ART. XX.—*Notes on the Early Geography of Indo-China.*
By G. E. GERINI, M.R.A.S.

PART I. PREHISTORIC PERIOD:

BEING RESEARCHES ON PTOLEMY'S GEOGRAPHY OF THE INDIA EXTRA-GANGEM.

1. *Introduction.*

Mi ritrovai per una selva oscura
Che la diritta via era smarrita.

DANTE : *Inferno*, i, 1.

HAVING been for years past engaged in researches on the early history of Siām and its border countries, I had, as a matter of course, to go into their ancient geography—a hitherto unexplored field—and this naturally led me to a study of the documents that the Western geographers of antiquity left us, more especially Ptolemy, who gives us the first collection of anything like authentic data on the countries in question. Thus it came to pass that I found myself hopelessly entangled in the “selva selvaggia, ed aspra e forte” of Ptolemy’s geography of India extra-Gangem. I must confess that the results attending my first attempts at interpreting this portion of the work of the great Alexandrian were far from encouraging. This was, however, to be expected, seeing that even master hands like those of Klaproth, Cunningham, Yule, Lassen, and others, whilst meeting with fair success in identifying Ptolemy’s names of places west of the meridian of the Ganges, had failed to evolve the slightest order out of the chaos of his trans-Gangetic geography, and to locate with certainty even a single one of the numerous cities he names beyond the outskirts of the Gulf of Bengal. The more eastern portion of Ptolemy’s geography came, therefore,

to be looked upon as utterly unreliable, if not fantastic; and the severest strictures were passed on the great cosmologist and geographer, to the effect that he had made a mess of his eastern longitudes and latitudes, coined names of cities and peoples out of his fancy, confused islands and continents, making pretence to a knowledge of regions which his contemporaries had never reached, and on which they possessed but second-hand information of the vaguest possible character.

But when I noticed the wide difference of opinion existing among Ptolemy's expounders and commentators as to the identification of his names of cities, gulfs, and even regions (some going so far as to connect his **Magnus Sinus** with the Gulf of Bengal, his coast of **Sinai** with that of the Malayan Peninsula, **Kattigara** with Kesho in Tonkin, and even with Kottawaringin in Borneo, **Serika** with the Peguan coast, and so forth), I at once realized the impossibility of reaching any definite goal by following paths so widely diverging; and I confess that I began then to ask myself whether—granted that Ptolemy had muddled—his commentators and would-be elucidators had not, despite their zeal and learning and evident good-faith, often made confusion worse confounded.

The reason why Ptolemy's trans-Gangetic geography should have given rise to so much controversy is plain enough: it is to be found in the methods of treatment it received—at times far too theoretical on one side, and far too empiric on the other; but always, and invariably, too scholastically uniform and systematic. Thus the most faithful of Ptolemy's votaries, the sincerest of his admirers, ever missed the goal, despite the deep learning and indefatigable research they brought to bear on the arduous subject: some in unsuccessful attempts to find out a general formula of correction applicable to the whole of his *habitabilis*, and others in the vain endeavour of making his geographical nomenclature fit in in modern maps by simply connecting the names he gives with places designated by similar appellations in the latter.

As regards the first method, if susceptible of fairly successful application to the countries lying west of the Indus, it becomes utterly unfit for the more eastern portion of the *habitalis*, where Ptolemy's measurement errors are far from being constant and uniform as might be anticipated, the position of places here depending on much more imperfect data; whereby it ensues that the amount of error must be detected and determined in almost every particular instance if anything like approximation is to be arrived at. Now this can only be done by a careful selection and individuation of the principal stations of Ptolemy's system; the ratio of error in intermediate points between the base stations thus established will then be reduced to a minimum, so as to allow, in the majority of cases, of a satisfactory identification of the same.

I purposely say in the majority, and not in the totality of cases, because, in spite of the rectification thus effected of Ptolemy's positions of his geographical elements, some of the latter will yet prove refractory to identification, owing partly to our still deficient geographical knowledge of some parts of Further India; and more—nay, principally—to our lack of reliable historical data on the past of the same regions, which often prevents us from tracing modern names of places back to the designation they bore in Ptolemy's time, so as to recognize them in his lists.

