The Geography

Γεωγραφικὴ Ὑφήγησις

Ptolemy

translated by E. L. Stevenson

Plato Scroll · plato-scroll.netlify.app

Scan to read online

The Geography — Book One

Translated by Edward Luther Stevenson, 1932. Book One contains Ptolemy's theoretical treatise on scientific cartography; Books Two to Seven, a gazetteer of some 8,000 place coordinates, are not included in this reader edition.

Preface

Claudius Ptolemy (CA. 90 — 168 A.D.) holds a place among the foremost of those who have made contributions to the science of geography. It is not a little surprising that there has never appeared a complete English, German, or French translation of his work in this field, often as his name is to be met with in the literature which treats of the expansion of geographical knowledge and the cartographical records of the same.

In his Introduction Professor Fischer has called attention to the lack of a thoroughly satisfactory edition of Ptolemy's Geography, and in the preparation of this translation based upon the generally recognized best Latin and Greek texts, and, it may be further noted, upon the critical texts and studies of Wilberg and Müller, this puzzling fact stands in the forefront of the difficulties with which it has been necessary to contend. No one edition is alone a safe guide.

There are doubtless imperfections in the translation; it, however, has been done with great care and labor. That there is a lack of exact agreement with this or that text will be noted by those who critically examine the translation. With very few exceptions geographical names have been given as in the original Greek or Latin texts. Occasionally the modern English word has been preferred. The intention has been to give that reading which, in the translator's best judgment, is a faithful presentation of what Ptolemy intended to set down in his great work. As close an adherence to the original as possible has been the aim, never overlooking the fact that not a few of his sentences, particularly in Book I and also in Book VII, are considerably involved. It has been stated that this fact may have contributed much to deter readers from a critical study of his Geography, particularly of his Book I, but which, of

course, must be read to be able to understand the remaining seven.

It is in the field of mathematical geography that Ptolemy's fame as a geographer especially rests, into which field he was led through his interest in mathematical and astronomical studies. Herein, it may be stated, his was the most considerable attempt to place the study of geography on a scientific basis, giving to him, therefore, first place among the ancient writers on the subject. Perhaps it is the completeness of his system, as has been noted, that especially contributed to that end. There is in it the appearance of a finality, a complete summing up of what had been contributed by those who had preceded him — by Hipparchus, by Eratosthenes, and especially by Marinus. His work is indeed the main foundation of our geographical knowledge of the classical day. "The whole of modern cartography has developed from his Atlas."

He made but little contribution to descriptive geography, noting, as he does, the imperfect character of his own information concerning many parts of the earth, chiefly because of their size and their remoteness, and the difficulty with which one is confronted in an effort to discriminate between statements made by geographers who had preceded him, and between statements also to be found in itinerary records, in the records of travelers and explorers.

Marinus (ca. 70-130 A.D.) appears to have been regarded his most reliable source and inspiration, whom he praises for his diligence and sound judgment, and whom he seems to have followed closely; yet he points out his many defects.

In chapters six to twenty of Book I we find his principal references to this noted Tyrian, his close contemporary, and it is from Ptolemy alone we have practically our only information concerning that great geographer.

Ptolemy considered it as his chief task to reform the map of the inhabited earth; perhaps we may well say the maps, considering, as he did, that the only trustworthy method in map-making had its basis in the determination of the latitude and longitude of places.

Professor Fischer, as will be noted, has presented a most admirable summary of Ptolemy's assumed task as a geographer, his methods and achievements, his

relation to Marinus and to certain others who were his predecessors in this particular field, to the relation of text and maps in his Geography, to the renaissance of Ptolemy's Geography more than a millennium after his day, in which revival Donnus Nicolaus Germanus was a great leader.

In his Books II-VII he lists more than eight thousand localities, giving what he thought to be the correct latitude and longitude of each, in which, of course there are numerous errors, as we know to-day. The remarkable fact, however, is that he was so nearly accurate in his records; that Ptolemy purposely falsified his records is hardly to be entertained for a moment.

It would be a task of years to carry through to completion a comparative study of the geographical information which we find set down in the various manuscript and printed editions of his work.

Since the issue of the first printed edition of Ptolemy's Geography more than fifty editions have appeared, varying greatly in contents and in value; in some of these the text is incomplete, and in many the maps do not appear.

Good editions of Ptolemy are regarded as items of great interest by those libraries and private collectors so fortunate as to possess copies.

More than forty manuscript copies of the geography are known, and here again there is great variation in the status. The number of those copies which can be considered fairly complete is not large; many are but fragments. The fine existing manuscript copies are in both Latin and Greek, the former dating from the Renaissance period or from the early fifteenth century, the latter as early as the eleventh century, and are the oldest ones known. Of his Geography in Arabic there is a fine copy in Constantinople dating from about the middle of the fifteenth century, and there are a few fragmentary copies extant.

In Europe during recent years a very considerable amount of scholarly research activity has been turned to an investigation of the character and influence of Ptolemy's Geography. Prominent among those who have labored diligently within this field may be named my very good friend Professor Fischer, Paul Dinse, Gudmund Schütte, Otto Cuntz, Carl Müller, Curtius Fischer, Lauri O. Th. Tudeer, and there are yet others.

It perhaps first would be observed by one who critically examines his maps, that in what were remote regions his most striking errors are to be noted. Important and lengthy lists of errors have been well referred to by certain Ptolemy students; that is, to certain coasts, for example, set down as rivers, to the names of certain mountains given as those of tribes, to a number of actually mistaken names, to certain names doubled or trebled, to the addition of an initial letter to certain names. One can easily become confused in an attempt to search out what we may call the correct spelling of very many of the names as set down in the various editions of his Geography. No special attempt, in this translation, has been made to pass upon the relative merit of the variations; it indeed will be found that many of the names recorded in the text do not exactly agree with the Ebner manuscript map records. That has been selected which, as before noted, has seemed to the translator to be the preferable one. Here again the reader may be referred to such critical studies as those of Wilberg and Müller and to the studies of a number of modern investigators of high rank.

A reference may well be made to his recorded length and breadth of the inhabited earth. He seems to have been the first to give to the terms length and breadth the designation longitude and latitude. He greatly exaggerated the total longitude of the inhabited earth, and yet he reduced this from that given by Marinus and by others who had preceded him. He increased by almost one third the length of the Mediterranean; he makes the Indian Ocean an enclosed sea by joining the south-eastern region of Asia to southern Africa, and by those who accepted his geography this might well have been the reason for less vigorous and less early effort to reach the Indies of the East by an attempt to circumnavigate Africa; he increased very greatly the size of the island Ceylon (Taprobana). Yet who is there who will not be remarkably impressed with the near approach to accuracy of his records, in the main, not forgetting the time in which he lived? Let the concluding paragraph of Professor Fischer's Introduction here be read.

To this translation there has been added, in full size reproduction, the twenty-seven maps of the Codex Ebnerianus now belonging to The New York Public Library, to the very remarkable importance of which manuscript attention has been called. Two other maps have been added: the Ruysch Map

in the 1508 printed edition of Ptolemy's Geography, and the New World Map in the 1522 printed edition, having the name "America" conspicuously appearing across what we now call South America, where Waldseemüller, in his great World Map of 1507, had placed it.

The Codex Ebnerianus is a copy of the Geography prepared by Donnus Nicolaus Germanus, great indeed as a geographical editor and copyist, the maps in this manuscript being largely taken as a basis for the earliest printed editions. (Mention may be made here of the study of "Donnus Nicolaus Germanus, sein Kartennetz, seine Ptolemaus-Rezensionen und -Ausgaben... zur Erinnerungandie 450.

Wiederkehr des Ausgabejahres 1482 der Ulmer Ausgabe," by Wilhelm Bonacker and Dr. Ernst Anliker, in Schweizerisches Gutenbergmuseum Zeitschrift fur Buchdruck-, Bibliophilieuni Pressegeschichte, Bern, 1932, Jahrg. 18, nos. 1 — 2.) Excepting the published reproduction of the Codex Athous graecus in 1867, but not of great value, the reproduction in connection with this English translation is the latest complete modern reproduction of Ptolemy's maps from a manuscript copy. (To the forthcoming issue of the Codex Urbinas graecus 82, Professor Fischer has called attention.)

It perhaps will not be without interest here to note that it has been my very great pleasure, but recently, to have issued, in a limited number of copies, a complete facsimile edition, photographed and hand colored, of one of the finest Donnus Nicolaus Germanus manuscripts of Ptolemy's Geography known. A typical renaissance dedication of a great scholar, that of Donnus Nicolaus [Nicholaus] to Duke Borso of Modena, his illustrious patron, as found in this edition, and written at a time when Ptolemy's Geography was approaching the period of its greatest influence, is presented with this translation as a second Introduction immediately preceding Book I.

It is the sincere hope that this first English translation of Claudius Ptolemy's Geography may find favor particularly with Ptolemy students, and lend some inspiration to those who seek pleasure and profit through a wider acquaintance with the great geographers of antiquity.

EDWARD LUTHER STEVENSON

Yonkers, N. Y., 1932

The Dedication of Donnus Nicholaus Germanus — To the Most Illustrious Prince and Lord LORD BORSO, Duke of Modena

I am not unaware, Most Illustrious Prince, that Ptolemy the Geographer depicted the earth with the greatest skill and the most thorough information, and that were we to attempt anything new in these studies, our work would incur the censure of many; for all those who examine this delineation of ours, contained in these maps, which we now send to You, especially if they are those who are ignorant of the art of geometry, and observe that it differs from that which Ptolemy set forth, will convict us forthwith either of ignorance or of rashness. They will affirm that we did not know our limitations, or that we were indiscreet in falsifying so great a work, as soon as they observe that we have altered it in the least particular. They will never be persuaded, nor will they think it other than impossible, if any one else should have a better method of depicting the earth, that that method had escaped the notice of such a great man as in truth was Ptolemy, for he alone, even including the many excellent geographers who flourished before him, first discerned a method by which he could represent the several localities of the entire earth in picture.

