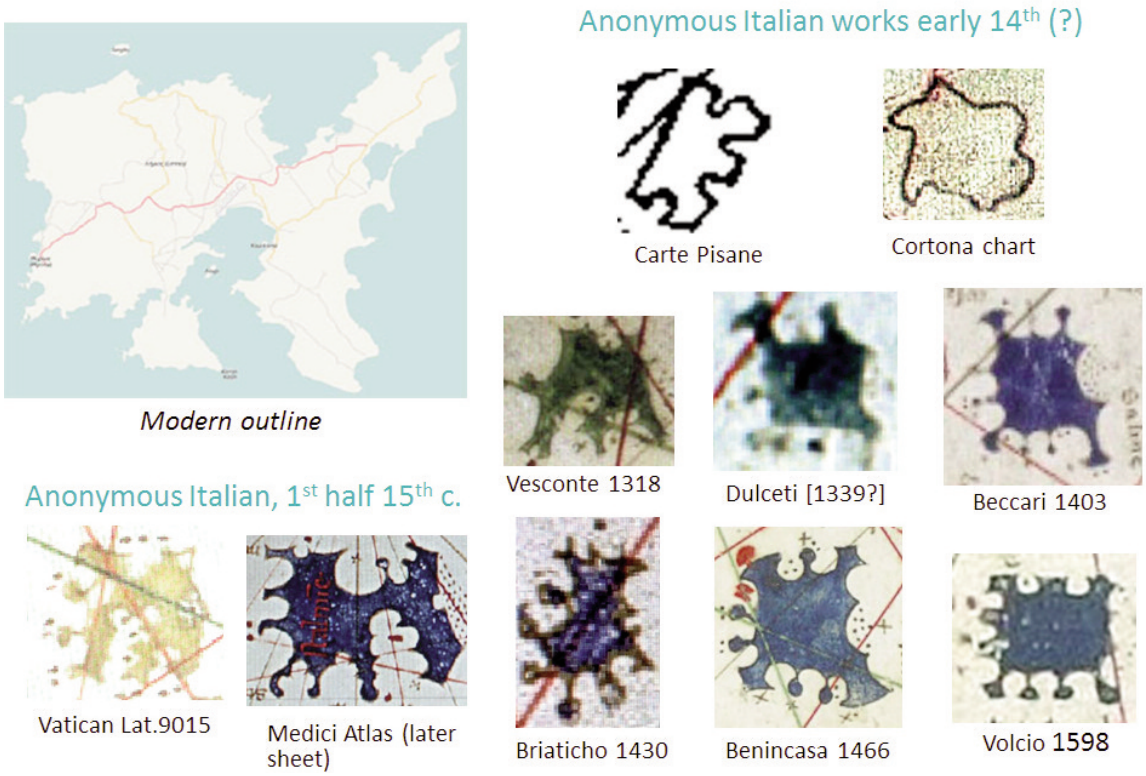


Figure 4 : The changing shape of Limnos (stalimene).