This is, indeed, the greatest drawback in a study of the subject under consideration; for many towns, marts, etc., which had existed, and even flourished, at that period, and were recorded by our eminent geographer, have now disappeared from the face of the earth, as well as from the memory of man; while others have changed several times their names, each change being often into a different language, according to the race of people under whose sway they successively fell, and are now unrecognizable under their modern appellations. To this must be added the transformation that names of places have undergone in the mouths of travellers speaking different tongues, especially at that remote period when geographical science was still in its infancy; not to speak

of the alterations caused in their spelling as originally adopted in the work of our author, by its passing through the ordeal of a legion of copyists, often innocent of geographical knowledge; so that the wonder is rather—after all these difficulties have been considered—that any of Ptolemy's names of places could now stand the test of identification at all.

Yet I trust to be able to show in the sequel that, despite so many drawbacks, Ptolemy's geography of the India extra-Gangem is still capable of fairly accurate interpretation, provided it is carried on on the lines mentioned above; and that, once the amount of error as to his fundamental stations has been determined, it is possible to push the work with equal success outside the limits of that field, even up to the scarcely as yet known regions of Western China and Central Asia. It will then appear how great was Ptolemy's knowledge of these remote countries at so early a time as his, and how careful his handling of the data he had at his disposal; as well as how little he deserved the strictures passed upon him and his work by commentators who did not know how to avail themselves of the precious materials accumulated by him.

With regard to the second method of interpreting Ptolemy's geography, its shortcomings are too evident to need pointing out here. Its inevitable failure with respect to India was well exemplified at the hands of Lassen, who thought that all that was needed was to compare the ancient and modern names of places to connect the two. Proceeding on sounder critical principles, Cunningham and Yule far better succeeded in interpreting Ptolemy's data, and gave us the most reliable explanation of his geography of India which we now possess. Yet McCrindle, while acknowledging that Colonel Yule's map of ancient India "is undoubtedly by far the best that has been yet [1885] produced," has to avow that "the result is far from encouraging."

As a matter of fact, it will be seen that Ptolemy's trans-Gangetic geography, when treated according to the method

laid down in the present paper, presents perhaps fewer difficulties than the cis-Gangetic portion. The only real hard crux I met with, after having succeeded in identifying some of Ptolemy's principal stations of Indo-China, was the determination of the amount of his shortening of the Malay Peninsula and of the lower portion of the Cochin-Chinese headland in favour of the Arakan-Burmese and Tonkinese coasts respectively.

On the other hand, the amount of error in Ptolemy's latitudes and longitudes in the northern portion of Indo-China could be so neatly determined, that its rectification enabled me to extend the work far out of the limits originally contemplated, which included nothing beyond the outskirts of Southern Indo-China and Malay Peninsula, a region of which I can speak with some personal knowledge. If success led me further than I intended, and carried me on to China and Central Asia, countries to the knowledge of which I cannot and do not make the slightest claim or pretence, I wish it to be distinctly understood, ere I proceed, that I do not consider that extra portion of my work by any means complete; and if I gave it a place in my map and in the present sketch, it was in order to show the correctness of the plan on which I have worked out Ptolemy's geography of Indo-China, even when tested on a much larger scale. Hence I did not concern myself with it beyond what had relation with trade routes in Ptolemy's time, a subject on which I lay great stress, as I think it by far the most important gain to geographical science resulting from this study, and an entirely novel discovery most likely to alter the opinions generally held hitherto as to the easternmost limits of the knowledge of the world possessed by the ancients, and of their trade relations.

This is all I could do under the unfavourable circumstances in which I am placed, of living in a far-away country out of reach of any well-stocked library containing the literature that has reference to the countries in question.

Therefore, I gladly leave it to scholars versed in the lore

of China and Central Asia to complete the investigation and fill in the blanks I have left. For the same reason I have had no access to any of the standard works bearing on Ptolemy's geography, and have had to carry on all my calculations of rectification of Ptolemy's geographical co-ordinates of positions on the base of the figures supplied in McCrindle's "Ancient India as described by Ptolemy," 1885 edition—a work embodying, as far as I can judge, nearly all that is known on the subject up to the present date, and which I have followed throughout as far as the portion of Ptolemy's geography treated on here is concerned. In the course of my labours I detected two misprints in it which somewhat led me astray at first, but which I have since corrected. The first regards the longitude of **Parisara**, which is given as 179° on page 225, a mistake for 149° ; and the other the longitude of the mouth of the river **Aspithra** (page 244), printed as 170° , whereas it should be 173° or 175° . I trust I have not fallen a victim to other possible misprints in that book, in the determination of the position of some other of Ptolemy's stations. Should, however, this prove to be the case, I would ask the indulgence of the reader, on the score that I had no means at my disposal to verify all such figures as I have taken from McCrindle's book.

