PTOLEMY’S MALTESE CO-ORDINATES
A Reassessment

Frank Ventura

Among the writers of classical antiquity that mention Malta one finds Claudius Ptolemaeus better known as Ptolemy.¹ He refers to five specific locations in the Maltese Islands for which he gives geographical co-ordinates² (Table 1).

Table 1

<table>
<thead>
<tr>
<th>Location</th>
<th>Ptolemy’s co-ordinates</th>
<th>Modern co-ordinates</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>longitude</td>
<td>latitude</td>
</tr>
<tr>
<td>Gaulos island and city</td>
<td>38 20</td>
<td>34 40</td>
</tr>
<tr>
<td>Melite island and city</td>
<td>38 45</td>
<td>34 40</td>
</tr>
<tr>
<td>Chersonesos city</td>
<td>38 40</td>
<td>34 45</td>
</tr>
<tr>
<td>Juno sanctuary</td>
<td>39 00</td>
<td>34 40</td>
</tr>
<tr>
<td>Hercules sanctuary</td>
<td>38 45</td>
<td>34 35</td>
</tr>
</tbody>
</table>

1. Ptolemy, born in c. AD 90 in Greece, spent most of his life in Alexandria. He certainly made astronomical observations between AD 127 and 145, and possibly up to 151. Arabian tradition claims that he died at the age of 78.

2. The geographical co-ordinates given here are taken from C. Müller, Claudii Ptolemaei Geographia, Vol. I. (Paris, 1883) which was considered as the most reliable of the four editions of Ptolemy’s work that were consulted. Other earlier editions contain significant differences in the co-ordinates, and in the name of one of the sites which is given as Chersonesos, meaning peninsula, and not as Chersonesos city. In this respect, it should be added that O. A. W. Dilke is of the opinion that in Ptolemy’s Geography, the Greek word polis tends to mean any sort of settlement (see O. A. W. Dilke, Greek and Roman Maps (Ithaca, N.Y., 1985), 207, n. 20). Thus the Greek Chersonesos polis could be translated as the settlement at Chersonesos rather than as the city or town of Chersonesos.

The co-ordinate which differs consistently from that given by Müller is the latitude of the sanctuary of Hercules. It is given as 34° 25’ in all the three other editions consulted, namely Octo Libri Ptolemei, 1490; C. Ptolemaeus, Auctus Restitutus Emaculatus, 1520, and M. Gio. Malombra, La Geografia di Claudio Tolomeo, 1574.
From this reference it appears that, provided Ptolemy’s information is correct, an understanding of his co-ordinate system and its relationship to the modern system should enable the identification of the locations with specific sites on the islands. The identification of the cities of Melite and Gaulos with Mdina/Rabat and the Gozo Citadel/Rabat respectively, and the proof by archaeological excavation that the Juno sanctuary was sited at Tas-Silg, provide further information which can be used to locate the other two sites.

The purpose of this paper is to explain the context of Ptolemy’s system of geographical co-ordinates and to show how the co-ordinates of the Maltese sites can be used to obtain an approximate location of Chersonesos and the sanctuary dedicated to Hercules.

The General Context

The co-ordinates mentioned above are found in Ptolemy’s eight-volume work *Geographike Huphegesis* variously translated as *Guide to Geography*, *Geographical Directory*, or *Cosmography* but more popularly known simply as *Geography*. Book I contains an extensive introduction in which Ptolemy discusses his purpose and similar work by Marinus of Tyre previously. He then proposes two methods for drawing a better map of the inhabited world, the oikoumene. Books II to VII contain lists of longitudes and latitudes of cities, sanctuaries, and other important geographical features such as islands, mountains, volcanoes, promontories, and river mouths. The books deal separately with Europe, the Mediterranean, Africa, the Middle East, Arabia, India, and Indochina. The Maltese localities are mentioned in the last selection of chapter III in Book IV, which deals with Africa. Along with Pantelleria, the Maltese Islands are referred