It would be much the same thing as to assert that neither the work of Homer, the prince of poets could be set in order by Pisistratus, or the divine work of Lucretius be emended by Cicero, or the paintings of Tolletana be corrected by Sepponius. Such persons are like those who will praise nothing that they do not think they can understand, since any method that they hope to understand and comprehend themselves they judge to be the best for representing the world.

If confused by the frequency of the lines of longitude, not equally distant one from the other, they might say they would the rather have that rare and vast picture of Ptolemy's set out in straight lines, than this our multiplex and elaborate picture with its inclined and curved lines.

And we do not now claim that there is anything to be found in the picture of Ptolemy that should be corrected or emended, or reduced to order, since all things were by him so skilfully and wisely represented, that nothing relating to the position of countries seems to be wanting in his maps; but we say this much that we may convict those men of their ignorance who, with or without knowledge of such matters, are moved by a kind of envy and hatred on seeing anything set down that is beyond their comprehension, and immediately turn and abuse the author.

If those who are not altogether ignorant of geography or cosmography, and are in the habit of reading Ptolemy, will compare, with a calm mind, our picture with his, they will certainly think our picture worthy of some praise, instead of blaming it, for they will see that we undertook a hard and difficult task, and brought it to such an excellent conclusion, that they will be compelled to wonder at it, especially when they discover that we have in no particular departed from the intention of Ptolemy, although we have deviated a little from his picture.

Since Thou canst plainly see, O Most Illustrious Prince, how things are, I beseech Thee to give heed for a while to what Ptolemy says and to what we have done.

Ptolemy, as I soon learned from his writings, tells us that there is a twofold system of depicting the terrestrial sphere. The first, he asserts, is that in which instead of circles (I quote his words which are in the eighth book) we represent the meridians neither inclined nor curved but as straight perpendicular lines. The second, he says, is that in which we use everywhere curved and inclining lines, as the scheme of the places on the earth itself demands, and not straight lines.

Of the two methods he approves the second as somewhat more artistic and subtle, but in his picture he has followed the first method, if that picture be his which is to be found in old copies, and in which, it appears that anyone depicting the earth and making use of straight lines for circles, is not far from the truth. But we for our part, Most Illustrious Prince, when we were reading at our leisure his writings, which were not altogether foreign to our profession, and came upon the description somewhere in the first book near the end,

wherein he says that we should regard what is done with care and with seriousness in a map rather than what is done too easily and too thoughtlessly; having read this, I say, we suddenly began to reflect by what means we ourselves might obtain some glory.

Believing that an opportunity was offered us whereby our powers might come to light by raising some monument to our industry, we immediately undertook the task of making a picture in the proper way, which would receive more general approval than previous pictures, even were he himself to be the judge.

Instead of circles we have made use of sloping lines, where they would seem to be required, that are not all equidistant (as he himself advises we should do) and the location of places falling between two parallels we have given in a reckoning from both. In order that one might make the more easily and accurately an estimate of the location of any place, which could not be clearly expressed by straight equidistant lines, we have not hesitated to express by means of parallels, in each of our pictures, the extent in miles of every degree whatsoever in longitude.

What shall I say further when in no copy of Greek or Latin text can be found a picture which tells us the size and shape of any island, or gives it proper description, or tells, in any region or province, how many and what kinds of peoples may be found, what towns, cities, rivers, harbors, lakes, and mountains, or under what place in the heavens they lie, or in what direction they face.

We have inserted certain of these things, but not all, yet all are given by Ptolemy himself in his writings; and we have distinguished boundaries by dotted lines, so that even an unpracticed eye can see them easily.

The size of the picture itself, which heretofore was too large and exceeded the common size of books, we have reduced, while carefully keeping the dimensions of all localities to a size that will make it more acceptable to those wishing to study it. The remaining work of that illustrious man we have left untouched, and it remains as it was at first.

When, therefore, I had almost finished this work, and was thinking of some distinguished person to whom to dedicate it, no one truly seemed to us to be more worthy of this dedication than Yourself) for Thou art the only one, to speak the truth, of all the rulers of Italy, who is greatly delighted by such writings and pictures, and who has around him other learned men excelling in this art, and in many other arts; who can readily correct any mistake on our part, and at the same time can give commendation to what is rightly done.

Omitting other learned men dwelling in Thy city in these times, who is more skilled in mathematics than Johannes Blanchinus, or in physics than Peter the Good? Who is more learned in medicine than Sonzinus? Who is more subtle in dialectics and in philosophy than Brother Francis? Who is more skilled in civil and canon law than Franciscus Porcellinus? Who is more advanced in theology than Johannes Gattus, and at the same time more expert in Greek and Latin? Who, in fine, is more excellent in every kind of teaching than Hieronimus Castellanus? Time would fail me, O Illustrious Prince, to enumerate the famous men who serve in Thy city, and fain would I follow their virtues! Truly they would not dwell in Thy city if they did not witness Thee (because Thou knowest that virtue is the guide of the life of men) giving Thy support to men who are eminent as teachers, and leading them from taking the ease they deserve to the active business of reading and writing. And so Thy integrity and Thy virtue can never be praised as they deserve. As in Thy past life Thy virtue has devoted itself to learning, may it still show favor to the learned, and by its munificence draw the rest of mankind to the same zeal for virtue.

Accept then, O Most Beneficent Prince, Who art the Ornament of our Italian nobility, this work, which we have dedicated to Thee, and which we now send Thee, not so much that Thou shouldst read it as that Thou shouldst correct it. If in it Thou shouldst find anything blameworthy, I beg that Thou mayest ascribe it not so much to weakness of my mind as to the greatness and difficulty of the task.

But shouldst Thou find that in this work we have labored for the common good not in vain, then we earnestly beseech Thee that in many other different arts, which hitherto have remained untouched, it may be permitted to us by

Thy kindness and liberality to give free exercise to our talents.

FAREWELL

Chapter I — In what Geography differs from Chorography

Geography is a representation in picture of the whole known world together with the phenomena which are contained therein.

It differs from Chorography in that Chorography, selecting certain places from the whole, treats more fully the particulars of each by themselves — even dealing with the smallest conceivable localities, such as harbors, farms, villages, river courses, and such like.

It is the prerogative of Geography to show the known habitable earth as a unit in itself, how it is situated and what is its nature; and it deals with those features likely to be mentioned in a general description of the earth, such as the larger towns and the great cities, the mountain ranges and the principal rivers. Besides these it treats only of features worthy of special note on account of their beauty.

The end of Chorography is to deal separately with a part of the whole, as if one were to paint only the eye or the ear by itself. The task of Geography is to survey the whole in its just proportions, as one would the entire head. For as in an entire painting we must first put in the larger features, and afterward those detailed features which portraits and pictures may require, giving them proportion in relation to one another so that their correct measure apart can be seen by examining them, to note whether they form the whole or a part of the picture. Accordingly therefore it is not unworthy of Chorography, or out of its province, to describe the smallest details of places, while Geography deals only with regions and their general features.

The habitable parts of the earth should be noted rather than the parts which are merely of equal size, especially the provinces or regions and their divisions, the differences between these being rather the more important. Chorography is most concerned with what kind of places those are which it describes, not how large they are in extent. Its concern is to paint a true likeness, and not

merely to give exact position and size. Geography looks at the position rather than the quality, noting the relation of distances everywhere, and emulating the art of painting only in some of its major descriptions. Chorography needs an artist, and no one presents it rightly unless he is an artist. Geography does not call for the same requirements, as any one, by means of lines and plain notations can fix positions and draw general outlines. Moreover Chorography does not have need of mathematics, which is an important part of Geography. In Geography one must contemplate the extent of the entire earth, as well as its shape, and its position under the heavens, in order that one may rightly state what are the peculiarities and proportions of the part with which one is dealing, and under what parallel of the celestial sphere it is located, for so one will be able to discuss the length of its days and nights, the stars which are fixed overhead, the stars which move above the horizon, and the stars which never rise above the horizon at all; in short all things having regard to our earthly habitation.

It is the great and the exquisite accomplishment of mathematics to show all these things to the human intelligence so that the sky, too, having a representation of its own character, which, although it can not be seen as moving around us, yet we can look upon it by means of an image as we look upon the earth itself, for the earth being real and very large, and neither wholly nor in part moving around us, yet it can be mapped by the same means as is the sky.

Chapter II — What presuppositions are to be made use of in Geography

What geography aims at, and wherein it differs from Chorography, we have definitely shown in our preceding chapter. But now as we propose to describe our habitable earth, and in order that the description may correspond as far as possible with the earth itself, we consider it fitting at the outset to put forth that which is the first essential, namely, a reference to the history of travel, and to the great store of knowledge obtained from the reports of those who have diligently explored certain regions; whatever concerns either the measurement

of the earth geometrically or the observation of the phenomena of fixed localities; whatever relates to the measurement of the earth that can be tested by pure distance calculations to determine how far apart places are situated; and whatever relations to fixed positions can be tested by meteorological instruments for recording shadows. This last is a certain method, and is in no respect doubtful. The other method is less perfect and needs other support, since first of all it is necessary to know in determining the distance between two places, in what direction each place lies from the other; to know how far this place is distant from that, we must also know under what part of the sky each is located, that is, whether each extends toward the north, or, so to speak, toward the rising of the sun (the east), or in some other particular direction. And these facts it is impossible to ascertain without the use of the instruments to which we refer. By the use of these instruments, anywhere and at any time, the position of the meridian line can easily be found, and from this we can ascertain the distances that have been traveled. But when this has been done, the measurement of the number of stadia does not give us sure information, because journeys very rarely are made in a straight line. There being many deviations from a straight course both in land and in sea journeys, it is necessary to conjecture, in the case of a land journey, the nature and the extent of the deviation, and how far it departs from a straight course, and to subtract something from the number of stadia to make the journey a straight one.