With these premises and reservations, I shall now proceed to explain as summarily as possible the method adopted in my inquiry, and the means through which I arrived at the solution of most of the intricate problems connected with the subject under consideration.

I first took up the study of Ptolemy's trans-Gangetic geography, in so far as had relation with the Gulf of Siām and the Malay Peninsula, as early as 1887; but I soon found out the inapplicability here of the formulas proposed for the correction of Ptolemy's co-ordinates of positions, and the inadmissibility of the few identifications ventured upon by various authorities up to that date of Ptolemy's places in these regions; with the sole exception of **Zabai**, connected by Yule with Campā, without, however,

attempting to definitely locate its position with any degree of precision. This prevented me from forming any estimate of the amount of Ptolemy's error in longitude and latitude at that point, so the latter could not be used as a base station for the purpose I intended. I had, in fact, by that time found out that no advance was possible in this direction unless one of Ptolemy's stations at least could be identified, and located with sufficient accuracy on the Gulf of Siām or the Cochin-Chinese coast, so as to give an exact idea of Ptolemy's amount of error in these far-away regions, and to furnish a clue to the detection and rectification of the errors in neighbouring stations.

So far, the most easterly point in Ptolemy's system that could be fixed upon with any degree of precision, was the delta of the Ganges, which was therefore considered as the *ne plus ultra* of all possible correct interpretation of ancient classic geography. As I was at the time—despite the most assiduous efforts—unable to discover any reliable base-point beyond that, I had to give up Ptolemy in utter discouragement, for I well saw that nothing could be done until such a point was found out. With this object in view, I, more unremittingly than ever, continued my study and collection of old records concerning these countries, confident that, should I arrive at establishing what were the principal marts and emporiums of trade that existed on these coasts in Ptolemy's time, and under what names, I would most likely, unless Ptolemy's names of localities were nothing but mere chimerical fancies, be able to recognize some one of them in his lists, whether in its genuine or modified garb. I need not tell how glad I was when some years afterwards—not a few though—my exertions were rewarded, and by the end of 1895 I was able to identify, with absolute certainty, Ptolemy's **Akadra** and **Pithonobaste** with the Bay of Ko: Tron or Ka-Dran (the *Kadranj* of the Arab navigators of the ninth century), corresponding to the present Hatien on the Kambojan coast of the Gulf of Siām; and **Pantaimeas** (French spelling) or **Panthāi-mās** (“golden-walled citadel”) near by, the

initial point from which Hindū civilization spread out over Kamboja, as I shall show in the sequel, and of which the present Hatien and Ko: Tron bay were the port, the most remarkable emporium of trade on the Gulf of Siām from the highest antiquity up to the beginning of the last century. This successful piece of work soon led me to the identification of **Samarade, Zabai, Aganagara, Takola**, and other principal stations of Ptolemy on the coast of the Malay Peninsula and Cochin-China. I became then aware of a new and important feature of Ptolemy's geography of these countries, namely, that it discloses to us the positions of the outposts occupied at that early time by Southern Indian colonists who were then just at the outset of the exploits by which their civilization was subsequently spread all over the Malay Peninsula, Siām, Kamboja, Campā, and the Malay Archipelago in general; and thus we are supplied with the solution of an ethnological mystery that could not hitherto be penetrated.

The other important feature that I discovered afterwards was that of the overland routes that Western traders followed at that early period, most of which were hitherto not only unknown, but hardly even dreamed of. The rest of the task proved comparatively easy, and I need not weary the reader any further with the *récit* of my personal experiences in this matter, beyond adding that the ultimate result of all of them was this preliminary essay, with the map that accompanies it. Neither of these, as yet so incomplete and imperfect, would I dare to send to the press were I not confident that, even in their present humble and uncouth form, they may prove interesting and useful to lovers of Oriental research. This is the only reason that induced me to decide on their immediate publication, rather than to wait for a more favourable opportunity when leisure and less deficiency of means of study would have permitted me to considerably improve them.

2. *Calculations.*

Though the process of rectification of Ptolemy's measurement errors—on the co-ordinates of his fundamental stations and on the intermediate places between two successive co-ordinates taken as base-lines—is sufficiently shown in the map hereto appended, a brief exposition of the method of calculation followed for the determination of the error at the principal stations will perhaps render the process clearer and more readily understood. We shall then begin at **Akadra**, the starting-point, which in our case proved the true key to the mystery that shrouded Ptolemy's trans-Gangetic geography. The longitude adopted for this harbour in the present study is $104^{\circ} 21'$ E. Greenwich, which corresponds to the actual anchorage of ships during the south-west monsoon in front of **Hatien**.