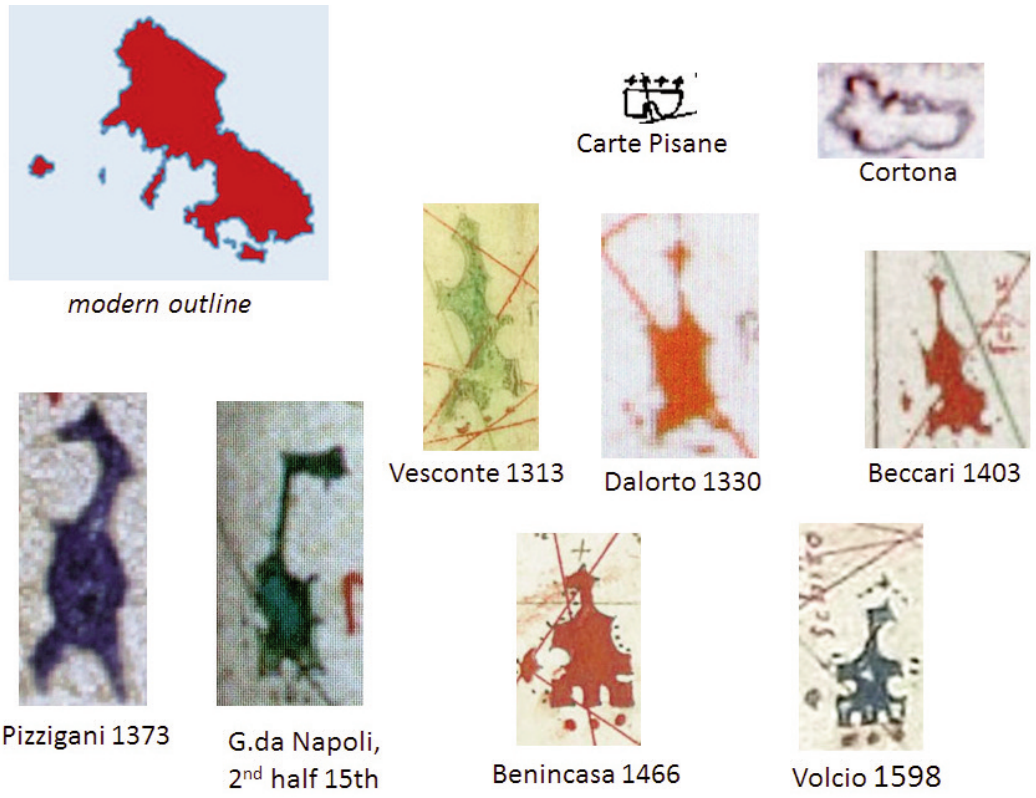


Figure 5 : The changing shape of Skyros.

