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On October 3 we crossed the Kien La, 18,600 feet, then once again the Marsi mik La, and camped that night in Ladak. Tankse was reached three days afterwards, and Leh on October 12.

Altogether our travels carried us over 8000 miles of country, the greater part previously quite unknown to the European, while an area of 35,000 square miles was accurately surveyed.

The success of the expedition was mainly due to my staunch and cheery companion, Lieut. Hargreaves; to our ever-willing, hardy, happy-go-lucky Lavaki servants; and to Babu Ram Singh, the sub-surveyor, whose excellent work gained him the title of Rai Sahib.

To Colonel St. G. Gore, late Surveyor-General of India, to Mr. Eccles, of the Survey of India, and to Major Ray, Intelligence Branch, who most kindly gave us every assistance and advice, I take this opportunity of tendering our sincerest thanks.

## PTOLEMY'S MAP OF ASIA MINOR: METHOD OF CONSTRUCTION.

By the Rev. H. S. CRONIN.

THE first condition of any study of Ptolemy's map is to disabuse our minds completely of the notion that we have in it a map which is accurate according to modern conceptions of accuracy, or which was constructed on modern lines. Such map-making, indeed, was beyond the means at Ptolemy's disposal—he had but few observations, none of those he had were strictly accurate, and he had no means of taking better ones. In any case, his map is not accurate. It is far too large. The distance from Issus to Rhodes should be 420 miles. Ptolemy makes it nearly 500. The distance from Rhodes to Chalcedon should be about 300 miles; he makes it over 400. Initial errors, so considerable as these, make themselves felt everywhere. They affect, for instance, the area; it is fully half the size again it ought to be. They affect the boundaries. Rhodes and Chalcedon being 100 miles too far apart, the whole western coast between the two has been pulled in towards the east. Ptolemy's western coast of the Troad is therefore about 70 miles from the line joining Rhodes and Chalcedon; it should be twice that distance. Again, this removal eastwards of the western coast has led to compression all along its course. Ptolemy's Cyzicus, for instance, is some 50 miles from his Nicæa—it should be 96 or 97—while the towns along the road which joins them are huddled together. Turning to the other boundaries, the northern is distorted, the southern is far too straight, and the eastern boundary for much of its course runs due north and south. In the interior of the map, places tend to move towards the centre. Compare, for instance, the positions of Laodicea, Antioch, and Amorium on Ptolemy's map and in reality.\* All this had to be to fill the map, and, without going into further details, we may note that the first principal and constant cause of Ptolemy's mistakes is this initial mistake, however he arrived at it, of making the area of Asia Minor so very much too big.

The second principal cause was the insufficiency and vagueness of the bulk of

\* Cotiæum is an exception only in appearance. It has moved south and east, but the western coast was also moving east.

the information, as much about the coast as about the interior, which he had at his disposal. He had an observation for Rhodes, which, if not strictly correct, may be allowed to pass. It is not so with his observations—if he had them; and I half incline to think he had—for the latitude of Smyrna, the Hellespont, Byzantium, Issus, and Trapezus. These are out, some of them very much out. To discuss the reasons, which led him to put these places where he did, would lead us too far from our subject. We should have to take into consideration facts, or supposed facts, outside Asia Minor which contributed to fix their position. It simplifies our problem to assume—and it is a fair assumption to make from the prominence, and the kind of prominence, Ptolemy gives to these localities, and it is probable enough in itself—that, when he left the map of the world and settled down to construct the special map of Asia Minor, the situation of these places had been fixed to his satisfaction, if not to ours; this assumption is made practical certainty by an examination of his map. Other observations, as far as we know, he had none. On the contrary, he had sometimes to rely merely on travellers' notes, often vague as to distance, and even vaguer as to bearing; the vaguest being that such and such a place was so many hours or days from such another place, or lay towards the north or the south. Vague and unsatisfactory by land, winds and currents would make these indications still less trustworthy by sea; and though Ptolemy claims that sea-coast towns are easier to place than inland towns, because their position relative to each other can be more easily shown, he does not find them very tractable. Precise indications of bearing there would be none; precise indications of distance would be found in practice only along the Roman roads; and even these roads, accurate as the information which they give may be, so far as it goes, afford no clue to the bearing of place from place, or to the allowance which had to be made for windings. These two things, then, were against internal accuracy. The area of the map was very much too large; the materials for constructing it—even the best of them—lacked completeness. The first drove Ptolemy to treat his materials in an arbitrary manner; the second, if it did not actually tempt to such treatment, could present no serious obstacles to its adoption.

Arbitrary, however, as many of his results appear, no one could have more desire than Ptolemy to treat his materials fairly, and no one could be more conscious of his lack of material, or of the disturbing effect this lack must have on his results. Arbitrary, indeed, is hardly the word to apply to Ptolemy, for it is clear that he had a method, and, considering everything, a good one. His materials are at fault; and if they are partly responsible for the defects of his method, no method, however good, could have eliminated confusion altogether from results built on information never complete and often contradictory.