The other base meridian worked upon in conjunction with **Akadra** is that passing through the centre of the Gangetic delta and the median mouth of the Ganges called **Kamberikhon** by our author, and supposed to correspond to the Barabangā estuary, for which the longitude adopted here is $89^{\circ} 30'$ E.¹ Recently Rylands, in his elucidation of Ptolemy's geography—a book which deserves recognition,² and from which I have derived useful hints as to the graphical method of treating Ptolemy's geography, although unable to accept his formula of reduction or his estimate of the true equivalent of Ptolemy's 180° as fit for my purpose—assigned long. 90° E. to **Kamberikhon**, which is evidently too much east of the centre of the delta. A glance at a map of Bengal will convince one of this. The longitude adopted by me for **Kamberikhon**, not only corresponding as nearly as possible to the centre of the delta, but also sensibly coinciding with the axis of the lower course of the Barabangā, must evidently lie within

¹ All longitudes referred to in the present sketch are computed from the meridian of Greenwich.

² "The Geography of Ptolemy elucidated," by T. G. Rylands. (Dublin, 1893.)

a few minutes of the true one as intended by Ptolemy. The calculation then proceeds as follows:—

LONGITUDE.—*Base Akadra—Kamberikhon.*

	Ptolemy's.	True.
Kamberikhon.	Long. 146° 30' E.	89° 30'
Akadra.	„ 167°	104° 21'
	Diff. 20° 30'	14° 51'

whence we obtain a formula of correction for Ptolemy's longitudes between **Kamberikhon** and **Akadra** :

$$\frac{14^{\circ} 51'}{20^{\circ} 30'} = 0.725 \times \text{Ptol. long. (a)}.$$

Determination of the longitude of Aganagara.

A. By formula (a) from **Kamberikhon**.

Kamberikhon. Ptol. long. 146° 30'

Aganagara. „ „ 169°

Diff. 22° 30' $\times 0.725$ (a) = 16° 18'

True long. **Kamberikhon** + 89° 30'

Corrected long. **Aganagara** 105° 48'

B. By formula (a) from **Akadra**.

Aganagara. Ptol. long. 169°

Akadra. „ „ 167°

Diff. 2° $\times 0.725$ (a) = 1° 27'

True long. **Akadra** + 104° 21'

Corrected long. **Aganagara** 105° 48'

which is the exact longitude of Hanoi.

LATITUDES.

As regards latitudes, let us, by way of trial, now determine a mean between those of **Kamberikhon** and **Akadra**. The true latitude assumed for the present for **Kamberikhon** is 22° 24' N., corresponding to that of the

village called Byracally on the maps, which may be **Kamberikhon** itself, and if not, must be not very far from the mark; considering that nearly eighteen centuries have elapsed from the time of collection of Ptolemy's data, and that at that period the delta could not be so far advanced southwards as at present. The figure assumed here will be, however, checked in due course; as we shall see, the error in latitude between the parallels of **Kamberikhon** and **Akadra** is far from being uniformly distributed. We have, then—

	Ptolemy's.	True.
Kamberikhon.	Lat. $18^{\circ} 40'$	$22^{\circ} 24' \text{ N.}$
Akadra (Hatien).	„ $4^{\circ} 45'$	$10^{\circ} 22'$
	Diff. $13^{\circ} 55'$	$12^{\circ} 2'$

whence a formula of correction for Ptolemy's latitudes between **Kamberikhon** and **Akadra** = $\frac{12^{\circ} 2'}{13^{\circ} 55'} = 0.8647$.

Applying this by way of trial to the determination of the latitude of **Aganagara**, we obtain—

Aganagara. Ptol. lat. $16^{\circ} 20' \text{ N.}$

Akadra. „ „ $4^{\circ} 45'$

Diff. $11^{\circ} 35' \times 0.8647 = 10^{\circ} 1'$

True latitude **Akadra** + $10^{\circ} 22'$

Corrected latitude of **Aganagara** $20^{\circ} 23'$

Now the true latitude of **Aganagara** (Hanoi) is $21^{\circ} 2'$, whereby we see that there is an error in the result of the above calculation of $39'$ less. This we shall be able to account for hereafter, and show that it is due to the excessive lengthening by Ptolemy of the coast of Arakan and Pegu between Chittagong and Cape Negrais; and, correspondingly, of the Tonkinese coast, whence the comparatively southern position resulting for **Aganagara**. But having made certain that the latter is really Hanoi, both by the approximation obtained in the determination of its geographic co-ordinates and by every other indication,

as shall be shown in due course, we must correct the error and adopt its true latitude of $21^{\circ} 2'$, so as to be able to use it as another base-point in the calculations that follow.