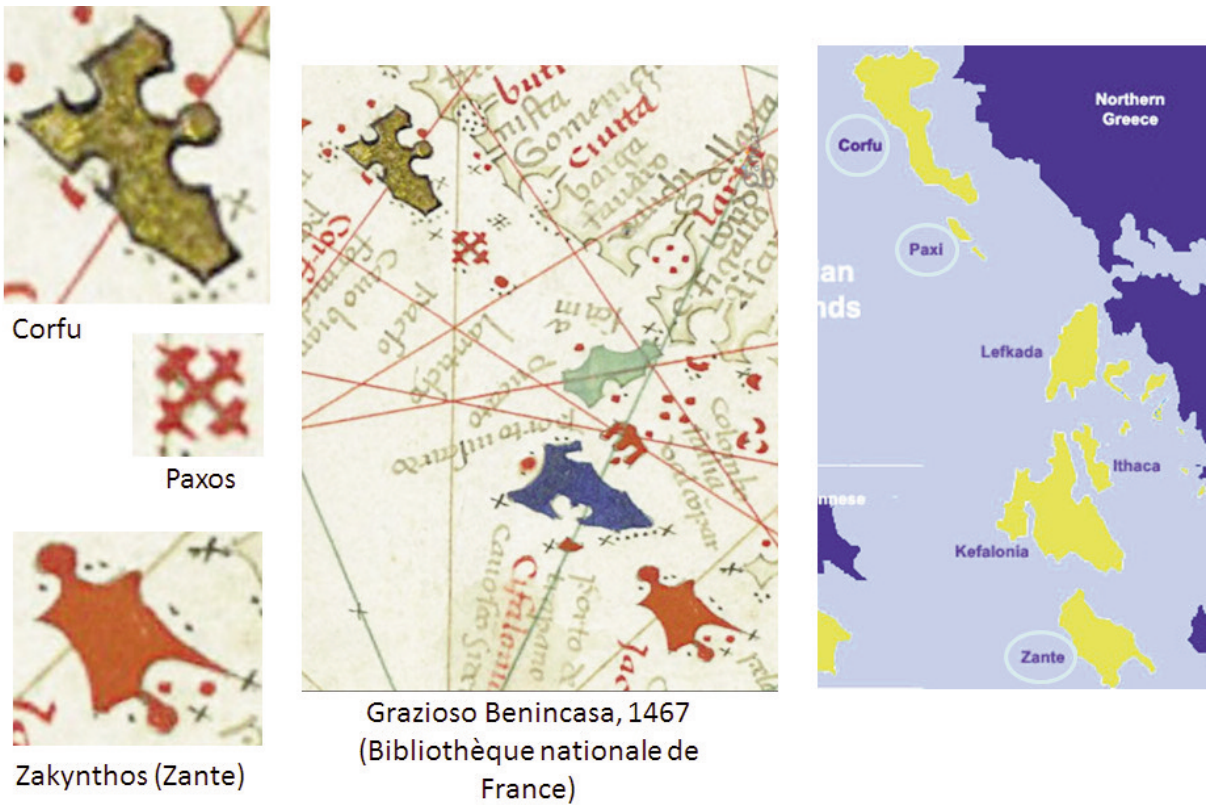


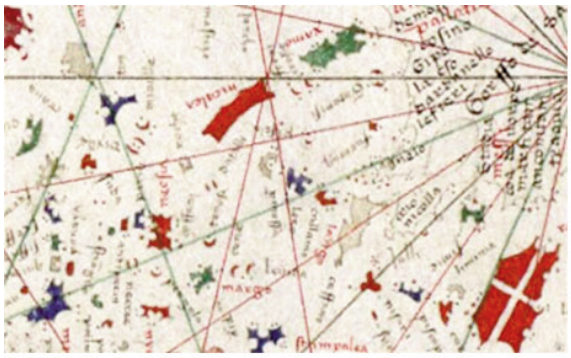
Figure 6 : The Ionian Islands.

Benincasa 1466

Benincasa 1467

Both Bibliothèque nationale de France

Figure 7 : The islands and islets between Euboea (Negroponte) and Rhodes.



Francesco Beccari, 1403 (Yale University, Beinecke Library)

Grazioso Benincasa, 1467 (Bibliothèque nationale de France)

Vincenzo Volcio, 1598 (Bibliothèque nationale de France)

Figure 8 : Euboea to Rhodes: mnemonic shapes through the centuries.

Figure 9 : Standard colours for the compass directions.

Figure 10 : The mnemonic Aegean shapes.

