

The day before April 1 2004, a remarkable book was published. Titled “The Vinland Map: A Short Summary”, it was written by students in another universe, and told the story of an ingenious but unsuccessful hoax which had attracted the amused attention of scholars for over 40 years. Of course the book itself was a hoax- but all the evidence it presented about the map was based on genuine research, including a great deal of work from the 1960s which was in danger of being forgotten or misunderstood, plus some recent image comparison experiments that could, and probably should, have been done in the late 1950s. The hotly-disputed chemical composition of the ink is by no means the only clue that the Vinland Map is a fake.

What you are now reading is a condensed version of the evidence presented in “The Vinland Map: A Short Summary” (without the “other universe” jokes, but looking rather more colorful). This text has also been revised to take account of some of the very latest research, published since April, and other significant information I was not aware of when I wrote the book (including one or two little things I should have been aware of, but missed).

THE VINLAND MAP

AN EVEN SHORTER SUMMARY

by David J. Bradbury

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CONTENTS

1	Introduction
2	The challenge of the map
2	Strange relationships
4	The Aegean
4	Western Europe
5	Eastern Africa
6	Fortunate and Unfortunate Isles
7	Rivers
7	Three extra islands (times two)
8	The philosophy of forgery
9	The Great Ink Debate
12	The 2002 revelations
13	Whoandwhydunnit?
15	The uncertainty principle
16	How to make a Vinland Map?
16	Appendix 1: The provenance of the manuscripts
19	Appendix 2: The Stefansson and Resen Vinland maps
21	Notes on sources

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This book is dedicated to Orson Welles and Bilbo Baggins.

For this revised edition, many thanks to Ken Towe

INTRODUCTION

In 1995, two scientists who had become involved in the study of the Vinland Map over 20 years earlier, were invited to an "informal discussion", to be held the following February. As there was no new evidence to consider, they both declined. What they were not told was the context for the discussion- the publication of a new edition of the 1965 book "The Vinland Map and the Tartar Relation", with added essays, to which they had not been invited to contribute. And what these two scientists, Walter McCrone and Kenneth Towe, had in common was that their research indicated that the Vinland Map was a 20th century fake. Learning about the new book shortly before the discussion was due to take place, they changed their minds, and on arrival were handed the official press release: "New Edition Vindicates Controversial Vinland Map". A good way to start a discussion, informal or otherwise? It was a fairly cheap trick, one of many in the story of the Vinland Map, as historian Kirsten Seaver has revealed in her recent book on the subject (though she gets the above story slightly wrong!). This "shorter summary" is less about such tricks than the actual evidence about the map, as revealed and interpreted over the past four decades. Academic arguments don't stay behind locked doors, and mistakes can probably cause genuine damage to reputations- or to look at it from the point of view of the next person in the chain, exposing your rivals' mistakes can cause genuine damage to their reputations. The Vinland Map blame-chain is at present wrapped tightly around the practitioners of Big Science, the folks with the lasers and the proton beams, but there's much more to the story than that. This short work attempts to summarize (with acknowledgment of arguments and criticisms) the major indications, over many different disciplines, which make it almost unavoidably apparent that the Vinland Map was not drawn in the Middle Ages- that indeed the perpetrator, if young at the time the forgery was made, may still be alive and giggling in 2005.

THE CHALLENGE OF THE MAP

About 1437, probably for use at the Council of Basle, a major conference to discuss strategies for the Roman Catholic church (and the future of Christianity worldwide), a scribe made a new copy of the multi-volume "Speculum Historiale" by Vincent of Beauvais, which, though written nearly 200 years earlier, included much material of relevance to the delegates. The date and place can be fixed with reasonable precision because of the way the one known surviving volume of the set was constructed. To save costs, each quire of pages for sewing into the binding consisted of a sandwich, in which two sheets of expensive but very durable parchment protected six sheets of cheaper but damage-prone paper. The paper was watermarked, and seems to have been manufactured in one of the papermills used to supply the Council. In addition, as a further cost-saving exercise, the "pastedowns" which attached the mass of pages to the covers were made from recycled parchment that had writing on the side to be pasted, including at least one piece of official correspondence, complete with date, 28 July 1437, and other information tying it to the Council of Basle (reconvened in northern Italy a few months later as the Council of Ferrara, for detailed discussions with the Greek Orthodox church, although some bishops remained at Basle and rebelled against the Pope). When the surviving volume was subjected to unusually intense study in the 1960s, even though the "pastedown" writing was not immediately revealed, the other evidence, in combination with the actual subject matter, gave it a clear and logical context. The context was important, because the scribe had made one or two unusual additions to the volume in question. The phrase "one or two" is being used with precision here- the "one" was the short piece called the "Hystoria Tartarorum" (translated as "Tartar Relation"), confirmed as genuine by the recent discovery of an older manuscript, but the "or two" is the remarkable artifact known as the Vinland Map.

The story of how the medieval volume arrived (in pieces) in New Haven, Connecticut, is interesting and possibly very significant, but its interpretation is very much a matter of speculation, so it is given here as Appendix 1. For now let it suffice to say that the Vinland Map attracted both excitement and deep suspicion, so when Yale University had the opportunity to acquire it, a very detailed study was called for. Within the core team of three men chosen to assess the Vinland Map and the Tartar Relation, the map specialist was Raleigh Skelton of the British Museum (usually known as Peter Skelton). He was probably one of the greatest living authorities on world maps from the Age of Discovery, and in addition to comparing the map with others in the Museum collection, he took advantage of a seven-month sabbatical as map consultant to the library of Harvard University from 1962-3 to study it more closely while writing up his report. The report as published, in the book "The Vinland Map and the Tartar Relation", mentions a great many observations which troubled Skelton (he even chose to call the map material vellum, though it looks like the cheaper parchment) but it seems that at the time neither he nor his colleagues could think of an effective way to investigate them. Additionally, some were presumed to be the products of their overactive imaginations.

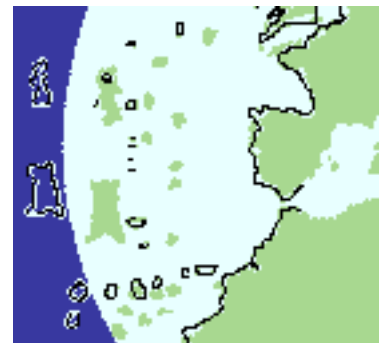
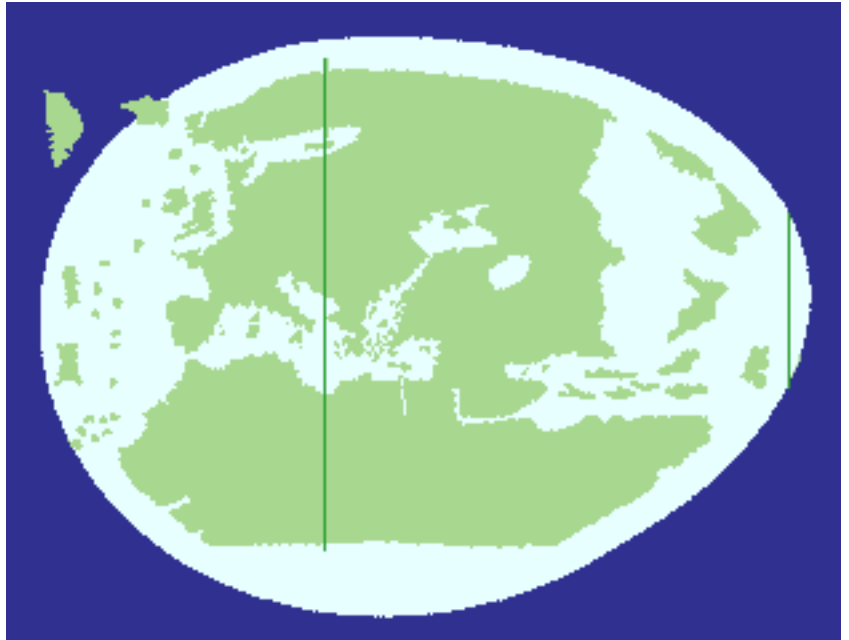
STRANGE RELATIONSHIPS

It was quickly established that the map was somehow related to a circular world map of 1436, by Italian navigator Andrea Bianco, but the nature of the relationship perturbed Skelton. He noticed, for example, a very small problem that happened to be rather close to his heart- the depiction of Great Britain, curiously stretched and askew, less reminiscent of Bianco's map than of a map by Henricus Martellus made half a century later. Martellus had a good reason for his odd depiction- he was using a trapezoidal map projection, quite good for small areas of the Earth's surface, but prone to shape distortion at the left and right edges. The Vinland Map should have shown a different sort of distortion in its adaptation of Bianco. Later research has revealed more and more areas of unexpected distortion; showed indeed that the relationship between the Vinland Map and the Andrea Bianco map was

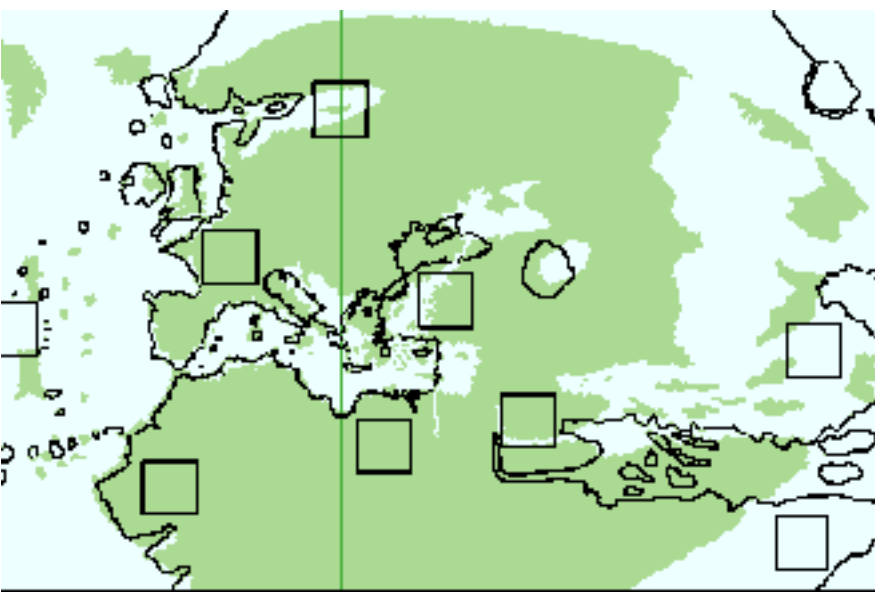
extraordinarily complex. In the illustrations which follow, direct comparisons are achieved with computer graphic tracings of the best available images of the two maps. For technical reasons, the Bianco map is represented as a black outline (with reference squares added to show the distortions), while the Vinland Map is shown as green/gray shading, with a thin line indicating the page fold. The technical reasons relate to the method used to show how areas on the Bianco map need to be trapezoidally distorted to match the Vinland Map- projecting an old-fashioned slide of the Bianco outline (albeit directly generated from the computer image with a laser printer) onto a printout of the Vinland Map computer image, from unusual angles. Unless otherwise stated, all images distorting the Bianco map outline are photographs of projected slides.



To understand the relationship between the maps, it is perhaps easiest to start with the overall shape of the Old World (Eurasia and Africa) as depicted on the Vinland Map. Eva Taylor, the great historian of the art of navigation, who was consulted during the assessment process, thought the map might have been constructed on a rather suspiciously sophisticated elliptical projection, but ultimately, the shape that best fits round the Old World (ignoring for now the problem of southern Africa) is an egg, with the big end at left. If that egg is expanded slightly as shown here, like the celestial frame bounding the great Ocean on an early-medieval world map, it can enclose all the islands copied from Bianco (but more expansion would be needed to enclose Iceland, let alone Greenland and Vinland). Or rather, it can enclose the Vinland Map version of Bianco's islands- but it could not enclose the same islands as Bianco drew them. The VM artist has perverted Bianco's substantially correct depiction of the seven major Canary Islands into short rows, and has also moved the great mysterious islands of the mid-Atlantic (which may themselves represent pre-Columbian knowledge of America) well to the east. Bianco had redesigned his map specifically to allow for the great distance to these islands, but the VM artist, despite having no confining celestial frame, and despite the great expanse of blank parchment to the west, chooses to cram the Atlantic islands into a narrow strip. It is most likely that this slightly expanded egg-shape is the ghost of an actual physical frame or mat (in reality perhaps not quite such a neat fit as shown here, of course) within which the bizarre process of converting Bianco's World to the Vinland Map version was conducted. Use of such a frame would also explain why the map as drawn, with the odd flattened south coast of Africa, does not occupy the full height of the page.

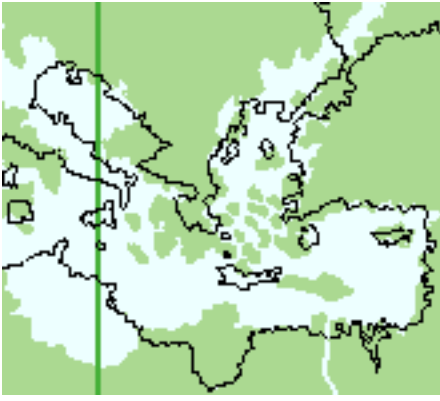


Another "invisible" feature of the Vinland Map is the way it deals with the page fold. Andrea Bianco paid no attention to the position of the page fold when drawing his map, except insofar as he placed the bulk of the landmass on a single page; he was quite happy, within that arrangement, to draw details crossing the fold. The Vinland Map artist, on the other hand, was very sensitive to the fold position; no place-names cross the fold, but five start or finish right next to it; the Adriatic Sea appears to have been deliberately widened to that neither Greece nor Italy has to touch the fold. Even some of the mysterious re-routing of rivers (to be discussed later) may relate to the fold- only the river running westward from the Nile crosses it, whereas several European rivers would do so if Bianco's geography was adhered to. The only map detail which does avoidably cross the fold is the island in the upper part of the Baltic Sea. This does not necessarily prove that the map was drawn after the fold was made, but microscopic study could probably settle that question, perhaps even giving an idea of how worn the fold was when the ink lines which do cross it were drawn.



