'THE LANDE OF JAVA' ON THE JEAN ROTZ MAPPA MUNDI

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Abstract. Using the latitudes and longitudes explicit on the 1542 Jean Rotz 'Mappa Mundi', the projection used by Rotz was analysed. It was found to be an Equatorial Stereographic of a type probably designed by Rotz. Using this, a modern coastline was projected and then overlaid on the Mappa Mundi using a Geographical Information System. This shows that 'The Lande of Java' on this map is not offset from the location of modern Australia as is sometimes suggested. The Mappa Mundi in Jean Rotz's atlas is a good 'first approximation' of the Australian continent. The continent is located in the right place, the width of the continent is greater but is of the right order of magnitude, the gross morphology of the east coast is correct, and the southern latitudinal extent of the west coast is correct. The south-eastward extension of the east coast may reflect early knowledge of New Zealand.

INTRODUCTION

The *Mapping Our World* exhibition of early maps held at the National Library of Australia over the summer of 2013-14 provided a setting for some interesting discussions. One seminar (10 November 2013), in which a panel debated 'The Dieppe Maps Controversy', was striking for the high level of disagreement amongst the panellists. Some of the strongest opponents of the argument that these represent the oldest surviving maps of Australia seemed to conflate two separate issues (W.A.R. Richardson, 2008). The first: do portions of these maps represent Australia? The second: who might have produced the original fragment from which this is drawn? The first of these is the focus of this paper.

The Dieppe maps are a group of maps produced in and around Dieppe in the mid-16th Century. There is an extensive literature regarding them which Van Duzer (2015) reviews comprehensively. Most of the maps present both new and legacy material and are often highly decorative. They were high value items which were not widely distributed and, in the case of some of the atlases, the single copy produced was shelved and forgotten. The cartographers involved include Jean Mallard, Jean Rotz, Guillaume Brouscon, Pierre Desceliers, Guillaume Le Testu and Nicolas Desliens. There are also surviving maps credited to the Dieppe School which are of anonymous origin. Amongst these is the Vallard Atlas (*c.*1547, reproduced by Moleiro, 2010), Nicholas Vallard being the client and not the cartographer. Many of these maps have distinctive features in common suggesting access to a common original. Jean Rotz explicitly credits an unidentified original source map (Wallis, 1981b).

All of these maps, except Mallard's, depict a large land mass labelled on some as *'The Lande of Java'*, between what is now Indonesia and Antarctica. In some of the maps, this 'Land of Java' is joined to a hypothetical, 'Ptolemaic', great southern landmass. Some of the maps refer to the same feature as '*Java la Grande'*. Much of the academic and popular interest in the Dieppe maps since the late 18th Century has focused on this landmass. A number of researchers, including Matthew Flinders (1814), Richard Henry Major (1859), George Collingridge (1895), Kenneth McIntyre (1977), Helen Wallis (1982, 1988

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& 1992) and Peter Trickett (2007) have concluded that this feature represents an early, first approximation, mapping of Australia. Others, such as W.A.R. (Bill) Richardson, argue strongly against this (W.A.R. Richardson, 2015).

In his atlas, Rotz appears to consciously avoid the speculative depiction of a great southern landmass around the pole, unlike some of the later Dieppe cartographers. He also states that the data was sourced from an unattributed original large chart of the world. Many of these large charts of the world were, at this time, mosaics of material drawn from different sources. Helen Wallis, in her preamble to the facsimile edition of the atlas, and after a long discussion of possible sources, suggests that the large chart of the world from which Rotz drew was by Pierre Crignon (Wallis, 1981c) although his map has not survived. This too was probably a copy of an older source. No records, other than these Dieppe maps, survive to document a voyage by Europeans down the East Coast of Australia prior to Cook. Much has been made of the lack of surviving historical documents referring to such a voyage but Luiz Filipe Thomaz (2010) makes the point that unlike the trade in cloves and nutmeg from the Spice Islands, trade in sandalwood from Timor was not a royal monopoly and was left to private merchants. Their records, if any, were not archived and preserved for posterity. It is possible that the unattributed original large chart of the world drew on such sources.

Speculation about the existence of a real landmass to the east and south of Java grew between 1520 and 1550. In the 1531 double-cordiform world map by the French cartographer, Oronce Fine, there is mention of a discovery of Terra Australis (Major, 1859). This map shows a land mass labelled '*Terra Australis recenter inventa, sed nondu plene cognita'* centred on the South Pole. The label, which translates as 'Southern Land, recently discovered but not yet fully known', suggested to Richard Henry Major evidence of an early discovery of Australia. The separation of the map from any text containing metadata which might have supported such an interpretation leaves this as speculation. Van Duzer (2015) describes Mercator's 1538 and 1541 world maps, noting that the 1538 version follows Fine in his depiction of Terra Australis but that the 1541 map has a very different depiction. On Mercator's 1541 globe Van Duzer notes a substantial peninsular land mass stretching north from the circumpolar land mass towards Java Minor at about the longitude of modern Australia.