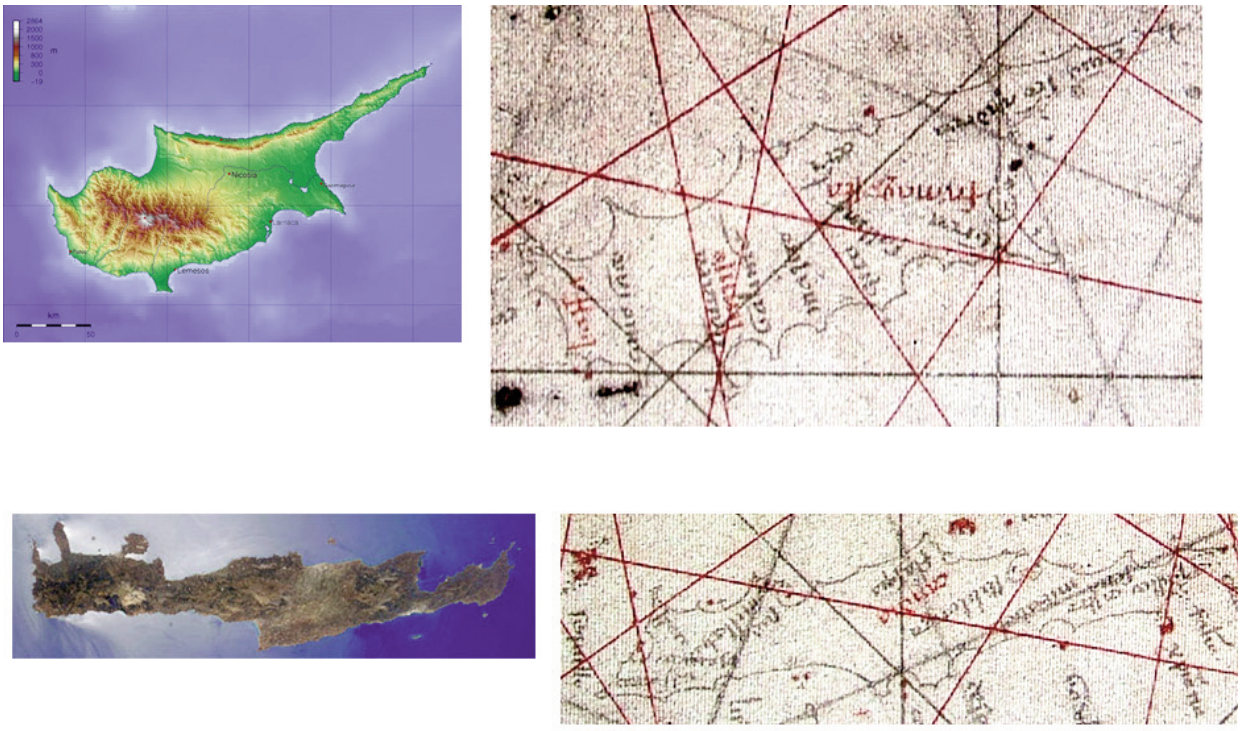
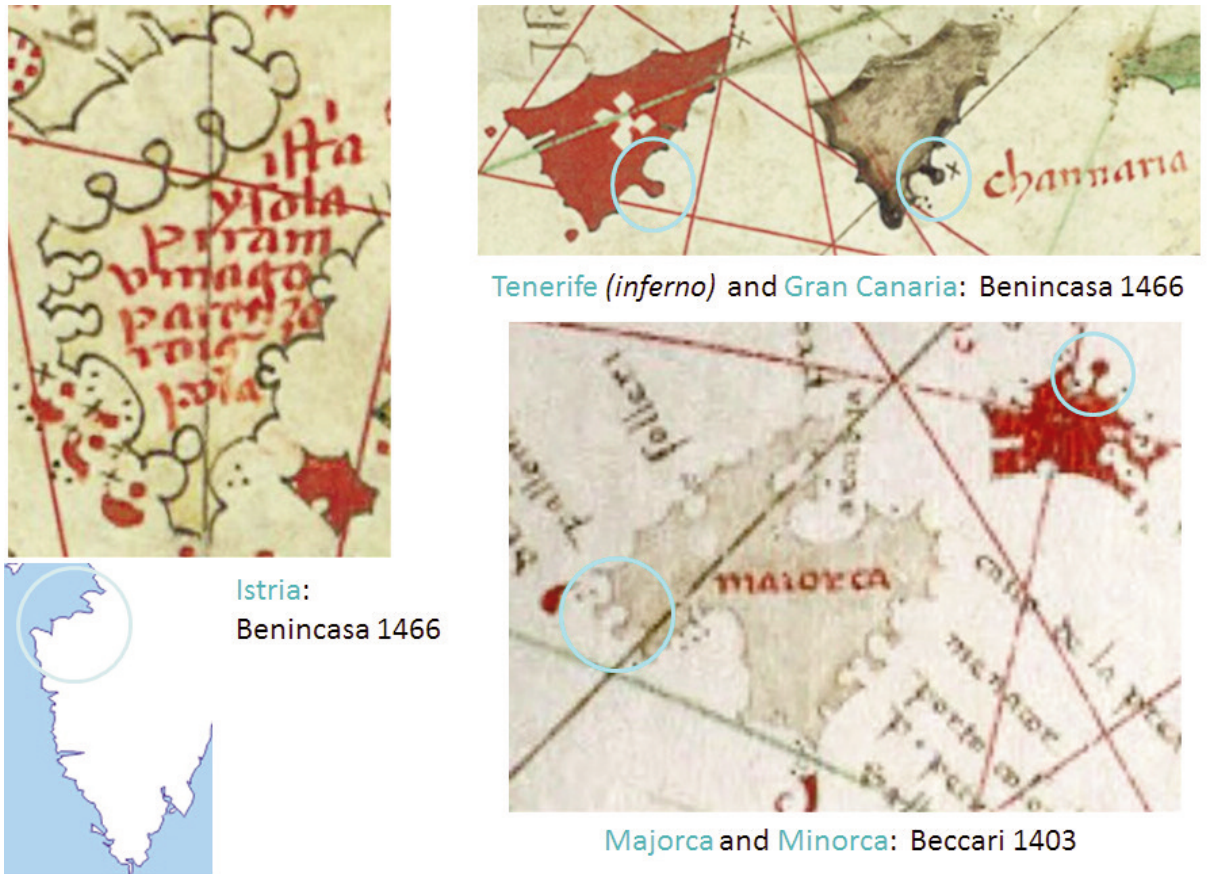


Figure 11 : Early outlines for Cyprus and Crete.