The next step is to find the relation of Ptolemy's and true latitudes between **Akadra** and **Aganagara**. This stands as follows:—

	Ptolemy's.	True.
Aganagara (Hanoi).	Lat. $16^{\circ} 20'$	$21^{\circ} 2'$
Akadra (Hatien).	„ $4^{\circ} 45'$	$10^{\circ} 22'$
	Diff. $11^{\circ} 35'$	$10^{\circ} 40'$

whence the correction for Ptolemy's latitudes between the above two stations = $\frac{10^{\circ} 40'}{11^{\circ} 35'} = 0.92 (\phi)$.

Ptolemy's equator deduced from this formula of correction would correspond to $5^{\circ} 58'$ true North Latitude. This, we may observe, closely agrees with the result that could be obtained from Ceylon, where Ptolemy's equator passes through **Nubartha** (Barberyn), the true latitude of which is $6^{\circ} 30'$ N.; and will do for our purpose, as shall be proved by subsequent researches.

That neither the error of latitude between the parallels of **Akadra** and **Aganagara**, nor that in longitude between the meridians of **Akadra** and **Kamberikhon**, is uniform, is proved by the displacement of Cape **Temala** (Negrais) too far east and south. This better results from the following calculations:—

Akadra (Hatien).	Ptol. long. $167^{\circ} 0' E.$
Cape Temala (Negrais).	„ „ $157^{\circ} 20'$
	Diff. $9^{\circ} 40'$

Applying to this the formula of correction (α) found above for longitudes, we have: $9^{\circ} 40' \times 0.725 = 7^{\circ}$. Subtracting this result from the true longitude of **Akadra** (Hatien), we obtain $104^{\circ} 21' - 7^{\circ} = 97^{\circ} 21'$ for the longitude of Cape **Temala** (Negrais). The true longitude of the latter, at Diamond Point, adopted in the present inquiry

is $94^{\circ} 22'$ E.; whence we see that Ptolemy's displacement of this cape is about 3° too far East.

Its displacement in latitude is shown by the following :—

Cape Temala.	Ptol. lat. $8^{\circ} 0'$
Akadra (Hatien).	„ „ $4^{\circ} 45'$
	Diff. $3^{\circ} 15'$

Applying to this the formula of correction for Ptolemy's latitudes found above (ϕ), we obtain—

$$3^{\circ} 15' \times 0.92 = 2^{\circ} 59'$$

$$\text{True lat. Akadra (Hatien)} + 10^{\circ} 22'$$

$$\text{Corrected lat. Cape Temala (Negrais)} \quad \underline{\underline{13^{\circ} 21'}}$$

The true latitude for this cape adopted in the present study being 16° N., it follows that Ptolemy's displacement of the same was nearly 3° further south than its true position. We see then that he lengthened the coast of Arakan and Pegu as far as Cape Negrais at the expense of the western coast of the Malay Peninsula, which thereby becomes represented shorter than it really is; and that therefore the latitudes given by him for stations north of the parallel of Cape Negrais (Temala) must be corrected to a greater extent than those of the places situated to the south of the same parallel.

Before, however, attempting to find what the new formula of correction should be, let us see whether the same rule applies to the coast of Tonkin, and in general all over the intermediate regions. In order to do this, let us prolong the parallel of Cape Temala (Negrais)—the latitude of which is 8° N. Ptol. = 16° N. true as shown above—as far as the Annamite coast. We see then that it intersects the latter a little below Turān (Tourane of French maps) and the homonymous bay, noted from the earliest time as a much frequented port on that coast, and which I have identified with Ptolemy's Throana. The latitude he assigns to Throana being $8^{\circ} 30'$ N., namely, just a little above the parallel now under consideration, we obtain thus a confirmation that the said parallel, marking the 8° of North

Latitude in Ptolemy's system, actually corresponds to the 16th parallel of true latitude in our maps. The consequence is that the coast of Tonkin and northern Annam has undergone at Ptolemy's hands the same lengthening at the expense of the southern as the corresponding coast on the eastern side of the Gulf of Bengal. A single formula of correction will then do for Ptolemy's latitudes of all places situated further north than his 8th parallel or our 16th parallel of North Latitude. This formula can be easily deduced from a comparison of the latitude of **Cape Temala** (Negrais) with that of **Aganagara** (Hanoi), as follows:—

	Ptolemy's.	True.
Aganagara (Hanoi).	Lat. 16° 20'	21° 1'
Cape Temala (Negrais).	„ 8° 0'	16° 0'
	Diff. 8° 20'	5° 1'

whence $\frac{5^\circ 1'}{8^\circ 20'} = 0.6 (\lambda)$.