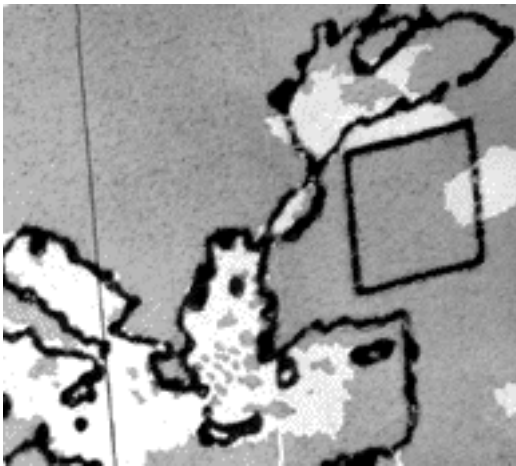
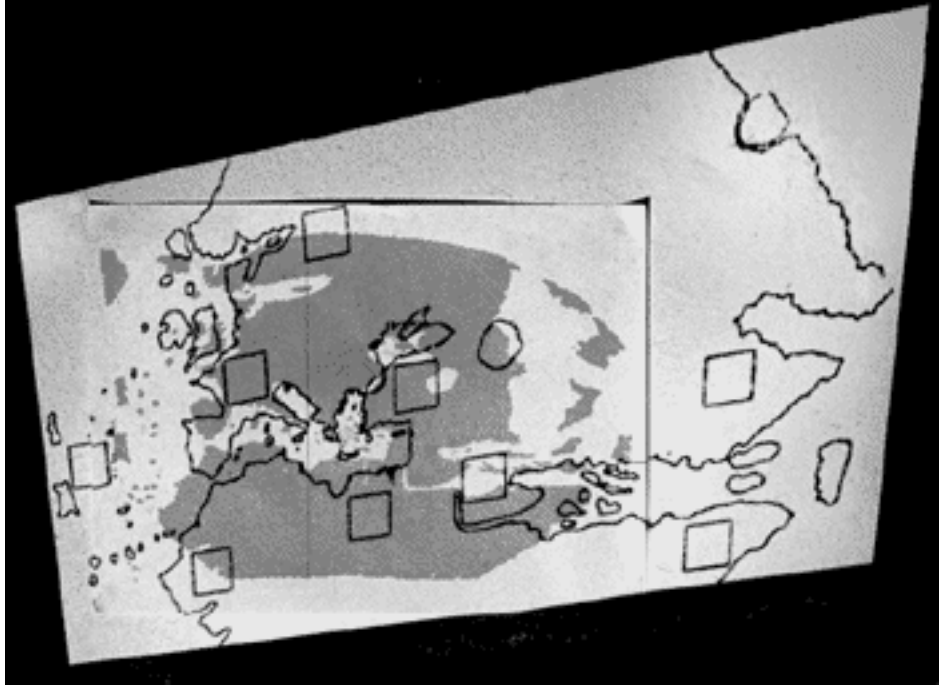
A further oddity swiftly noticed by Skelton was the fact that the geography of Bianco's world has not been stretched sideways in the change of shape from very-rough-circle to egg-shape. Instead, the great northern and southern curves of Eurasia and Africa have been compressed. In truth, as shown here, the east-west extent across Africa has actually been decreased relative to the north-south extent of the "geographically significant" coastline from Scandinavia to the abrupt southern end of Africa. Leaving aside the

correction of Bianco's apparent mistake about the size of the Baltic Sea, there are many anomalies of scale in comparisons between the two maps, in addition to the trapezoidal distortions. If we arbitrarily take the scale of the distance from Scandinavia to the bottom of Africa as "standard", for example, then Arabia has been copied roughly at the same "standard" scale, but the east-west scale along the nearby African coast from its eastern extremity to the prominent pair of capes in the coastline is only 70% of "standard". At the other extreme, the north-south scale from Cyprus to the Bosphorus is 140% of "standard".



THE AEGEAN

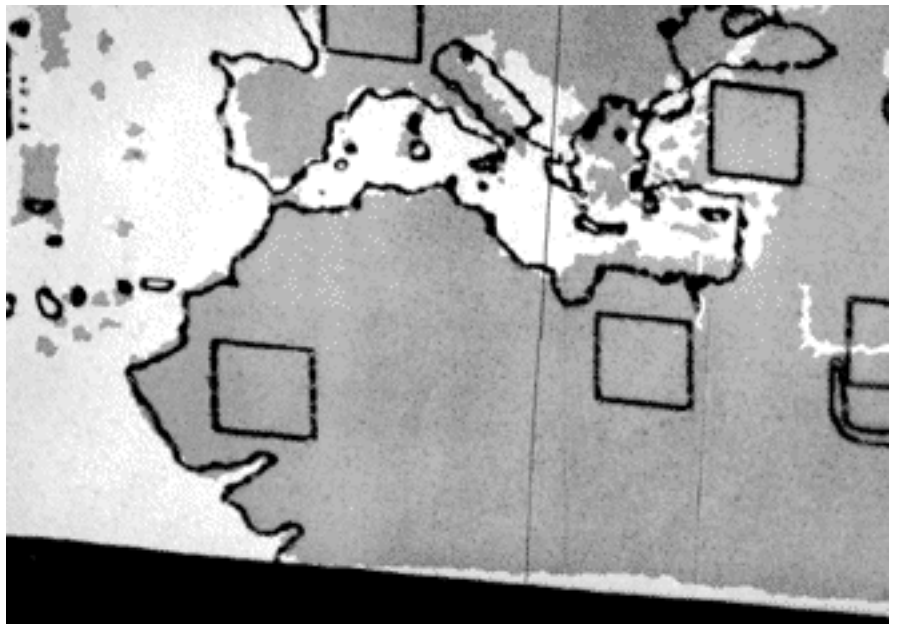
In fact, the Aegean and Sea of Marmara provide the most spectacular example of Skelton's trapezoidal distortion, allied to that mad exaggeration of scale. In the direct computer superimposition above left, the scale has been matched to give roughly correct distances from the north-east corner of the Mediterranean, south to the south-east corner, and west to the south-east corner of the Aegean (which also gives roughly the correct width for the southern end of the Aegean). The Vinland Map version of Greece, the Aegean and the Sea of Marmara is not only on a far larger scale, it smoothes out the north coast of the Aegean and denies the existence of the Dardanelles.



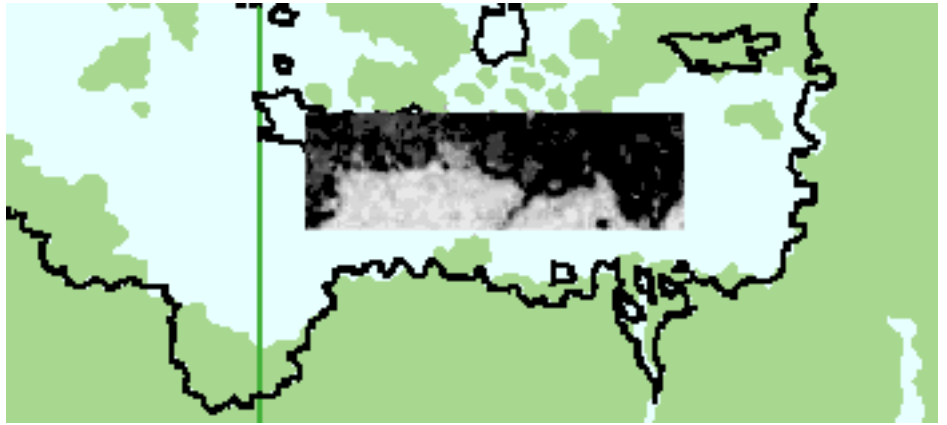
As Skelton pointed out in his report, the Vinland Map maker liked to embellish his coastlines. Bianco did too, making little random scallops all the way along, but on the Vinland Map the scallops have become wiggles, and nearly every cape and bay is also slightly exaggerated. Allowing for this exaggeration (particularly in the depiction of the Peloponnese) it can be seen that with the slide projector in the right strange position, every major feature along the east coast of the Adriatic and the west coast of the Aegean and Sea of Marmara can be made to coincide almost exactly (apologies for the coarseness of the slide image, but comparison with the previous computer-generated image should clarify what is being shown where). The reference squares on the Bianco slide, however, are far from square, and the entire slide image, which ought to be a 3 x 2 rectangle about the same width as the Vinland Map image, looks very large and very oddly-shaped, as shown above. With the projector in this position, the eastern shores of the Aegean and Sea of Marmara are also at roughly the right scale, but the wrong shape, while the Black Sea is too large and hopelessly distorted.

WESTERN AFRICA

The whole of western Africa can be matched in two sections, divided at the page fold (it seems likely that the artist drew the straight southern coast of Africa with the western coast). As usual, the distorted projector superimposition matches distances and angles between major features, but those features are depicted in slightly different ways. The eastern section is a bit more challenging. Andrea Bianco placed the Gulf of Sidra too far east on his map, but the Vinland Map restores it to roughly its correct position, south of the Adriatic. There are two ways this could have been done; either by enlarging the scale of the south-east Mediterranean section, or by adding an entirely new section. Either way, part of the coastline further west would have to be lost to compensate. Finding the lost section is relatively simple, if rather



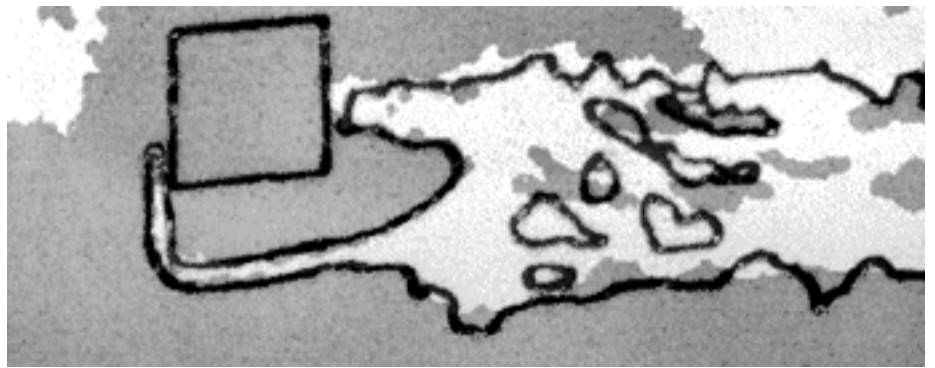
surprising- the large eastern bay of the Gulf has vanished from the Vinland Map. The appearance of a fictional promontory on the coast to the east of the Gulf suggests at first that a new section of coastline has been inserted, but as the pictures here show, the reality may be another surprise. If the eastern section of the Mediterranean is enlarged, various features unexpectedly line up; notably the mouth of the Nile, which would thus become the only river to terminate in the same place on both maps. The added



promontory lines up with an odd piece of careless artwork on the Bianco map, where both the scalloped line depicting the coast and the blue-green color of the sea have been smudged into a pale patch (inset). This computer superimposition does not have any trapezoidal distortion; bearing that in mind, take a close look at the eastern end of the Mediterranean.

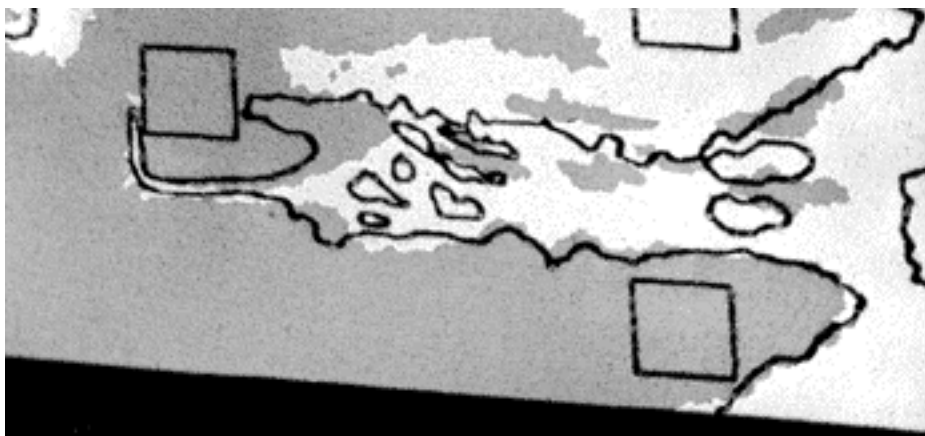
EASTERN AFRICA

More strange things happen in eastern Africa, as shown in the photos here. Matching the distance from the Red Sea to the eastern extremity of the continent (photo below), the pair of capes right of the middle occur at pretty much the correct distance from either end, but the length of relatively featureless coast between those capes and the major bay further left is very different on the two maps; further-



more, the size of the Arabian peninsula is dramatically different (the Red Sea is also longer on the Vinland Map). When the Arabian peninsula is expanded to its correct size (photo above), the major bay on the African coast is in roughly the correct position, and although the bay features seem different, the coast realigns further east. Apparently, this coastline, just like the western African coast discussed above, is made from two separate components at different scales, which have been joined together at a bay by a short length of freehand drawing.

The trapezoidal distortion applied in the eastern Africa match photo below is relatively minor (just enough to make the angle between the north and south-east coastlines roughly correct) because its main purpose is to illustrate another remarkable oddity. Just as it is about to be obscured by the dark frame of the Bianco map slide, the



south-east coast of Africa on the Vinland Map abruptly changes direction and heads more to the west than the Bianco version. Looking back at page 4, you will see that on the west coast of Africa the slide frame cuts off the Bianco map at the same inlet where the Vinland Map begins its unusual straight southern coast for the continent. Is it just coincidence that, although the south-east coast of Africa is much longer on the Vinland Map than on Bianco's, it is drawn as a fairly smooth curve except at this one point?

Besides which, why does the Vinland Map give Africa a straight southern coast, instead of continuing the curve to complete the egg-shape? It even names a feature on the coast, the "Sinus Ethiopicus" (Ethiopian Gulf) which ought to be drawn as, well, a gulf- a large indentation in the coastline. Bianco's map does show such a gulf, but uniquely names it "Nidus ahimalion", possibly meaning "nest of dragons" as such creatures are pictured there. The only vague medieval parallels to the Vinland Map's "straight line" occur on maps with straight-sided enclosing frames, or on works such as Leardo's world map of 1448, which has, at about the same latitude, major gulfs in both east and west coasts of Africa, almost cutting the continent in two.

FORTUNATE AND UNFORTUNATE ISLES



The mystery deepens when you take a closer look at the Canary Islands. Although, as noted on page 3, the Vinland Map appears to cram the seven islands into rows in order to stay within an invisible egg-shaped frame, it really didn't have to; the innermost island is actually shown further away from the African coast than on Bianco's map (or almost any map you care to examine). Skelton was ultra-cautious at this point, but four decades on, we can be somewhat bolder; they look more like the Cape Verde Islands than the Canaries. The impression is reinforced by the slight exaggeration of the cape to the north-east of the islands, which makes it look a bit like Cape Blanco, so if the cape south-east of the islands is taken to be Cape Verde itself, the map seems to be depicting Africa more-or-less as we would now expect to see it, with the coastline turning more south-easterly beyond Cape Verde.

In reality, this was not the way the continent was perceived around 1440. Prince Henry of Portugal sent ship after ship south along this coast with instructions to find the River of Gold and the place of the Silent Trade, rumors brought to him by the Muslim traders who moved freely through northern Africa, and still had a European toehold at Granada. The Silent Trade was a system for fair trading between merchants who were not fluent in each others' languages, and promised to open up vast riches to the first Europeans who reached the area, a river on a great gulf somewhere in the southern part of Africa. One problem for the Portuguese navigators was the Sahara Desert; beyond the Canary Islands, the African coast was almost completely barren, and they hadn't even reached the really hot lands where the summer sun shone from straight overhead. Another problem was what is now known as the North Equatorial Current, which made it much more difficult to return from those latitudes than to reach them. A key turning-point, hardly visible on the map but a reef-infested place of terror for sailors, was rounded in 1434. This was Cape Bojador, and not far beyond was found an inlet with a small settlement, which for a time was thought to be the mouth of the River of Gold. Cape Verde was not reached until about 1445, and the islands, some 550km off shore, over a decade later. The strange ambiguity of the Vinland Map, converting the Canaries into a vague imitation of the Cape Verde Islands, simply does not ring true.