Even in sailing the sea the same thing happens, as the wind is never constant throughout the whole voyage. Thus although the distance of the places noted is carefully counted, it does not give us a basis for the determination of the circumference of the whole earth; nor do we ascertain an exact position for the equatorial circle or for the location of the poles.

Distance which is ascertained from an observation of the stars shows accurately all these things, and in addition shows how much of the circumference is intercepted in turn by the parallel circles, and by the meridian circles which are drawn through the places themselves; that is to say, what part of the circumference of parallel circles and of the equatorial circle is intercepted by the meridians, or what part of the meridian circles are intercepted by the parallels and equatorial circle.

After this it will readily be seen how much space lies between the two places themselves on the circumference of the large circle which is drawn through them around the earth. This measurement of stadia obtained from careful calculations does not require a consideration of the parts of the earth traversed in a described journey; for it is enough to suppose that the circuit of the earth itself is divided into as many parts as one desires, and that some of these parts are contained within distances noted on the great circles that gird the earth itself. Dividing the whole circuit of the earth or any part of it noted by our measurements which are known as stadia measurements, is a method not equally convincing. Therefore because of this fact alone it has been found necessary to take a certain part of the circumference of a very large celestial circle, and by determining the ratio of this part to the whole of the circle, and by counting the number of stadia contained in the given distance on the earth, one can measure the stadia circumference of the globe.

When we grant that it has been demonstrated by mathematics that the surface of the land and water is in its entirety a sphere, and has the same center as the celestial globe, and that any plane which passes through the center makes at its surface, that is, at the surface of the earth and of the sky, great circles, and that the angles of the planes, which angles are at the center, cut the circumferences of the circles which they intercept proportionately, it follows that in any of the distances which we measure on the earth the number of the stadia, if our measurements are correct, can be determined, but the proportion of this distance to the whole circumference of the earth can not be found, because no proportion to the whole earth can thus be derived, but from the similar circumference of the celestial globe that proportion can be derived, and the ratio of any similar part on the earth's surface to the great circle of the earth is the same.

Chapter III

How, from measuring the stadia of any given distance, although not on the same meridian, we may determine the number of stadia in the circumference of the earthy and vice versa

THOSE GEOGRAPHERS WHO lived before us sought to fix correct distance on the earth, not only that they might determine the length of the greatest circle, but also that they might determine the extent which a region occupied in one plane on one and the same meridian. After observing therefore, by means of the instruments of which I have spoken, the points which were directly over each terminus of the given distance, they calculated from the intercepted part of the circumference of the meridian, distances on the earth.

As we have said, they assume the location of the points to be in one plane, and the lines passing through the terminals of the distance, to the points which are directly overhead, must necessarily meet, and the points where they meet would be the common center of the circles. Therefore if the circle drawn through the poles were intercepted by lines drawn from the two points that were marked overhead, it would be understood that it formed the total extent of the intercepted circumference compared with the whole circuit of the earth.

If a distance of this kind is not on the circle drawn through the poles, but on another of the great circles, the same thing can be shown by observing in like manner the elevation of the pole from the extremities of the distance, and noting simultaneously the position which the same distance has on the other meridian. This we have clearly shown by an instrument which we ourselves have constructed for measuring shadows, by which instrument we can easily ascertain a great many other useful things. For on any day or night we have the elevation of the north pole, and at any hour we have the meridian position of the given distance by performing a single measurement, that is, by measuring the angle that the greatest circle drawn through the line of the distance makes with the meridian circle at the vertical point: in this way we can show the required circumference by means of this instrument, and the circumference of the equatorial circle which is intercepted between the two meridians, these meridians being parallel and circles like the equator. According to this demonstration, if we measure only one straight distance on the surface of the earth, then the number of stadia of the whole circuit of the earth can be ascertained. And as a result of this we can obtain the measurements of all distances, even when they are not exactly on the same meridian or parallel, by

observing carefully the elevation of the pole, and the inclination of the distance to the meridian, and vice versa. From the ratio of the given part of the circumference to the great circle, the number of the stadia can be calculated from the known number of stadia in the circuit of the whole earth.

Chapter IV — Carefully observed ‘phenomena should be preferred to those derived from the accounts of travelers

Since this is so, travelers who have journeyed over the regions of the earth one by one, had they made use of observations of a similar kind, would have been able to give us a wholly correct description of our habitable earth. But when no one except Hipparchus has given us the elevation of the north pole, and even he, of only a few places out of the great number known to geographers, and since he has marked but a small number of the sites that are on the same meridian; and when others coming after him have noted the position of the places opposite each other, not giving us those of equal distance from the equator, but only those lying on the same meridian, taking this from successful voyages made to the north and to the south; and calculating most of their distances, especially those which extended to east or west, from a certain general tradition, not because of any lack of skill or because of indolence, on the part of the writers, but because in their time, the use of exact mathematics had not yet been established; and when in addition to this not many eclipses of the moon have been observed at the same time in different localities as was that eclipse at Arbela which was noted as occurring there at the fifth hour, from which observation it was ascertained by how many equinoctial hours, or by what space of time, two places were distant from each other east or west; it is just and right that a geographer about to write a geography should lay as the foundation of his work the phenomena known to him that have been obtained by a more careful observation, and should make the traditions subordinate to these, so that the relative positions of localities may be determined with greater certainty and be more nearly accurate than is possible by relying on primitive traditions.

Chapter V — Attention must be paid to the latest researches because the earth, in the course of time, undergoes change

After these preliminary remarks we are able to make a beginning of our work. Since, however, all regions cannot be known fully on account of their great size, or because they are not always of the same shape or because not yet satisfactorily explored, and a greater length of time makes our knowledge of them more certain, we think we should say something to the readers of our geography on the subject of varying traditions at various times, viz., of some portions of our continents, on account of their great size, we have as yet no knowledge; with regard to other parts we do not know what is their real nature, because of the negligence of those who have explored them in failing to give us carefully prepared reports; other parts of the earth are different to-day from what they were, either on account of revolution or from transformation, in which processes they are known to have partially passed into ruin.

We consider it necessary therefore for us to pay more attention to the newer records of our own time, weighing, however, in our description these new records and those of former times and deciding what is credible and what is incredible.

Chapter VI — Concerning the geographical narrations of Marinus

Marinus the Tyrian, the latest of the geographers of our time, seems to us to have thrown himself with the utmost zeal into this matter.

He is known to have found out many things that were not known before. He has searched most diligently the works of almost all the historians who preceded him. He has not only corrected their errors, but the reader can clearly see that he has undertaken to correct those parts of the work which he himself had done badly in the earlier editions of his geographical maps. If we examine closely his last work we find few defects. It would seem to be enough for us to describe the earth on which we dwell from his commentaries alone, without

other investigations.

When, however, he appears to agree with certain others in a conclusion that is unworthy of belief, most often in questions concerning the method of drawing, or when he refuses to give the attention he should to an opportune invention, we have been moved by no unworthy motive to think, as regards part of his reasoning and method, that we could bring forward something more in keeping with the rest of the work and its author. And this without wasting words we will endeavor to do to the best of our ability, dwelling briefly on each kind of error as reason dictates.

First of all let us deal with that which pertains to history. He considers that our earth extends a greater distance in longitude eastward, and to a greater distance in latitude southward than is right and true. For not unreasonably we call the distance extending from the setting to the rising sun the longitude, and the distance from the north to the south pole the latitude, when we mark the parallels in the vault of the heavens. Moreover the greater distance we call longitude, which is accepted by all, for the extent of our habitable earth from east to west all concede is much greater than its extent from the north pole to the south.

Chapter VII — The opinions of Marinus relating to the earth's latitude are corrected by observed phenomena

First of all, Marinus places Thule as the terminus of latitude on the parallel that cuts the most northern part of the known world. And this parallel, he shows as clearly as is possible, at a distance of sixty-three degrees from the equator, of which degrees a meridian circle contains three hundred and sixty. Now the latitude he notes as measuring 31,500 stadia, since every degree, it is accepted, has 500 stadia. Next, he places the country of the Ethiopians, Agisymba by name, and the promontory of Prasum on the same parallel which terminates the most southerly land known to us, and this parallel he places below the winter solstice.

Between Thule and the southern terminus he inserts altogether about eighty-seven degrees which is 43,500 stadia, and he tries to prove the

correctness of this southern termination of his by certain observations (which he thinks to be accurate) of the fixed stars and by certain journeys made both on land and on sea. Concerning this we will make a few observations.

In his observation concerning the fixed stars, in the third volume of his work, he uses these words: "The Zodiac is considered to lie entirely above the torrid zone and therefore in that zone the shadows change, and all the fixed stars rise and set. Ursa Minor begins to be entirely above the horizon from the north shore of Ocele which is 5,5 stadia distant. The parallel through Ocele is elevated eleven and two-fifths degrees.

"We learn from Hipparchus that the star in Ursa Minor which is the most southerly or which marks the end of the tail, is distant from the pole twelve and two-fifths degrees, and that in the course of the sun from the equinoctial to the summer solstice, the north pole continually rises above the horizon while the south pole is correspondingly depressed, and that on the contrary in the course of the sun from the equator to the winter solstice the south pole rises above the horizon while the north pole is depressed."

In these statements Marinus narrates only what is observed (on) the equator, or between the tropics. But what, after being learned from the records or from accurate observations of the fixed stars, are the happenings in places south of the equator, he in no wise informs us, as if one should place southern stars rather than equatorial directly overhead, or assert that mid-day shadows over the equator incline south, or show all the stars of Ursa Minor risen or set, or some of them visible at the time when the south pole is raised above the horizon.

In what he adds later he tells us of certain observations, of which, nevertheless, he is not entirely certain in his own mind.