3. In this paper it is assumed that Ptolemy’s information about five different sites is essentially correct. However, it should be noted that doubts about the separate identities of the sanctuaries of Juno and Hercules have been cast by H. C. R. Vella and H. O. Hvidberg-Hansen who both suggest that the sanctuary at Tas-Silg may have been dedicated not only to Juno but also to Hercules referring to Melqart, the Phoenician god, and not to the Graeco-Roman Hercules. Refer to H. C. R. Vella, *The Earliest Description of Malta (Lyons 1536)* (Malta, 1980) 55, n. 91; H. C. R. Vella, ‘Quintinus (1536) and the temples of Juno and Hercules in Malta’, *Athenaeum*, LX (1982). 1—II. 273—276. See also the papers by H. O. Hvidberg-Hansen and H. C. R. Vella in A. Bonanno (ed.). *Archaeology and Fertility Cult in the Ancient Mediterranean* (Amsterdam, 1986).


5. All we know about Marinus of Tyre and his treatise, which is now lost, is based on Ptolemy’s reference to him. Marinus’ work takes into account conditions based on events as late as AD 107 but ignores changes which took place between AD 114 and 116.
Finally Book VIII consists mainly of 26 maps and a list of 356 important cities, including Melite, with the maximum number of daylight hours on the longest day and the difference in hours between local time and the time at Alexandria for each city. These last two parameters were the traditional measures of latitude and longitude respectively used by the Babylonians and by other geographers before Marinus and Ptolemy. The inclusion of these parameters has been interpreted as an attempt to assuage traditional geographers since in *Geography* Ptolemy makes a complete break with tradition. In fact it has been stated that after this work, geography took on an entirely new character which persisted up to modern times.\(^7\)

**Two projections**

In Book I Ptolemy makes it clear that his intention is to find a method to project positions on a sphere onto a plane so as to produce as far as possible an undistorted map of the world. He goes on to discuss the work of Marinus of Tyre, the latest geographer of his time to tackle the same problem. With some modifications, Ptolemy accepts Marinus' geographical co-ordinates which were obtained carefully from travellers, merchants, and military itineraries but he rejects his method of making a map of the world using orthogonal co-ordinates and which practically amounts to a cylindrical projection. With this projection, distances on all meridians and on the parallel of Rhodes (latitude \(36^\circ\)), which Marinus uses as his base, appear on the same scale and undistorted but distances in longitude between the equator and the parallel of Rhodes are foreshortened and increasingly enlarged north of it. This can be seen by reference to figure 1a which shows six locations (a,b,c,d,e,f) on part of a sphere, and to figure 1b which shows a map with orthogonal co-ordinates like that proposed by Marinus. The distances a-c, c-e, a-e on one meridian and b-d, d-f, b-f on another meridian on the sphere are represented on the same scale and undistorted on the map. However, the longitudinal distances a-b, c-d, e-f are distorted, because if c-d on the map is taken to be on the same scale as that distance on the sphere, then the distance a-b on the map is larger than it actually is on the sphere, and e-f on the map is shorter than it should be. Similarly it can be shown that all longitudinal distances above and below the latitude containing c and d are distorted on the map.

Ptolemy then describes two methods which can be used to map the known

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7. Neugebauer, 934.
Figure 1a. Part of a sphere with six locations marked (a, b, c, d, e, f).

Figure 1b. Map with orthogonal co-ordinates as suggested by Marinus showing the six locations of fig. 1a.

Figure 1c. Map with co-ordinates following Ptolemy's first projection showing the six locations of fig. 1a.
inhabited world and which are a great improvement on the method used by Marinus. As boundaries of the inhabited world Ptolemy accepts the parallel of the island of Thule (latitude $63^\circ$), in the north, and the parallel below the equator at latitude $-16^\circ 25'$, in the south. The extension in longitude is taken as $180^\circ$ with the western boundary on the longitude passing through the Fortunate Islands (the present day Canary and Madeira groups of islands) and the eastern boundary in China. Following Marinus, Ptolemy takes the extent of one degree in longitude at the equator as 500 stades as determined by Posidonius rather than the more accurate 700 stades per degree found earlier by Eratosthenes. Therefore, according to Ptolemy, the extent of the inhabited world at the equator is 90,000 stades. Using these values, Ptolemy sets up a framework consisting of three arcs north of the equator (see fig. 1c), another arc below the equator, all representing the parallels of selected latitudes, and straight lines representing the lines of longitude or meridians. The dimensions of the arcs he draws are as follows:

<table>
<thead>
<tr>
<th>Latitude</th>
<th>Radius of arc</th>
<th>Half arc length</th>
</tr>
</thead>
<tbody>
<tr>
<td>$63^\circ$ (Thule)</td>
<td>QB = 52</td>
<td>40</td>
</tr>
<tr>
<td>$36^\circ$ (Rhodes)</td>
<td>QC = 79</td>
<td>72</td>
</tr>
<tr>
<td>$0^\circ$ (Equator)</td>
<td>QH = 115</td>
<td>90</td>
</tr>
<tr>
<td>$-16^\circ 25'$</td>
<td>QK = 131.416</td>
<td>86.33</td>
</tr>
</tbody>
</table>

These values are calculated by Ptolemy to satisfy two conditions: (a) that the distances on all meridians are all on the same scale, and (b) that the ratio of the distances on the parallel of Thule and the equator should be constant. The fact that these conditions are satisfied can be easily confirmed by checking first of all that the difference between any two radii is equal to the difference in latitude between them (for example QC − QB = 79 − 52 = 27 which is the difference in latitude between Thule and Rhodes); secondly, that the ratio $52:115 = \cos 63^\circ : \cos 90^\circ$ so that the distances on the parallel of Thule and the equator are

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8. Thule is probably today's Iceland which lies between latitude $63^\circ 24'$ and $66^\circ 32'$. The latitude $-16^\circ 25'$ is referred to as Anti-Meroe meaning symmetrical to Meroe but south of the Equator. Meroe, now a city in Sudan, was originally Egyptian and it became the capital of the Nubian Kingdom in about 300 BC.

9. Posidonius (135−50 BC) found a method for determining the size of the Earth by means of the altitudes of stars observed from different locations.

10. Eratosthenes (276−194 BC), born in Cyrene, North Africa, studied in Athens and became librarian in Alexandria where he lived for about 60 years. He is renowned for an accurate determination of the size of the Earth using the Sun's shadow at two different locations.
Figure 2a. Ptolemy's first projection.

Figure 2b. Ptolemy's second projection.
in the correct ratio with respect to one another. Referring to figure 1c, this means that the ratio of the distances a-b: e-f is the same both on the sphere and on the map.

As already mentioned, besides the arcs, the framework is made up of straight lines originating from the focal point, Q in figure 2a. These lines divide the whole figure into 36 equal segments of 5° each. The final result is practically a conic projection for the part of the figure north of the equator. South of the equator, Ptolemy introduced a discontinuity by making the part between the equator and the latitude of −16° 25′ symmetrical with its northern counterpart rather than continuing with the conic projection which would have resulted in a continuous distortion of longitudinal distances in this region.

Not content with this projection, Ptolemy proposes a second framework based on three arcs representing the parallels of Thule (latitude 63°), Syene (latitude 23° 50′), and the southern boundary of the oikoumene (latitude −16° 25′). He also draws the lines of longitude as approximately circular arcs obtained by joining points of the same longitude on the parallels of latitude.11 The end product (figure 2b) bears a closer resemblance to a part of a sphere and should therefore result in a more faithful representation of the oikoumene than the first projection. However, as Ptolemy predicts,12 the first method was more often employed by later geographers because its grid is much easier to construct.

Using the first projection and the geographical co-ordinates given in Books II to VIII, a map of the oikoumene can be constructed, as in figure 3. As can be seen from the map, the continental lands and islands around the Mediterranean Sea have a similar outline to the one with which we are familiar today. Further east and to the north, however, the outline and relative sizes of various countries are less familiar. Thus, for example, the island of Taprobane (present day Sri Lanka) is disproportionately large when compared to India, whose familiar triangular outline is missing. Similarly, to the north, the outline of Scotland and its size compared to England and Wales, are both very different from modern representations. These and other inaccuracies do not arise because of the projection adopted, which is essentially valid, but because of the inaccurate geographic co-ordinates provided by or deduced from travellers’ tales.