This formula of correction, when tested all over the geographical field under consideration, was found to apply to all places situated by Ptolemy above his 8th parallel, even as far up as Mongolia and Central Asia. From it we may deduce the correct latitude for **Kamberikhon**, as follows:—

Kamberikhon.	Ptol. lat. 18° 40' N.
Aganagara (Hanoi).	„ „ 16° 20'
	Diff. 2° 20' $\times 0.6 (\lambda) = 1^\circ 24'$
	True lat. Aganagara (Hanoi) + 21° 1'
	Corrected lat. of Kamberikhon <u>22° 25'</u>

But a more correct result would be obtained from the latitude of **Cape Temala** (Negrais) taken as a base, thus:—

Kamberikhon.	Ptol. lat. 18° 40' N.
Cape Temala (Negrais).	„ „ 8° 0'
	Diff. 10° 40' $\times 0.6 (\lambda) = 6^\circ 24'$
	True lat. Cape Temala (Negrais) + 16° 0'
	Corrected lat. of Kamberikhon <u>22° 24'</u>

Y Ptol. = 89° 30' E. Greenwich, true).

N.
Or IDENTIFICATION.

Approximate position of the place identified
in modern maps.

							Name.	Longitude E. Greenw.	Latitude
...	...	...	...	...	...	...	Harashar ...	87° —	42° 15'
...	...	...	...	...	...	...	Khoten ...	80° —	37° —
...	...	...	...	...	...	...	Chikut Cho lake ...	88° —	31° 30'
...	...	...	...	...	...	...	Thok Jalung ...	81° 35'	32° 20'
uke	...	...	...	...	...	...	Tiruta-puri ...	80° 45'	31° —
of)	...	...	...	...	...	...	—	81° 15'	31° —
op)	...	...	...	...	...	...	Tsaprang ...	79° 35'	31° 25'
ashi-gong ?)	...	...	...	...	...	...	Gartop ...	80° 25'	31° 40'
...	...	...	...	...	...	...	Gar ...	80° —	32° 10'
...	...	...	...	...	...	...	Hanle ...	78° 40'	32° 55'
to the west of it ?)	...	...	...	...	...	...	Simla ...	77° 20'	31° 8'
?	...	...	...	...	...	...	Srinagar ...	78° 50'	30° 12'
...	...	...	...	...	...	...	Sukertal ...	78° 10'	29° 28'
...	...	...	...	...	...	...	Sambhal ...	78° 20'	28° 35'
...	...	...	...	...	...	...	Kanauj ...	79° 50'	27° 3'
...	...	...	...	...	...	...	Oude ...	82° 15'	26° 50'
if not, Salmura, Supur, or Satahung, a city	...	...	...	...	...	...	Chamukula ...	85° 50'	29° 20'
...	...	...	...	...	...	...	Satahung ...	83° 35'	28° 8'
river	...	...	...	...	...	...	Gorkha ...	84° 22'	27° 53'
...	...	...	...	...	...	...	Patna ...	85° 17'	25° 24'
itse ?	...	...	...	...	...	...	Shakia ...	88° 5'	28° 55'
?	...	...	...	...	...	...	Sana ...	89° 22'	27° 52'
ickpoor)	...	...	...	...	...	...	Gorakhpur ...	87° 35'	25° 7'
...	...	...	...	...	...	...	Khatang ...	86° 50'	27° 18'
ti)	...	...	...	...	...	...	Rajmahal ...	88° —	25° —
er	...	...	...	...	...	...	Dinajpur ...	88° 40'	25° 38'
it	...	...	...	...	...	...	Jessor ...	89° 20'	23° 7'

table is that of the "Stone Tower."