A study of the names given to the various Atlantic island groups adapted by the Vinland Map artist from a Bianco-style prototype is also interesting. They are not named on Bianco's circular world map, but another of the charts in his 1436 atlas identifies every island. It is understandable that the Vinland Map chooses to name groups rather than individual islands, but the labels chosen are quite intriguing. The Vinland Map is unique in labeling the Azores and Madeira groups jointly as "Desiderate insule", which G. Crone suggested might relate to the name "Insule deserte" occasionally given to a couple of the Atlantic islands. The use of a version of the old Roman name "Insule fortune" for the Canaries (or imitation Cape Verde Islands) is actually quite amusing, because some late 15th century maps, such as Martin Behaim's beautiful globe made in 1492, do give this name to the Cape Verde Islands instead of the Canaries! Similarly, Behaim and others abandon the two very large islands shown by both the Vinland Map and Bianco to the west of the Azores (named Antillia and Satanxio in Bianco's atlas and on most other maps of the period), but give the name St. Brendan's Island to an equally mythical island of similar size and rectangular outline, west of the Cape Verde islands. The name "Brazil" (oddly Latinized on the Vinland Map as "Branziliae") is another cartographic wanderer sometimes associated with St. Brendan; it was originally used for the circular island shown on medieval maps off the Irish coast, but later attached to other islands further out in the Atlantic, and finally, of course, to the South American mainland.

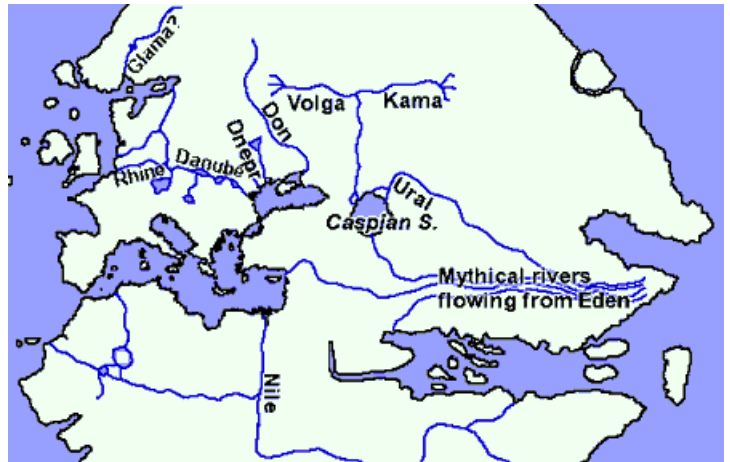
Skelton studied all the names and captions on the map in great detail, with the help of George Painter, the team member concentrating on the Tartar Relation (by the bye, the team members themselves felt that the actual handwriting on the map was the same as the handwriting of the Tartar Relation and "Speculum", albeit much smaller, but specialist paleographers disagreed, finding numerous subtle differences). Apart from the above islands, most names within the "familiar" parts of the Vinland Map are fairly easy to trace; indeed the majority are just latinized versions of the same names Bianco uses. Notable exceptions are "Maori" in the middle of what we would call the Sahara Desert (perhaps a misplaced Mauritania or a miscopied name containing "maioris", mused Skelton), "Nimsini" as an alternative name for the Himalayas (Skelton clutched straws) and "aben" for southern Spain (best guess- a reference to the power-broking dynasty of the Aben Cerrajes, who struggled to stop the Islamic state of Granada from becoming a puppet of Catholic Castile, which it finally did in 1492). Castile itself is not named; nor is Portugal, which at the time of the Basle conference was the major player in attempts to outflank the Muslim world by developing sea power (that Bianco also omitted it *should* be irrelevant, but probably isn't). Some other names not adapted from Bianco's map are found in standard sources such as Ptolemy's "Geographia", which after being translated from Greek to Latin became the basis of a "new" style of map in the 15th century (based on the coordinates and instructions Ptolemy had written over a thousand years earlier). Bianco's atlas includes a Ptolemaic world map as well as the more famous circular version, but it only features selected names from the ancient list.

In Asia, many names are taken from the Tartar Relation- or to be precise, as Skelton and Painter noticed, from the first few pages of the Tartar Relation, as if the artist ran out of time or patience. To be even more precise, they are taken from the first few pages of the actual copy of the Tartar Relation which they accompany, mistakes and all. For example, researcher Robert Stonehouse has emphasized a point left open for debate by the cautious 1960s team, about the place-name "Apusia" which appears on the Vinland Map roughly where we would now expect to find

eastern Germany. The Tartar Relation is not strong on capital letters for proper names, so its opening page appears at first glance to contain the word "apusia"- but the T.R. frequently uses small superscript letters, and on closer inspection and consideration of the sense of the Latin, it becomes apparent that we are actually seeing the two words "a prusia", meaning "from Prussia". The \$64,000 question is- how did the VM artist manage to put such an unrecognizably misread name in almost the right place? To double your money, consider the problem that the location is much more correct for the 20th century definition of Prussia than the medieval one. In other cases, as with the tribes of Gog and Magog, it seems that the cartographer is simply pretending to make a map, pepper-and-solting the blank parchment with names almost at random, completely ignoring the location details given in the Tartar Relation text.

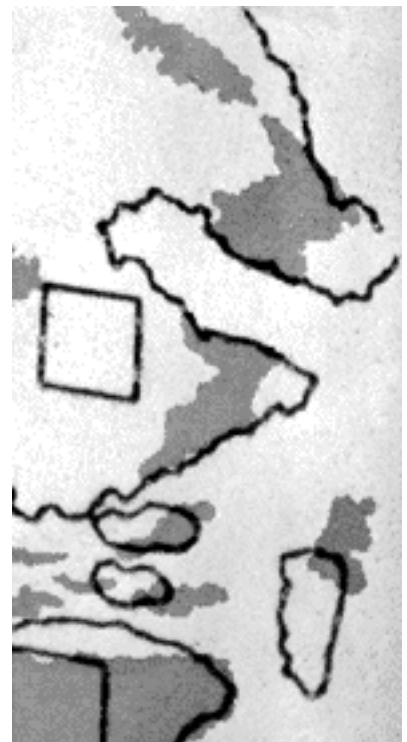
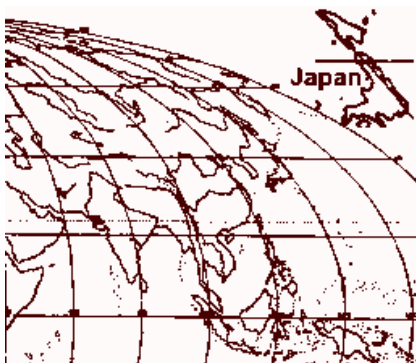
RIVERS

The Vinland Map artist skimps as much on rivers as on place-names, but what's really remarkable is that they appear to present a deliberate challenge to Andrea Bianco's geography. One aspect of this is understandable, the removal of the four great legendary rivers flowing out of the Garden of Eden- but other changes are quite mysterious. The addition of a second major river at the south-east of the Caspian Sea leads to speculation that perhaps the artist is here thinking of the Aral Sea (as it happens there was genuine confusion over the rivers and seas of central Asia among medieval cartographers, so this may be forgivable), while in the case of the Dnestr, there seems almost to have been a willful choice to highlight the only major Black Sea river not given adequate prominence by Bianco. Similarly, there seems to have been a conscious decision not to use a Bianco-type rendering of the (mythical) branches of the Nile west across the Sahara. The river "Tatartata" on the Vinland Map is another of the artist's careless borrowings from the first page of the Tartar Relation, in which the two words "tatar tata" happen to be adjacent at a sentence break with a missing full-stop (two "mistakes" in copying from the first page seemed very significant to the likes of Robert Stonehouse; as if the map artist was deliberately emphasizing links between the map and the attached manuscript).



THREE EXTRA ISLANDS (TIMES TWO)

Right; we can't put it off any longer. At the top right of the Vinland Map are drawn three large islands, which do not appear on Bianco's map or any other of the period. Two of the three, however, loosely but worryingly resemble the islands one would find in the same location on a modern world map. The third lacks most of the distinctive features of its modern equivalent, but is still very roughly what one would expect to find in its particular position. One problem with the two "recognizable" islands is that they are out of scale relative to each other, the larger appearing too small; also they are recognizable from two completely different types of map- one from its very angular depiction at the north-east of an oval/elliptical world map, the other from a locally centered map. On the Vinland Map these islands are called "Postreme insule" and "Insule Sub aquilone zamogedorum" (though depicted quite a long way from the far northern home of the Samoyed people), while the vaguer third island has no name. Between the two northern islands and mainland Asia the sea is labeled "Magnum mare Tartarorum". Bizarrely, although there is space at the top right corner of the page, these islands (which have nothing at all to do with the Tartar Relation, or even the great "Speculum Historiale") have been added to the map by turning about a third of the Asian landmass into sea. Even more bizarrely, the two southern islands can be shown, using the slide projector, to have been drawn using parts of the coastline of two peninsulas on the



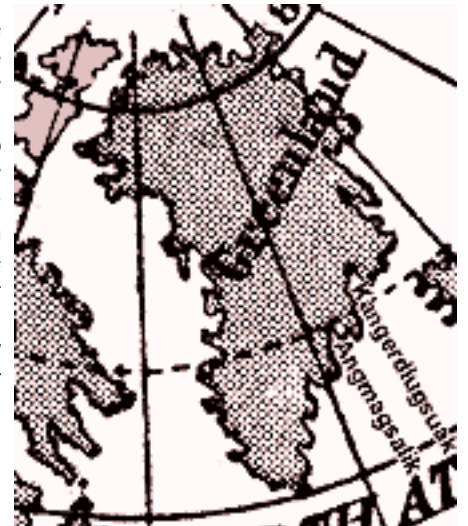


Bianco-type map (within the egg-frame). This was very hard indeed to explain as a legitimate operation- the best offer was that the original Bianco-type map had been in full color, like most medieval world maps, and for some reason the western part of Asia (presumably including the tips of the two peninsulas, but not the areas which came to be rendered as islands) was painted almost the same color as the sea; green jungle, perhaps. A confused copyist had then rendered the non-green parts of the peninsulas as islands when making the original version of the Vinland Map, and names were added at random to fill up empty space.

But that doesn't explain the similarity which Skelton swiftly noticed, to the islands we would call Honshu, Hokkaido and Sakhalin, the latter two enclosing the Gulf of Tartary. Still less does it explain why a similar pattern is repeated on the opposite side of the map, with the two now-familiar islands of Iceland and Greenland (one rather flattened, as it would appear near the north of an oval/elliptical world map, the other more as it would appear on a locally centered map) plus the less recognizable, more vaguely drawn Vinland. Skelton was startled by Greenland; Eva Taylor, when she was consulted in 1962, was outraged. At that time, no sea-voyage round Greenland had ever been recorded (the northern coastline was mapped with 20th century technology), and Scandinavian accounts from before 1400, possibly with much earlier origins, indicate that the Arctic ice-cap effectively joined Greenland and Russia to create a vast frozen wasteland over the North Pole. The earliest known map to include Greenland, drawn in 1427 by Claus Claussøn Swart (in Latin, Claudius Clavus Niger; a Dane who had arrived in Rome in 1424, and made at least two Ptolemaic-style maps of

northwest Europe, of which the 1427 version was for Cardinal Filiaster) showed it in exactly that way, as the end of a peninsula curving round north-west then south, from east of what is now called the Barents Sea.

Even in the mid-13th century, before global cooling really got under way, the most detailed early text on the geography of Greenland, in a remarkable compilation called the "King's Mirror" (*Speculum Regale*), addressed very specifically the question "is Greenland an island?", with a detailed explanation which boiled down to "nobody knows, but probably not". The only people who were sure it was an island seem to have been those, such as 11th century cleric Adam of Bremen, who knew of it only at second- or third-hand, but adhered to a view that beyond the European coast there were only islands in a great ocean encircling the single world landmass. Yet the compiler of the Vinland Map, supposedly working for the Catholic church a few years after Clavus, chose to draw it, quite correctly, as an island, in roughly the shape shown on modern maps. Skelton was badly let down by the artist who drew the sketches comparing the Vinland Map version with modern knowledge for the 1965 book; he had plausibly identified some of the coastal features with actual inlets, but the "modern" sketch showed major inlets as shallow bays, and added insult to injury by mislocating some of the place-names (*and* chose to omit neighboring Ellesmere Island). The map here, from a 1920s original with two misplaced names added, shows Greenland in more useful detail.



On the subject of defects- a brief Greenland diversion. Taylor and the other experts consulted by the inquiry team seem to have kept their promises not to say anything about the existence of the map until after the report was completed. One expert who had not been consulted, Gerald Crone of the Royal Geographical Society, thus had his first impression of the Vinland Map from a printed photograph in 1965, and immediately he spotted something which should have told Skelton the map was made after Columbus within five minutes. Just south-east of Greenland, he saw an island which could not possibly have been shown on a map of 1440, because it was entirely imaginary, invented around 1500. At least he thought he saw an island; Skelton, an old friend, had the jolly task of explaining that it was actually the edge of a bookworm hole in the map (and he reported that Crone went rather pink in the face the next time they met). Of course, if you want to be really paranoid, maybe the Vinland Map artist positioned Greenland deliberately so that experts would wonder if the later invented island was inspired by this very wormhole...

THE PHILOSOPHY OF FORGERY

The bookworm holes in the Vinland Map are actually just about the best piece of evidence that it might be genuine, because in a couple of places they go right through the inked lines. In addition, they tie the whole "*Speculum Historiale*" volume together, because some of them go through every page (more on this later). They have, of course, been examined microscopically to check that they were not made with a drill or hole-punch. The direction of at least some of the holes through the volume suggests that they were probably not made by imprisoning bookworms on the ink-lines so that their only means of escape was to chow down. This matter does, however, lead us to some reflections on the philosophy of deception. To make a perfect forgery is almost impossible, particularly

if you are working several centuries after the purported date of the item you are forging. A large part of the forger's art therefore consists of psychological manipulation. Perhaps the most important aspect of this is that the people you are fooling must really want what you appear to be offering (a point to ponder while reading page 17) but the best way to deal with the problem of imperfections is, quite simply, to do as many impossible things as you can. Your victims will be so impressed that they will actually try to explain away your mistakes.

There are nearly always different viewpoints on what is and is not impossible. For example, all our awkward and not-wholly-successful attempts to match sections of the Vinland Map and the Bianco map with a slide projector were made from the viewpoint of an investigator, trying to find the one right configuration among an infinity of wrong ones. The artist had no such worries; whatever the reason for the distortions, the angle for each "jigsaw piece" could be chosen more-or-less at random, probably in a matter of seconds. Similarly, if the artist was able to find a convincing way of drawing ink lines across wormholes, the fact that nobody else can say exactly how it was done is irrelevant. Probably the best known example of this (the very best, of course, aren't known) has been provided by the notorious forger and murderer Mark Hofmann, who was interviewed in prison about the many ingenious techniques which had so consistently fooled the trade. He explained how he would make printing from modern photographically-prepared zinc plates look like hand-set letterpress work by filing and polishing down individual letters. To fool carbon-14 dating tests, he also devised an apparatus to create "lamp-black", the essential ingredient of black printer's ink, by burning paper which had been made at the correct date. He would even smuggle a different fake document with the same title as the valuable document he actually wanted to fake, but no great antiquarian significance, into a dealer's stock, buy it himself, and ask for a written receipt- thus establishing apparently legitimate provenance for the fake "extraordinary discovery" which followed. Arguably, the team investigating the Vinland Map should have been led by a professional magician, who would have had a tendency to look at things from the creator's point-of-view, which to be blunt is the only viewpoint that matters when trying to detect forgeries.