The publication in 1901 of the second part of the first volume of Müller's 'Ptolemy' has made the task before us considerably easier now than it was three years ago, but great difficulties still remain.\* Accuracy of transmission, always difficult to secure where copyists are concerned, is particularly difficult in the case of figures. We cannot, therefore, be certain always that we have the right reading. Recent exploration has done much to fix the sites of the more important towns, but some still remain uncertain; and we are still without definite information as to the length and course of the roads which joined some of those towns, the sites of which are definitely ascertained. Yet we now know something for our

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\* I have adopted Müller's readings throughout, and as a rule his spelling. The information he has collected in his notes has often been of considerable service to me; so, also, have been his maps in the preparation of the maps which accompany this article. The work, which is published at Paris by Firmin-Didot, was left incomplete at Müller's death, and is being continued by Fischer.

purpose, especially if we bear in mind that Ptolemy's map does not aim at precise accuracy, and that positions on it are indicated by twelfths of degrees—that is to say, only within 4 or 5 miles.\*

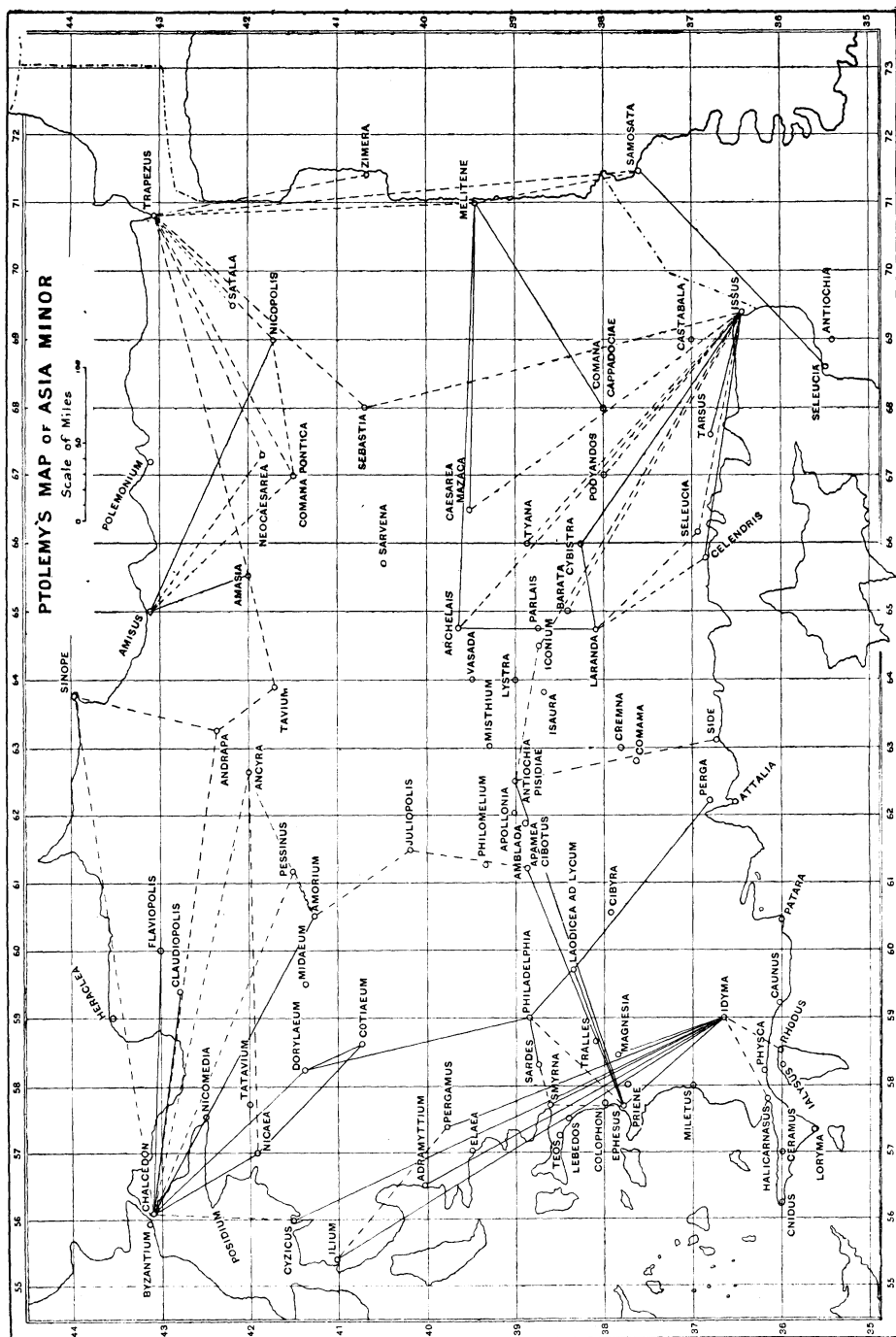
Our best plan now will be to take a map constructed from Ptolemy's figures, and to see what that can tell us of his method, or of his lack of method, in constructing it, and to begin its examination from Rhodes—that is to say, from the south-west corner of the map—working from thence up the western coast. The south-west corner is characteristic of Ptolemy and his difficulties—I believe, also, of his methods. Rhodes figures largely in Ptolemy's introduction, and is for that reason, as well as for others, a natural place from which to begin, while the outline of the coast, or at all events the positions of the more important sites along the coast, would have to be determined before the task of fixing the positions of places inland could be approached.†