Van Duzer (2015) also discusses Jean Alphonse "who was of Portuguese origin [but] worked in Normandy". Alphonse's 1544 manuscript, *Cosmographie*, relied heavily on the 1519 *Suma de Geografia* of Martin Fernandez de Enciso. The only one of Alphonse's maps to show Java la Grand depicts only the most northerly tip and what is probably Sumatra and Southeast Asia in a very similar fashion to the Dieppe maps but with different labels. This is interesting as it has text on the map which, translated by Van Duzer (2015), reads:

> Java Minor is an island, and Java la Grande is a continental landmass with many islands around her. This Java stretches west to the Straits of Magellan, and east to the southern continent, according to the sphericity of the Earth. And according to what I understand, it goes all the way down to the South Pole, given that between the one (Java) and the other there are many branches of the sea that are unknown to us, and one does not know whether they separate those lands into islands, and it has not been discovered further than Java because of the great cold at the South Pole.

This statement is strengthened by Alphonse's claim to have sailed along the coasts of "Java la Grande et La Petite" (Wallis, 1981a). Matthew Richardson (2010) notes that in 1597 Cornelius Wytfliet, in his *Descriptionis Ptolemaicae Augmentum* published at Louvain, wrote:

> The Australis Terra is the most southern of all lands, and is separated from New Guinea by a narrow strait. Its shores are hitherto but little known, since after one voyage and another that route has been deserted, and seldom is the country visited unless sailors are driven there by storms. The Australis Terra begins at

> two or three degrees from the Equator, and is maintained by some to be of so great an extent that if it were thoroughly explored it would be regarded as a fifth part of the world.

The sources on which Cornelius Wytfliet drew seem to have had knowledge of the separation of New Guinea by a strait from the much more extensive land to the south of it, but they imagined that the southern continent was far vaster than was actually the case. The Terra Australis of Cornelius Wytfliet was a continent stretching right round the South Pole. Cornelius Wytfliet does not provide any information on his sources or the several voyages to which he refers.

W.A.R. Richardson, in numerous papers and a book (Richardson, 2008 & 2015), argues strongly against the view that the 'Lande of Java' on some of the Dieppe maps represents Australia. He bases most of his arguments on toponomy rather than cartography. This reliance on place names has led him to make some quite dramatic claims. He claims (W.A.R. Richardson, 2015) that *Java le Grande* may have been "composed of misplaced copies of no longer extant Portuguese charts of lands that the French (Dieppe mapmakers) were unable to identify, either from their outlines or their inscriptions, but nevertheless considered genuine and therefore incorporated hypothetically. Clearly these charts must have lacked coordinates, scale and even apparently orientation". He goes on to claim that the east coast of *Java le Grande* is copied from an early Portuguese chart of Vietnam without any evidence that such a chart or charts existed. To do this he inverts the east coast of *Java le Grande,* moves it into the northern hemisphere, and separates it from its west coast which he rotates through 90° and also moves north to become eastern Java (Schreiber, 2008).

Matthew Richardson devotes seven pages of his book *The West and the Map of the World* (M. Richardson, 2010) to forensically demolishing Bill Richardson's claims. Schreiber also takes Bill Richardson to task on a number of his many assumptions (Schreiber, 2008). Importantly, what neither draw attention to, is that Bill Richardson also ignores the latitude and longitudes shown on several of these Dieppe maps in his frequently repeated figure showing a superimposition of an outline of *Java* and *Java le Grande* taken from a Dieppe map on a modern outline of Southeast Asia and Australia. Bill Richardson's use of the island of Java as a single co-registration and scaling point results in the *'The Lande of Java'* sitting far to the west of the location of Australia (W.A.R. Richardson, 2008). By ignoring the latitudes and longitudes shown on several of these historical maps a possibly misleading impression is given. Richardson's figure needs to be checked. The aim of this paper is to see what the latitudes and longitudes on the Rotz Mappa Mundi have to tell us about this.

THE MAPPA MUNDI

To compare these maps with modern cartography, one needs to know the projection, the prime meridian used and the distinction between what is thought to be known and what is speculation. Here we concentrate first on Jean Rotz's 1542 Mappa Mundi as a source because (a) it is one of the earliest of the Dieppe maps and, presumably, closer to the source material; (b) it is explicitly projected and it displays a graticular network of latitude and longitude; (c) it is the only one of the maps to have 'Metadata' (Rotz's *Boke of Idrology*, reproduced in facsimile by Wallis, 1981a) and (d) it does not show the imaginary great southern landmass postulated by many cosmographers.

The metadata are important. Today, spatial data without accompanying information about their quality, antecedents and fitness for use are unacceptable. Few old maps have such data. Unusually, the *Boke of Idrology* is an exception. In it Rotz explicitly states that the atlas in which the Mappa Mundi is contained depicts only "that which is known". The atlas comprises a preamble, a series of detailed portolans at large scale showing regions of the continents, and a comprehensive, double-page Mappa Mundi at small scale.