To give another example, on the subject of wormholes- and possibly carbon-14 tests too- it is worth taking a close look at our odd volume of the "Speculum Historiale". When it came onto the market in the 1950s, it was no longer a whole book. Examination of the various wormholes showed that the slim volume in fairly modern binding containing the Vinland Map and the Tartar Relation consisted of one double-page sheet of parchment with the map on, which belonged at the very beginning of the "Speculum" volume and one quire (6 sheets of paper sandwiched between two of parchment and folded) from the very end. In addition, though, enough sheets for an entire section of the "Speculum" had disappeared- the first four whole quires and the first leaf of the next quire. This disappearance could be detected both by the slight discontinuity in the wormholes between the map and the first remaining page of the "Speculum", and by the original binder's careful marking of each quire with a letter of the alphabet- a to d being absent. Possibly somebody had a really decent reason to remove section 20 of the Speculum, but it seems more likely that somebody had the same sort of reason as Mark Hofmann. The lost section of the book would have been tremendously valuable to a forger, offering the opportunity to practice imitating the handwriting in situ, writing very small between the lines (just as the writing on the Vinland Map is much smaller than the other writing in the volume). If the wormhole magic trick did involve developing some technique to write over existing wormholes, the missing pages would provide dozens of holes to experiment with. And of course, if the forger was working not long before the map appeared on the market, and was aware of the development of carbon-14 dating (which first became widely known in 1952) then the burned-paper-soot ink trick would neatly recycle the missing sheets of paper. Anybody thinking "but Mark Hofmann did not invent that trick until decades later" should go to the back of the class.

THE GREAT INK DEBATE [sp. DÉBACLE?]

The ink of the Vinland Map has in fact caused the greatest controversy of all, for a very simple reason. The map IS the ink, and whatever the age of the vellum on which it is drawn, the ink lines could as easily have been made in 1957 as in 1437. Despite all the evidence that the map is a fake, there is a slim possibility that, sooner or later, a new dating technique might prove that the ink was applied well over 500 years ago. If that were so, our understanding of the history of Norse colonization (and ink technology too!) really would be changed quite dramatically. A few people have made the classic mistake of inverting this logic and given undue significance to demonstrations that something quite like the Vinland Map ink *could have been* used over 500 years ago, but there has also been a large element of professional rivalry involved in the tests and theories over several decades.

To the investigators in the early 1960s, the ink of the Vinland Map seemed odd (and the way the black component appeared to have flaked away from most of the lines, leaving just the yellowish binder, was worrying from a conservation point-of-view) but the analysis techniques then available would have involved destroying a significant section of the map, which would cause serious embarrassment if it was not a fake. Still, once its existence was known, and Wilcomb Washburn of the Smithsonian Institution had gathered academics from various disciplines together 1966 to exchange their theories about it, the one thing everybody could agree on was that it would be well worthwhile to have the document subjected to more scientific tests. When the book was made available to European scholars at the beginning of 1967 (the year Alf Önnersfors' edition of the Tartar Relation was published) it therefore spent some time in the laboratory of the British Museum. From the limited tests he and his colleagues could carry out, David Baynes-Cope, Principal Scientific Officer, had nothing very positive to report about the map. On examining the manuscript with a microscope they found that, unlike the Tartar Relation, the map's bookworm holes had lost the dried slimy lining the worms leave as they chew through pages. This, he felt, confirmed the general impression it gave of having been not just wiped clean but thoroughly washed (with the apparent exception of the area along the very worn and delicate page fold)- an odd thing to do if the map was to remain in its binding rather than being separated for display.

Baynes-Cope's microscopic examination of the ink lines revealed a further puzzle and began the Great Controversy in earnest. The lines gave the impression of having a black pigment (about 90% of which had fallen off) with a yellow-brown underlying binder, but in many places there seemed to be tiny fragments of the black beyond the apparent limits of the binder. This caused Baynes-Cope to wonder if the black was not part of the ink at all, but the remains of a pencil line that had subsequently been followed with a brown ink, then rubbed-out as far as possible. That impression was reinforced by the observation that only the actual map outlines had significant quantities of black remaining, and the delicately written detailed captions seemed to be entirely brown. To test the theory further, he shone infrared and ultraviolet lights on the map. Had the black been a component of an "iron-gall" ink (more scientifically called "iron-gallotannate"), the standard both for real medieval documents and most forgeries, it would, for example, have had the effect of suppressing fluorescence under the ultraviolet, making the lines look blacker even if only the smallest traces of iron remained. Instead Baynes-Cope was surprised to notice that, not only was this effect absent, the fluorescence of the whole sheet of vellum looked abnormal, indicating that the mysterious washing had used some sort of chemical agent. The Tartar Relation and the "Speculum" remnant, by contrast, looked just as medieval manuscripts drawn with iron-gall ink should have done. The "non destructive testing" order created a problem here; a few tiny fragments were scraped off the bottom edge of the parchment for analysis to identify the washing chemical, but a larger sample was needed.

A good forger of medieval documents would probably have known that before the 16th century exploitation of the graphite mines at Borrowdale in northern England, the usual material for drawing fine pencil-type lines in Europe was lead. The ultraviolet and infrared light tests indicated that the lines were not lead, or one of the other soft metals sometimes used- so if they were supposed to be pencil lines, they were probably graphite, over a century too early. Later, Baynes-Cope also tested the theory that the lines might be an unusual ink based on organic materials such as berry juices, or soot (which though a standard ingredient of printing ink was less common among early writing inks in Europe, for reasons to be explained later), but found no medieval-style formula that gave results looking like the Vinland Map ink. Having thus gained more questions than answers, a year later Yale had the bright idea of contacting one of the world's leading specialists in ultramicroanalysis. McCrone Associates of Chicago could potentially analyze samples so small that they could be taken from the map without doing any visible harm. Walter McCrone agreed in principle, but advised the clients that greatly improved new techniques would soon be available, so they decided to wait a while. In 1971, the Chicago lab acquired an early commercial model of the promised equipment, an ion microprobe analyzer, so the map left Yale again in February 1972.

McCrone Associates lived up well to their reputation. The 29 samples they took from the Vinland Map, using a tungsten scraper wielded by a technician using a microscope, would scarcely have been visible to the human eye even if they had been piled up together in a heap. One thing they quickly established was that the black line was on top of the yellow-brown line, not underneath, so it could not possibly be a preliminary pencil line. This led them to suggest that it had been made to imitate a medieval black ink, some components of which would soak into the underlying parchment and create a yellow stain that would spread slightly beyond the black over time. In other words, it seemed that the map outline and text had been drawn in yellow-brown, then a slightly narrower black line had been drawn over the map outline- though perhaps not over all the text- and "worn" away (making sure to remove the bits which were most badly out of register with the underlying yellow). The samples concentrated on the yellow-brown line, but some of course featured black particles and unwritten parchment. The first test was McCrone's specialty, polarized light microscopy, which relies on the fact that properties such as the refractive index of translucent materials, and the associated property of birefringence (double refraction) can be estimated even on very small samples under polarized light. It quickly became apparent that the yellow-brown lines were (unusually for an ink) scattered with huge numbers of crystalline particles, scarcely a ten-thousandth of a millimeter across but densely packed, among which two types predominated. Because they were so extremely small, positive identification of the particles was undertaken by X-Ray Diffraction. The first type, which had showed high birefringence, but a low refractive index, turned out to be calcite, the essential component of limestone/chalk (first reports stated it was in a precipitated form, but some years later, following queries, they decided it had been produced by grinding).

The second common type was more intriguing. The refractive indices of the crystals were much higher, so that they looked quite opaque, but they were very good reflectors; the X-R.D. result indicated that they were titanium dioxide, commonly found in nature and used as a white pigment or a lightener for colored pigments. They were not the most frequently encountered form of TiO₂, the mineral called rutile, but anatase, less common in nature (which would also help to explain why the pigment did not appear black under Baynes-Cope's ultraviolet light, as anatase, unlike rutile, does not absorb most of the "UVA" part of the ultraviolet spectrum). A third instrument, the Transmission Electron Microscope, confirmed this identification (through a technique called selected area electron diffraction) and most significantly, it showed that these crystals had not been created by simple grinding. After Californian specialist Per Larssen ground some anatase from the Smithsonian Institution for comparison, McCrone's team could see from the T.E.M. imaging that, however fine the grinding, there was always a great range of crystal sizes and shapes, even when the average was the same as the Vinland Map samples. On the other hand, anatase samples from a commercial pigment company looked very similar indeed to the Vinland Map crystals- nicely rounded and within a small size range. It turned out that the commercial manufacturing process had been patented in 1914, and involved three separate stages: chemical precipitation of the anatase from the rock, followed by calcining at 600-900° celsius, followed by milling to separate the crystals. This seemed to be pretty sure confirmation that the brown component of the ink was based on a modern paint formula (the 1914 patent was actually for a pale yellow pigment, colored by impurities, and though pure, brilliant white anatase was manufactured later, the older process remained useful).

Some specialized tests, including Scanning Electron Microscopy with an "energy dispersive system" for spectrum analysis, had been performed on a small number of samples, just to confirm the polarized light findings, but McCrone

decided to submit sixteen of the 29 tiny fragments to electron microprobe analysis. Sure enough, significant quantities of titanium (10-40%) were found in nearly every yellow ink sample, but not in the blank parchment samples. Finally, the new Ion Microprobe Analyzer was employed on nearly all samples to do the sort of comparative tests Baynes-Cope had tried years before, but this still revealed more about what the ink was unlike than what it was like. The I.M.A. was also used to test the ink of the Tartar Relation and "Speculum Historiale", which were confirmed to be similar to each other, but quite unlike the Vinland Map ink (containing much less titanium, for example). The black particles, unfortunately, did not refract light at all but were completely opaque, so the polarized light technique wasn't much help (at this point feel I should just mention that McCrone's 1988 paper on the 1972-3 experiments also isn't much help on this particular issue- he forgetfully selected for discussion a black pigment sample, number 9-C-2, which had been loose when found, and was suspected to be a stray which had stuck to the ink as it contained high percentages of iron and chromium- unlike the rest of the map, but more like loose particles found later in the map fold). In fact, not many techniques are helpful for distinguishing carbon, which was the main suspect after lead and other "medieval pencil" substances were ruled out, from carbon-based organic compounds which are the basis for all sorts of everyday substances, so that question would remain unanswered for some time.

There was one fundamental problem with the McCrone findings; their huge expertise in ultramicroanalysis did not actually include previous experience with allegedly medieval manuscripts. One of the first to pick holes in the results, which were announced in January 1974, was Jacqueline Olin of the Smithsonian Institution's Conservation Analytical Laboratory. She argued that the anatase could be a byproduct of a known medieval ink-making process involving the creation of a substance called green vitriol (now known as ferrous sulfate) from iron-rich rocks. One iron-rich mineral, ilmenite, happens also to be an important source of titanium, which remains present within the green vitriol as anatase (ilmenite also typically contains traces of various other metals- consistent with trace findings by the McCrone team). Olin demonstrated her theory by making ink samples, but when these were examined by Smithsonian geologist Kenneth Towe it was clear that the anatase particles did not have the size and shape range found in the Vinland Map ink and in modern paints. He suggested, after checking with manufacturers, that this was because Olin's medieval recipes only included the first of the three stages of the modern production process (a 19th-century description of an American ink recipe- not medieval as has sometimes misleadingly been implied- was later found which was closer to the 20th-century process, but its calcining step involved much lower temperatures than the anatase process). Another possibility considered at this time was that the anatase came from clay, often used as an ink thickener, or in "pounce", an absorbent powder formerly used when writing to prevent inkblots, but they swiftly dismissed this idea, because the McCrone diffraction patterns showed that the other 98% or so of the supposed clay- kaolinite etc.- wasn't in the ink (in the 1990s, despite being told this, pro-authenticity enthusiasts made much of a 1976 paper by mineralogist Charles Weaver, describing the form of titanium minerals in kaolin-type clay- yes, rounded anatase particles within a limited range of sizes). The McCrone team had taken a general look at the map's ink lines during their 1972 sampling process, but it was Ken Towe who drew attention in 1974 to a spectacular variation on Baynes-Cope's misplaced black particles; on the west side of Great Britain the black line, though mostly within the yellow line, seemed to have been drawn with the pen at a completely different angle.

It may perhaps not have been a perfect idea for McCrone Associates to use their Vinland Map work as the focus of an advertorial in the journal *Analytical Chemistry*, in 1976. On the one hand they gained new business, including the job of analyzing the pigment of the image of Christ on the Turin Shroud (which they found to be a medieval painting, just as had been claimed in 1356 by the bishop of the diocese where it was first exhibited). On the other hand, the objections from Olin and others grew to a clamor, and Kenneth Towe was asked to look for possible flaws in the tests. Reporting to Yale in October 1982, he suggested a few weaknesses (mostly sorted out in subsequent discussions) but found the conclusions basically sound. In an attempt to settle the matter, Yale then commissioned further tests by a different method, possibly suggested by Olin. At the end of January 1985 Crocker Historical & Archaeological Projects (CHAPS), based at the University of California's Davis campus, used the recently developed technique of proton-induced x-ray emission (PIXE) spectroscopy, firing a narrow beam of protons from a cyclotron through the map (harmlessly) and observing how its spectrum was affected by the atoms it encountered.