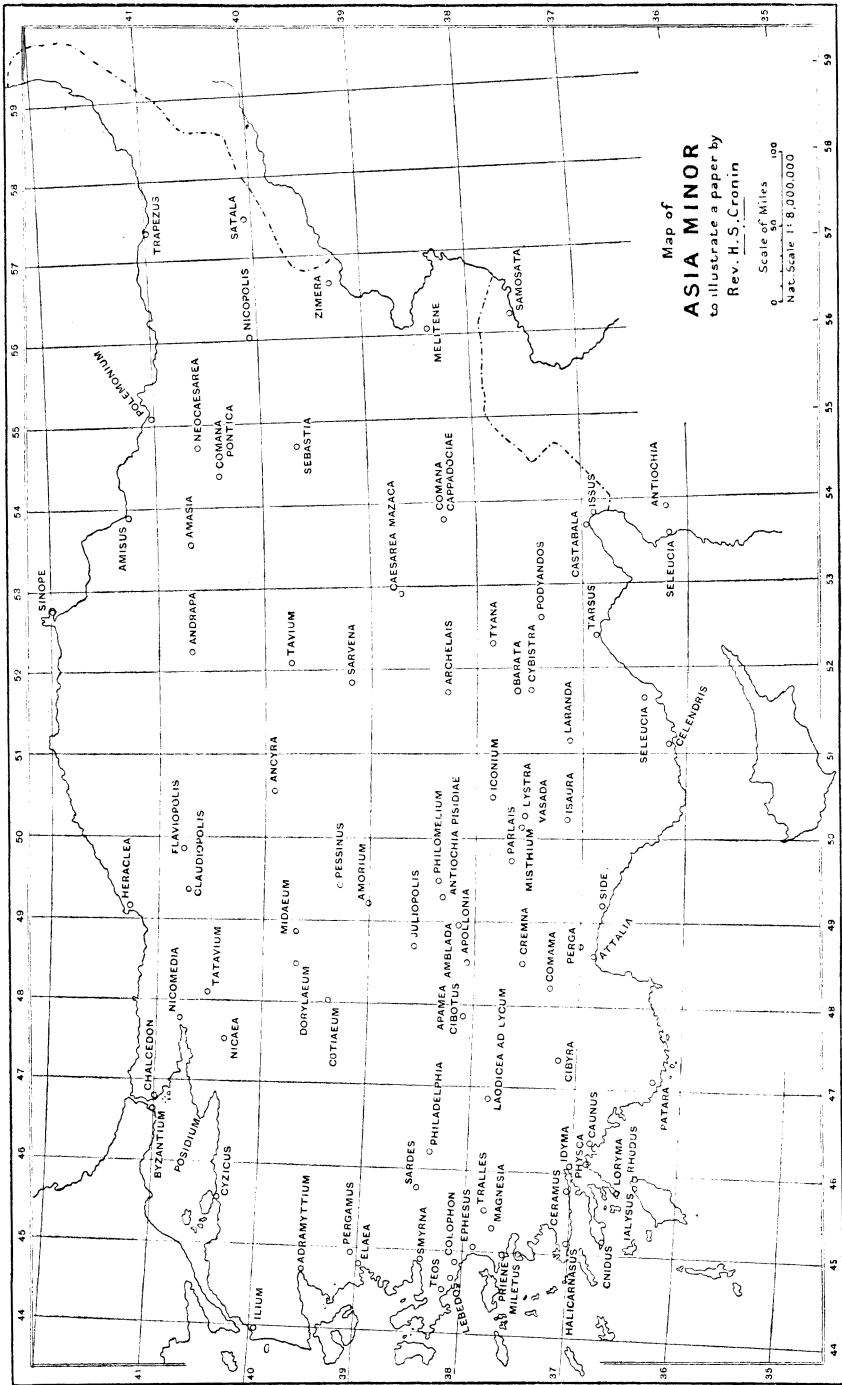
Travellers going north from Rhodes would land at Physca (or Phycus), whence a road led to Ephesus by Idyma (or Idymus), Tralles, and Magnesia. Physca lies almost north of Rhodes, at a distance of 30 miles. Ptolemy places it almost north-west, and at a distance of 23, an error of 7 miles in distance, and of half a right angle in bearing. I have, however, just pointed out that Ptolemy's unit is a twelfth of a degree, so that the 23 miles may represent as much as 28; probably in this case it does represent as much as 25 or 26. Moreover, when I said that the distance from Rhodes to Physca was 30 miles, I meant that that *is* the distance according to modern maps; I did not mean Ptolemy knew that it was such. A successor, indeed, of Ptolemy makes it 28, and as distances at sea were hard to estimate, there were probably other estimates placing it even lower. Now, just because sea-distances were hard to estimate, any such estimate, when obtained, would be the less convincing, and accordingly the less able to resist the claims to consideration of other and conflicting *data*, when such existed. In the south-west corner of Asia Minor such claims do exist in considerable force. A comparison of the two maps will show how much the coast winds; that Ptolemy had no exact information of its windings, and that, as he practically ignores them and makes the coast-line nearly straight, he gets into great difficulties. Loryma and Cnidus are, for instance, far from where they ought to be; and the length of the south coast west of Physca is such that, if its windings are neglected, the proper northern coast is not long enough to match it. Ceramus has been carried west of Halicarnasus; Idyma, to which we shall return shortly, is made apparently an inland town, 58 miles (or roughly its right distance from Halicarnasus) from the sea. To put it briefly, the course of the whole coast-line has been changed, and the Ceramic gulf more or less suppressed.‡ In such circumstances—and I can only sketch them

\* For the special maps, Ptolemy treated both meridians and parallels as parallel and straight lines. His degree was 500 stades, or approximately 58 English miles; the proportion of a degree of latitude to one of longitude in the map of Asia Minor was 4 to 3 (Ptolemy, 'Geographia,' 2, 1, § 9; 8, 2, § 6 and *ad πιν. 'Ασ. δ*). The minimum margin, therefore, would be a little under 4 miles measuring from east to west, and *vice versa*; the maximum, along a diagonal, a trifle over 6. Ptolemy may have chosen either the corner of the parallelogram nearest to where his *data* placed the town, or, perhaps, the most convenient.