In the plate showing West Africa, it is clear that Rotz used Ferro as his prime meridian for the portolans in the atlas. The Rotz Mappa Mundi clearly has longitude measured from a prime meridian at Boavista in the Cape Verde Islands, and not at Ferro (Wallis, 1981a, pl.17-18). Wallis also notes that the Mappa Mundi has details not shown on the portolans which she suggests indicates two original sources, with the source for the Mappa Mundi being of a later date (Wallis, 1981a).

The Jean Rotz Mappa Mundi (**Fig. 1.**) is a type of dual-hemisphere Equatorial Stereographic (azimuthal) projection with one hemisphere having a specific prime meridian and the other its antemeridian. It is the oldest surviving example of the equatorial stereographic projection being used for a map of the world (Keuning, 1955; Wallis, 1981a).

A detailed description of the projection is not available, but it can be determined by starting with the projection of Arzachel (Abū Ishāq Ibrāhīm al-Zarqālī, a Toledo mathematician) which pre-dates it (see Shirley, 1983). This is described in Fournier (1643), in which it is referred to as the planisphere d'Arzael.

Fournier (1643, pp.668-669) describes the method of constructing the Arzachel Projection. The resulting graticular network (**Fig. 2.**) clearly does not match that of Rotz's mappa mundi. On Arzachel's projection, the distances between meridians of longitude along the equator increase away from the central meridian and towards the edges of the map. In contrast, those on the Rotz mappa mundi are equally spaced. Additionally, the parallels of latitude have a higher curvature on Rotz's map than on Arzachel's projection.

In Arzachel's projection, map coordinates are calculated by first fitting the parallel of latitude and then the meridian of longitude. The parallel of latitude is a circle that passes through three points. The first two are the positions of the latitude along the circumference of the circle in the eastern and western hemispheres. The third point is the intersection of the central meridian with a straight line drawn between the eastern of the first two points and the westernmost edge of the map circle at the equator (this is symmetrical, so one can also use the western point and easternmost edge along the equator). Using Fournier's illustration (**Fig. 2.**) as an example, the 60th parallel is a circular arc that connects points I and K via the intersection of lines I-D and A-B. The meridian of longitude is a circular arc that passes through the north and south poles and an equatorial point located the same distance from the east or west edge of the map as the equivalent latitude is from the relevant pole. In this way the distance from the north pole to the 60°N along the central meridian (line A-F in **Fig. 2.**) is the same as that for the eastern edge of the map to 60°E along the equatorial line (line C-S in **Fig. 2.**).

The method used by Rotz is to calculate meridians of longitude, and then the parallels of latitude. In Rotz's map the meridians of longitude are evenly spaced along the equator, so it is a simple matter of fitting a circle to the appropriate point along the equator and the two poles. The parallel of latitude follows Arzachel's method for the location of the first two points on the circumference of the circle. The third point is also the intersection of a line from the edge to the opposite hemisphere, but with the 30° meridian in the same hemisphere instead of the central meridian. A fourth point can be calculated for the opposite hemisphere, but only three are needed to fit a circle. This intersection with the 30° meridian can be confirmed by plotting these lines on the mappa mundi (**Fig. 3.**).

Rotz (1542) mainly discusses trying to resolve the problems of magnetic variation, but he also deals with an instrument with a base which is essentially a magnetic compass with a vertical set of astronomer's rings. It has, in the base, a moveable meridional ring which can be set to latitude. It was set up to be used as a sundial. He also describes a second instrument. He worked (for two years) on the problem of calculating how the convergence of meridians towards the poles could be calculated, and it is possible that one or other of these instruments could be used as a circular slide-rule to achieve this.

Unfortunately neither has survived, even if they were built. Rotz's projection appears to be of his own design (Taylor, 1929).