He says that those who sail from India to Limyrica, as did Diodorus the Samian, which is related in his third book, tell us that Taurus is in a higher position in the mid-heavens than in reality it is and that the Pleiades are seen in the middle of the masts, and he continues, "those who sail from Arabis to Azania sail straight to the south, and toward the star Canopus, which there is called Hippos, that is the Horse, and which is far south. Stars are seen there which are not known to us by name, and the Dog Star rises before Procyon

and Orion, and before the time when the sun turns back toward the summer solstice."

For these observations concerning the stars Marinus clearly states that some places are located more northerly than the equator, as when he says that Taurus and the Pleiades are directly over the heads of the sailors. As a matter of fact these stars are near the equator. He indeed shows some stars to be no further south than north, for Canopus can be seen by those who dwell a long distance north of the summer solstice; and several of the fixed stars, never seen by us, can be seen above the horizon in places south of us, and in places more toward the equatorial region than those in the north, as around Meroe. They can be seen as is Canopus itself, which, when appearing above the horizon is never visible to those who dwell north of us. Those who dwell toward the south call this star Hippos, that is the Horse, nor is any other star of those known to Us called by that name.

Marinus infers that he himself determined by mathematical proofs that Orion is entirely visible, before the summer solstice, to those who dwell below the equatorial circle; also that with them the Dog Star rises before Procyon, which he says is observed as far south even as Syene. In these conclusions of Marinus there is nothing appropriate or of value to us because he extends the position of his inhabited countries too far south of the equator.

Chapter VIII — They are also corrected by measuring journeys on land

In computing the days one by one, occupied in journeying from Leptis Magna to Agisymba, Marinus shows that the latter locality is 24,680 stadia south of the equator. By adding together the days occupied in sailing from Ptolemais Trogloditica to Prasum he concluded that Prasum is 27,800 stadia south of the equator, and from these data he infers that the promontory of Prasum and the land of Agisymba, which, as he himself expresses it, belongs to Ethiopia (and is not the end of Ethiopia), lies on the south coast in the frigid zone opposite to ours. In a southerly direction 27,800 stadia make up fifty-five and three-fourths degrees, and this number of degrees in an opposite direction

(i.e.. north) marks a like temperate climate, and the region of the swamp Meotis, which the Scythians and Sarmatians inhabit.

Marinus then reduces the stated number of his stadia by half or less than half) that is to 12,000 which is about the distance of the winter solstice from the equatorial circle. The only reason for this reduction that he gives us is the deviation from a straight line of the journeys and their daily variations in length. After he has stated these reasons, it seemed to us necessary not only to show that he was mistaken, but also to reduce his figures by the required one-half.

At the outset, when writing of the journey from Garama to Ethiopia he says that Septimius Flaccus, having set out from Libya with his army, came to the land of the 'Ethiopians from the land of the Garamantes in the space of three months by journeying continuously southward. He says furthermore that Julius Metemus, setting out from Leptis Magna and Garama with the king of the Garamantes, who was beginning an expedition against the Ethiopians, by bearing continuously southward came within four months to Agisymba, the country of the Ethiopians where the rhinoceros is to be found.

Each of these statements, on the face of it, is incredible, first, because the Ethiopians are not so far distant from the Garamantes as to require a three months' journey, seeing that the Garamantes are themselves for the most part Ethiopians, and have the same king; secondly, because it is ridiculous to think that a king should march through regions subject to him only in a southerly direction when the inhabitants of those regions are scattered widely east and west, and ridiculous also that he should never have made a single halt that would alter the reckoning. Wherefore we conclude that it is not unreasonable to suppose that those men either spoke in hyperbole, or else, as rustics say, "To the south," or "Toward Africa" to those who prefer to be deceived by them, rather than take the pains to ascertain the truth.

Chapter IX — They are also corrected by measuring journeys by water

Concerning the voyage from Aromata to Rhapta, Marinus tells us that a certain Diogenes, one of those who were accustomed to sail to India, having been driven out of his course, and being off the coast of Aramata, was caught by the north wind and, after having sailed with Trogloditica on his right, came in twenty-five days to the lake from which the Nile flows, to the south of which lies the promontory of Rhaptum. He tells us also that a certain Theophilus, one of those who were accustomed to sail to Azania, driven from Rhapta by the south wind came to Aromata on the twentieth day. In neither of these cases does he tell us how many days were occupied in actual sailing, but merely states that Theophilus took twenty days, and Diogenes, who sailed along the coast of Trogloditica, took twenty-five days.

He only tells us how many days they were on the voyage, and not the exact sailing time, nor the changes of the wind in strength and direction, which must have taken place during a voyage of such long duration. Moreover he does not say that the sailing was continuously south or north, but merely says that Diogenes was carried along by the north wind while Theophilus sailed with the south wind. That the wind kept the same strength and direction during the whole voyage is related in neither case, and it is incredible that for the space of so many days in succession, it should have done so. Therefore although Diogenes sailed from Aromata to the swamps, to the south of which lies the promontory of Rhaptum, in twenty-five days, and Theophilus from Rhapta to Aromata, a greater distance, in twenty days, and although Theophilus tells us that a single day's sailing under favorable circumstances is calculated at 1,000 stadia (and this computation Marinus himself approves) Disocorus nevertheless says that the voyage from Rhapta to the promontory of Prasum, which takes many days, as computed by Diogenes is only 5,000 stadia. The wind, he says, varies very suddenly at the equator, and squalls around the equator on either side of the line are more dangerous.

From these considerations we thought we ought not to assent to the numbering of the days, because it is plain to all that on the reckoning made by Marinus, the Ethiopians and the haunts of the rhinoceros should be moved to the cold zone of the earth, that is, opposite to ours. Reason herself asserts that all animals, and all plants likewise, have a similarity under the same kind of climate or under similar weather conditions, that is, when under the same

parallels, or when situated at the same distance from either pole.

Marinus has shortened the measures of latitude around the winter solstice, but has given no sufficient reason for his contraction. Even should we admit the number of days occupied in the series of voyages that he relates, he has shortened the number of daily stadia and has reasoned contrary to his customary measure in order to reach the desired and correct parallel. He should have done exactly the opposite, for it is easy to believe the same daily distance traveled as possible, but in the even course of the journeys, or voyages or that they were wholly made in a straight line, he ought not to have believed. From them it was not possible to ascertain the distance but it was correct to assert that in latitude the places in question extended beyond the equator. Even this could be known with greater certainty from astronomical observations. Any one could have ascertained exactly the required distances if he had, with more skill in mathematics, considered what takes place in those localities. Since this observation was not made, it remains that we follow what reason dictates, that is, we must ascertain how far the distance extends beyond the equator. We can also ascertain what we require to know through information concerning the kinds, the forms, and the colors of the animals living there, from which we draw the conclusion that the parallel of the region of Agisymha is the same as that of the Ethiopians and extends from the winter solstice to the equator; although with us in places opposite to that region, that is, in the summer solstice, they do not have the color of the Ethiopians, nor is the rhinoceros and elephant to be found, yet in places not far south of us the inhabitants are moderately black such as from the same cause are the Garamantes, whom Marinus himself describes, and whom he places neither under the summer solstice nor north of it, but much too far to the south. In the regions around Meroe the inhabitants are very black, and closely resemble the Ethiopians, and there we find that elephants and other kinds of monstrous animals are bred.

Ethiopia should not be placed more to the south than the parallel which is opposite the parallel passing through Meroe IN agreement therefore with this information, viz., that the inhabitants are Ethiopians, as those who have sailed there have told us, Marinus describes the region of Agisymba and the promontory of Prasum, and the other places lying on the same parallel, as

situated all on one parallel, which is opposite the parallel passing through Meroe. That would place them on a parallel distant from the equator in a southerly direction 16° 25' or about 8,200 stadia, and by the same reckoning the whole width of the habitable world amounts to 79° 2s' or altogether 40,000 stadia.

Now the distance between Leptis Magna and Garama, according to Flaccus and Maternus, is placed at 5,400 stadia. The time of their second journey was twenty days, a more nearly correct time than the first because it was directly north, while the first journey of thirty days had many deviations. The travelers who several times made the voyage kept the reckoning of each day's distance, and this was not only properly done, but done of necessity on account of the changes of the water and the weather. Just as we should have doubts with regard to distances that are great in extent, and rarely traveled, and not fully explored, so in regard to those that are not great and not rarely but frequently gone over, it seems right to give credit to the reports of the voyagers.

Chapter XI — The errors of Marinus in calculating the longitude of the habitable earth

How far the latitude of the habitable earth extends is clear to us from what we have just stated. Marinus gives us the longitude, between two meridians, enclosing a total space of fifteen hours. It seems to us that the distance eastward is shown to be greater than it should be, and that if it be reduced, as it ought to be, it will be seen to include not quite the space of twelve hours, that is, by locating the Fortunate Islands at the extreme west and placing at the extreme east the Seres, Sina and Cattigara.

The distance from the Fortunate Islands to the Euphrates at Hieropolis, which we place with Marinus on the parallel passing through Rhodes, must be reckoned according to the number of stadia, determined by Marinus, both because of the continual measuring of this distance by voyagers, and because Marinus has corrected the reports of the distance by ascertaining the allowance to be made for deviation and the variations of the rate of travel. Marinus also makes one degree of the three hundred and sixty which the

largest circle contains, measure 500 stadia on the surface of the earth, a measurement which is proved by distances that are known and certain. Likewise the circle which passes through Rhodes, Marinus shows to be 36° distant from the equator, and each degree to measure approximately four hundred stadia, and the excess of that number (according to an exact reckoning of the location of the parallels), in some measure counterbalances the defect in the others, and is negligible in the whole computation.