e) and Cape Temala (longitude 157° 20' Ptol. = 94° 22' E. Green

IDENTIFICATION.							Approximate position of the place identified in modern maps.		
							Name.	Longitude E. Greenw.	Latitude
9	...	...	...	...	...	...	Pidshan ...	90° 25'	43°
0	...	...	...	...	...	...	Hami ...	93° 25'	42°
1	de ...	...	...	...	...	...	—	90° 45'	32°
2	...	...	...	...	...	...	Shabando...	94° 50'	32°
3	...	...	...	...	...	...	Dhejen ...	91° 30'	29°
4	ngpu river	...	...	...	...	...	Shigatse ...	89° —	29°
5	...	...	...	...	...	...	Sindong ...	94° 10'	29°
6	...	...	...	...	...	...	Rangamati ...	90° 4'	26°
7	it and the Brahmaputra river)	...	...	...	...	...	Jaintiapur ...	92° —	25°
8	...	...	...	...	...	...	Sylhet ...	91° 42'	24°
9	r Manipūr, Tammu, or Sumjok?)	...	...	...	...	...	Manipur ...	94° —	24°
0	akka ...	...	...	...	...	...	Barisol ...	96° 10'	23°
1	Kuladan? Kalé district in Burma?	...	...	...	...	...	—	—	—
2	...	...	...	...	...	...	Byraccally ...	89° 25'	22°
3	...	...	...	...	...	...	Chittagong ...	91° 50'	22°
4	l ...	...	...	...	...	...	Muri river ...	91° 45'	21°
5	...	...	...	...	...	...	Arakan (ancient capital)...	93° 26'	20°
6	...	...	...	...	...	...	Kuladan river ...	92° 50'	20°
7	i ...	...	...	...	...	...	Ramri ...	94° —	19°
8	bove Sandowê (Ma-i river? Tan-lwai river?)...	...	...	...	...	...	—	94° 10'	19°
9	...	...	...	...	...	...	Sandoway ...	94° 30'	18°
0	sein) ...	...	...	...	...	...	Peemabeenlah ...	95° —	17°
1	imilu-gyun)	...	...	...	...	...	Tha-mee-hla-kywon (Diamond island)	94° 19'	15°
2	in (Timira?)	...	...	...	...	...	—	—	—
3	nira, from Diamond island)	...	...	...	...	...	Cape Negrais ...	94° 22'	16°

se meridians.

e) and Cape Takola (longitude 158° 40' Ptol. = 98° 19' E. Green

IDENTIFICATION.							Approximate position of the places identified in modern maps.		
							Name.	Longitude E. Greenw.	Latitude
14	ogaung)	...	...	...	...	...	Tshenbo ...	96° 47'	24°
15	...	...	...	...	...	...	Prome ...	95° 12'	18°
16	...	...	...	...	...	...	Syriam ...	96° 19'	16°
17	uttara (Raṅgūn)?	...	...	...	...	...	Tahtōn ...	97° 14'	16°
18	Downloaded from https://www.cambridge.org/core . INSEAD, on 09 Sep 2018 at 18:34:12, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms . https://doi.org/10.1017/S0035869X00024710	...	...	...	...	...	—	97° 30'	16°

Kwala Kang-sa, in the actual district of

 ice called Sābah is some twenty miles up

st of Malay Peninsula
 rce of which is at Mount Batu *Ātap* in

; in Malay *Permatang*, whence Permuda,

 overland route across the Kra isthmus
 iām (*Sāmaraṭṭhē*)
 vriting)
 not, the river of Kampong Som... ..

ttle to the north of Hatien
 n bay, the *Kadranj* of the Arab navigators

f Sumatra

Perak ...	—	—		
Mouth Perak river	100° 42'	4° 3'		
Kwala Semba vil- lage ...	101° 30'	3° 25'		Pr
Tanjong Kwāntān	103° 30'	4° 8'		
Tringanu river (mouth) ...	103° 5'	5° 20'		
Kelantan, capital ..	102° 15'	6° 10'		Th
Ligor, old ...	100° —	8° 26'		
Chump'hōn ...	99° 12'	10° 30'		
S'ri Vijaya ...	100° 4'	13° 49'		
Muang Krat ...	102° 18'	12° 12'		
Kampōt river ...	104° 5'	10° 35'		
Panthāimās ...	104° 21'	10° 52'		
Hatien bay ...	104° 21'	10° 22'		Ba
Rach-ja bay ...	105° 5'	10° —		
Centre, Si-Biru group ...	99° —	SOUTH. 1° 30'		

lians.

which checks the figure assumed for the latitude of the latter place at the outset of our calculations.

Identification of Solana.—As a test for our formula of correction for Ptolemy's latitudes north of the parallel of Cape Temala (Negrais), let us look up the meridian of Aganagara (Hanoi) in our map; we will find Ptolemy's Solana, for which he gives—

Long. $169^{\circ} 0'$ E. (same as Aganagara).