Looking more closely at the Mediterranean region, which presumably was the most-travelled and best-known in those days, it is evident that its extent in longitude from the straits of Gibraltar to the shore of Lebanon is given as 60°. However, modern values show that this extent is only 40°. Other similar comparisons with

11. For an explanation of Ptolemy’s mathematical derivation of both projections, see Neugebauer, VB 4, 2 and 3, 880–885.
modern values show that longitudinal distances are, in general, one-and-a-half times the presently accepted values. This systematic error arises mainly because of the inaccurate value of 500 stades per degree of longitude adopted by Ptolemy.\textsuperscript{13} That large errors in the measurement of longitude should exist in Ptolemy's days is not surprising since such a measurement requires knowledge of precise astronomical data regarding the sun, the moon, and the stars; an accurate chronometer; and an established system of time measurement. These requirements were not available then and navigators had to wait for over 1,500 years until the establishment of Greenwich observatory which was dedicated to finding a solution to the problem of determining longitude at sea,\textsuperscript{14} and for the production of accurate clocks.

Less expected are errors in latitude since this parameter can be easily derived say from the length of a shadow at noon on any particular day, a method which was well-known to Ptolemy. Except for a few places such as the cities on the eastern coast of Sicily whose latitudes are given with reasonable accuracy,\textsuperscript{15} the latitudes of most places in the Mediterranean are in error by about one degree. The occurrence of such errors indicates that few geographical co-ordinates were actually measured.

The Maltese co-ordinates
Armed with this background about Ptolemy's system of co-ordinates, it is now

\textsuperscript{13} Ptolemy mentions one check of longitudinal distances in Book I, chapter 4. This refers to the lunar eclipse of 20 September 330 BC preceding the battle of Arbela (present day Erbil or Khurbet Irbil on the river Tigris). The eclipse was also observed from Carthage with an estimated difference of three hours in local time. Actually, using the modern longitudes of Arbela and Carthage the difference is equivalent to only two hours fifteen minutes. This inaccurate observation is consistent with Ptolemy's systematic error in longitudinal distances. It should be noted that the method of estimating longitudinal distances by observing lunar eclipses at two or more stations should yield quite accurate measurements. However, it seems that it was not used frequently and, in any case, in those days the timing accuracy was about 30 minutes, equivalent to seven and a half degrees of longitude. About the accuracy of timing see R. R. Newton, 'Two uses of ancient Astronomy', \textit{Philosophical Transactions of the Royal Society of London}, A 276 (1974), 99–116.

\textsuperscript{14} The Royal Greenwich Observatory was instituted in 1675 by King Charles II who commanded the first Astronomer Royal to apply himself '... with the utmost care and diligence to the rectifying of the tables of the motions of the heavens, and the places of the fixed stars, in order to find the so much desired longitude at sea, for the perfecting of the art of navigation'. C. A. Ronan (ed.), \textit{Greenwich Observatory 300 years of Astronomy}, (London, 1975), 17.

\textsuperscript{15} Ptolemy's latitudes for Syracuse, Catania, Taormina, and Messina are 37°, 37° 40', 37° 45', and 38° 10' while the modern values are 37° 04', 37° 31', 37° 51', and 38° 12' respectively. For these locations the average error is only slightly more than 5 minutes of arc.
possible to discuss his geographical co-ordinates of the five Maltese sites in more
detail. First of all, considering the differences in longitude between the known
sites one can check whether the systematic 'stretching' in longitude, so evident
in Ptolemy's map, also applies to the small scale of the Maltese islands. Table
2 lists the differences in longitude between the known sites as given by Ptolemy
and as found by modern methods.
PTOLEMY’S MALTESE CO-ORDINATES

Table 2

<table>
<thead>
<tr>
<th>Localities</th>
<th>Difference in longitude in minutes of arc</th>
<th>'Stretching' factor</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Ptolemy</td>
<td>Modern</td>
</tr>
<tr>
<td>Gaulos city – Melite city</td>
<td>25</td>
<td>9.9</td>
</tr>
<tr>
<td>Melite city – Juno sanctuary</td>
<td>15</td>
<td>8.9</td>
</tr>
<tr>
<td>Gaulos city – Juno sanctuary</td>
<td>40</td>
<td>18.8</td>
</tr>
</tbody>
</table>

From the table it is clear that Ptolemy’s distances reflect the general stretching observed for the whole Mediterranean region. In this case, however, the longitudinal distances are, on average, twice as large as the modern values and the stretching factor, obtained by dividing Ptolemy’s values with the modern ones, varies widely from one place to another.