The distance from the Euphrates at Hieropolis to the Stone Tower, Marinus gives as eight hundred and seventy-six schena, or 26,280 stadia. The distance from the Stone Tower to Sera, the capital of the Seres, which is a journey of seven months, he computes at 36,200 stadia. Since these two distances are measured on the same parallel, we shall shorten both by making a necessary correction, as it is clear that Marinus made no reduction for deviations in either journey, and in computing the second journey fell into the same mistakes as those he made when measuring the distance between the Garamantes and Agisymba, for in that measurement he reckoned the number of stadia traversed in four months, and was compelled to make a reduction. It is quite possible that the rate of travel was not uniform over so long a space of time, and that this was the case in the seven months' journey it is not unreasonable to suppose, and it is more likely to have been the case, than in the journey from the Garamantes to Agisymba. This last journey was made by the king of the country, as was becoming with no small preparation, and was made wholly in fine weather. The journey from the Stone Tower to Sera was exposed to winter tempests, for it lies, according to Marinus himself, on the parallel that passes through Byzantium and the Hellespont. Wherefore there must have been many deviations in that journey, especially since it was undertaken for the purpose of carrying merchandise. Marinus tells us that a certain Macedonian named Maen, who was also called Titian, son of a merchant father, and a merchant himself, noted the length of this journey, although he did not come to Sera in person but sent others there.

Marinus does not seem to agree with the findings of these merchants, and he especially disagrees with the statements of the merchant Philemon whose reckonings make the length of the island of Hibernia from east to west a twenty days' journey. Marinus would not believe this, although Philemon told

him that he himself had heard it from the merchants themselves.

Marinus says of the merchant class generally that they are only intent on their business, and have little interest in exploration, and that often through their love of boasting they magnify distances. In their journey that occupied seven months they brought no information worth remembering, and what they related on their return about the time they had consumed in travel was nothing but an extravagant statement.

Chapter XII — The calculation of longitude corrected by land journeys

For these reasons therefore, and because the journey is not on one and the same parallel, for the Stone Tower is on the parallel that passes through Byzantium, and Sera is more to the south and on the parallel that passes through the Hellespont, it seems to us proper that the number of the stadia, viz., 36,200, which was computed from a journey of seven months, should be cut down to not less than one-half; and for an easier understanding only to one-half; so that the distance in stadia may be computed as 18,100, or forty-five and one-fourth degrees.

It would be inept and absurd should any one follow on both journeys, that is, on this journey and on the journey from the Garamantes, reasoning which led to this conclusion, for the reason was based upon the difference noted in the animals which inhabit the region of Agisymba, animals which can not be transferred to localities outside the limits of those assigned to them by nature. This reason does not hold likewise in reckoning the distance of the Stone Tower from Sera, for throughout the whole distance, be the intervals great or small, there is the same temperate climate. It is much the same as though a man, who could not be convicted by law as a thief, could be convicted nevertheless, according to the rightful precepts of philosophy.

Wherefore the former distance which Marinus gave from the Euphrates to the Stone Tower, viz., 876 schena must be reduced because of deviations on the journey, to only 800 schena or 24,000 stadia; and this is verified by the particular measurements taken on that journey, and by the frequent visits

made to those places on that journey. That the journey had deviations is clear from statements made by Marinus himself, for in making the journey from the ford over the Euphrates at Hieropolis through Mesopotamia to the Tigris, and through the Garamantes of Assyria and Media to Ecbatana and the Caspian Gates, and from there through Parthia to Hechatompilum, the right course is to follow the parallel of Rhodes, as this parallel passes through those regions. To proceed from Hechatompilum to the city of Hyrcania it is necessary to deviate to the north. The city Hyrcania lies about midway between the Smyrna and the Hellespont parallels, the parallel of Smyrna is also called the parallel of Hyrcania, but the parallel of the Hellespont passes through the southern shores of the Hyrcanian sea, which are situated somewhat to the north of the city of Hyrcania which takes its name from that sea. The journey thence to Antioch Margiana through Asia, first turns to the south (since Asia is on the same parallel as the Caspian Gates), and then turns to the north, since Antioch is close to the Hellespont parallel.

From Antioch to Bactria the journey deviates to the east, and after ascending the Comédon mountains it bends to the north. From the mountains, where it comes to the plain at their base, it inclines to the south, for the mountains extend north and east. The ascent is placed by Marinus on the Byzantium parallel, and the southern and eastern ranges are located on the Hellespont parallel. The mountains themselves he places to the east, but plainly extends them so as partially to decline to the south. Likewise he says that the journey for fifty schena before coming to the Stone Tower, deviates to the north. When you have traversed the plain, at the base of the mountains you arrive at the Stone Tower, and from there you come to the mountains which run in an easterly direction, ending at Imao which is north of Palimbothris.

Adding the degrees which have been noted, they amount to sixty or 24,000 stadia. When we have added the forty-five and one-fourth degrees from the Stone Tower to Sera, the total distance from the Euphrates to Sera on the parallel of Rhodes will amount to 105° 15'. We will now add, from the distances which Marinus gives, the other degrees on the same parallel, and first of all from the meridian passing through the Fortunate Islands, as far as the Sacred promontory of Spain 2° 30', thence to the mouth of the river Baetis, and from the Baetis to the Strait and to Calpe is likewise 2° 30', being one and

the same distance; from the Strait to Caralis, a city in Sardinia, is 25°; from Caralis to the promontory of Lilybaeum in Sicily 4° 30'; from Lilybaeum to Pachynus is 3°; from Pachynus to Taenarus in Laconica is 10°; thence to Rhodes is 8° 15'; from Rhodes to Issus is 11° 15'; from Issus to the Euphrates is 2° 30'; the sum of all these degrees is 72 °. Hence, the length of the known earth, that is, from the meridian drawn through or terminated by the Fortunate Islands in the extreme west, to Sera in the extreme east is 177° 15'.

Chapter XIII — The same calculation of longitude corrected by sea journeys

One might then conjecture that the entire distance was only a certain total, by summing up the separate distances given by Marinus in sailing from India to the region of Sinarus and Cattigara, after taking account of deviations from a direct course, the variations in the rate of sailing, and the position of the regions themselves.

After the promontory called Cory, which closes the bay of Colchis, he says that the bay of Argaricus is next, and that it extends to the city of Curula, a distance of 3,400 stadia.

He adds that the city is situated north of the promontory of Cory, hence we gather that the voyage, if we subtract one-third for the circuit of the bay of Argaricus, may be reckoned as 2,030 stadia, not allowing for any variation in the wind. If however we subtract one-third for the variation from a direct course owing to the winds, there remains a distance of about 1,350 stadia in a direct northerly course. When this distance is transferred to a distance measured on the equatorial parallel, and is diminished by one-half in proportion to the intercepted angle, we have the distance between the two meridians passing through the promontory of Cory and the city Curula as 675 stadia or about i° 20', because the parallel drawn through these points differs from the greatest circle in nothing worthy of note.

From the city of Curula the course of navigation is, so he tells us, toward the winter rising of the sun as far as Palura and measures 9,450 stadia. Subtracting one-third for changes in the direction of wind we have a distance in one

direction of 6,300 stadia. Taking from this distance one-sixth we may then reduce it to the equatorial parallel and we shall then find the distance between these meridians to be 5,250 stadia or 10° 30'. The shore of the Gangetic bay he places at a further distance of 19,000 stadia.

From Palura to the city of Sada is 13,000 stadia by navigating the aforesaid bay toward the equatorial rising of the sun, and since the course is directed toward the equatorial rising we must allow for the deviation and deduct one-third. When we have done this we are left with a distance of about 8,670 stadia or 17° 20'.

Thence he makes the voyage from Sada to the city of Tamala to measure 3,500 stadia in a direction toward the winter rising of the sun. Deducting one-third for variable winds we have a distance in a straight line of 2,330 stadia, and deducting a further one-sixth for deviation toward Velturnus we find that the distance between the meridians is 1,940 stadia or about 3° 30' plus 20', that is 3° 50'.

The next distance from Tamala to the Golden Chersonesus he gives as 1,600 stadia toward the winter rising of the sun, so that a like fraction being deducted there is a distance left between the meridians of 900 stadia or 1° 48'.

Chapter XIV — Concerning the voyage from the Golden Chersonesus to Cattigara

Marinus does not tell the number of stadia from the Golden Chersonesus to Cattigara, but he says Alexander wrote that the shore line extends toward the south, and that those sailing along the shore came, after twenty days, to Zaba. From Zaba carried southward and toward the left, they came after some days to Cattigara. He lengthens the distance, interpreting some days to mean many days, and believing (ridiculously it seems to me) that the expression "some days" was used because the days were too many to be counted. Who is there who could not count the number of days even if they expressed the circuit of the entire earth, or what induced Alexander, when he meant many days, to say some days?

He indeed says concerning Dioscorus that he occupied many days sailing from Rhapta to Prasum. One very naturally would understand by some days a few days, for that is how we are accustomed to speak. Lest, however, we seem, like our friends, to accommodate our conjectures to the number we have laid down, let us compare the voyage from the Golden Chersonesus to Cattigara, a voyage consisting of two voyages — one voyage of twenty days to Zaba, the other of some days to Cattigara — let us compare, I say, this twofold voyage with the sailing from Aromata to the promontory of Prasum, which took the same number of days as far as Rhapta (as Theophilus relates), and many more to Prasum (as Dioscorus tells us).

Now let us, as Marinus did, agree that some days and many days correspond in meaning, when from conclusions which are in keeping with reason we have shown by celestial phenomena that Prasum is situated on the parallel which lies 6° 25' south of the equator, and when the parallel drawn through Aromata to Prasum is counted as 20° 40'.

Hence it is not incongruous to assign the same number of degrees to the distance between the Golden Chersonesus and Cattigara by way of Zaba. The part of this distance which lies between the Golden Chersonesus and Zaba need not be lessened, because it extends in a straight line, following the course of the equator, but the part of the distance lying between Zaba and Cattigara, because its navigation deviates to the south on its eastern shore, must be lessened, that we may bring it to the norm of the equator. If then we attribute half of the degrees to both distances on account of our knowing no difference between them, and then subtract because of known deviations a third part of the degrees measured between Zaba and Cattigara, which were at first set down as 10° 20', we shall have a distance from the Golden Chersonesus to Cattigara equated to the position of the equator, or about 17°

'.