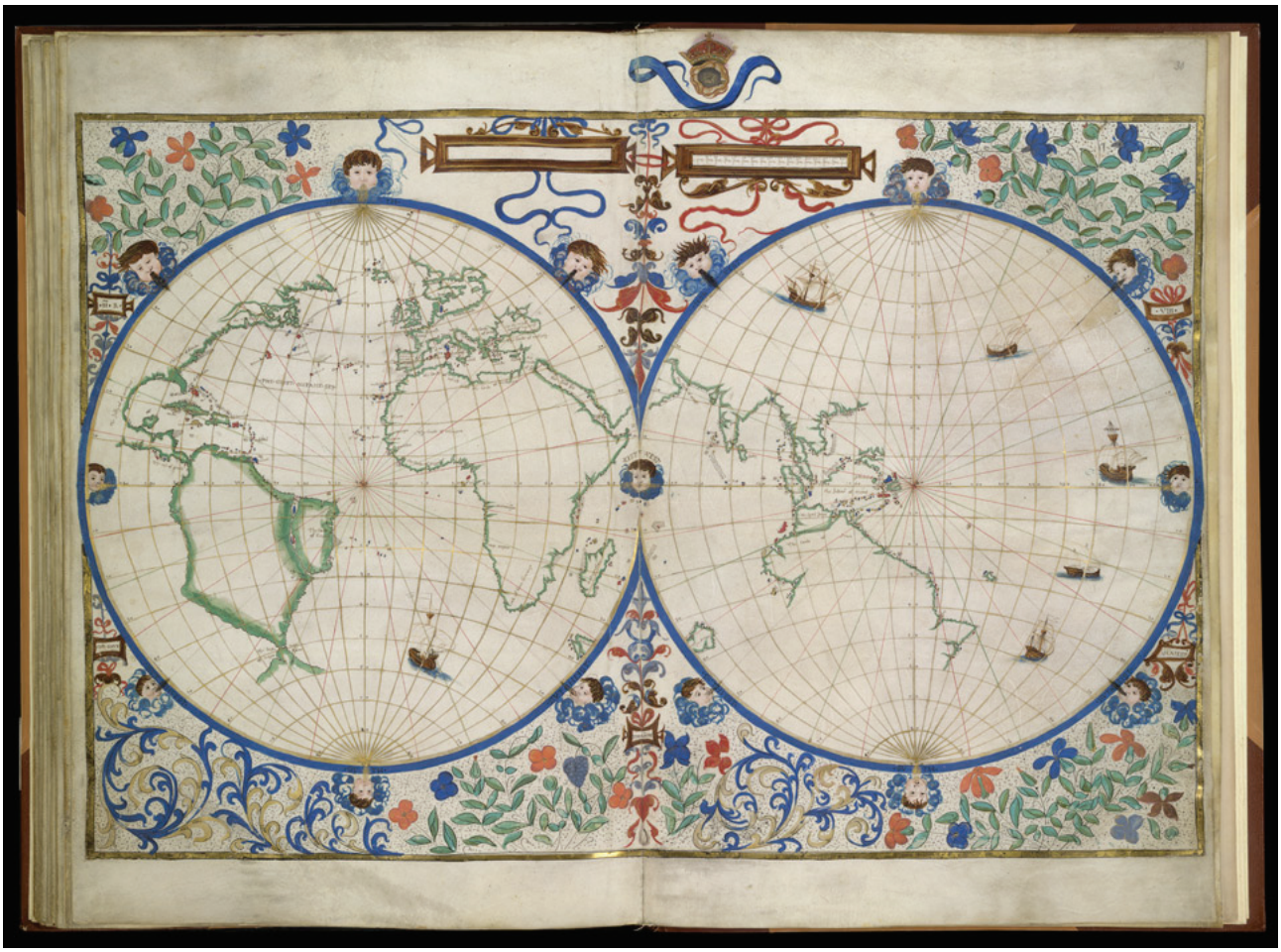

Figure 1. *The Jean Rotz Mappa Mundi* © British Library Board (Royal MS 20 E. 9; Item number: f. 30). Reproduced with permission.

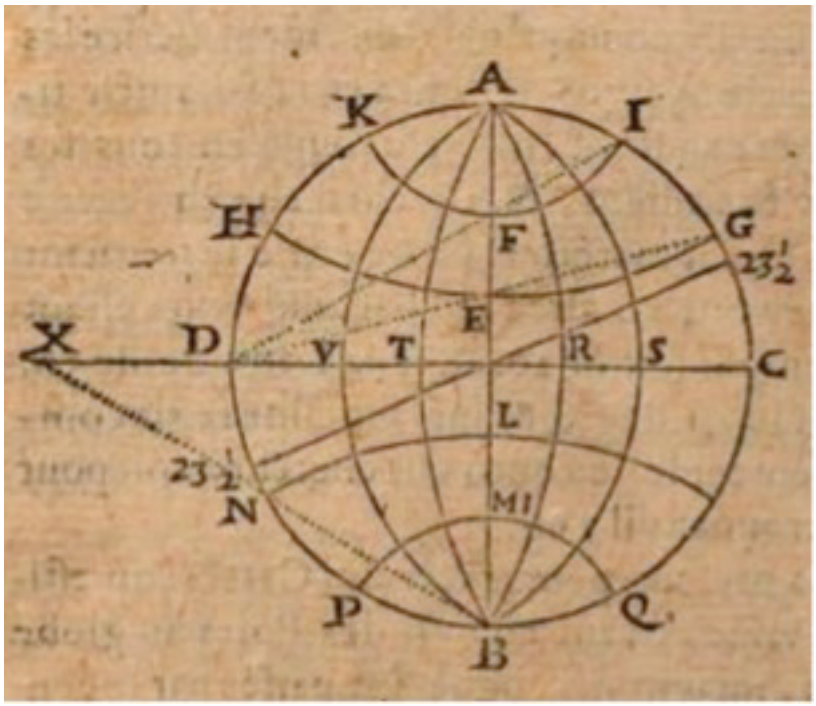

Figure 2. Arzachel's projection uses circles fitted to the intersections of lines with the circumference of the hemisphere (Fournier, 1643).