Tenerife *(inferno)* and Gran Canaria: Benincasa 1466

Istria:
Benincasa 1466

Majorca and Minorca: Beccari 1403

Figure 12 : Other examples of 'lollipops'.

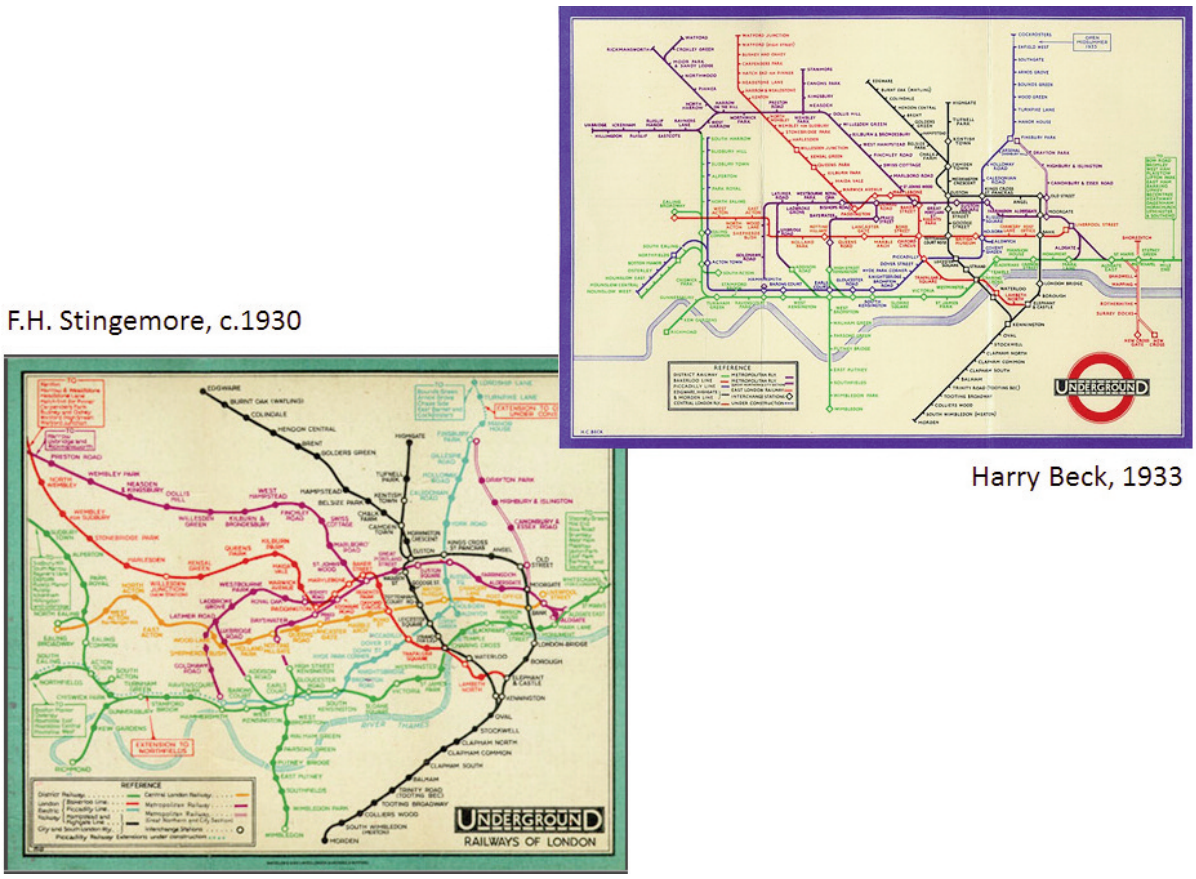


Figure 13 : The London Underground Map.

Figure 14 : The Sea of Azov showing navigational symbols.