When considering differences in latitude between the various places mentioned by Ptolemy, one comes up against two distinct problems. First of all Ptolemy shows no difference in latitude between Gaulos city, Melite city, and the sanctuary of Juno while in fact significant differences exist. Because of this discrepancy, if one were to follow Ptolemy’s latitudes after correcting for the stretching in longitude, the Gozo citadel would be placed in the sea well west of Mdina and the Juno sanctuary in the Grand Harbour area (see figure 4). The latter observation could well have been the reason that led Quintinus to wrongly identify some ruins he had seen between Fort St Angelo and Vittoriosa with the sanctuary of Juno.16

The second difficulty concerns the latitude of the sanctuary of Hercules which Ptolemy puts on the same longitude as the city of Melite. Now, from the difference in latitude between Chersonesos and the sanctuary of Hercules which Ptolemy gives as 10 minutes of arc and which corresponds roughly to the width of Malta, one can infer that Ptolemy means to put the two sites on opposite coasts of the island, one to the north-northwest of Melite city and the other directly to its south. However, when the latitudes of these sites are considered separately with respect to Mdina, while Chersonesos falls in Mellieha Bay, the sanctuary of Hercules falls in the sea close to the island of Filfla. This does not mean that Ptolemy’s latitude of the sanctuary of Hercules is entirely wrong. It is sufficient to note that the 5 minutes of arc distance between Melite and the sanctuary of Hercules is the smallest fraction of a degree that he uses throughout his work. Even if the distance were smaller, it would still have been given as 5 minutes or one twelfth of a degree since Ptolemy must have been aware that the reported co-ordinates

could not be more accurate than that. Indeed it is important to note that that the geographical co-ordinates of the Maltese sites are all given to the nearest 5 minutes of arc which shows that Ptolemy allows for an error of this order of magnitude.

By analogy one can imagine a man with an accurate clock whose dial only has five-minute markers. Anybody asking this man for the correct time and getting the answer, say, 25 minutes past the hour, would not be sure whether the precise time is 23 minutes past the hour which has been given as 25 minutes past or whether it is 27 minutes past instead. In such a case, the precise time could be within two minutes either way of the 25 minutes given as the correct time. Imagine now that the clock itself works inaccurately. If it goes fast or slow at a known regular rate a correction can be applied for this systematic error and the precise time would still be within two minutes either way of the corrected time. But, if the person giving the time reads the clock carelessly or the clock works irregularly, the error in the stated time would be random and it would probably be much more than two minutes either way.

Applying this analogy to geographical co-ordinates and considering the difficulties encountered in the determination of the longitude of a place in Ptolemy’s time, and the smaller difficulties in determining the latitude, the errors in Ptolemy’s co-ordinates must be at least 5 minutes of arc either way of the stated longitude and 2.5 minutes of arc either way of the stated latitude. Therefore, at best, Ptolemy’s co-ordinates can locate a site within an error box having a length of 10 minutes and a width of 5 minutes of arc. However, even after correcting for the known stretching in longitude\(^\text{17}\) and considering the error boxes mentioned, Gaulos city would still be located in the sea and the Tas-Silg site would still not be within the Juno sanctuary error box (see figure 4).

**A corrected version**

Having identified the main difficulties encountered when trying to use Ptolemy’s co-ordinates, it is tempting to make other corrections besides that for systematic error in longitude in order to overcome the problems already mentioned and to locate the unknown sites within a specific area, however large. A satisfactory result is obtained if three corrections are applied in the following order:

(i) The North-South direction and consequently also the East-West line of Ptolemy’s grid for the Maltese Islands should be rotated clockwise through \(40^\circ\) so that the line through the positions of Gaulos city, Melite city, and the sanctuary

\(^{17}\text{Both the differences and the margin of error in longitude were halved in accordance with the average stretching factor found from Table 2. The differences in latitude were kept as in the original work.}\)
of Juno aligns with the band containing the Gozo citadel, Mdina, and the Tas-Silġ site.