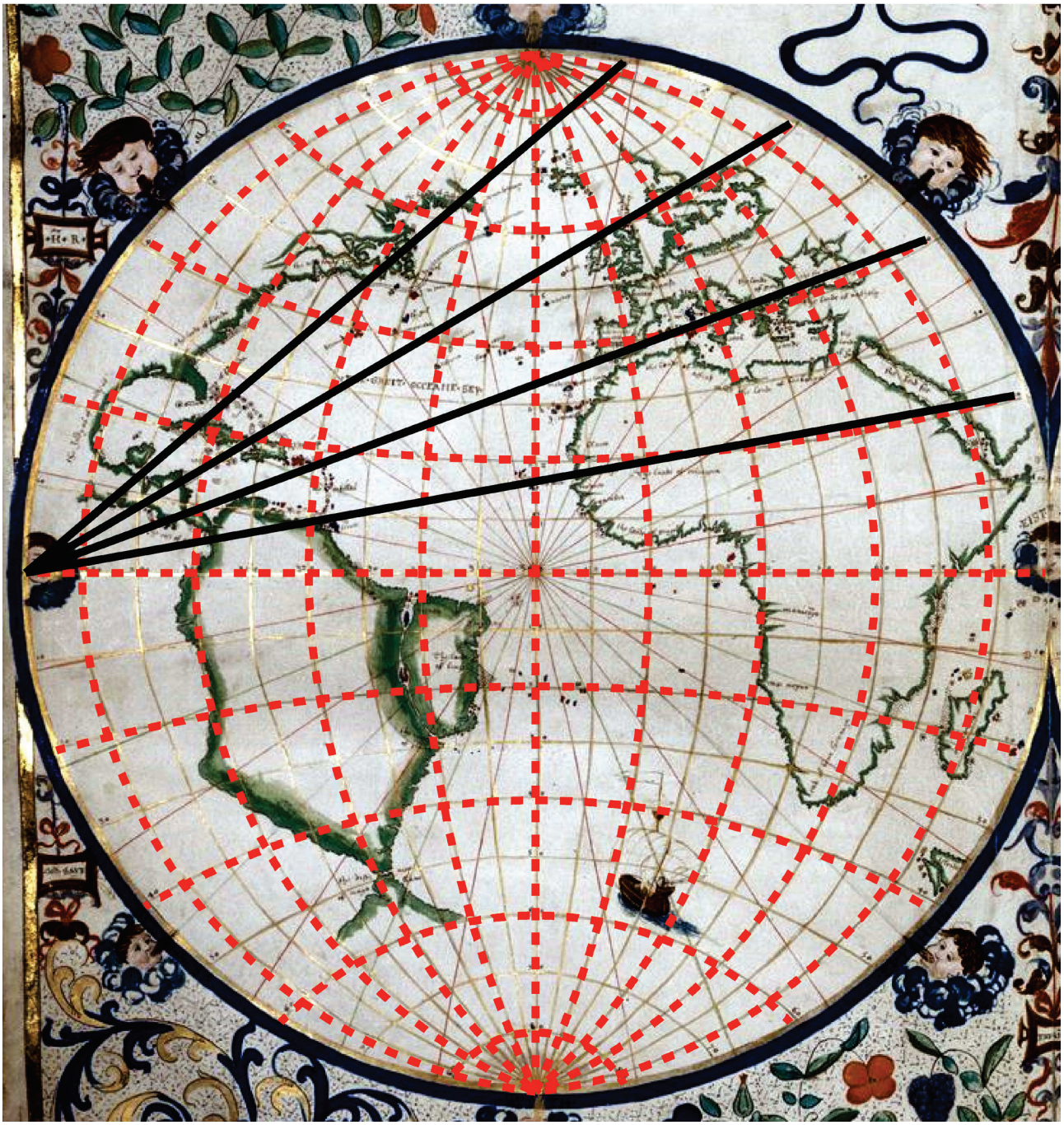

Figure 3. Straight lines show that, on Rotz's projection, the lines intersect the meridians of longitude at 30° from the central meridian, not at the centre. The overlaid graticular network (20° increments) is generated using the reconstructed method and acts as a check of the accuracy of the 'fit'. Original background © British Library Board, reproduced with permission.

Having deconstructed Rotz's projection, we can now reproduce it. The knowledge about the projection and prime meridian allows us to apply some simple geographic technology and project a modern coastline in Rotz's projection and overlay it onto this old map.