We have already shown that the distance from the promontory of Cory to the Golden Chersonesus is 34° 48'. Wherefore the whole distance from Cory to Cattigara amounts to about 52°. The meridian, which is drawn through the source of the Indus river, Marinus places just west of the most northerly promontory of the island of Taprobana, which is opposite Cory. From

Taprobana the meridian which runs through the mouth of the Baetis river is distant a space of eight hours, or 120°, and furthermore the meridian passing through the Baetis is 5° from the meridian drawn through the Fortunate Islands. Whence we gather that the meridian drawn through Cory is distant from the meridian drawn through the Fortunate Islands by a little more than 125°. The meridian drawn through Cattigara is distant from the meridian through the Fortunate Islands a little more than 177, which very nearly agrees with the distance we found elsewhere by measuring the parallel passing through Rhodes.

If we grant that the entire longitude as far as the metropolis of the Sines is 180°, or twelve hours' interval, observing that all agree that Cattigara lies a little toward the east, then we can determine the length of the parallel, passing through the island of Rhodes as measuring about 270,000 stadia.

Chapter XV — Concerning discrepancies in some of the explanations of Marinus

The general distances of Marinus, both of longitude eastward and latitude northward, we have shortened for the reasons we have already given. Besides doing this we have altered the positions of cities in several places where Marinus has given contradictory and false traditions which he took from various faulty editions with incorrect notes concerning places which were wrongly said to be opposite each other or on the same meridian. For example, he says that Tarragona is opposite Caesarea, which he calls Iol, and he says that one meridian is drawn through Tarragona and through the Pyrenees mountains, which mountains in reality are not a little to the east of Tarragona.

He also places Pachynus opposite Leptis Magna, and Himera opposite Thenis. He gives the distance from Pachynus to Himera as about 400 stadia, and from Leptis to Thenis as more than 1,500 stadia, following the writings of Timosthenes, and in another place says that Tergestum is opposite Ravenna, and from the bay in the Adriatic sea into which flows the river Tilamentus, he says that Tergestum is distant toward the summer rising of the sun 480 stadia, and that Ravenna is distant toward the winter rising 1,000 stadia. He likewise

says that Chelidonia is opposite Canopus, and Achamanta to Paphos, and Paphos to Sebennitum. He places Achamanta 1,000 stadia distant from Chelidones. Now the distance from Canopus to Sebennitum, according to Timosthenes, is 290 stadia. But if this last distance is measured on the same meridians, then without doubt it should be greater as lying on the circumference of a greater parallel.

After this he says that Pisa is distant in a southerly direction from Ravenna 700 stadia, but in the division of climas and hours he puts Pisa in the third hour interval and Ravenna in the fourth. From London in Britain he puts Niomagus fifty-nine miles south, in a somewhat westerly direction.

He places Mount Athos on the same parallel as the Hellespont, and yet notwithstanding this, Amphipolis, and the neighboring places on the Hellespont parallel, and adjoining one another, and those that are situated on Athos, and at the mouth of the river Strimon, he places in the fourth clima, that is, next below the Hellespont parallel. In the same way he places almost the whole of Thrace below the Byzantine parallel, and yet all its interior cities he places in the clima that is above the parallel.

He also says he will locate Trapezos on the Byzantine parallel, after showing that Satala in Armenia is sixty miles toward the south, when he draws the parallels he draws the Byzantine parallel through Satala, and not through Trapezos.

He promises that he will truthfully describe the Nile, so that one can trace its course from its source northward as far as Meroe. Likewise he says that navigation with a north wind can be made from Aromata all the way to the lakes from which the Nile takes its beginning, although Aromata is actually far east of the Nile. For Ptolemais Theron lies east of Meroe and east of the Nile a journey of ten or twelve days, and Angustiora, which is between Ocelim peninsula and Diren, is 3,500 stadia east of Ptolemais and the Adulicus gulf, and from this strait to the promontory of Great Aromata toward the east still, 5,000 stadia more.

Chapter XVI — In fixing the boundaries of provinces Marinus has made some mistakes

Marinus makes some mistakes with. reference to the boundaries of certain regions. For example, he makes the Pontic sea the eastern boundary of the whole of Moesia. He makes Thrace to be bounded on the west by Upper Moesia, and he makes Italy to be bounded on the north not by Rhetia and Noricum only, but also by Pannonia, and Pannonia on the south he bounds by Dalmatia only and omits Italy. He says that the Sogdiani, and their neighbors the Saci, who inhabit the middle of the habitable earth, adjoin India, but the parallels through the territory of these peoples do not closely follow those two which are drawn north of the Imaus, the most northerly mountains of India; I refer to the Hellespontine and the Byzantine parallels, but they follow the parallel which is drawn through the middle of the Pontus.

Chapter XVII — Wherein Marinus dissents from the findings made in our time

These and similar mistakes have been made by Marinus, either on account of the multitude of volumes, all disagreeing, of which he made use, or because, as he himself says, he has not yet come to the last delineation of his maps in which, so he tells us, he would make some necessary corrections in the climas and the hour indications.

In addition to these mistakes he gives us some further assignments of localities with which the knowledge of our times does not agree. For example he places the bay of Sachalita on the western shore of the promontory of Syagros, but all who navigate these parts unanimously agree with us that it is toward the east from Syagros, and that Sachalita is a region of Arabia, and from it the bay of Sachalita takes its name.

Again Simylla, an emporium of India, is not only placed by Marinus west of the Comarris promontory, but west of the river Indus, whereas in fact it is as far to the south as the mouths of the river, according to the testimony of those who have navigated those waters and have thoroughly explored those parts,

and have come directly from there to us. It is called by the aborigines "Timula," and from those who have come to us we have learned many more details concerning India, especially of its divisions into provinces, and we have also learned much concerning its interior as far as the Golden Chersonesus, and from there to Cattigara. We have also learned that those who sail there sail to eastward, and those returning sail to westward.

The navigators say that the time of the passage is uncertain, and that beyond Sina is the region of the Seres and the city Sera. What regions lie east of this they say are unknown, for they have stagnant marshes, in which grow reeds so thick and so large, that catching hold of them, and upborne by them, men can walk across these marshes. They say further that not only is there a way from there to Bactriana through the Stone Tower, but also a way to India through Palimbothra.

The journey from the capital Sina to the gate of Cattigara runs to the southwest, and therefore does not coincide with the meridian drawn through Sera and Cattigara, as Marinus reports, but with one drawn more to the east.

We have learned also from the merchants that from Arabia Felix they sail to Aromata, to Azania, to Rhapta, and to the regions called Barbary. This sailing is not exactly south, but southwest. The voyage from Rhapta to Prasum is also southwest.

The lakes from which the Nile takes its beginning are not near the sea, but are very far inland. The shore line from the Aromata promontory to Rhapta is otherwise than Marinus has shown it to be; nor can an ordinary day - and - night voyage be counted in stadia because of the changeableness of the winds at the equator, but is limited to about 400 or 500 stadia at the most.

There is, first of all, a continuous bay in which, after sailing for one day from Aromata we come to Panocone and to Opone, an emporium, distant one day's sail from Panocone. Sailing from the emporium, they say that we enter another bay which marks the beginning of Azame, at the entrance to which appears the Zingis promontory, and Mount Phalangis, remarkable for its three peaks. The name of this bay is Apocopa, and it takes two days and nights to cross it. After this is Parvum Litus (Little Shore), at the distance of two days' voyage, then Magnum Litus (Great Shore). Of the five distances, the last two

are said to occupy the same time in sailing.

A further four days' sailing, they say, brings us to another bay, in which there is the emporium of Essina. It requires two days and nights to cross this bay; then after a day and night sail one comes to the seaport of Serapionis; thence begins the bay which leads to Rhapta, a voyage of three days and nights. At the head of this bay they say there is an emporium called Tonicus. From this emporium toward the Rhaptum promontory there is, they inform us, a river called Rhaptus and also a city of the same name, not far from the sea.

The bay extending from Rhaptum to the Prasum promontory, although great in size, is not of great depth. The barbarians who dwell on its shores are cannibals.

Chapter XVIII — The inconvenience of the method of Marinus for delineating the habitable earth

What is worth remembering in tradition and story, we have thus far set down, lest we should seem to have raised doubts and to have left them unsolved, for we believe that all things will be known to us when we have settled all the particulars.

It remains for us to turn our attention to the method of making maps. There are two ways in which this matter may be treated; one is to represent the habitable earth as spherical; the other is to represent it as a plane surface. Both have this common purpose, that is, they are constructed for use, to show (in the absence of any picture) how from commentaries alone the student may be able, with the utmost facility, to construct a new map.

Recently the making of new copies from earlier copies has had the result of increasing some of the faults that were originally small into great discrepancies. If then there are not enough data for the method of constructing maps from commentaries (without any traditional pictures), it will be impossible for us to reach our desired end. That has happened in the work of Marinus several times, for copyists do not follow his last edition of a world map, but attempt to construct a map merely from commentaries. Thus they are misleading in

many particulars on account of their unbecoming shape and general confusion which any one expert in geography, can easily detect. Although it is necessary to know the longitude as well as the latitude of any place that we may be able to fix its right position, nevertheless in the edition of Marinus this cannot be immediately found. For in one place he gives only the location in latitude, as in his explanation of the parallels, but in another place he gives only the longitude; hence in his drawing of meridians we find, as a rule, no note of both longitude and latitude, but in one instance we find reference to parallels, in other instances we find meridians so noted that when we have one position we lack the other.