This technique could very rapidly indicate the amounts of particular elements at a given point on the map, though it could not indicate the form in which the element was present (e.g. distinguish anatase from other titanium-based minerals). The CHAPS team, led by Thomas Cahill, fired the beam through many points on the map, not just the ink lines- this was essential because a beam fired through the lines also went through the parchment underneath, so the elemental characteristics of the parchment had in effect to be subtracted from those of the parchment + ink, by matching each ink test to a test on an apparently similar area of blank parchment. What they reported, in 1987, was that there appeared to be titanium contamination all over the map, and that overall the amount present in the ink lines was rarely more than 10 times as much as on the parchment; they later suggested it could have been due to modern dust containing tiny flakes of paint (apparently sticking more easily to the ink than to the bare parchment). Indeed, the titanium concentration within the lines actually appeared to be around ten thousand times lower than McCrone had claimed; the competence of either McCrone's team or CHAPS was effectively called into question. The CHAPS team checked their results, for example by drawing thin lines with modern titanium-based pigments and then rubbing them out- they found that even when the line was invisible to the eye, PIXE detected more titanium than in the Vinland Map lines. Their suspicion was that the McCrone technician who removed the tiny ink fragments from the map had unconsciously chosen samples which had similar characteristics, perhaps ease of removal, or apparent density of ink, and were not necessarily typical of the whole map. One of the CHAPS team, Gregory Möller (who had produced his own theory about the anatase, flawed like Olin's, before the 1982 Towe report) did separately analyze some loose particles found in the fold of the map by a different technique and found significant quantities of titanium- but scientifically, it could not be assumed that these strays (some also rich in chromium) had ever been part of the map ink. Cahill's tests failed, again, to confirm the identity of the black pigment particles, but that failure was enough

in itself to give a pretty good idea; the substance most likely to give such negative responses to all the various tests attempted over the years was, as Baynes-Cope had suspected, carbon, in the form of good old soot or lamp-black. CHAPS, which included historians and document experts, also studied the double-ink problem. Out-of-register yellow lines were found on several genuine medieval documents, and an analysis of the two lines on the Vinland Map found that where the black line survived at all, it nearly always matched the yellow one to within a tenth of a millimeter (their report did not make it clear whether they had found any of Baynes-Cope's isolated black particles). They concluded that the ink had probably not been applied as two separate lines. Kenneth Towe re-entered the battle at this point, to try and make sense of the wildly conflicting results. One of his first objections to the CHAPS claims was that the sort of X-Ray Diffraction images obtained by McCrone were physically impossible with the low concentrations reported by Cahill (McCrone himself suggested that such clarity would require at least a 5% concentration of anatase in the sample, not the minute fraction of one percent implied by Cahill's measurements). Towe also ultimately concluded, in his 1990 report, that the "non-random McCrone samples" explanation seemed unlikely. McCrone, of course, preferred to assume that the PIXE beam (which was at least as wide as the Vinland Map ink line) was not precise enough, and most of the readings were from blank parchment even when the beam was focused on the ink, and he tested fresh microsamples, confirming the presence of anatase and at last arriving at a workable theory about other components of the ink, including a gelatin-based binder, and traces of ochre for additional coloring.

For Jacqueline Olin, who also doubted the CHAPS figures, the discrepancies emphasized a need for more comparative studies of different documents to understand the way materials behaved under different tests. She conducted her own tests of a medieval document against a modern document with medieval-style ink in 1992, with Neutron-Activation Analysis (even less finely focused than PIXE, so by no means ideal), PIXE itself and Electron Microprobe Analysis. Although she did find titanium in the genuine medieval ink, she was convinced that better techniques were needed. CHAPS also got into the habit of checking for titanium in their PIXE tests on old documents over the next few years, and remained convinced that if anything the Vinland Map ink contained relatively low amounts of titanium by medieval standards (though of course PIXE could not tell whether or not any of these documents' titanium was in anatase crystals). Statistical analysis of their results from the Vinland Map provided further intriguing hints, suggesting that the artist had used a different batch of ink for the three Atlantic enigmas (but not a different type of ink- all over the map it contained essentially the same ingredients, including the awkward titanium, so a suggestion that perhaps only the Vinland drawing was faked, and the rest of the map genuine, was unrealistic).

THE 2002 REVELATIONS

Jacqueline Olin was also involved with the next major tests, conducted in 1995-6 by a team under University of Arizona physicist Douglas Donahue. These provided the long-awaited carbon-dating information, obtained by the destruction of a sliver of parchment (without ink) from the bottom edge of the map. The parchment could be dated quite precisely to within a few years of 1434- but only after it had been ruthlessly washed to remove an unidentifiable organic chemical with which it had been thoroughly soaked (making over 20% of its total weight) at a time when there was lots of atomic bomb fallout in the atmosphere- the 1950s. This chemical was presumably the cause of the parchment's odd appearance under ultra-violet light, as observed by Baynes-Cope; indeed his successors at the British Museum, when they saw the Donahue team's report, wrote to emphasize the possible significance of the chemical, but it remains unidentified. The carbon-dating itself only advanced the study of the Vinland Map to the extent of tending to confirm the general suspicion that it was drawn on a blank sheet from the "Speculum" volume.

Although the basic testing was conducted over a period of weeks, matters like the mystery chemical delayed the results for six years. Spookily, this meant that it appeared just before the publication of the next chemical analysis, by a method neither McCrone nor Cahill had used. Katherine Brown and Robin Clark of University College London subjected the map to Raman probe spectroscopy, which in some senses crossed the divide between McCrone's techniques and Cahill's, and which they had used on a variety of other manuscripts. Like PIXE, it involved firing a relatively broad beam (in this case a laser, guided by a fiber-optic probe) directly at the map, without the need to remove samples, but it identified different minerals, not just elements. It shared with X-Ray Diffraction a tendency to give null results for very low concentrations, and differed significantly from PIXE in that the laser did not penetrate through the material under investigation, so no subtractions of unmarked parchment figures were required. The mysterious organic contaminant seems to have been indistinguishable from the (very definitely organic) parchment. When the probe was pointed at the yellow-brown lines though, peaks indicative of anatase could be seen in the spectrum graph, one particularly strong (sadly, fluorescence swamped the Raman readings from the apparently organic binder component of these lines). Also, the in-situ examination of the black particles finally confirmed that they were carbon (the anatase signal was still present, but weaker, as if it was mostly blocked by the black particles- implying that CHAPS' "modern dust" was *under* the black). There was, as predicted by Baynes-Cope, scarcely any iron and the Raman testing found no evidence whatsoever of the remnants of ilmenite one would expect from a less-than-perfect medieval process. Brown and Clark also tested the Tartar Relation, establishing that its black ink was not carbon-based, and as a bonus that its red ink- not found at all on the Vinland Map- was natural vermilion.

Also in 2002 was belatedly published the result of a more modest scientific experiment, by James Enterline, who in an appendix to "Erikson, Eskimos & Columbus", his second book speculating on the extent of Norse influence in North America, suggested a mechanism which might explain several of the more curious features of the map, including the nature of the surviving ink. He assumed (like historian David Quinn way back in the 1960s) that the ink problems were directly related to the bleached appearance of the parchment, and argued on the basis of experiments he had conducted in the mid-1970s that an attempt at chemical cleaning of the map could have involved a protective white tissue overlay which, under the influence of the bleaching chemical, was the source of the anatase crystals, and also

softened the possibly tannin-based (but in this theory not iron gallotannate) ink so that the crystals stuck to it. After the Raman testing, Enterline considered repeating the experiment with carbon added to the ink, to see how such cleaning would affect it (how could anatase get *under* the black lines?). What legitimate reason anybody could have for applying such a drastic technique to any document without first trying a small test patch is, of course, another question- though a cleaning disaster would certainly explain why the map was not displayed after treatment.

It is important in considering the conflicting theories to understand the different ways that inks can work. The use of iron-gall ink on parchment was itself effectively a chemical process. The color was not derived from a pigment at all; when the ink was first prepared it was quite transparent, but over time it would oxidize, becoming darker and darker (normally, the ink would be left for a while to darken before use, but a scribe in a hurry might add soot to freshly prepared ink to make it slightly more visible while writing). After being applied to parchment, the ink would not only continue to oxidize, it would, as the months went by, react with the collagen in the fibers of the parchment (similar reactions occurred with the cellulose in paper, but these could very easily go too far and destroy the paper over long periods of time). Anything written with iron-gall ink on parchment was there to stay; water would not wash it off, the only ways to remove it were by the use of special acid mixtures not too long after it was applied, or by scraping off the surface of the parchment with something like a pumice stone. Because parchment was expensive to produce, the latter process was quite commonly used to create "palimpsests"- sheets of parchment which had their original writing scraped off and replaced by a different text. Modern techniques such as ultraviolet lighting can quite easily detect palimpsests, and often even recover the erased text (if the Vinland Map is a palimpsest, it must have had both thorough scraping and chemical treatments, for not a trace of earlier writing has ever been found).

The other classic writing ink formula, invented in China but now usually known as "India ink", is very different. It derives its permanence from the absolute lack of chemical reaction in its pigment: carbon derived from soot. The above iron-gall mixture could in theory be used neat, but in practice was mixed with some sort of gum to make it more controllable; in a soot-based ink, the gum is a key component, the binder attaching the black particles to the paper. Paper was the preferred medium for this type of ink; when used on parchment it could quite easily be scraped or rubbed off. Worse, on any medium it would be very susceptible to damp, which was why in Europe the iron-gall formula became so popular (and ultimately mandatory for permanent records). Effectively, the Vinland Map ink, with its remnant carbon particles adhering to a substantial binder, is utterly unlike an iron-gall ink, but more like a traditional soot-based ink. The "green vitriol" theory for the presence of the anatase is therefore spectacularly unlikely; but the one difference from traditional "India ink" is the strange nature of the binder. Beyond that, there is the question of why anybody with any experience would use a soot-based ink to write very tiny lettering on parchment, knowing that the soot would quickly rub off, so the ink would only remain visible if the binder was fairly dark.

As noted above, the Brown and Clark results appeared at almost the same time as the delayed carbon-dating figures, in summer 2002; the contrast generating many column-inches in both scientific journals and the popular press. Cahill, his results again thrown into doubt, weighed in with the argument that the Raman tests had not been sufficiently thorough (covering far fewer points on the map than the PIXE study) and that, given the CHAPS microscopic measurements, Clark & Brown's support for the double-inking hypothesis was unrealistic. Prof. Clark replied that while the double-inking theory remained unproved, no better explanation of the detectable anomalies had yet been offered; and that sufficient Raman tests had been conducted to demonstrate beyond doubt that anatase was present in the yellow lines in much higher concentrations than on the uninked parchment, contrary to the PIXE figures. Jacqueline Olin, who for some years had been self-employed though remaining connected to the Smithsonian, gained more press coverage as late as November 2003 by insisting that the ink could be an iron-gall ink to which carbon had been added; Kenneth Towe wearily reminded the world in February 2004 that she had been pushing the iron-gall claim for a very long time but had consistently failed to offer any convincing explanations for the largest holes in the theory. It is notable, on reading through Olin's 2003 article, how much she confines the argument: focusing on the anatase claims of McCrone, Towe, Brown & Clark; assuming that Cahill was wrong; not even mentioning Baynes-Cope (or Enterline, or Weaver...).

WHOANDWHYDUNNIT?

Although attempts at chemical analysis of the Vinland Map remain controversial, they offer much more reliable information than the attempts to identify the artist. The tendency has been to look for somebody who lived in continental Europe (most probably after paint with anatase became widely available in the 1920s) and who knew a lot about old maps and the history of Roman Catholicism in the Middle Ages. One early candidate, before McCrone's tests, was Luka Jelić (1863-1922), a Franciscan friar who in the 1890s had written a study of the Roman Catholic church in America (i.e. mostly in Greenland) before the Columbus expeditions. His name was put forward from within Yale itself, by Prof. Robert Lopez of the Medieval Studies department, in conjunction with religious historian Dr. Stephan Kuttner. Some of the reasons for suspecting Jelić will be seen later, but they don't amount to anything like proof. Norwegian-American historian Kirsten Seaver, author of "The Frozen Echo", a detailed (and not uncontroversial) study of medieval Greenland, suggested an alternative in 1995: Fr. Josef Fischer (1858-1944), a Jesuit expert on medieval geography who also wrote about pre-Columbian America. Seaver skillfully found both a potential means (an auction catalog entry for a similar volume suggested the possible source of the "Speculum" fragment) and a potential motive, but the latter is the great weakness of her proposal. She saw the map as an attempt to make fools of the Nazis- who apart from being generally arrogant and brutal, in 1938 closed down the Jesuit college in Austria where Fischer was living in retirement- by faking proof of the Viking (blond Aryan hero-type) voyages to mainland

(N.B. Apart from a couple of corrections, I have resisted the temptation to steal from Kirsten Seaver's 2004 book about the Vinland Map, which includes the definitive statement of her theory; but see my mini-review on page 21.)

America, which were then completely unsupported by trustworthy archaeological evidence. The sting, according to Seaver, lay in the Catholic references found all over the map, from America to China; the Nazis couldn't have their Aryan triumph without an acknowledgment of the extraordinary global influence of the Roman Catholic church.

If you have read all the preceding chapters of this book, you should have serious doubts about the suitability of the Vinland Map for such a purpose. It is simply unique in too many different ways- not just Vinland itself but the detail of Greenland and Iceland, the rendering of the Old World, the far eastern islands, the ink and so on. Fischer knew a great deal about medieval maps, and would have had no trouble adding Vinland to a very conventional Clavus-type outline if he had wanted to make a forgery for a serious purpose (in fact, an Italian named Niccolo Zeno had done almost exactly that in the 16th century, fooling cartographers for decades). There is also the simple fact that if it was aimed at the Nazis, it didn't work. That doesn't absolutely rule out Fischer as the forger, but given the mischievous design of the map, it would have had to be made as a cheery prank, in which case it should have been "discovered" in the 1930s, not the 1950s- the idea of a respected academic leaving a "time bomb" which could posthumously ruin his reputation is very unlikely.

If there is a serious purpose to the Vinland Map, it is most probably to illustrate Sir William Alexander's famous observation, "those that think them wise, are greatest fools." Of course, you may not consider Sir William's observation to be famous at all, outside a small circle of literary historians who have studied his "Tragedy of Croesus", but you'd be wrong- it was chosen for this book from a pocket-sized dictionary of quotations. You would be equally wrong, for the same reason, to assume that the faker of the Vinland Map had to be an expert on medieval maps, Latin, church history and pre-Columbian America. Mark Hofmann knew far less about the authors whose works he was imitating than the experts who pronounced his fakes to be genuine; but he made sure to find out everything he needed to know.

Similarly, the Vinland Map artist could expand upon what the battered "Speculum" volume revealed about itself with the help of a decent academic library. Most obviously, this would include the full content of the recycled "paste-downs", which were removed when the Tartar Relation volume was created, leaving only the ghost of their ink on the inside of the cover boards. They provided not just a date, but also a significant name- Bartholomeus Poignare, a man historically associated, between about 1434 and 1439, with the Council of Basle. Even though paper-watermark reference books could not quite prove that the volume was written in Basle, that information would be a perfectly adequate start. The forger almost certainly had only the one volume of the "Speculum", but it was a work familiar to historians, and descriptions of its content could be found, which would show how it might have been relevant for the Council of Basle, and just as usefully, that the Tartar Relation was linked to other accounts of the 13th century Carpini mission to Asia. If this research also revealed that the Scandinavian King Erik VII sent a deputation to Basle in 1434, and that a major contributor to the Council was Nicolaus Cusanus (scientist, geographer, philosopher and later author of "De Docta Ignorantia", which demonstrated that to be truly learned you must be aware of your ignorance), so much the better. The design of the map suggests, perhaps intentionally, that the artist was quite ignorant about the conventions of medieval cartography. There were plenty of round medieval world maps, one or two more elongated salami-shaped world maps (on which the "straight-line" southern coast of Africa would have looked just fine), quite a few very odd-shaped Ptolemaic maps; but egg-shaped? Finally of course, knowledge of Latin is nothing special even today, and until quite recently it remained in fairly regular use as an international language for academic books and essays.