METHOD

Rotz's method was implemented as a computer program (available on request) by one of us (SWL). A modern outline of the world's coasts was rotated to use Rotz's central meridian, and then divided into eastern and western hemispheres. Each was then projected using Rotz's method, shifted and rescaled to image units, and overlaid on the image of the Mappa Mundi (**Figs. 4 & 5.**). By projecting the vector data to fit the imagery, any re-sampling effects caused by projecting the image to a modern projection are avoided.

Figure 4. Modern coastlines projected onto the Rotz Mappa Mundi.
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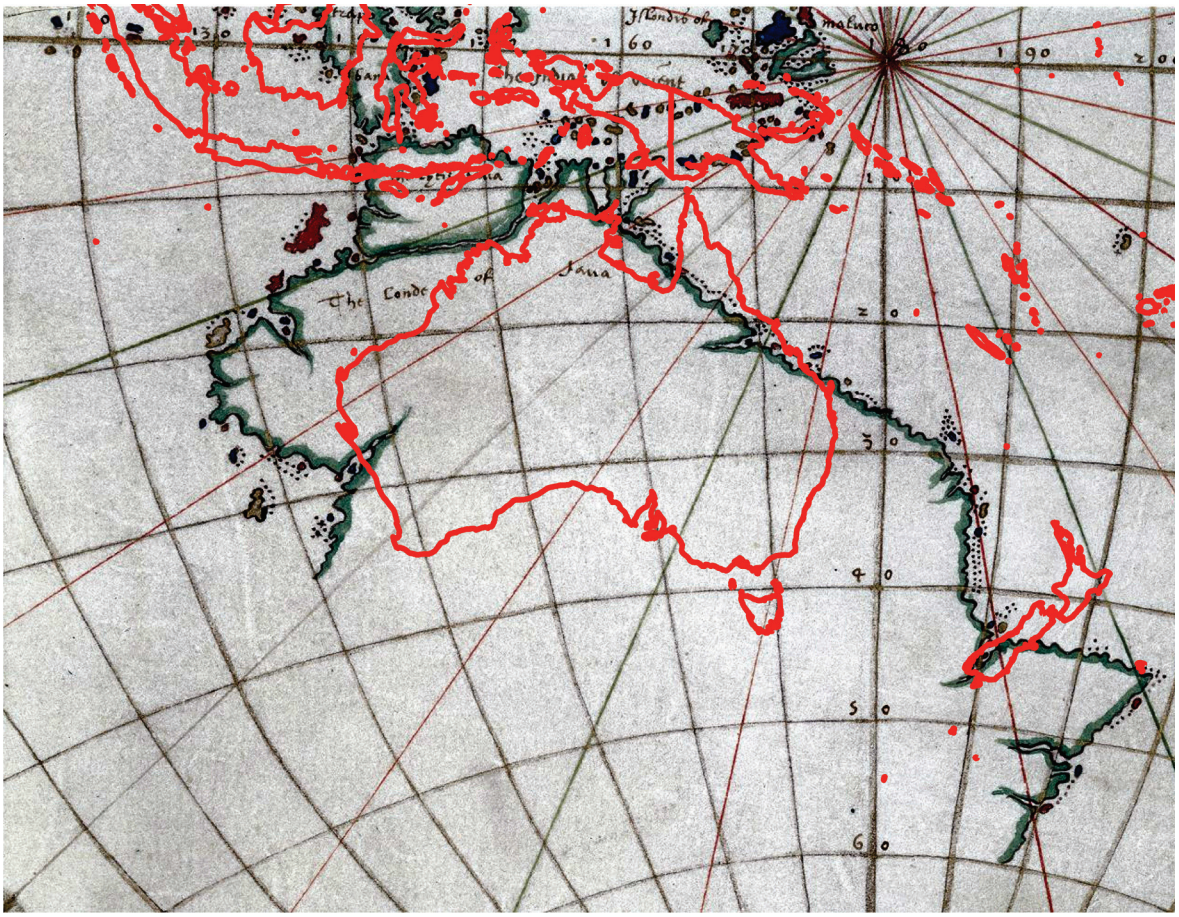

Figure 5. Modern coastlines projected onto the eastern hemisphere of the Rotz Mappa Mundi.
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RESULTS

A number of variables can be checked on **Figures 4 and 5**. The longitudinal distance from the Iberian Peninsula across the Atlantic to North America (Florida) is nearly 10° greater than we now know it to be. The gross morphology of the east coast of North America is recognisable, as is the coast of Africa, but South America, whilst accurately located to the north of Recife, is set 10° too far east to the south of Recife and is clearly a 'first approximation'. The coastline is smooth with a broad green band behind it to suggest uncertainty. The west coast of North America is not shown. The Baltic is quite distorted as is the north of the British Isles. In the eastern hemisphere India and Sri Lanka are distorted somewhat but the coastlines of East and Southeast Asia are recognisable as far north as Fuzhou (26° N) beyond which point the alignment of the coast is not shown. However, the East Asia and South-east Asia coasts are 20° too far to the east.