† The position of Rhodes is not given in Book V. of Ptolemy's 'Geography'; for some reason or other it has fallen out. Its position, however, can be recovered from the eighth book, and it is  $58^{\circ} 40'$ ,  $36^{\circ}$  (cf. Müller, p. 838; Book VIII. is not yet published).

‡ Mr. J. L. Myres, who has kindly made many useful suggestions to me on the subject of this paper, tells me that native sailors try to avoid the Ceramic gulf. Is the opening marked in the Peutinger table between Myndus and Cnidus the Ceramic gulf, such as Ptolemy perhaps conceived it, or the Meander, which is not represented in its proper place?







now—Ptolemy would be glad to place Physca as far east as possible, and of two estimates of its distance from Rhodes would choose the shorter. The proceeding might be desperate for us; unhampered, as he was, by too accurate knowledge, it was a natural expedient for him.

Suppose, then, we take Ptolemy's map, place one point of a pair of compasses on Rhodes and the other point on Physca, turn the second point round until it rests on the line joining Rhodes and Idyma, and measure the distance between it and Idyma; we shall find that it measures 15 miles. The site assigned to Idyma is Guiova, at the head of the Ceramic gulf, and the distance of Guiova from Marmario (Physca) is 14 or 15 miles, the distance we have just obtained.\* Idyma, then, is, I do not say the right distance from Rhodes, but the distance which Ptolemy apparently thought Physca was from Rhodes, *plus* the right distance from Physca to Idyma by land.† Its insular position prevented Rhodes from serving as a general centre of measurement for the mainland. Physca, the port for Rhodes on the mainland, would be its natural representative; it was, however, not available for such a purpose—the claims of the south coast had carried it too far west—and it is not so used. Idyma, on the other hand, the next town along the road to Ephesus, and a town away from the southern coast, was available, and measurements from it yield some interesting results.

The first places on the west coast to be fixed would be Ephesus, Smyrna, Adramyttium, Ilium, and Cyzicus. Ptolemy's map-distances for these places from Idyma are 87, 129, 221, 296, and 304 miles respectively. Placing Idyma at Guiova, and measuring the distance by road to Ephesus, and then on, we get, as nearly as I can calculate, the following results: Idyma to Ephesus,  $84\frac{1}{2}$  miles; Idyma to Smyrna, 125 or 126; to Adramyttium, 224; to Ilium, 300; to Cyzicus, 300; that is to say, the map-distance is sometimes 2 or 3 miles too much, sometimes 2 or 3 miles too little—it is never out a twelfth of a degree. Such correspondence is not true of every place along the coast, and between these distances and the air-distances there is no correspondence at all. In spite, therefore, of the risk there must be of slight error in calculations of this sort, it would not be rash to say provisionally that these five places had been specially picked out—reasons for their selection would not be hard to find—that their positions had been fixed partly by their road-distances from Idyma, as representing Rhodes, and that no allowance was made for windings, although, as it is very much to our purpose to observe, the road winds a great deal. I shall return to this point later. Suppose, however, this were done, Smyrna would be where a circle with Idyma as centre and the road-distance from Idyma as radius cut the parallel of Smyrna; the parallel of the Hellespont would fix the site of Ilium; while Cyzicus would be fixed by its sea-distance from Byzantium, a distance apparently measured by Posidium, and not too much to be trusted.‡

The position Ptolemy assigns to Ephesus is instructive. He places it 53 miles due south of Smyrna. The correct position is 37 miles a little east of south; the

\* It is not unusual, as we shall see later, for Ptolemy to calculate the distance of A from B *via* C, and then, if necessary, to place C right away from the line which joins A and B.

† Land-distances were more easily measured and not so easily adjusted. Idyma has approximately the right bearing from Rhodes. The road from Physca to Idyma is nearly direct.

‡ It would not be difficult in any of these cases to choose between the two points where the circles, or the circles and parallels, intersected. Elsewhere it has been less easy, and mistakes have led to great confusion.

road-distance is 41 English miles, which corresponds, as nearly as we can expect, considering the way the map was made, with the difference in the map-distances of Smyrna and Ephesus respectively from Idyma. But though Ptolemy seems to know the distance and to use it when it suits, he also disregards it when it suits. He could not place Ephesus on the line joining Smyrna and Idyma—it would be too far east. He could not, if my hypothesis is true, go back on his measurements from Idyma, and place Smyrna further south or Ephesus further north. Moreover, if the whole western coast was to be pulled out, the coast-line between Smyrna and Ephesus would have to do its share. To do as he did was obvious; probably on the whole his solution was not so very inconsistent with his facts, especially as the coast road \* would give him most of the statistics he required to justify his action. We have here both the effect of the influence of the initial error, and another instance of the practice to which I have already called attention, in the case of Rhodes, Physca, and Idyma, of measuring from A to B *via* C, and placing C right off the line which joins the two.