(ii) All Ptolemy's distances in longitude should be reduced by a factor of 1.63.

(iii) The latitudinal distance between Chersonesos and the sanctuary of Hercules should be reduced from 10 to 7 minutes of arc to correspond with the width of Malta at the rotated longitude of Mdina.

The reasons for the first correction can be inferred from the comments made already, especially about the position of the city of Gaulos which falls in the sea whatever correction in longitude is applied. In addition, when the co-ordinates of other nearby places such as Pantelleria, the Aeolian islands, and the islands around Crete are taken into consideration, in each case a rotation in the clockwise direction of Ptolemy's co-ordinate grid gives a much better fit with modern positions. The error in rotation is particularly evident for the coastal towns and promontories of Sicily. Considering the southern coast only, Ptolemy gives practically the same latitude for modern Cape Passero, Agrigento, Selinunte, and Castellamare since the difference in latitude between the southernmost and northernmost of these points is given as only 10 minutes of arc. However, modern values show that the difference should be 82 minutes of arc. As a result of these errors, the southern coast of Sicily is known to run roughly in an East-West direction on Ptolemy's map (see fig. 5) while modern maps show that it should run approximately from South-east to North-west. 

The second correction stems from the distortion in longitude which has been explained in an earlier section. The extent of the correction has been arrived at by taking the modern direct distances in minutes of arc between the known sites as being the longitudinal distances referred to by Ptolemy. Comparing these with Ptolemy's differences in longitude, the values of stretching in longitude shown...
in Table 3 are obtained.

<table>
<thead>
<tr>
<th>Localities</th>
<th>Differences in longitude</th>
<th>Ptolemy</th>
<th>Modern</th>
<th>Stretching Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Melite c. – Juno s.</td>
<td>15</td>
<td>9.38</td>
<td>1.60</td>
<td></td>
</tr>
<tr>
<td>Gaulos c. – Juno s.</td>
<td>40</td>
<td>23.95</td>
<td>1.67</td>
<td></td>
</tr>
<tr>
<td>Gaulos c. – Melite c.</td>
<td>25</td>
<td>15.45</td>
<td>1.62</td>
<td></td>
</tr>
</tbody>
</table>

As can be seen from the table, using these distances, a much more constant stretching factor is obtained than when non-rotated distances are considered as

Figure 5. Ptolemy's map of Sicily from Octo Libri Ptolemai, 1490.
in Table 2. The average stretching is 1.63 and this is the factor by which Ptolemy's longitudinal distances should be corrected.

The third correction is the least necessary but it should be applied for completion. Besides the reason given above about the difference in latitude between Chersonesos and the sanctuary of Hercules being roughly equal to the width of Malta, the sanctuary of Hercules is mentioned along with the city of Melite in the planum circulationis of the Classis Praesidiaria, the garrison fleet of the Roman Empire.²⁰ This suggests that the sanctuary may have been on the coast or at least a landmark visible from out at sea. The name of the other site, Chersonesos, meaning peninsula, implies that it was by the sea. Therefore it seems reasonable to put the sites on opposite coasts of the island.

With these corrections, a new grid is drawn in which the positions of the sites mentioned by Ptolemy can be inserted. Additionally, an error box 10 minutes of arc wide in longitude and 5 minutes wide in latitude is centred on each to take care of the least error in both geographical co-ordinates.²¹ When the new rotated positions are superimposed on a map of the Maltese Islands with the position of Melite at the centre of Malta rather than at Mdina, each site falls within a specific area of the islands as in figure 6.