Figure 5 shows that the Australian landmass is not as dramatically offset from the *'The Lande of Java'* as is suggested by W.A.R. Richardson using toponomy to overlay the maps. It can be seen that the continent of Australia and *'The Lande of Java'* occupy the same locations on the globe. The tip of the Cape to the northeast of *'The Lande of Java'* is 7°30′ west of the correct position of Cape York (**Fig. 2.**). The west coast is 8° too far west. The east coast, at 35°S, is 15° too far east.

Until late in the 15th Century the only method of determining longitude was by dead reckoning. As the 15th Century drew to a close, advances in astronomical methods provided methods of greater accuracy. The oldest surviving description of the 'lunar distance' method for determining longitude was published in 1474 by Regiomontanus. The method was again described in 1514 by Johann Werner and in 1524 by Peter Apian, which latter work had appeared in 30 editions and three languages by 1600 (Sobel & Andrewes, 2003). All of which suggests that there was a possibility after 1475 that a European expedition carried someone who could calculate an approximate longitude using the 'lunar distance' method and, after 1524, that this possibility had significantly increased. However, as Rotz himself noted, the calculation was so difficult and time consuming, and the tables so poor, that few people attempted it.

Rotz made it clear in his preamble to the *Boke of Idrology* that he had sourced his information from a large original (Wallis, 1981a). The mismatch in longitudes between Southeast Asia and *'The Lande of Java'* is probably due to the assembly of the mosaic from which the large original was derived. The component from which the Australasian region was derived appears to have adjusted the width of the equatorial South Pacific so that it is only 10° of longitude too narrow. This mapping is, presumably, of a later date than the northern region when the determination of longitude was improved. The eastern displacement of the longitude of East and Southeast Asia and the western displacement of the longitude of *'The Lande of Java'* result in, when combined in a composite, Southeast Asia and the Indonesian archipelago 'crashing' into *'The Lande of Java'* at the equator. It seems likely that the composite from which the Dieppe Maps drew was derived from a source with access to charts of parts of Australia, and possibly New Zealand, some of which were surveyed after 1513, and before 1540. This practice of mosaicking charts of different ages and sources is explicitly described in an inscription on the Pirie Reis map of this period (1513). McIntosh (2000) notes that that map was based on twenty charts and mappae mundi. These maps included eight Ptolemaic maps, an Arabic map of India, four newly drawn Portuguese maps from Sindh, and a map by Christopher Columbus of the western lands. The original drawn on by Crignon (1531) may have had a similar number of sources.

THE EAST COAST

The gross similarities between the form of the east coast of Australia and that of *'The Lande of Java'* in the Dieppe maps are striking. There is no plate in the Jean Rotz Atlas, other than the Mappa Mundi, which shows the east coast of *'The Lande of Java'*. One has to move to the Vallard Atlas for a larger representation (see Moliero, 2010).

The general morphology of the east coast of Australia on these maps is distinctive. Matching capes and bays on these old maps with a modern map is pointless. Even trying to match capes and bays using Cook's original charting is difficult as he transited much of the coast some distance offshore noting only the major features apparent from telescope range. He only approached the coast in a few places. So trying to do so with a much earlier representation would be misleading. What can be compared are the broad trends of the coast. Looking at both the Jean Rotz Mappa Mundi and the larger, Vallard version, from their equivalent of Cape York, the coast runs at 125° Magnetic (136° True) from the compass rose located on the coast at 15°S on the original, portolan, version of the Vallard map, to the southern part of an inshore island lying at 28°S. The southern point of the island on the Jean Rotz Mappa Mundi at 28°S has a corrected longitude of approximately 162°E, which is east and south of the actual longitude of Frazer Island at 25° 54′S 153° 06′E which it may represent. The Tropic of Capricorn is shown in a correct relationship to these features. The bearing of the coast is 8° east of the real, True bearing from Cooktown to Rainbow Beach (onshore from Fraser Island) which lie at these locations (calculated by Meridional Parts using Norrie's Tables (Blance, 1968). This is the difference one would expect when the magnetic variation was not known.

The coast of *'The Lande of Java'* turns southwards at latitude 25° 30′S until 30°S where it then trends southeast to "Cap Amato" (as named on the Vallard). This reflects the change in alignment of the coast of southern Queensland and New South Wales. "Cap Amato" on the Jean Rotz Mappa Mundi lies at 43°S 168°E. The southern tip of the actual east coast of Australia is probably best represented as Tasman Island (43°15′S 148°00′E) so the Jean Rotz Mappa Mundi locates "Cap Amato" well to the east of Tasmania but at the correct latitude. The actual Australian coast runs SSW from 32°S and so diverges slightly westwards from the alignment shown on the Dieppe charts. Nonetheless the gross morphology of the East Coast of Australia is well represented by both the Rotz and Vallard maps between the latitudes of 10°S and 43°S, such that one is led to conclude that it had been visited and mapped.