As we are at Ephesus, we may as well discuss the evidence of the trade-route, and therewith the question of the way in which Ptolemy dealt with the interior. Magnesia is some 14 miles from Ephesus, and lies south-east; Ptolemy places it 40 miles away and slightly north of east. Tralles is 28 miles from Ephesus, and lies east-south-east; Ptolemy makes the distance 50 miles, and the bearing nearly north-east. So far no method is apparent, but when we take the principal road-centres along the road—Laodicea-ad-Lycum, Apamea Cibotus, and Antioch—we find the road-distances agree as closely with the map-distances as they did in the cases examined on the western coast. The inference again is that the roads were used, that they were treated as straight lines, and that, as we might expect, the chief road-centres were fixed first. The trade-route, or its continuation, gave one clue; measurements from Perga in the case of Laodicea, measurements from Side in the case of Antioch—again the map-distances and road-distances practically agree—would give the other.

Now, with regard to his treatment of these roads, it is natural enough that Ptolemy should use the valuable information they afforded; it would be unreasonable to expect detailed acquaintance with their windings, but the apparent absence of all knowledge that they did wind—at least no indication thereof in practice—is hard to understand.† But suppose he had been able to ascertain the correct air-distance, say, to Laodicea from the coast, suppose he had fixed its position accordingly, and suppose he could have done the same for other places, what would have happened? Every place which occupies the centre of his map would have moved by so much towards the coast, and would have left a space in the middle of the map roughly 100 miles wide by 300 miles long without a town in it at all.‡ What else, then,

\* For much of his perimeter data, Ptolemy would depend also on the track of a circumnavigating vessel.

† Ptolemy is, as a matter of fact, aware of what he was doing, and speaks with regret (Bk. i. 2) of his ignorance of the windings of the roads. Would anything else, however, have served his purpose and led, on the whole, to better results, except a knowledge of details altogether beyond his reach? Would, moreover, the extent of error, introduced by the neglect of the windings, be as obvious to an Egyptian as to a native of a mountainous country? Roman roads, moreover, are straight, and Ptolemy was a geometrician rather than a traveller. Since writing the above, I have come across two passages in Bunbury ('History of Ancient Geography,' 2, p. 27, and 1, p. 642) which bear on this question (cf. Bunbury, *op. cit.*, 2, p. 27).

‡ The same, albeit perhaps to a less extent, would have happened if a fixed allowance had been made for windings.



could he do, in order to do justice to all his facts, but place Laodicea as far from Ephesus as his information made possible, and, *mutatis mutandis*, treat other selected places in the same way? With regard to intermediate places, Magnesia, for instance, or Tralles, he would naturally deal with them later, and to be consistent, he ought to have placed them at their proper distances along the line joining the two road-centres between which they came—*i.e.* to take the case before us, on the line joining Ephesus and Laodicea. This, at all events, he does not do. The road gives him the distance from centre to centre. He recognizes its existence afterwards to this extent only—he places intermediate towns at more or less appropriate distances about its course; but otherwise its direct course is ignored. The positions of these latter towns are determined on no fixed principle. Sometimes Ptolemy was guided by their distance from one or other of his centres; sometimes by the distance between place and place; sometimes, it must be confessed, by the effect produced on the general appearance of his map. The district, for instance, which we are considering, lying as it does towards the west, has been influenced by the course Ptolemy has assigned to the western coast; various western towns are therefore too much to the east, and have usurped positions which belong to other places. Priene, for example, is, relatively to Ephesus, almost where Magnesia ought to be. In other words, results already obtained demanded that freedom of handling which Ptolemy's materials tolerated, and made him glad to avail himself of reasons for moving Magnesia and other places also to the east. Measurements from Ephesus were unmanageable, and were ignored in favour of others, so that we find that, within the usual limits, Magnesia is its right road-distance from Idyma, as well as from Tralles, which, in its turn, appears to go back through a series of windings to Laodicea.

It appears to me most natural that in his treatment of the roads Ptolemy should adopt the method I have described; any other method—he probably tried others—would have led to trouble. Its naturalness is a great presumption in its favour. Nor are proofs of its adoption lacking; I have already given several instances. I have indicated on the map by lines certain others which I consider likely, dotted lines, as a rule, denoting those measurements of which I have a little doubt, or for which the *data* are not quite satisfactory. The instances could be increased, but, allowing for an occasional desertion—and the risk of error in measurements and calculations of this kind must not be overlooked—they are, I think, sufficient in number to make my hypothesis exceedingly probable. The evidence, moreover, afforded by such general correspondence between map-distance and road-distance for road-centres along main roads, must be taken in conjunction with the absence of similar phenomena where, on my hypothesis, it would not be expected.