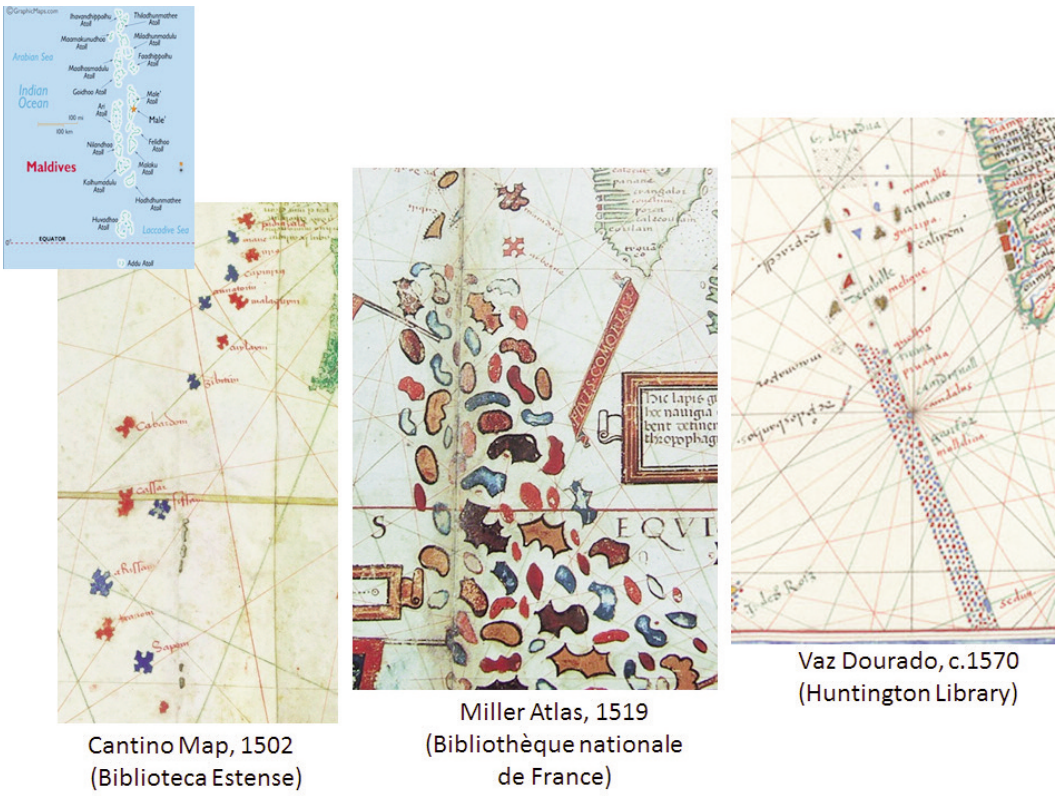


Figure 15 : Different ways of representing the Maldive Islands.