Making sense of the features south of 43°S on the east coast without further evidence has led to considerable speculation. Hervé's view that it represents a cartographic 'fudge' to include some early knowledge of the east coast of New Zealand makes as much, perhaps more, sense as any of the other ideas extant (Hervé, 1982 & 1983). Despite Tasman's 1642 discoveries, there remained for some considerable time speculation that New Zealand was joined to Australia. As late as 1767 Cartaret made a point of noting a strong current flowing from the south as he passed through the Coral Sea indicating, he felt, that there was open sea between New Zealand and Australia (Wallis, 1965).

THE WEST COAST

The latitudinal extent of the west coast of *'The Lande of Java'* is an important diagnostic feature. The cut-off of the west coast at 35°S, close to the latitude of Cape Leeuwin (34° 22′S) where the Australian coast turns to the east, is noteworthy. It is unlikely to be a coincidence. The longitude of the western extremity of Rotz's west coast is 10° too far west. But it is very distorted if it is supposed to be Western Australia. Researchers such as Peter Trickett (2007) and Mathew Richardson (2010) suggest that the Victoria River, Queen's Channel, Cambridge Gulf, Collier Bay, King Sound, and so on, can be identified and that the bulge in the northwest is the Kimberly. Certainly, the major gulf shown by Rotz

on the northwest coast is at the same latitude as King Sound and has the same form. However, the alignment of the west coast is not as easily related to modern mapping as the east coast. The latitudes and longitude suggest that it may well be drawn from an early reconnaissance of the west coast. Bunting's map of 1581 is a more convincing early depiction of Western Australia, but that is not the topic of this paper.

It is clear that using the latitudes and longitudes explicit on the Rotz Mappa Mundi to overlay a modern coastline on the historical map gives quite a different result to the use of toponomy. The Mappa Mundi in Jean Rotz's 1542 atlas is a good 'first approximation' of the Australian continent. The representation of the Australian continent is distorted, but not much more than that of South America or the Baltic on this map. Looking at the difference between Rotz's representation of South America, where he clearly suggests uncertainty, his avoidance of including a fictitious 'Great Southern Land' and considering his comment that he depicts 'only that which is known', it seems that Rotz was confident that he had something reliable in *'The Lande of Java'*. The continent is located in the right place to be Australia, the width of the continent is greater but it is of the right order of magnitude, the gross morphology of the east coast north of 43°S is correct, and the latitudinal extent of the west coast to the south is correct.

CONCLUSION

Once the projection and Prime Meridian used by Rotz was understood, projecting a modern coastline onto the Rotz Mappa Mundi showed that, in a time when longitude was still difficult to determine, Rotz achieved something remarkable. The gross morphology of the east coasts of North and South America are clearly recognisable although the east coast of North America is offset 10° of longitude to the west, and the southern part of the south coast of South America is offset 10° of longitude to the east.

His depiction of West Africa is good in the north, but increasingly diverges to the east as one moves south. The gross morphology of the east coast of Africa is good but it is offset 10° of longitude to the east along its whole length. India is too narrow and is set almost 20° of longitude too far east as are East and Southeast Asia.

Rotz's *'Lande of Java'* is firmly in the location of Australia, but his west coast is offset 10° of longitude too far west. The southern limit of his west coast at 35°S matches the Australian coast. His depiction of the east coast matches the gross morphology of the Australian east coast only as far south as 43°S. It begins 10° of longitude too far west and at 43°S is 10° of longitude too far east. The bearing of the coast is 8° east of the real, True bearing from Cooktown to Rainbow Beach. This is the difference one would expect when the magnetic variation was not known.

Making sense of the features south of 43°S on the east coast without further evidence has led to considerable speculation. We incline to Hervé's view that it represents a cartographic construct to include some early knowledge of the east coast of New Zealand (Hervé, 1982 & 1983). We reject Bill Richardson's use of toponomy to suggest that *'The Lande of Java'* is not Australia.

Errors such as the fusing of northern Australia with the Indonesian Archipelago and the strange triangular extension to the southeast can be understood as modifications made by cartographers trying to assemble a global mosaic from different sources. Despite the lack of a written record, a careful co-registration of modern cartography with the map suggests that knowledge of the Australian continent was carried back to Europe in the early part of the 16th Century, nearly 80 years before the Dutch explorers arrived. Who was responsible for this is unknown.

ACKNOWLEDGEMENTS

This article was inspired by the East Coast Project of the Australian National University Emeritus Faculty. In particular, it has been informed by discussions with Bob Clements, Andrew Eliason, Nik Fominas, the late John Moloney, Bill Owen, Verna Rosling, and Di Riddell. It benefited from some suggestions by C. Delano-Smith. We are grateful to an anonymous reviewer for advice which has greatly improved the paper.

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