When we are working with commentaries, it is requisite to have a knowledge of both latitude and longitude at the same time, since in all commentaries something is always said concerning both positions. If we were not to search out, one by one, through the whole volume, the data concerning any given place, we should miss particulars which are worthy of note.

Moreover in giving the positions of cities, maritime cities are the more easily described, and he keeps generally a certain order in naming them, but in treating of cities that are inland, the same method has not been employed; for the distances between them are not noted, except in a few instances where it happens that the longitude in the one case and the latitude in another case have been given us.

Chapter XIX — Of the convenience of our method of delineating the whole earth

We therefore are undertaking a double labor, first in keeping the intention that Marinus had throughout his whole work, besides that which we have obtained by corrections; and second in adding those things, with as much accuracy as possible, which to him were not known, partly on account of history then unwritten, and partly on account of a later series of more accurate maps.

In addition we have given special attention to a better method in fixing the boundaries of each particular country; we have given their particular position

both in longitude and in latitude. After that, we have recorded noteworthy information concerning the inhabitants of the various countries, and their relations one to another. We have noted the chief cities, rivers, gulfs, and mountains, and all other things which in the map itself might show distances where they are worth knowing, that is to say how many degrees (the great circle has 360 such degrees), if it is a question of longitude, the meridian drawn through a certain place is distant from the meridian that marks the utmost boundary of the west. If it is a question of latitude, then we note how many degrees the parallel drawn through it is distant from the equator on the same meridian. We are able therefore to know at once the exact position of any particular place; and the positions of the various countries, how they are situated in regard to one another, how situated as regards the whole inhabited world.

Chapter XX — Of the lack of symmetry in the map that accompanies the geography of Marinus

Each method of map making has something peculiar to itself. When the earth is delineated on a sphere, it has a shape like its own, nor is there any need of altering at all. Yet it is not easy to provide space large enough (on a globe) for all of the details that are to be inscribed thereon; nor can one fix one's eye at the same time on the whole sphere, but one or the other must be moved, that is, the eye or the sphere, if one wishes to see other places.

In the second method wherein the earth is represented as a plane surface there is not this inconvenience. But a certain adjustment is required in representing the earth as a sphere in order that the distances noted therein may be shown on the surface of the globe congruent, as far as possible, with the real distance on the earth.

Marinus gives this point his deepest consideration, criticising and rejecting all previous methods of delineating distances on the surface of a sphere, yet nevertheless he chose a method which is the least satisfactory of all for locating distances with congruency. For with regard to the lines which he inserts for the parallels and meridians he writes in at equal distance from one another, as

is the general custom, in the form of straight parallel lines.

Only the parallel through Rhodes has he kept in right proportion to its meridian and the circumference of the equatorial circle. This parallel is distant 36° from the equator. In this he follows almost exactly the method of Epitecartus. In the case of the other parallels he has paid no attention whatever either to the right proportion of their length, or to their spheric shape.

At the outset, if the eye is fixed on the middle of the fourth part of the northern hemisphere, in which part the most populated portion of the world is situated, the meridians will have the appearance of straight lines, when the sphere is turned, and that surface comes directly under the eye. But this cannot be the case if they are parallel lines on account of the elevation of the north pole; for the segments of the circles clearly show their curvature in the direction of the meridian. Now according to both truth and appearance the same meridians intercept the similar but unequal circumferences of the parallels which differ in length but are always greater the nearer they are to the equator.

Marinus notwithstanding makes all the interceptions equal. The space of the climates north of the parallel passing through Rhodes, he extends beyond the actual, and the climates in the south he makes smaller than the actual. It follows that the distances of places from one another as shown on his map cannot be the same as their measured stadia, for the distances that are on the equator lack one-fifth of their given measurement, which is the proportion the parallel passing through Rhodes is less than the equator. The distances that are on the parallel passing through Thule, Marinus increases by four-fifths, which is the proportion the parallel through Rhodes is greater than the parallel passing through Thule. It being given that there are one hundred and fifteen parts into which we divide the equator, of these parts the parallel passing through Rhodes, which is 36° distant from the equator, measures 93°, and further the parallel which is 63° distant from the equator, and passes through Thule, measures fifty-two such parts.

Chapter XXI — What must be done should one desire to delineate the earth on a plane surface

Wherefore we shall do well to keep straight lines for our meridians, but to insert our parallels as the arcs of circles, having one and the same center, which we suppose to be the north pole, and from which we draw the straight lines of our meridians, keeping above all else similarity to a sphere in the form and appearance of our plane surface.

The meridians must not bend to the parallels, and they must be drawn from the same common pole. Since it is impossible for all of the parallels to keep the proportion that there is in a sphere, it will be quite sufficient to observe this proportion in the parallel circle running through Thule and the equinoctial, in order that the sides of our map which represent latitude may be proportionate to the true and natural sides of the earth.

The parallel passing through Rhodes must be inserted because on this parallel very many proofs of distances have been registered and inserted in right relation to the circumference of the greatest circle, following in this Marinus who followed Epitecartus. By thus doing we shall insure that the longitude of our earth, which is the better known, will be in right proportion to the latitude. We will now show how this may be done, treating first, as far as is necessary, of the properties of a sphere.

Chapter XXII — How the habitable earth may be shown on a sphere

The intention of the individual who wishes to make a globe, having regard to the greater or smaller number of place names he may wish to insert, will determine the size of the globe, which, in accord with his ability and purpose will be constructed. The larger it is made, the clearer and the fuller will be the description of the various places that are indicated on its surface. Whatever size the globe to be constructed may have, the position of the poles being determined, let there be connecting them a semicircle which we will place a very little distance from the globe's surface, so that when it revolves it almost touches it. Let this semicircle be narrow that it may not cover many places by its width. Divide one side into 180 divisions, and mark on this the numbers, beginning at the middle which cuts the equator. Repeat this process for the

other side.

In like manner draw the equinoctial line; divide this second semicircle into a like number of parts, viz., 180, and begin the numbering from the limit of the most western meridian. Begin the work of inscribing by noting the degrees of longitude and latitude assigned to the various places in the known commentaries. Insert each of the places in its right position on the globe, finding the position of the intersection of the parallels of latitude with the movable meridians as we previously explained.

Next inscribe the degrees of longitude found in the commentaries, at the points where the meridians cut the parallels of latitude. Mark the degrees of latitude along a meridian line, then you can put in the localities in their ascertained positions in the manner in which it is customary to fix stars on a solid sphere. We can insert meridians of whatever number we wish, by using semicircles instead of straight lines. The position of the parallels of latitude we can indicate by placing our instrument for drawing parallel lines in its proper position, which position when found with regard to one meridian, we can then adjust to the other meridians, including both meridians that shut in the habitable world.

Chapter XXIII — 'Explanation of the meridians and parallels used in our delineation

The meridians, according to what we have already shown, will embrace the space of twelve hours. The parallel that bounds the most southern limit of the habitable world will be distant from the equator in a southerly direction only as far as the parallel passing through Meroe is distant in a northerly direction.

It has seemed proper to us to put in the meridians at a distance from each other the third part of an equinoctial hour, that is, through five of the divisions marked on the equator. The parallels that are north of the equator we have inserted so that:

The first parallel is distant from the equator the fourth part of an hour, and is distant from it geometrically about 4° 15'.

The second parallel we make distant half an hour from the equator, and geometrically distant 8° 2’

The third parallel we make distant from the equator three-fourths of an hour, and geometrically 12° 30’.

The fourth parallel is distant one hour and is 16° 25’. This is the parallel through Meroe.

The fifth parallel is distant one and one-fourth hours, and 20° 15’.

The sixth parallel, which is under the summer solstice is distant one and one-half hours, and 23° 50’, and is drawn through Syene.

The seventh parallel is distant one and three-fourths hours, and 27° 10’.

The eighth parallel is distant two hours, and 30° 20’.

The ninth parallel is distant two and one-fourth hours, and 33° 20’.

The tenth parallel is distant two and one-half hours, and 36°, and is drawn through Rhodes.

The eleventh parallel is distant two and three-fourths hours, and 38° 35’.

The twelfth parallel is distant three hours, and 40° 55’.

The thirteenth parallel is distant three and one-fourth hours, and 43° 05’.

The fourteenth parallel is distant three and one-half hours, and 45°.

The fifteenth parallel is distant four hours, and 48° 30’.

The sixteenth parallel is distant four and one-half hours, and 51 30’.

The seventeenth parallel is distant five hours, and 54°.

The eighteenth parallel is distant five and one-half hours, and 56° 10’.

The nineteenth parallel is distant seven hours, and 58°.

The twentieth parallel is distant seven hours, and 61°.

The twenty-first parallel is distant eight hours, and 63°, and is the parallel drawn through Thule.

Besides these, one other parallel must be drawn south of the equator with the time difference of half an hour. It should pass through Rhaptum promontory

and Cattigara, and should be about the same length as the parallel in the opposite part of the earth which is distant 8° 25' north of the equator.

Chapter XXIV — How the habitable earth can be shown on a plane so that its measurements are in keeping with its spherical shape

In the delineation which is made in the map, the following will be our method of showing the proportions of the special parallels. We will draw a right-angled parallelogram ABGD, the side AB of which is about twice as long as the side AG. (See Figure I.)

Place the side AB uppermost which will represent the northern limit of the delineation. We will then divide the side AB in half by the line EZ drawn to it at right angles; and to this line we will so construct the congruent normal straight line that, midway of the length of the former line (AB), it makes one and the same straight line with EZ, that is, then, the line EH. Now let the line EH consist of thirty-four parts, then HZ will measure 131 and five-twelfths. With H as a center and at a distance of seventy-nine parts measured along the line HZ, draw the circle TKL, which will represent the parallel through Rhodes.