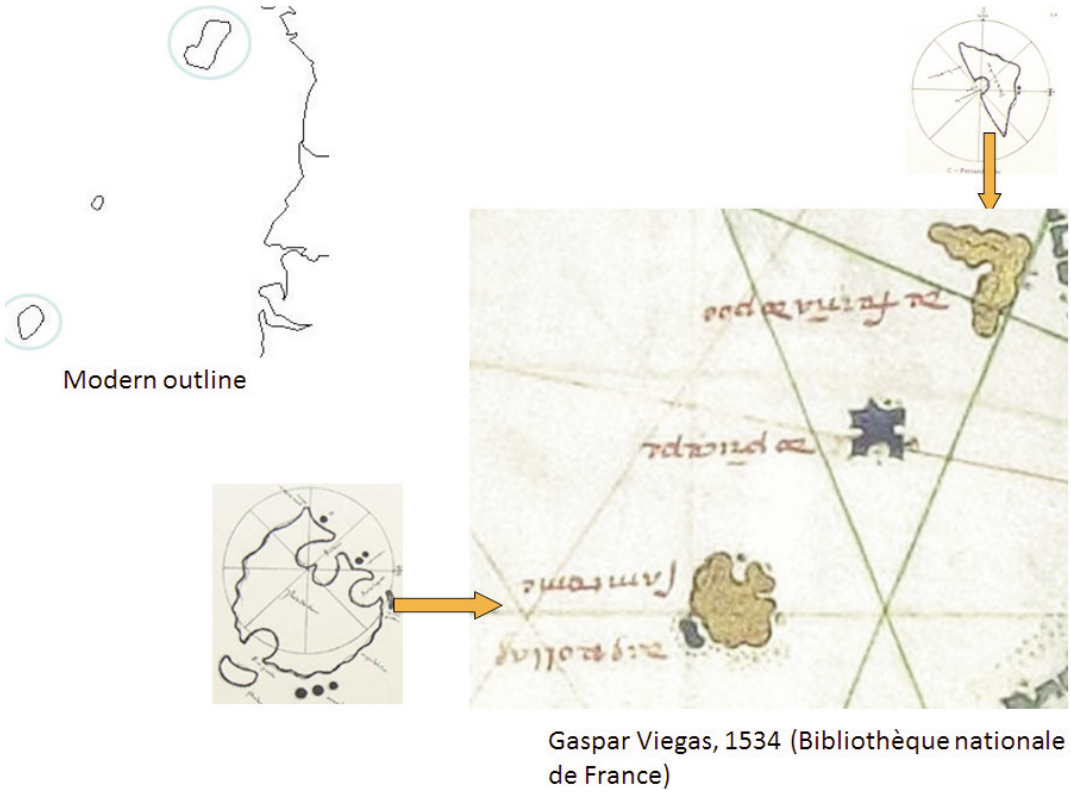


Figure 16 : Equatorial Guinea islands.

Figure 17: Potential mnemonic shapes around Madagascar.

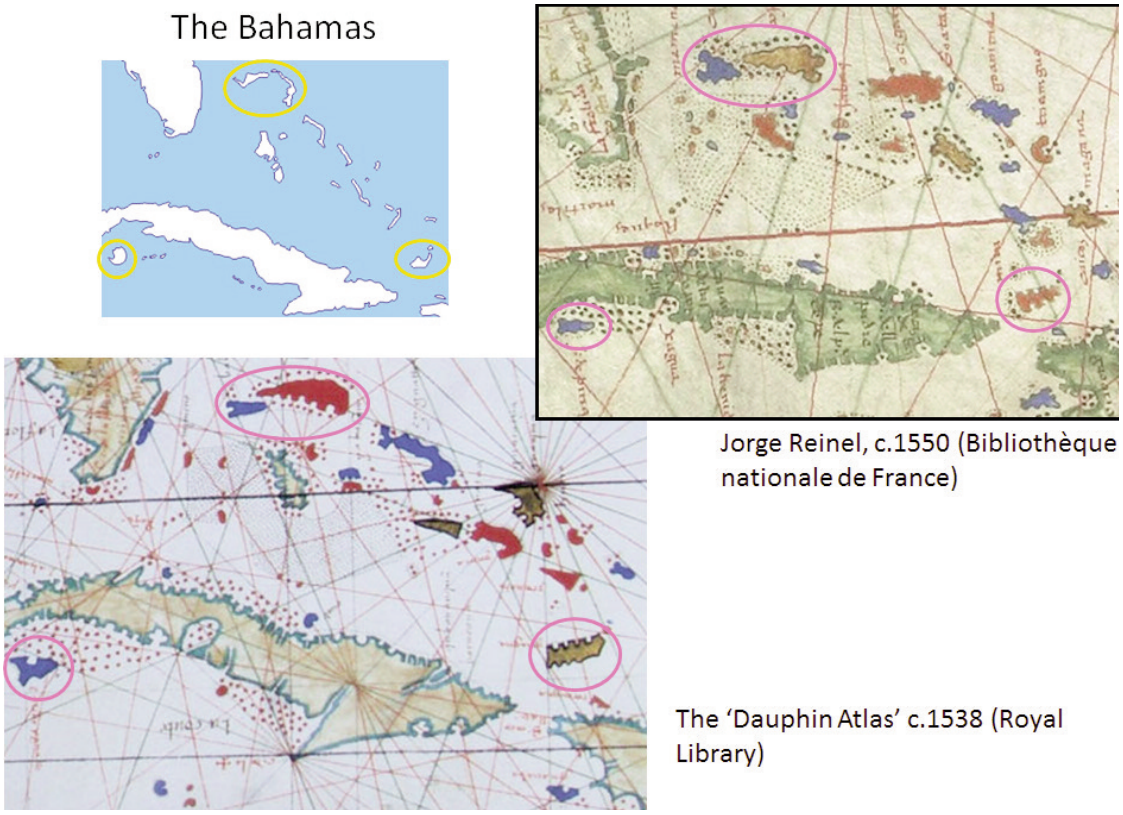


Figure 18 : Mnemonic shapes in the Bahamas.