The authorities on which these measurements are based are most conveniently given in an appendix (see p. 438); a few points, however, which arise from an examination of the map require notice here.\* We should have expected the triangulation of the map to have been built up from Rhodes, or rather from a base measured from Rhodes. As a matter of fact, for the interior there were four main centres of triangulation, and four independent systems—Idyma, the representative of Rhodes, Chalcedon, the representative of Byzantium, Trapezus, and Issus being the centres respectively for the south-west, north-west, north-east, and south-east systems. Though sea-coast towns, Ephesus, for instance, notably, and Amisus, are used in the triangulation, or inland towns, such as Melitene, they ultimately derive their position from one or other of the corners of the square. The independence of the

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\* The note will bring out, also, how great the difficulty often is in arriving at an absolutely correct estimate of the distance of one place from another.

systems is clear from several considerations. In the first place, map-distances and road-distances, measured from sites belonging to a given system to the centre appropriate to that system, are found to coincide. In the second, when similar measurements are made to a centre belonging to another system, no such correspondence can be traced. In the third, as we shall see, towns in the centre of the map are often either too close together or too far apart. It is interesting to note that in measurements from Trapezus, which pass through Satala, the distance between the two given by Marinus—60 m.p.—is retained. Ptolemy's censure applies only to the latitude assigned to Satala.\* I was led to this conclusion by observing that the measurements, Trapezus to Nicopolis, Trapezus to Sebastia, etc., were, on any other condition, out by a uniform amount. A site once fixed was available for fixing the position of another site more in the interior or off a direct road from the coast. Thus the position of Philadelphia is fixed from Laodicea and from Ephesus, and itself affords one clue to the position of Dorylaeum.†

It is towards the middle of the map that Ptolemy's method breaks down. On the one hand, the eastern and western systems tend to overlap, on the other the northern and the southern refuse to meet. The first is conspicuous in the case of Tavium and Ancyra, the second in the case of Tavium and Cæsarea. The position of Ancyra was fixed from the north and west,‡ that of Tavium from the north and east. In spite of Ptolemy's initial error, Chalcedon and Trapezus were still too close together to allow the windings of the roads to be ignored completely. Tavium and Ancyra, the border towns of the two systems, are therefore not far enough apart—not by a third of their proper distance. The road which joins them is, accordingly, represented on the map with exaggerated windings. The position of Cæsarea Mazaca, on the other hand, was fixed from south and east, and Ptolemy's method, neutralized to some extent by the fact that it pushed Tavium west as well as south, failed to catch the distance up. Tavium and Cæsarea should be about 100 miles apart: Ptolemy could not make them less than 170. The direct road which joins the two had therefore to be dropped; but a *détour* was available, which figures, more or less, in the Peutinger Table, and measures, according to that authority, 191 Roman miles.§ With the help of Ptolemy's map it appears

\* 'Geographia,' lib. i. c. 15. The distance on Ptolemy's map is 83 English miles.

† The distance from Ephesus to Philadelphia is measured by Hypæpa and Sardes. It is interesting to note that the distance from Ephesus to Sardes *viâ* Smyrna agrees with the map-distance also measured *viâ* Smyrna, the map-distance from Ephesus to Smyrna being as much too great as the distance from Smyrna to Sardes is too small. This method of compensation is not without parallel in Ptolemy, and it had to be here no account of the course of the western coast.

‡ On the whole, I am inclined to think that Ancyra was fixed from Amorium, a secondary base, and Sinope, but distances are uncertain.

§ To Ptolemy, however, a road was chiefly a means of ascertaining the distance of one place from another; it was not, except incidentally, a means of journeying from place to place. It is, therefore, hardly right to say that the road is represented on the map, or that a *détour* was available. What, I imagine, Ptolemy did was this. Being in a difficulty, he fixed the position of some place accessible from both—perhaps it was Sarvena—from Tavium and Cæsarea by the help of its road-distances, not necessarily direct, from those places. This place and Tavium (or this place and Cæsarea) gave the clues to intermediate places, and kept them somewhere near the line joining the two. Where, on the other hand, there was compression—for instance, between Cyzicus and Nicæa, or between Ancyra and Tavium—it was convenient to measure from place to place along the road. Allowance, however, has to be made in such cases for Ptolemy's standard of accuracy, and for the consideration with which we deal in the next paragraph.

direct. Many of the towns mentioned in the table are scattered at appropriate distances about the line which joins the two.

Ptolemy's system of constructing his map by means of the intersection of circles gave two points for the position of each site. Between the two Ptolemy had to make his choice, and he was guided to make it by general considerations and by previous results. The point he did not choose, for instance, for Smyrna would be too far east; the point he did not choose for Nicopolis would be in the Euxine sea. These cases were straightforward, but even where our fuller knowledge shows him to be very wrong, his choice was never altogether inconsistent with the knowledge he possessed, and was required by the results he had already obtained. The district south-east of the Pisidian Antioch is from this point of view one of the greatest interest. Iconium, indeed, is approximately its right distance from Antioch, but while Lystra is north of the line joining the two instead of south, Vasada and Amblada, which should be nearly south of Antioch,\* are placed relatively to that city, the one as much north of east as the other is south of west; Parlais, which probably should be at Beysheher, has been removed east of Iconium, and Misthium has been carried from the position now assigned to it to a distance from Pappa the same as now, but a little west of north instead of west of south. What has happened is, I venture to suggest, as follows: Antioch is, on Ptolemy's map, too far from the south coast; the western group of colonies, which depended on it, have therefore been carried east, so much so that Cremna is 8 or 9 miles east of the line joining Antioch and Side instead of about 40 miles west of it. They and the towns immediately east of them accordingly occupy the ground which from the latest results ought to have received Lystra, Vasada, and the other towns I have mentioned. These could not be also carried east—the towns of the south-eastern system, to which Iconium and probably Isaura belonged, prevented that—so they have been squeezed out between the two groups. Lystra has suffered least. It is still approximately its right distance from Pappa and Iconium, and the relative positions of the three would not be so very far out, if the southern point of intersection of the circles had determined its site, and still less, if the site of Pappa had been fixed from Iconium, instead of from Antioch. With regard to the other places, the geography of the locality is too uncertain to justify at present an attempt to discover Ptolemy's mode of dealing with them, but experiments with various centres of measurement—Vasada, for instance, is its right distance from Antioch—appear to promise with fuller knowledge results similar to those obtained with Lystra.