Knowledge of the Norse expeditions to America, on the other hand, has significant implications for more than one aspect of the map. Never lost by the Scandinavians, it was brought to the attention of the rest of the world in the 1830s, when Carl Rafn cunningly published a short summary of his very detailed work "Antiquitates Americanae" for the benefit of the press. It may be no coincidence that huge numbers of Scandinavians emigrated to the United States over the next half-century; certainly the search for further information about Vinland has continued unabated ever since. Among the most remarkable discoveries were the Vatican records relating to Greenland, unearthed at the end of the 19th century. These finds, decades after Rafn's book was published, sparked allegations of a Church cover-up, and fueled the wider notion that the Vatican archives were a vast repository of suppressed information about What Really Happened in History. It was that controversy which brought the aforementioned Fr. Josef Fischer into the Vinland affair, with his book and later essays explaining the extent to which the Vatican material had been misinterpreted by over-eager scholars. It also provided a spectacularly effective cover-story for the Vinland Map. By associating the map specifically with the Roman Catholic church (even the names of two Popes were innocently added to explanatory captions) almost any anomaly could be explained as "secret Vatican information".

Some anomalies relating to Vinland itself may even be deliberate; in particular the dating of the Vinland expedition of Bishop Eirik (Latinized as Henricus), given in Icelandic sources as 1121, is dated on the map to the last year of Pope Pascal (Pascal II, who died in 1118). This is such a specific reference that it has to be based on a reliable source- unless of course it is a lie. Lies are rather more adaptable than the truth, unfortunately. Tantalizingly, although the map caption gives details of Bishop Eirik's stay in Vinland and eventual return to Greenland (the Icelandic sources only mention his departure) it then states vaguely that he "ad orientem hiemalem humillima obediencia superiori voluntati processit"- proceeded south-east in humble obedience to the will of his superiors. It's informative, without actually telling you anything useful (George Painter of the assessment team suggested that if true it could lead to further clues in the Vatican or Scandinavian archives, but forty years and much searching later, it hasn't) and it also neatly echoes a formula used at the beginning of the Tartar Relation, where the Asian explorers set out in "filialis obediencia ... superioris voluntatem". Oddly, though it has nothing to do with Asia, the same caption contains other apparent borrowings from the Tartar Relation, such as the reference to Vinland as "hac terra spaciosa vero et opulentissima", not a million miles from "Hec terra est magna et spaciosa valde et erat opulentis-

sima" in section 6 of the TR [*not section 5 as misprinted in the 1965 book*]. Equally oddly to some scholars, this caption which Latinizes Eirik as "Henricus" also Latinizes Eiriksson- as "erissonius" (the use of "-sonius" instead of the separate word "filius" for "-son" in Latinization was never popular, and almost unknown before 1600).

The caption gives Bishop Eirik what appears to be a formal title "Grouelande regionumque finitimarum sedis apostolicae episcopus legatus". Curiously, this appears to be a conflation of Eirik's title in Luka Jelič's work (where the post is described as "episcopum regionarum Groenlandiae regionumque finitimarum") and the designation given to Giovanni Da Pian Del Carpini, in the first paragraph of the Tartar Relation ("sedis apostolice legato"). Peter Foote, a specialist in the medieval history of Scandinavia, found this more than a little intriguing; so far nobody has managed to trace a copy of any actual official document, or even any earlier listing of bishops, containing such a title. In fact, long before the Vinland Map appeared, the German expert on early Atlantic exploration Richard Hennig made strenuous efforts to trace Jelič's source, deciding in 1950 that his words were probably not a title at all, merely a description by a historian who happened to be using Latin as an international language. Foote, writing over 20 years later, agreed, having failed to find examples even of an expected general term like "episcopus regionarius" in church documents. One thing is certain- Jelič did not get the title from the Vinland Map, or at the very least he would have mentioned the Pope Pascal date. Okay, that's two paragraphs of peculiarities so far from a single caption; we can continue by exploring Kirsten Seaver's observation that a history of Greenland published in 1765 first suggests, in a demonstrably mistaken way, that Leif Eiriksson and Bjarni Herjólfsson discovered Vinland together (not years apart as indicated in the Icelandic sources). But why bother, with so many other anachronisms to explain already?

I will only mention one more caption; not on the map but on its reverse, apparently a binder's note that the map is an illustration for the first, second and third parts of the "Speculum". The "Speculum" volume includes the conclusion of the third part, so that seems like another good link between the two manuscripts. The inevitable catch? Most of the Tartar material in the full "Speculum" occurs AFTER this third part, in the last part of the set. It is true that there are sets of the "Speculum" with different volume divisions, but a note specifying a link to the "first second and third parts" makes more sense as the work of a forger trying to explain the map's presence in an odd volume. If the map illustrates the whole of the "Speculum" including the material in the last part to which it seems most closely linked, there is no need to specify "first second and third parts". Unless there are two other Vinland Maps out there...

THE UNCERTAINTY PRINCIPLE

It is in some senses quite important not to get too bogged down in speculation about the detail of the Vinland Map, because that was almost certainly part of its creator's intention. Less than a year after the 1966 academic discussions, physicist and Norse-America enthusiast Dr. O.G. Landsverk, with Alf Mongé, a cryptologist who had helped break Japanese ciphers in the Second World War, announced the discovery of encoded information on the map which identified it as a version of an original by Bishop Henricus, dated August 23, 1122. Among other things, the alleged hidden information offered a solution to the above-noted question of where the Bishop went after his return from Vinland. After the tantalizing word "processit", the next words below start a new caption, which oddly repeats information- "Vinilanda Insula a Byarno rep'a et leipho socijs". But if you take the first letter of each word in that caption you get v i a (the Latin and English word "via"), followed by what may be the start of a place-name, b r e l s. From that moment, you're hooked: Mongé's lead was followed by others such as linguist Dr. Cyrus Gordon (who had also worked on cryptanalysis in WW2) and James Enterline, whose article, published in 1991, was so complex that the journal concerned had to issue two pages of corrections to their printing errors. The trouble with cryptanalysis on allegedly medieval documents is that early cryptographers tended to use quite simple "hide in plain sight" steganographic techniques like acrostic variants or anagrams, so it's all-too-easy to find apparently encoded information where none exists.

The Vinland Map artist may have put in a few deliberate hints (which would help to explain some odd spellings and sentence construction, or mislocation of place-names) specifically to whet the appetite of cryptanalysts, but much of what has been discovered is quite probably a figment of the researchers' imaginations. So too may be the observation that if you mirror-flip A.A. Bjornbo's early 20th-century sketch-map demonstrating the medieval Norse world concept, Europe and Greenland fit neatly over eastern Asia and the two northern "Japanese" islands. And do you remember the map with the island that matched a Vinland Map wormhole? Drawn by Nicolo Caveri about 1503, it also shares with the Vinland Map a tendency to depict North Atlantic features too close to Europe, including a mysterious island, thought to represent the Canadian coast, in almost the same position as Vinland (but positioned there for a reason that only existed after the 1493 Treaty of Tordesillas). The list goes on, and on, and on.

After those unsettling suggestions, it seems like a good moment for a few random thoughts about Devil's Advocacy. In the original 1965 book, the versatile George Painter contributed both the major study of the Tartar Relation and a shorter essay with some personal observations about the Vinland Map. Although most of these related to the strange way the map was linked to the Tartar Relation, he did emphasize factors which should be considered as supporting the map's authenticity. He has never to my knowledge conceded that the map is a fake, and even continued to defend it at the London symposium which discussed the map after McCrone's apparently damning results were published in 1974; Francis Maddison, curator of the Museum of the History of Science at Oxford, rose to the challenge by providing a Devil's Advocate essay attempting to demonstrate that the Tartar Relation could be a fake... When the official Yale book was republished with additional material in 1995, following the Cahill tests, Painter's new contribution was a short update containing further "pro-authenticity" suggestions (for example, a gorgeous dig at Walter McCrone's observation that titanium was only discovered in 1791; oxygen was, historically speaking, only discovered a few years earlier, but fortunately for our ability to breathe, it had existed long before).

In recent years, the principal Devil's Advocate on behalf of the Vinland Map and a number of other presumed hoaxes has been economist J. Huston (Hu) McCulloch. He does not exactly state that he personally believes the items to be genuine, but he obsessively seeks out weaknesses in academic arguments. He sometimes twists the facts, but he did a useful demolition job on key points of a bizarre contribution by Douglas McNaughton to an official Smithsonian publication "Vikings: The North Atlantic Saga" in 2000. McNaughton had attempted to argue on the basis of findings by the Cahill team that the Vinland Map ink was deteriorating rapidly despite its careful handling by the Beinecke Library, but McCulloch demonstrated that this was just a misinterpretation of different types of photographic evidence (McNaughton had also claimed, largely on the basis of Möller's analysis of loose particles, and McCrone's 9-C-2 [p11] that the ink was based on chromite- contrary to all analyses of the ink itself). He dealt equally effectively with McNaughton's interpretation of the wormholes in the map. Boldly, he also attempts a point-by-point critique of Paul Saenger's presentation of paleographical arguments against the map's authenticity, and offers a thoughtful reminder that Raman spectroscopy can be hypersensitive to anatase. McCulloch's work is useful for presenting alternative viewpoints, but by its very nature leaves the production of a unified theory of genuineness to others; for example both Olin's ilmenite theory and the rival kaolin theory are presented as explanations of the anatase.

HOW TO MAKE A VINLAND MAP?

We have seen that the Vinland Map is related in some (literally) oblique way to the circular world map drawn in 1436 by Andrea Bianco. Considerations such as the different names for places shown on Bianco's world map but only named on other maps in his atlas, and the truncation of Africa, lead to a simple conclusion- the Vinland Map artist was not working from Bianco's world map in the atlas, but from another map almost identical to the northern part of Bianco's world map. Peter Skelton reasoned that if the Vinland Map were genuine it could, like the rest of the material in the volume, have been copied from an earlier version, created perhaps as much as a decade or two earlier from a base-map (or a set of regional maps at different scales) also used for Bianco's circular map. The problem with that suggestion was the accuracy of distances within each oddly-scaled and distorted piece of the Vinland Map "jigsaw puzzle". Copying aids such as the "pantograph" had not been invented in the 15th century- and even the recent theory that the "camera obscura" was secretly used as a drawing aid by early Renaissance artists is based on the observation that some paintings seem to be reversed- as one would expect with a "camera obscura" in the days before sophisticated optics, and quite a handicap when copying a map. 15th century maps, except for navigational charts, tend to be copied by eye, with few measurements; as a result, even two maps by the same cartographer can depict the same features in quite different ways. The various trapezoidal distortions in different directions also seem to rule out the most effective low-tech method for copying and rescaling- use of squared grids.

Andrea Bianco's circular map, spread across two pages of the atlas, is drawn on a single sheet. It is glued on the back, along the page fold, to a binding strip which in turn is sewn into the book. This would have looked very elegant when the book was new, but over the centuries, the aging of the glue has left a badly discolored strip visible on the map, either side of the fold. The slide used in the superimposition and distortion experiments for this book was based on an official publicity photo of the Bianco map, which shows only the area north of the discolored strip. Given factors such as the cutoff of the west coast of Africa at the same point on the Vinland Map, and the notch in the otherwise featureless east African coastline at what would have been the cutoff point if the scale and latitude had not been changed, it seems likely that the Vinland Map was derived from a similar publicity photo. The trapezoidal distortion, which can be mimicked with a slide projector, implies that the Vinland Map was drawn by tracing round a projected image; projection from an angle would have the dual benefit of disguising the direct link with the Bianco map and reducing the problems caused by the artist's own shadow. The "jigsaw puzzle" variations in scale and projection angle, with the deliberate unsteadiness of the ink lines, would add to the misleading impression of copying by eye. The use of a carbon-based ink on parchment is very interesting. Carbon could have been chosen to avoid the problems of artificially aging iron-gall ink, which depends on chemical reactions, but there is a strong possibility that the ink will be found to have been made using an early version of Hofmann's trick to fool carbon-dating techniques, with a gelatin binder made by boiling some of the missing *Speculum* parchment (but that theory raises serious questions about the carbon-14-rich mystery chemical saturating the parchment).

The Vinland Map does not seem to have been made for financial gain; it takes too many lily-gilding risks for that. In a sense, it could be said that it was not made to deceive at all. Rather, it served as an excellent test of human powers of self-deception. Quite possibly, Enzo Ferrajoli was not deceived for an instant; for the above reason, I do not believe that he was the forger (also, the anatase in the ink and the stray particles containing chromium suggest somebody who worked in a small printing business) but the latest evidence indicates he knew more than he was telling, and guessed more than that. So in the end, the Vinland Map scam probably depended on one simple and curious thing. The creator of the map had no intention of using it to gain either profit or prestige, and thus was able to introduce it at a very reasonable price into a supply chain where cash and kudos were the only considerations. It made its earliest known appearance in the spring of 1957; wouldn't it be neat if the exact date was 1 April?

APPENDIX 1: The Provenance of the Manuscripts

Note that much of the following is based on an article written by the late Laurence Witten in 1989, at a time when he was beginning to suffer severe illness. The article contains several proven errors, other apparent inconsistencies, and occasional strange narrative discontinuities. The paranoid fringe have inevitably suggested that these aberrations in an otherwise lucid piece are deliberate clues to The Truth.

In 1955, at a sale organized by Geneva book dealer Nicolas Rauch, young Connecticut dealer Laurence C. Witten II (a specialist in early manuscripts, who had started his business at New Haven in 1951 after graduating from Yale School of Music) met a remarkable entrepreneur, born in Italy but domiciled in Spain, named Enzo Ferrajoli de Ry. Ferrajoli made his living traveling round southern Europe, seeking out old books and manuscripts in the war-scarred, economically blighted region and selling them to international dealers. In early autumn 1957, Witten met Ferrajoli again at Rauch's shop, and had the opportunity to see his latest assortment of interesting finds. In addition, he was shown a slim, neatly bound volume which Ferrajoli had acquired some time earlier, containing a short essay called "Hystoria Tartarorum" and an accompanying world map. Rauch was considering buying this himself, but was concerned that it might be a fake; after careful study, Witten decided that it was genuine, written around the mid 15th century in a Germanic area of Europe. It was agreed that Witten should buy the volume for \$3,500. He did not know at the time that the London dealer Irving Davis (of British/Italian firm Orioli and Davis) had tried and failed to persuade the British Museum to buy it. When Davis and Ferrajoli had taken the map to the B.M. it was examined by Peter Skelton and the Keeper of Manuscripts, Dr. Schofield; George Painter was also called in to offer his opinion. Matters such as the depiction of Greenland were challenging in themselves, but further criticism had come from Schofield, who found several "howlers"- beginner's mistakes- in the Latin map captions (nonetheless, the B.M. team did, without permission from the dealers, secretly make a tracing of the map, just in case it later turned out to be important). It was also rumored after 1965 that the volume had been turned down when Ferrajoli tried to sell it in Paris.