Then, that we may arrive at the limits of longitude which are distant at intervals of six hours measured on both sides of the point K, we will take a distance measuring four parts on the line HZ, the line of the median meridian, which is equal to five on the parallel of Rhodes, for the reason that the ratio of a great circle to that parallel is as that of a quinary number to a quaternary, as it is measured by Epitecartus. Measuring nine of these parts from the center K along the parallel through Rhodes in both directions, we have eighteen points through which to draw meridians with H as a center. Any one of these meridians will differ in time from the next by one-third part of an hour, and also those meridians which bound the edge of the known world will be HTM and HLN.

In the same manner the parallel of Thule is drawn at an interval which is distant fifty-two parts from H in the line HZ: this is the arc COP; then we will

draw the equinoctial line ISR from the center H with a radius of 115 parts, and the southernmost parallel, opposite that drawn through Meroe, MYN at an interval of 131 and five-twelfths parts distant from H.

The ratio of the arc RSI and COP will be the same as that of the numbers 115 and 52, which is the ratio of these parallels on a globe, since the line is made up of 115 parts such as the 52 of the line HO, and as the ratio of the line HS to HO so is the arc ISR to COP.

Now there remains the distance on the meridian OK or that between the parallel passing through Thule and that through Rhodes, which is found to measure twenty-seven parts, or segments, and the distance between the parallel of Rhodes and the equator which should measure thirty-six parts or segments, and finally the distance between the equator and the parallel opposite that passing through Meroe which should measure sixteen and five-twelfths like parts or segments.

Furthermore OY representing the extent in latitude of the known world is seventy-nine and five-twelfths such units, or in whole numbers eighty, the median extent in longitude represented by TKL will be 144, which agrees with those which are fixed by the authority of geographers; about the same proportion have the 40,000 stadia of latitude to the 72,000 stadia of longitude in the parallel of Rhodes. From the same center H, and at intervals distant from S the same number of parts or segments we have given above, we can draw as many of the remaining parallels as we wish.

Now indeed we are not permitted to carry the lines which are to be drawn as meridians through in one straight course to the parallel MYN but only to the equator RSI; and with the arc MYN divided in both directions into ninety parts or segments equal in size and number to those taken on the parallel of Meroe we can then draw to these marked points the intervening straight lines from those points marked in the equator the course of which will seem deflecting toward the south on the other side of the equator such as are the lines RF and IX.

Then, that we may the more easily mark the localities which are to be placed on the map, let us take a narrow ruler, equal in length to the line HZ or to the line HS, and so attach it at the point H that it can be moved, and when it is

swung over, throughout the length of the map, one of its sides can be applied to the meridian line for its entire length, by means of a notch in the side just at the pole. This done, let us divide this side into 131 and five-twelfths parts or segments corresponding to the line HZ or at least into 115 segments on the line HS, and we then number these segments beginning at the equator. Through these numbers we shall be able to draw parallels to the southernmost parallel which we have put down on our map. If, however, we divide the meridian OY on the map into all of the segments, and put the numbers beside them, we are apt to confuse the writing in of the places situated next to them. Having divided the equator into 180° embracing a space of twelve hours, and having given them numbers beginning from the west we may always carry forward the edge of the ruler to any indicated degree of longitude. Finding then the given position in latitude by means of the division made on the ruler we can make the correct notation of every locality, just as we have demonstrated above in the case of spherical delineation.

We shall be able to make a much greater resemblance to the known world in our map if we see the meridian lines, that we have drawn, in that form in which meridian lines appear on a globe, when the axis of the eyes is imagined as directed upon a motionless globe through a point before the eyes in which occurs the intersection of that meridian and that parallel which divides respectively the longitude and the latitude of the known earth into two equal parts, and also through the center of the globe, so that the extreme parts which lie opposite each other appear and are perceived by the eye in like condition.

First, however, in order that we may determine how great is the inclination of the parallel circles and of that plane which is passed through that point of intersection and through the center of the globe at right angles to the median meridian in longitude, the great circle limiting the hemisphere before our eyes is taken, i.e.. the line ABGD (see Figure II), and the semicircle of that meridian which divides the hemisphere in halves, is the line AEG, and the point in which, before our eyes, this semicircle intersects the parallel cutting the middle latitude, is the point E; then through the point E there is drawn the semicircle of another great circle BED so that it makes right angles with the semicircle AEG, its plane, as is apparent, falls upon the axis of the eyes; and with the arc EZ, of twenty-five and five-sixths degrees marked off (for by this many

degrees, in fact, is the equator distant from the parallel passing through Syene, which is placed almost in the median latitude of the known world), there is also described, through the point Z, the semicircle BZD of the equator.

Therefore both the equatorial plane and the plane of the other parallels will appear inclined twenty-three and five-sixths degrees to the plane placed in the axis of the eyes; and of so many degrees is the arc EZ.

Now the lines AEZG and BED (see Figure III) are considered to stand in the place of the arcs, whence BE has the ratio to EZ that ninety has to twenty-three and five-sixths. And the line GA, passes through the center of the circle of which BZD is an arc, and it is proposed to find the ratio of the line HZ to the line EB. A straight line is drawn which bisects BZ at the point T, there is also then drawn TH, which plainly is the perpendicular to the line BZ. Now since the straight line BE is of ninety parts and EZ of twenty-three and five-sixths, the hypotenuse, BZ, will be ninety-three and one-tenth of the same; the angle BZE 150 and one-third (units) of the 360, which is the measure of two right angles; the other angle which is equal to THZ or twenty-nine and two-thirds of the same units.

For the same reason, the ratio of the line HZ to ZT is that which 181 and five-sixths has to forty-six and eleven-twentieths. The straight line ZT has forty-six and eleven-twentieths parts as the straight line BE has ninety; therefore the straight line BE has ninety parts and ZE twenty-three and five-sixths, and we will have the straight line HZ measuring 181 and five-sixths such parts and H that point from which all parallels are drawn when the delineation is to be made upon a plane.

Having settled these preliminaries let us draw again the map ABGD (see Figure IV), in which AB is twice the length of the line AG, and AE and EB equal. Draw EZ at right angles to AB.

Now divide EZ into ninety parts, the number of degrees in a quadrant of a circle, then the line ZH which is marked off at sixteen and five-twelfths degrees, HT at twenty-three and five-sixths degrees, HK at sixty-three of the same; if we consider the point H as lying in the equinoctial line, then the point T will be that through which is drawn the parallel of Syene which is located almost in the middle of the habitable earth, and Z that through which will run

the parallel which terminates the southern boundary of the world and is opposite the parallel of Meroe, and K is that through which is drawn the parallel which terminates the northern boundary of the known world running through the island of Thule. Now if we produce the line ZE, and in this produced line we make HL to have 181 and five-sixths of the same segments, or even 180 degrees (whether we take the one number or the other does not make much difference in our map's appearance), then let us draw the arcs PKR and CTO, and MZN, with the center L and intervals K, T, Z. In this manner, let us keep the right ratio of the inclination of the parallels to the plane that corresponds to the line of vision when the line of vision is made to direct itself to the point T and is necessarily perpendicular to the plane of the map, so that in consequence the extreme parts of the map which are drawn opposite to one another are equally well discernible.

But, in order that longitude may agree with latitude, let it be our task to determine the eighteen meridians so that the number of semicircles may be complete, by which all longitude is embraced, since on a globe a great circle is made up of five parts such as the parallel of Thule has about two and one-fourth, that of Syene four and seven-twelfths and that of Meroe four and five-sixths, and since on either side of the meridian line ZK, at every third part of an equatorial hour, the number is completed; we take segments which on each of these three parallels are equivalent to one-third of an hour, or five degrees; that is, segments of which the line EZ contains ninety, and we make incisions on the three parallels at two and one-fourth units from K, at four and seven-twelfths from the point T, and at four and five-sixths from the point Z. Then when we have drawn the arcs through the three mutually corresponding points to represent the other meridians, as also the arcs SIV and FXQ, which are the limits of longitude, we shall also add the other arcs to represent the remaining parallels, again with the center L, and at intervals of as many segments as are to be made on the line ZK for the distance of the parallels from the equinox.

That a greater likeness to a sphere is achieved by this method than by the former will be self-evident. When the sphere stands motionless before the eyes, and is not revolved (which necessarily holds true for a plane map), and the eye rests on the middle of the object, one certain meridian which, because of the

globe's position, lies at the middle of the plane passing through the axis of the eye, will exhibit the appearance of a straight line, while those on either side appear indexed with their concave side toward it, and the more so as they lie farther from it, which is also observed here with exact analogy, just as it is also seen that the symmetry of the parallel arcs keeps the proper ratio of one to another, not only in the equatorial line and the parallel of Thule (as was done in the former case), but in the others also, as closely as they can be made — the difficulty of doing this is evident — and that the conformity of latitude as a whole serve toward a true, general longitude ratio, not only in the parallel drawn through Rhodes, but in all of the parallels.

Now if we produce the straight line SWY, as was done in the earlier figure, the arc TW clearly makes a smaller ratio to the arcs ZS and KY than that proper one which is shown in this map and which occurs in the arc IT; and if we were to make this arc TW agree with the extension KZ of latitude, the arcs ZS and KY will be greater than those which agree with the line ZK just as arc IT itself is larger; and if we take the arcs ZS and KY to agree with the line ZK, the arc WT will be smaller than that corresponding to the line KZ, just as it is smaller than the arc IT.

Although for these reasons this method of drawing the map is the better one, yet it is less satisfactory in this respect, that it is not as simple as the other; because with that method, when the ruler is applied and carried over the map, given even one parallel drawn in and divided, individual localities, can be put in place; here, however, since such a thing can no longer be done, by reason of the meridian line being indexed at the middle, all of the other circles must be written in, and positions which lie inside those quadrate circles must be found by conjecture, after finding their relation from the given data to the whole sides which limit the areoles. Since this is so, even though for me both here and everywhere the better and more difficult scheme is preferable to the one which is poorer and easier, yet both methods are to me retained for the sake of those who, through laziness, are drawn to that certain easier method.