## APPENDIX.

### TABLES OF DISTANCES AND AUTHORITIES EMPLOYED.

In this Appendix the following abbreviations have been used:—

- M. = Charles Müller, 'Claudii Ptolemæi Geographia.'
- H. G. = W. M. Ramsay, 'The Historical Geography of Asia Minor.'
- C. B. = W. M. Ramsay, 'Cities and Bishoprics of Phrygia.'
- F. = the French map of Asia Minor.
- K. = H. Kiepert's map of Asia Minor.
- St. = J. R. Sterrett, 'Wolfe Expedition,' and 'Epigraphical Journey in Asia Minor,' vols. 2 and 3 of the Journal of the American School at Athens.
- P. = the Peutinger Table.

\* Cf. Ramsay, "Pisidia and the Lycaonian Frontier," in the Annual of the British School of Athens, No. ix. I gladly take this opportunity of acknowledging the many obligations under which I am to Prof. Ramsay. Some of them will be clear from the note which follows, but the note cannot show but a very small proportion of them.

The handbooks referred to are either Murray's 'Handbook to Constantinople' or Murray's 'Handbook to Asia Minor.' The measurements were made on a map specially constructed. The size of the maps which accompany this article makes them unsuitable for such a purpose; they are, in fact, merely convenient means of indicating results obtained by other means. I shall be glad to receive any corrections, of the probable need of which I am most conscious, and to facilitate them I have given references, and endeavoured to indicate how I arrived at my results. It is, however, the general coherence and naturalness of the method here suggested which appealed to me. Until my results have been tested, it is premature to discuss the use which can be made of them; but it appeared to me, as I was engaged on this work, that, if they stand the test, Ptolemy's information would be available, more than heretofore, to fix or suggest the sites of towns and the courses of the roads. They might also increase, for the same purpose, the value of the Table and the Itineraries.

## I. MEASUREMENTS FROM IDYMUS.

	Map-distance.	Road-distance.
Idymus to Ephesus ... ..	87	84½
„ Smyrna ... ..	129	125 or 126
„ Adramyttium ... ..	221	224 or 225
„ Ilium ... ..	296	300
„ Cyzicus ... ..	304	300
„ Magnesia ... ..	73	72
„ Pergamus ... ..	190	189 or 190

Idymus to Tralles, 56 miles (M., p. 815, F. K.); Tralles to Ephesus, 28½ miles (H. G., p. 164); Ephesus to Smyrna, 40 or 41 miles (H. G., p. 165); Smyrna to Pergamus, 63 miles (H. G., p. 165); Pergamus to Adramyttium, 35 miles (H. G., p. 166, note, F.); Adramyttium to Ilium, 75 miles (H. G., p. 166, note, gives Adramyttium to Assos, 41 miles; F. gives 33 or 34 miles on; cf. Murray's Handbook (Asia Minor), p. 63, and Peutinger table); the French map gives a distance in a direct line of approximately 72 miles from Adramit to the ruins of Cyzicus; the direct distance from Bergamo is 100 miles in the Handbook.

## II. MEASUREMENTS FROM EPHEBUS.

	Map-distance.	Road-distance.
Ephesus to Laodicea-ad-Lycum ...	97	100
„ Apamea Cibotus ...	167	164
„ Antiochia Pisidiæ ...	225	225
„ Philadelphia ( <i>viâ</i> Smyrna)	115	112
„ „ ( <i>viâ</i> Hypæpa)	81	82
Perga to Laodicea ... ..	140	139
Laodicea to Philadelphia ... ..	46	45
Side to Antiochia ... ..	130	128
Philadelphia to Dorylæum ... ..	148	150

Ephesus to Laodicea and Apamea (C. B., pp. 748 and 170; cf. H. G., p. 164); Apamea to Antioch (St. map); Ephesus to Philadelphia (*viâ* Smyrna and Sardis, H. G., p. 167; *viâ* Hypæpa, *ib.*); Perga to Laodicea (C. B., p. 255); Side to Antiochia (St. map); Laodicea to Philadelphia (H. G., p. 167); Philadelphia to Dorylæum (H. G., p. 168).

## III. MEASUREMENTS FROM CHALCEDON.

	Map-distance,	Road-distance.
Chalcedon to Nicæa ...	74	74
„ Dorylæum ...	133	137
„ Amorium ...	219 or 220	217
„ Pessinus ...	239	235

The distance from Chalcedon to Nicæa was not measured by Niccmedia, but probably by the ferry at Cibotus. The distance given in Murray's Handbook (Constantinople) for this route corresponds very closely to the distance on the map, namely, Haidar Pacha to Dil Iskelesi,  $34\frac{1}{4}$  miles; Ferry, 2 miles; Hersek to Isnik, fifteen hours, say 38 miles (cf. pp. 116, 132, and H. G., pp. 186, 188, and 240 ff.). Nicæa to Dorylæum, 63 miles (Peutinger, M., p. 804, R.G. map); Dorylæum to Tricomia, 42 miles (H. G., p. 239); Tricomia to Amorium, 38 or 39 miles (H. G. map); Amorium to Pessinus, 27 miles (H. G., p. 237); Dorylæum to Pessinus, 62 miles.