Back home in New Haven in October, once the book had been delivered, Larry Witten showed it to his friend Thomas Marston, curator of classics in the library of Yale University and a keen book collector. After he had researched the mission led by Giovanni Da Pian Del Carpinus which was described in the Tartar manuscript, and attempted to find how the map related to known medieval cartography (it was apparently Witten who first spotted the similarities with Andrea Bianco's circular world map of 1436) he and Tom took it to the director of the library's map collection, Alexander Vietor. Although the research had established a clear medieval context for the essay and map, there were serious problems, not least of which was the fact that both map and essay had bookworm holes, but not in the same places, so Vietor was not interested in a purchase. In the end, Witten gave the book to his wife as a present (one of the mistakes in the 1989 article is a statement that she had been the purchaser). About the beginning of April 1958, Tom Marston was sent a preview copy of an interesting catalogue by Orioli and Davis, and arranged to buy some items from it, not through Witten but through another local dealer he was friendly with (at this time, Marston was buying early manuscripts at the rate of more than one a week, roughly half through Witten, the rest through other dealers and auctions). Among the new acquisitions he was able to show off to Witten some weeks later was a hefty volume in a worn and repaired 15th century binding, which had been listed in the catalogue at the bargain price of £75. It was part of the well-known "Speculum Historiale" by Vincent of Beauvais, and it had what appeared to be the same page sizes and handwriting as the Tartar essay. Comparing the two, Witten soon found that the bookworm holes matched up, with the map at the front and the Tartar essay at the back. Transatlantic communications later confirmed that Enzo Ferrajoli had sold the "Speculum" volume for just £50 to Davis at the same time as he offered him the Tartar book, but neither had spotted the link between them. The previously cryptic note on the reverse of the map also linked it to the "Speculum", and suddenly it seemed that the map was both genuine and very important.

Now Cora Witten was the owner of a slim volume of potentially enormous value, and Tom Marston had at his disposal a hefty tome of little intrinsic value, but great importance in the study of its detached piece. With commendable chivalry and good sense, Tom gave his "Speculum" manuscript to Mrs Witten (probably in the summer of 1958; unfortunately Witten's essay seems to place some events of 1958-9 about eight months too late). Yale now took a serious interest in the Vinland Map, and later in 1958 managed to enlist the help of Paul Mellon, 1929 alumnus and fabulously wealthy son of the late banker and Treasury Secretary, Andrew Mellon. Paul was willing to risk buying the reunited manuscripts himself, at their now extremely high price (said to be around \$300,000) then donate them anonymously* to the University Library if they could be firmly authenticated, until which time knowledge of their existence was to be kept secret. He apparently turned down Witten's offer of a money-back guarantee. This arrangement was agreed, and a long process of study and debate began.

To be fair to Larry and Cora, \$300,000 was a high price for two volumes that might in whole or part be fakes, but if, after careful and authoritative research, it was found to be genuine, the Vinland Map would be one of the great icons of American culture, and the most conservative estimate of its market value would probably be a million dollars. This raises an interesting point about the tax rules for charitable donations. Today it is very common for donors to take advantage of the fact that charitable tax deductions are made on the assessed market value of donated items *at the time of donation* (up to a limit of 30% of annual income). Not many people even today could get the full tax advantage from a single donation valued at \$1,000,000- presumably Yale had this in mind when they approached one of the world's few billionaires back in 1958 (at which time, by the way, the top income tax rate was 91%, though it fell to 77% in 1964, about the time the donation was made).

Alexander Vietor probably did not know, when he approached one of the greatest living experts on medieval world maps, that Peter Skelton had already seen the Vinland Map. Presumably Skelton told him, and recommended one of the others who had rejected the volume back in 1957, George Painter, to help decide the issue once and for all. Although Painter's field, strictly speaking, was early printed books, he was something of a polymath (for example, the first volume of his great summary of the life of Marcel Proust appeared in 1959, the conclusion in 1965) which meant that he would be able to assess information from a variety of disciplines. This did create a slight ambiguity in the assessment team, for Painter's skills made him an obvious choice to coordinate the final report, but that job

* His name was released when Yale published the new edition of the 1965 book in 1995. He died in 1999.

arguably belonged to the Yale representative. Because of his early involvement, and his great knowledge of old manuscripts, Tom Marston filled that role, but again, in strict academic terms, he was working outside his area of expertise. There would probably have been fewer complaints in later years if either Marston or Painter had been replaced by a world-ranked expert in medieval handwriting and inks; fewer still if there had been at least one more permanent member of the team, with specialist knowledge of the Norse exploration era. And of course, don't forget the magician.

While the team went to work, Laurence Witten kept up correspondence with Ferrajoli about the two volumes, but this was dramatically interrupted when Enzo was arrested by the Spanish police on charges of theft from the Cathedral of La Seo in Zaragoza. His business files were impounded as evidence, but when (after he had been in prison for a year and a half) his wife found at home two letters from one of the cathedral canons, offering him books, she sent them to Witten for safe keeping. The police sent out a list of items allegedly stolen from La Seo, but Laurence and Tom were relieved to see that it contained nothing resembling the all-important pair of volumes. Shortly afterwards though, a police press release announced that other stolen manuscripts had been sold by Ferrajoli to Yale University through Witten. This provided the ideal opportunity to reveal the two letters rescued by Margarita Ferrajoli; and as the manuscripts in question had been handled not by Witten but by the other New Haven dealer who had imported the "Speculum" volume for Tom, the Spanish police were left looking very foolish indeed. Not long afterwards, in mid-1963, Enzo was released on parole, and that autumn, Laurence visited the family in Barcelona. It was perhaps following this visit that Witten reported to the investigating team that he had been allowed to make a detailed search of the private collector's library from which the two books had been bought by Ferrajoli, in hopes of finding the rest of the "Speculum" or other related items. He later described it as quite large, containing numerous early printed books and manuscripts; the Vinland volume had apparently been in the collection for a couple of generations, some 60 years. However, he insisted that he could not reveal the location of the library to anybody else, though it was later said that he was considering the possibility of writing it in a letter to be kept sealed until long after all concerned were dead. The only possible hint Larry ever gave was to mention a dealer and collector named Luis Fortuny, who had collaborated with Ferrajoli in the 1950s for the sale of numerous items from a branch of the Columbus family.

As a lighthearted counterpoint to the foregoing: by the 1960s, Tom Marston's own collection was probably large enough to rival the mysterious library. He had been collecting in a small way since the 1930s, but had taken great advantage of the postwar conditions found by Witten and others in Europe to increase his holdings enormously between 1954 and 1961. A 1962 census of early manuscripts held in America found he had nearly 300, one of the largest private collections in the country, but that figure was already out-of-date when it was published. In 1961 Tom began selling off his manuscripts, some by auction, some through Witten, but most in a single deal, effectively to his own employers (via the Yale Library Associates) in 1962. He had also given five to the Yale School of Music, and later donated further manuscripts to Yale's Beinecke Rare Book & Manuscript Library (which was not built until 1963). Barbara Shailor, who began compiling a detailed catalog of the Beinecke collections for publication in the 1980s, was not impressed by the accuracy of the background information Marston himself had provided about his collection; perhaps he preferred to take off his librarian's hat when pursuing his hobby.

On a less lighthearted note: at the Vinland Map Conference in 1966, serious questions were asked of Laurence Witten and Thomas Marston, relating to the acquisition of the two volumes. Witten explained his promise to protect the anonymity of the source library, come what may, but reiterated the story of his painstaking research there. He also gave assurances that there had been no hidden deal with Ferrajoli, Rauch or Davis; the \$3,500 he had paid was the total price for the map volume, not some sort of deposit to be supplemented later by a percentage of the sale price as commission. He went so far as to invite inspection of his financial records, and of his wife's too, for she of course had been the owner of the volume when it was sold to the then-anonymous Mellon. The main reason for the suspicion was the miracle which had reunited the two volumes- Davis sees both at roughly the same time, fails to spot the similarities (as, apparently, had Ferrajoli), rejects one but buys the other very cheaply, then offers it a year later at a bargain price in an advance copy of a catalogue sent to a friend and major customer of the dealer who had bought the rejected volume. No such advance copy was sent to Witten himself (while the final version of the catalogue, number 159, was not apparently published until late in the winter of 1958-9, several months after catalogue number 160) and as we have seen, he was not even asked by Marston to handle the import of the purchases, but was invited to see them as soon as they arrived. This occurred months after Witten had paid over his \$3,500, and Marston assured his interrogators that he had no special relationship with Davis- if anything the relationship was quite poor. Assuming that Marston and Witten were honest it all came down to a simple point made by the latter- \$3,500 just wasn't enough reward for a conspiracy.

The final episode in the "discovery", confirming scholarly deductions from other evidence, did not actually happen until months after the assessment team had reported. In 1966, before the two books were sent on their visit to Europe, the Beinecke Library decided something should really be done about the binding of the "Speculum Historiale" volume. Not only was it in a rather tattered condition, the fleur-de-lys decorations on the covers were upside down, suggesting that when the Tartar Relation and other pages had been removed, the front cover had been replaced on the back and vice-versa (as previously mentioned, in the same operation, the original pastedown sheets attaching the cover boards to the pages had been removed, probably taking all indications of former ownership with them). The covers appeared to be of original 15th century make, so they were treated with great respect, which turned out to be a good thing as the famous ink-ghosts from the lost original pastedowns were then revealed, providing the researchers with the final clues linking the Vinland Map to the Council of Basle.

The actual launch of the map and the official book had been intended to take place early in 1965, but it was suggested that it should be unveiled on the second annual Leif Eiriksson Day, October 9. However, that was a Saturday, not a good day for ballyhoo and press conferences, so the great event was moved, reportedly at Paul Mellon's personal request, to the following Monday. The day before Columbus Day (all publicity is good publicity...).

The McCrone findings at the beginning of 1974 had a most dramatic effect. Witten was asked to meet with senior Yale officials who suggested that he really ought to abandon his promise not to reveal the location of the library, in case it was at the center of a major forgery operation. Cornered, he then confessed that he had not actually visited the library at all, and could not even be sure that it existed. He had made up the story of the visit to buy time while he tried to find out more from Ferrajoli, but then stuck with it even after his supplier had died. He made this confession public in the 1989 article, but carefully gave the impression (with repeated suggestions that he had felt under no pressure from the investigating team to give more information about the library) that he had first uttered the lie during hard questioning at the 1966 conference, whereas he had actually used it to deceive the investigators years earlier.

Paul Saenger of the Newberry Library also noted in his 1998 article that the 1989 piece contains the first known reference to a meeting between Witten and rival dealer Davis in Milan, immediately after Laurence had purchased the map; plus, most significantly, an account of the immediate consequence of the 1974 confession. Asked by the Yale officials to return the money to Paul Mellon, Witten claimed that in addition to tax, some of the money had been paid out as commission to the (deceased) dealers Ferrajoli and Rauch- contrary to his 1966 insistence that no such commission arrangement existed. The story of the map's acquisition as given in his 1989 essay even included specific (but slightly confusing) references to the transactions involved.

When Mellon was contacted about the "private library" deception (Witten offered to go and break the news in person) he was content, for his own reasons, to let the matter go, so Laurence C. Witten will probably be best remembered not for his multiple lies, but for his valuable antique collections, including the fine stringed instruments acquired from him in 1984 for the Shrine to Music Museum.

In 2004, a PBS/ UK Channel 4 TV documentary about the Map broadcast an interview with a retired antiquarian book dealer to whom Ferrajoli had mentioned, around 1956, that he had put the Map and the Tartar Relation in the new binding as part of a plan to boost their value. This does not prove that he had anything to do with the creation of the Map, but it means he certainly was not unaware of the link between the Map and the Speculum, and suggests that at the very least he had doubts about the Map's authenticity. The principle of doing "impossible" things works for all tricksters, not just forgers, and it now seems to be confirmed that the "miraculous reunion" of the two volumes was no miracle at all.

APPENDIX 2: The Stefansson and Resen Vinland maps.

In 1590, a young Icelandic scholar, Sigurdur Stefansson (who sadly drowned a few years later) produced a map of the North Atlantic as it might have been perceived by his Norse ancestors centuries earlier. Although the map had scales of latitude and longitude, even the depiction of Old World features such as the British Isles was seriously inaccurate by the standards of the time; indeed Greenland was turned through a full 90 degrees. This has led some researchers to speculate that Stefansson's map was based on a much earlier original, made independently of mainstream European cartography (though the depiction of Greenland itself is reminiscent of the "Baccalaes regio" on Oronce Fine's world map of the 1520s). One problem with that theory is that the 1590 map only marks region-specifically regions named in the sagas and old Norse geography texts and not, for example, ports. Another is that it does not depict the reality that was experienced by sailors (Adam of Bremen, for example, was informed in the 11th century that Greenland is "opposite" to the Swedish mountains, about the same sailing distance as Iceland- which is actually true, as Sweden's mountains are in the far north of the country, and sailing due west from a port on that latitude, such as Narvik, crosses to the nearest part of Greenland). Hence if Stefansson's work is derived from an earlier map, that map itself was a scholarly exercise, not a practical aid to navigation. In practice, the claim made for the map's origin is that it was "ex antiquitatibus Islandicis maxima sui parte desumpsisse videtur" which clearly indicates that though based on ancient material, it had many sources. It is most likely that Stefansson drew a freehand map, based solely on literary references, then attempted to extrapolate a scale of latitude and longitude from his knowledge of the coordinates of Iceland, using a totally unrealistic rectangular grid.

About 1605-6, Bishop Hans Resen, working in Copenhagen, made another map along the same lines as Stefansson, based on "antiqua quadam mappa, rudi modo delineata, ante aliquot centenos annos, ab Islandis". As he was working long before the days of photography and air travel, he would not have been surprised if the Icelanders sent him a carefully drawn copy rather than the precious original. The map he was sent depicted Greenland in the same idiosyncratic way as Stefansson's, spelled at least some place-names just like Stefansson's, and so presumably was a copy of Stefansson's, complete with the explanatory note about its antique Icelandic sources, which Resen misinterpreted as meaning that it was a copy of an antique map. Be that as it may, he adopted a brilliant strategy to try and make sense of this crudely drawn source, based on the old Norse technique of open-sea navigation by maintaining constant latitude. For this purpose he copied the latitude and longitude grid for the northern Atlantic, with outlines of the European coastal area, from a world map using the very latest data, on the trapezoidal "Donis" projection. This projection has the important quality of giving tolerably accurate distances for medium-sized areas

Outlines of
the two maps

Left:
Stefansson



Right: Resen, with inset
from a map dated c1600



of the planet's surface, while representing east-west routes as straight lines, just as they would be treated by the navigators hundreds of years earlier.

The "antique" map he was attempting to interpret also depicted parts of the European coastline, with major offshore islands including Great Britain, Ireland and the Faeroes. The key to Resen's ingenious strategy was probably the tip of the Vinland promontory itself, marked at the same latitude as the middle of Great Britain on his source map. On his modern map, he would have found a similar feature in a similar position- the northern tip of Newfoundland. This, with the known position of the southern tip of Greenland (the only west-Atlantic place on the old map which still had the same name) would give him a base from which to estimate the position of other features. However, another clever aspect of Resen's approach was that he did not intend to find precise equivalents on the modern map for all points on the original, he just needed some understanding of the way it was distorted relative to the "real" geography he could see on his modern map. Having established from his first points that the old map consistently depicted east-west distances across the Atlantic as too short relative to north-south distances (and that the longitude markings themselves were wrong, with the American coast at around 310 degrees Ptolemaic instead of 330) he probably made just one other comparison with the modern map, to try and establish the extent to which this might affect the depiction of the American coastline itself.