From the figure it is immediately clear that although the corrected positions of the cities of Gaulos and Melite and the sanctuary of Juno still do not coincide exactly with the Gozo Citadel, Mdina, and the Tas-Silġ site respectively, these places are within the respective error boxes. Furthermore, the position of Chersonesos falls in the sea beyond Qawra point and its error box contains various places on the coast. Among these, the tongue of land, similar to a peninsula, which includes Qawra and Bugibba, is the most likely candidate for Chersonesos. The centre of the error box containing the sanctuary of Hercules falls on Dingli cliffs and the error box contains a large area of surrounding land. In both cases a reassessment of places of archaeological interest in the areas concerned could lead to the identification of the unknown sites.²²

²⁰. Pauly-Wissowa, Realencyclopadie, I e., 450 quoted by Lattyak, A., Excerptum ex Opere Explicatio Geographiae Claudii Ptolemaei, I, (Budapest, 1929) 7. I would like to thank Prof. A. Bonanno for access to this source.

²¹. The differences and the margin of error in longitude were reduced by a factor of 1.63 and those in latitude by a factor of 1.43 (or 10/7) to correct for the stretching mentioned in the text.

²². Allowing for random errors in Ptolemy's co-ordinates, the error boxes should be enlarged, especially longitudinally. Such an extension in the case of the error box around the position of the sanctuary of Hercules could include well-known sites such as those at Ras ir-Raheb and Ras il-Pellegrin. The one at Ras ir-Raheb is particularly interesting since D. Trump has suggested that it may be a religious site and noted that its courtyard shows some similarity to that of Tas-Silġ. D. Trump, Malta: an archaeological guide, (London, 1975), 127.
Conclusion

From the foregoing discussion it should be clear that in his Geography, Ptolemy's main intention was to suggest methods for projecting positions on a sphere onto a plane to produce an undistorted map of the known world. Although both his projections are valid, the geographical parameters he accepts, including the value of the circumference of the Earth and the geographical co-ordinates of most places, are rather inaccurate resulting in a distorted map. In particular, the Mediterranean Sea is greatly extended in longitude and this stretching is reflected in the co-ordinates of the five sites he mentions in Malta and Gozo. These co-ordinates and others of nearby islands indicate that Ptolemy's grid is rotated with respect to the true North-South direction.
The fact that Ptolemy’s smallest unit of measurement of both longitude and latitude is one twelfth of a degree or 5 minutes of arc indicates the limit of accuracy of his co-ordinates. From a consideration of the greater difficulty of determining longitude and the limited accuracy of the given co-ordinates, it has been shown that, at best, each of the Maltese sites can be placed within an area of 10 by 5 minutes of arc. It should also be noted that allowing for possible random errors in the co-ordinates of the sites, the area has to be extended, especially by increasing its length, since this dimension corresponds to longitude, the co-ordinate more liable to be in error.

By correcting Ptolemy’s geographical co-ordinates for rotation, stretching in longitude and error in latitude, and superimposing them, with error boxes included, on a modern map of Malta, one can arrive at the general location of the unknown sites. Thus Chersonesos is placed in the Qawra-Bugibba and surrounding area while the sanctuary of Hercules is placed at Dingli cliffs and the surrounding land. These results can only be considered as working hypotheses and not as evidence for the sites being in the areas mentioned. Such evidence can only come from detailed textual interpretation of ancient sources and, more reliably, from archaeological excavation and interpretation.

Finally, it should be amply clear that any naive reference to Ptolemy for indications about the positions of the unknown sites will not yield useful results. In particular, the search for the sanctuary of Hercules in the south of Malta cannot be supported by the claim that Ptolemy placed it there on his map. In fact it appears that Ptolemy meant to place the site on the high ground to the west and south-west of the island.

23. V. Borg reviews the work of several authors whose general opinion is that the sanctuary of Hercules was situated in the area of Marsaxlokk. See V. Borg, ‘Tradizioni e documenti storici’ in Missione archeologica a Malta. (1964) 41 – 51. On the other hand, in the paper on Quintinus and the location of the temple of Hercules at Marsaxlokk, Melita Historica, VIII. 3, (1982) 190 – 204, A. Bonanno concludes that we do not know where in Malta the temple of Hercules was sited. Moreover, referring to a statue of Hercules first mentioned by G. F. Abela, he states that we are almost certain that this statue did not come from Marsaxlokk.

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