The distances to Ancyra are perplexing, and the problem cannot be settled without fuller information than I possess. It is worth while, however, to note that the distance from Amorium to Ancyra is on the map 100 miles, or within a mile or two of the correct road distance (H. G., p. 238). The map-distances from Chalcedon to Claudiopoli and Flaviopolis respectively also agree with the distances by road as given on Ramsay's map. I am inclined to think now that both Pessinus and Ancyra were fixed from Amorium.

## IV. MEASUREMENTS FROM TRAPEZUS AND AMISUS.

	Map-distance.	Road-distance.
Trapezus to Nicopolis ...	112	110
„ Neo-Cæsarea ...	169	170
„ Comana Pontica ...	189	189
„ Amasia ...	243	243
„ Sebastia ...	185	185
„ Tavium ...	320	324
Amisus to Amasia ...	64	60
„ Neo-Cæsarea ...	123	133
„ Nicopolis ...	188	185
„ Comana Pontica ...	123	115

Trapezus to Satala, 54 miles (M., p. 41); Satala to Nicopolis, 56 miles (K. cf. H. G., map); Nicopolis to Neo-Cæsarea, say 60 miles (H. G. map, and Murray's Handbook of Asia Minor, map and pp. 44 ff.); Niksar to Koilu-hissar is 19 hours, say 50 miles, and it is about 10 miles on to Purkh; Neo-Cæsarea to Comana Pontica, 19 miles (H. G., p. 263); Nicopolis to Sebastia, 75 miles (M., p. 875); Neo-Cæsarea to Amasia, 73 miles (H. G., p. 263); Amasia to Tavium, 81 miles (H. G., p. 260); Amisus to Amasia is 24 hours, say 60 miles. Kiepert makes the distance from Amasia to Neo-Cæsarea less, and that to Comana more.

## V. MEASUREMENTS FROM MELITENE.

	Map-distance.	Road-distance.
Melitene to Cæsarea Mazaca ...	198	200
„ Comana Cappadociae ...	153	155
„ Arohelais ...	275	272
„ Samosata ...	115	115

The authorities for these statements are H. G., p. 273 (cf. Sterrett, 'Epigraphical Journey in Asia Minor,' p. 234 ff. and map), and C. B., p. 749; the distance from Melitene to Samosata is given in M., p. 892, as 115 miles.

The distance from Trapezus to Melitene corresponds approximately with the measurements on Kiepert's map—54 miles being allowed for the distance between Trapezus and Satala, and the route *viâ* Aziris being taken. The same is true of Zimara, but the geography of this part is very obscure.

#### VI. MEASUREMENTS FROM ISSUS.

	Map-distance.	Road-distance.
Issus to Mopsuestia ... ..	29	33
„ Adana ... ..	51	49
„ Tarsus ... ..	77	75
„ Mopsucrene ... ..	103	97
„ Podyandus ... ..	133	121
„ Cybistra ... ..	174	169
„ Baratta ... ..	206	206
„ Iconium ... ..	249	251
„ Tyana ... ..	205	204

The earlier road-measurements agree with the itineraries as restored by Prof. Ramsay in the *Journal* for 1903, Part ii. p. 408. The distance between Podyandus onwards is given in H. G., p. 357, as 54 m.p. to Cybistra, 41 to Barata, and 50 to Iconium. Tyana is measured *viâ* Cybistra, from which it is distant 39 m.p. I think it most probable that Archelais, Sebastia, and Cæsarea Mazaca were fixed from Issus; but though the figures, such as I can get, agree approximately, I cannot get exact measurements of the road-distances. For the measurements from Laranda to Seleucia and Celendris, cf. H. G., p. 362. Mopsucrene may have been fixed from Issus; Podyandus was not. The resumption of conformity after they were passed is interesting, and we should not expect conformity in their case—they are intermediate places. The map-distance of Podyandus from Cybistra is 46 miles.

## REVIEWS.

### EUROPE.

#### BRITISH TRADE.

'Wirtschaftsgeographische Studien aus Grossbritannien.' Von Stefan D. Popescu, Professor an der Handelshochschule zu Jassy. Leipzig: 1903.

In the summer of 1902 (May—August) the author made a journey to Great Britain, where he studied the navigation, shipping, and trade of this country with a view to the present study. In compiling the same, he has made especial use of the publications of the Board of Trade, such as the Annual Statements (1) of the navigation and shipping, and (2) of the external trade, of the United Kingdom. Four main divisions are adopted, in which the Bristol Channel, the Mersey, the Clyde, and the British coal-trade are successively chosen as the subjects of discussion; in relation to each, a mass of useful and instructive, if not very novel, statistics and observations are collected. The physiographical circumstance of the Bristol Channel, Mersey, and Clyde basins is the subject of particular attention; questions of local orography and hydrography, of meteorology, of tides and alluvial deposits, are discussed with some detail; and the historical development