At this point, reality started to get in the way of Resen's ingenuity. The latitudes of key points can be seen to be derived from further transatlantic matches, but the longitudes are entirely Resen's work. Greenland he copied quite faithfully, perhaps by translation of coordinates to the corrected longitude scale (it looked a bit distorted because of the overall east-west squeeze of the old map, and he did add a few known offshore islands) but for the peninsulas and inlets of Helleland, Markland and Vinland, he greatly increased the east-west exaggeration. He may well have observed that his up-to-date map showed a very long inlet just to the north of Newfoundland- shown far larger on maps of c1600 than Hamilton Inlet, as it is now named, is in real life. The comparable inlet on the "antique" map was about the right width, but much shorter, even with the corrected longitude scale, which seems to have made him adjust his depiction of the entire coastline accordingly. He did perhaps slightly spoil the academic purity of this work by adding an extra section at the south end, copied directly from his modern map- the St. Lawrence (note that despite this, he did not attempt to "correct" the old map's apparent depiction of Newfoundland as a peninsula). Only when he had drawn this outline did he attempt to find the modern equivalents for the other ancient place-names, deducing that Helleland was Estotiland (later found to be part of Baffin Land), Markland was Labrador and the land of the Skrellinger was New France with the inland area to its north. He also added information from historical documents and recent exploration, including various details (not all from reliable sources) of the old Greenland settlements. For the still-mysterious lands towards the North Pole he left the ancient names to speak for themselves.

The wonderful thing is that all this academic improvisation actually kind-of worked. Norwegian researchers Helge and Anne Stine Ingstad thought it worthwhile to follow the information that the maps supplied about Vinland, and chose also to accept the argument of Swedish philologist Prof. Sven Söderberg that the name Vinland had originally meant "grazing land" not "wine land". They therefore explored the promontory marked on the Resen map, and were shown a site near the shore with overgrown mounds, where they excavated in the early 1960s and found genuine, incontrovertible evidence of Norse settlement. Their discovery caused excitement in academic circles, and was featured in the National Geographic Magazine in November 1964, but somehow remained little-known. After the Vinland Map launch (and the subsequent widely-reported Columbus Day editorial in Spain's conservative newspaper "A.B.C." suggesting that the Norse stories of American exploration belonged with the notoriously mendacious medieval travel stories of Sir John Mandeville) the Ingstads promoted their Newfoundland work again, this time with great success. Their findings do not necessarily prove that the Resen map was correct in its identification of Vinland (some clues hint that it was further south and still awaits rediscovery) but the Norse settlement site at L'Anse aux Meadows is what the Vinland Map could have been if genuine: one of the world's great historical symbols.

NOTES ON SOURCES

VMTR● Skelton, R.; Marston, T.; Painter, G. "The Vinland Map and the Tartar Relation" Yale University Press, 1995

[the 1965 official book, republished with introductory essays & updates; usually abbreviated VMTR2]

VMTRcaps● VMTR pp128-141, list of all Vinland Map captions, with numbered key map

● both the Vinland Map itself (property of the Beinecke Library, Yale University) and Andrea Bianco's circular map (in his atlas at the Biblioteca Nazionale Marciana, Venice, Italy) are illustrated in VMTR, but the outlines shown here are based on www.bnl.gov/bnlweb/pubaf/pr/photos/2002/vinland.jpg & www.tin.it/veniva/venetie/sources/sourc033.htm

● fresh visual analyses and comparisons of the maps have been performed in 2004 to provide illustrations for this book

● some other medieval map resources: www.henry-davis.com/MAPS & www.capurromrc.it/mappe/mappe.htm

GJ74● "The strange case of the Vinland map: a symposium" in the Geographical Journal, vol. 140 (1974), pp 183-214

HT● C. de Bridia "Hystoria Tartarorum"; photographic reproduction and text in VMTR. See also:

● A. Onnerfors [Ed.], "Hystoria Tartarorum C. de Bridia monachi" (Kleine Texte für Vorlesungen und Übungen, 186), 1967

VS● "The Vinland Map" in the Saga-book of the Viking Society, vol. XVII pt. 1 (1966), pp 63-89

VMC1● the first Vinland Map Conference, Nov 15-16 1966 [see:

W.E. Washburn (Ed.), "Proceedings of the Vinland Map Conference", University of Chicago Press, 1971]

McCu● Hu McCulloch Vinland web page: www.econ.ohio-state.edu/jhm/arch/vinland/vinland.htm

● some other Vinland Map resources: www.isidore-of-seville.com/vinland (*not updated recently*) + <http://webexhibits.org/vinland>

Page by page:

2) Quires♦VMTR p24♦ Pastedowns♦VMTR pXVII♦ older Hystoria Tartarorum manuscript♦G. Guzman in Vincent of Beauvais Newsletter 33 (2003) pp 3-7♦ Sabbatical♦obituary, London "Times" Dec 11 1970♦ Britain shape♦VMTR p117

3-5) Comparison experiments as illustrated

3) Taylor♦VMTR pXIII♦ No sideways stretch♦see VMTR p231

4) Embellished coastlines♦VMTR p115

5) Leardo map♦VMTR p119

6) Canaries♦VMTR p122♦ Island names♦VMTR pp128-141 (captions 61-63)♦ Insule deserte♦G.R. Crone "The Vinland Map & the Tartar Relation" in the Geographical Journal, vol 132 (1966), pp75-80 ♦ Handwriting♦eg VS, summary by D.B. Quinn (and see also the very cautious Yale Beinecke Library catalog entry for the map volume, MS 350A)♦ Mystery names♦VMTRcaps (21, 37, 15)♦ Tartar Relation & captions♦VMTR p244 note ♦ Robert Stonehouse♦Google Groups [*search terms*: apusia latartata]

7) Gog & Magog♦VMTR p153, + VMTRcaps (47-48), + other problem captions pp244-5♦ Rivers♦as shown, + VMTR p117♦ Tatarata♦VMTRcaps (51) ♦ Extra islands♦as illustrated, + VMTR pp152-3

8) Color confusion♦VMTR p250♦ Skelton on Greenland♦VMTR p184 + p231♦ Taylor♦VMTR pXIV ♦ King's Mirror♦"Speculum Regale" chap. XVII♦ Adam of Bremen♦his "Gesta Hammaburgensis ecclesiae pontificum", appendix on "Descriptio insularum aquilonis", ch. 36. ♦ Crone mistake♦letter, London "Times", Oct 14 1965, + VMTR pXII ♦ Wormholes♦GJ74 G. Painter article, pp193-4.

9) Hofmann♦J. Tanner "Confessions of a White Salamander", Utah Lighthouse Ministry, 1987♦ Pagination♦VMTR p24 ♦ Carbon dating♦see W. Libby "Radiocarbon Dating", 1952♦ Ink♦VMTR p109♦ Washburn♦VMC1 ♦ British Museum tests♦GJ74, A.D. Baynes-Cope article, pp208-211.

10) McCrone tests♦GJ74 W. & L. McCrone article, + W. McCrone "Authenticity of medieval document tested by small particle analysis", in Analytical Chemistry, 1976, pp676a-679a, + W. McCrone "The Vinland Map" in Analytical Chemistry, vol 60 (1988), pp1009-18 ♦ Ground anatase♦McCrone report to Yale, 1974 ♦ Anatase Patent♦US Patent 1087575, Feb 17, 1914

11) Stray sample♦McCrone report to Yale, 1974♦ Olin♦J. Olin & K. Towe, in "Abstracts of International Congress for the History of Cartography", (Washington DC), 1976, p25 ♦ American recipe♦D. Carvalho "Forty Centuries of Ink", 1904, chap. XXI ♦ Early rejection of clay♦K. Towe, pers. comm. (citing correspondence from himself as editor for the Clay Minerals Society) ♦ Weaver♦cited VMTR pXXVI, + McCu♦ Advertorial♦McCrone 1976 op. cit.♦ Shroud♦ www.mcri.org/vm_shroud_update.html ♦ Towe♦cited in K. Towe "The Vinland Map: still a forgery" in Accounts of Chemical Research, Nov 1990; also, my thanks to Ken for his comments and additional information, Sep 2004 ♦ CHAPS tests♦T. Cahill et al. "The Vinland Map, Revisited" in Analytical Chemistry, vol 59 (1987), pp829-833, + VMTR ppXXIX-XXXIX♦ Møller♦his Preliminary Report, CHAPS May 1985 (+ anatase theory submitted to "Nature", 1982)

12) McCrone reply♦McCrone, 1988 op. cit.♦ Towe♦Towe 1990 op. cit.♦ Olin♦J. Olin "Lessons from a Medieval Map" in minutes of the Philosophical Society of Washington, 2066th meeting, Dec 13 1996, + J. Olin "Without Comparative Studies of Inks, What Do We Know About the Vinland Map?" in Pre-Columbiana, vol 2 no. 1 (Jun 2000), pp27-36 [a revision of a 1993 unpublished paper]♦ CHAPS titanium♦report of the 2nd Vinland Map Conference, in the London "Times", Feb 26 1996♦ New ink batch♦L. Lönnroth, review of VMTR in Alvisismál, 7 (1997) pp115-20, citing G. Harbottle♦ Carbon dating♦D. Donahue et al. "Determination of the Radiocarbon Age of the Parchment of the Vinland Map," in Radiocarbon, 44/1 (August 2002), pp45-52 ♦ British Museum letter♦Radiocarbon 44/2, p599 ♦ Raman tests♦K. Brown & R. Clark "Analysis of Pigmentary Materials on the Vinland Map and Tartar Relation" in Analytical Chemistry, vol 74 (2002), pp3658-3661, + the unfortunately-titled "America- discovered by the Vikings?" (SPD/CS/077), Renishaw plc Spectroscopy Products Division, Jul 2001 + R. Clark pers. comm. via K. Towe♦ McNaughton♦D. McNaughton essay in W. Fitzhugh & E. Ward (Eds.) "Vikings: The North Atlantic Saga", Smithsonian Institution, 2000, pp257-269♦ Enterline♦title cited, Johns Hopkins University Press, 2002, [based on unpublished paper presented at the 7th International Conference on the History of Cartography, Washington, D.C., Aug 1977, cited in VMTR pXXV]♦ Quinn♦VS.

13) Inks♦ booklet "An introduction to writing inks", Public Record Office (England), 1998 ♦ Cahill & Clark♦S. Borman "Real or Fake" in Chemical & Engineering News, 7 Aug 2002♦ Olin♦J. Olin "Evidence that the Vinland Map Is Medieval" Analytical Chemistry, vol 75 (2003) pp2645-47♦ Towe♦K. Towe letter in An. Chem., Feb 1 2004 ♦ Luka J♦cited in GJ74, H. Wallis article♦ Seaver♦K. Seaver "The Frozen Echo", Stanford University Press, 1996, + K. Seaver "The Vinland Map: who made it and why?" in The Map Collector, 70 (1995), pp32-40, + numerous later articles by K.S. ♦ N.B. Oddly, K.S. avoided asserting the "fooling the Nazis" idea in the TV documentary "Vinland: Viking Map or Million Dollar Hoax?" (Granite Productions, UK, 2004)

14) Poinare♦announced at VMC1, + see for example references on www.phil.uni-passau.de/histhw/cancellaria/Basel.htm ♦ King Erik etc.♦noted by D.B. Quinn in VS ♦ Vatican records♦T. Smart (Ed) "The Flatey Book and Recently Discovered Vatican Manuscripts", Norræna Society, 1906 & 1908♦ Fischer♦e.g. article on "Pre-Columbian Discovery of America" in the Catholic Encyclopedia, 1914 ♦ Caption anomalies♦VMTR p224 + p251, + P. Foote "On the Vinland legends on the VM" in VS ♦ south-east♦see G. Freibergs in Terrae Incognitae, vol 21 (1989) p1

15) Seaver♦K. Seaver, 1995 op. cit.♦ Binder's note♦VMTR pp25-26 + P. Saenger "Vinland re-read", Imago Mundi, vol 50 (1998) pp199-202 ♦ Cryptography♦see J. Enterline "Cryptography in the Yale Vinland Map" in Terrae Incognitae, vol 23 (1991)♦ Bjornbo♦GJ74, G. Crone article♦ Caveri♦(as "Canerio") D. McNaughton, op. cit. 2000 ♦ Painter♦VMTR pplX-XVII + 243-261, + article in GJ74♦ Maddison♦GJ74 article "A sceptical view of the Tartar Relation"

16) McCulloch♦McCu♦ Evidence against chromite theory♦e.g. Chromite molecules contain 2 atoms of chromium and 1 of iron, but the PIXE elemental analysis found less iron than titanium in the black lines of the map, and chromium wasn't reported♦ Skelton speculation♦VMTR p118♦ Publicity photo♦e.g. see online version cited ♦ Witten article♦reprinted in VMTR ppXLI-LVIII.

17) British Museum + Paris♦GJ74, H. Wallis article. ♦ Speculum♦VMTR ppXLVI-XLVII + p3♦ Catalogue price + Marston purchases + sale to Mellon♦P. Saenger, 1998 op. cit. ♦ Leif Eiriksson Day♦U.S. Public Law 88-566, approved by Congress on Sep 2 1964♦ Painter♦British Library catalog.

18) Ferrajoli problems♦VMTR pLIII ♦ Visit to library♦VMTR p4♦ Marston collection♦P. Saenger, 1998 op. cit. + www.oew.ac.at/ksbm/gjm/lanoe2.htm ♦ Awkward questions♦VMTR pLVI + Witten essay in VMC1, + P. Saenger, 1998 op. cit.♦ Rebinding♦VMTR ppXVI-XVII.

19-20) Stefansson & Resen maps♦both illustrated in VMTR.

19) Launch Day♦VMTR introduction + Granite Productions op. cit.♦ Witten confession♦Witten article as reprinted in VMTR + P. Saenger, 1998 op. cit. ♦ Witten collection♦e.g. see Journal of the Violin Society of America v12, n2 (1992), pp13-21♦ TV documentary new evidence♦testimony by Diego Gomez Flores in Granite productions op. cit.♦ Adam of Bremen♦his op. cit.

20) 1600 inset♦from Barent Langenes "Caert Thresoor" miniature atlas, c1600 ♦ Ingstad announcements♦"Vinland ruins prove Vikings found the New World" in National Geographic Magazine, vol 126 no. 5 (Nov 1964) pp708-734 + London "Times", Dec 14 1965

P.S. "*Maps, Myths, and Men*" by Kirsten Seaver (ISBN 0-8047-4963-9, July 2004) The reference notes to Kirsten Seaver's book on the Vinland Map are longer than the whole of the text you have just read. It's a very very detailed work, with plenty of material on the reality of Norse expeditions across the Atlantic, and on genuine early maps. As noted on page 13, I don't agree with Kirsten's central theory about the forger (however the book provides a useful biography of Fr. Fischer) and I feel she makes too much of some other ideas- and marginalizes Bianco. She gives relatively little space to the evidence against the Map and misses much of what you have read here (though she presents more on Baynes-Cope's tests) but she reveals a great deal about the misdeeds of its various promoters. Highlights include details of the indignities inflicted in the rebinding of the two volumes (including suspicions that the two pages of the Map may be two pieces of parchment joined together) and of the 1965 and 1996 PR campaigns.