Lat. $37^{\circ} 30'$ N.

Reducing the latter according to formula (λ), we get $33^{\circ} 43'$ corrected North Latitude, which, on the meridian of Aganagara (Hanoi= $105^{\circ} 48'$ true E. Long.), brings us within $2'$ or $3'$ of Si-ho or Si-ho-hien, near the Si-niu river in Shen-si. This Si-ho, we may then reasonably conclude, is Ptolemy's Solana, a fact confirmed, moreover, by the similarity of name.

Identification of Sera Metropolis.—But supposing this to be a mere haphazard coincidence, let us test formulas (a) and (λ) together for the position of Sera Metropolis. The co-ordinates given by Ptolemy for the latter are—

LONGITUDE.

	Ptolemy's.	True.
Sera Metropolis	177° E.	—
Aganagara (Hanoi)	169°	$105^{\circ} 48'$ E.
Diff.	8°	

By formula (a) $8^{\circ} \times 0.725 = + 5^{\circ} 48'$

Corrected long. of Sera Metropolis $111^{\circ} 36'$

LATITUDE.

	Ptolemy's.	True.
Sera Metropolis	$38^{\circ} 35'$ N.	—
Aganagara (Hanoi)	$16^{\circ} 20'$	$21^{\circ} 1'$ N.
Diff.	$22^{\circ} 15'$	

By formula (λ) $22^{\circ} 15' \times 0.6 = + 13^{\circ} 21'$

Corrected lat. of Sera Metropolis $34^{\circ} 22'$

The resulting position for **Sera Metropolis** is therefore:

LONG. 111° 36' E. LAT. 34° 22' N.

This position, when looked for on a map of China, will be seen to fall a little to the south-west of Honan-fu in Honan, and therefore sensibly correctly near the site of where stood LOH-YANG which, it is well known, was the capital of China previous to and during the Han dynasty (A.D. 25-221), namely, exactly at the time that Ptolemy collected his data. I would not go so far as to say that the position here obtained is quite correct to a minute; I do not find Loh-yang marked in the maps of China lying at my disposal, and therefore cannot judge of its exact position; but all works on China agree in saying it lays somewhere to the west of the present Honan-fu. Hence the position just found must be correct within less than half a degree of either longitude or latitude. Such a surprising approximation will be obtained for the majority of the places named by Ptolemy in the region situated northwards of the parallel of Cape Temala (Negrais), after the above formulas of correction have been applied; and by this means they may be identified in nearly every instance.

The longitudes, however, present some complications in this field, owing to several slight errors affecting the intermediate regions between the meridians of **Akadra** and **Kamberikhon**. Such errors, nevertheless, are found, as in the case of latitude errors between **Aganagara** and **Akadra**, to compensate themselves to such an extent as not to sensibly alter the proportion of the whole. I shall explain this by an example. For instance in latitude, we find the position of **Akadra** correct enough respecting **Aganagara** and **Kamberikhon**; and yet the intermediate latitudes are not correct, because there is an error between the parallels of **Kamberikhon** and **Aganagara**, and that of **Akadra**. Yet this does not affect the position of **Akadra** in relation to the two former places. This shows that **Akadra**, **Kamberikhon**, and **Aganagara** must have been fundamental stations for

which Ptolemy obtained reliable data deduced from accurate observation; whilst Cape **Temala** and other intermediate places were merely secondary points which he determined simply on the base of road and sailing distance as reported by travellers. **Sera Metropolis** and other important inland towns, which we shall meet with afterwards, must have been also as many fundamental stations.

In the same manner, as regards longitudes, we find an identical proportion between **Kamberikhon**, **Akadra**, **Aganagara**, and **Sera Metropolis**; while we detect errors between **Kamberikhon** and Cape **Temala** (Negrais); the latter and Cape **Takola** (Takôpa); this and **Balongka** and **Akadra**; and we find the whole coast-line of Cochin-China and Annam as far as Hanoi displaced in longitude. Yet these errors compensate themselves so far as not to cause any sensible disproportion in the distances between the fundamental stations named above. This phenomenon confirms the fact resulting from the previous examination of the latitudes; that is, that **Kamberikhon**, **Akadra**, and **Aganagara** are Ptolemy's fundamental stations in Indo-China.

In order to more clearly prove this, I shall now show that the proportion mentioned above exists almost unaltered up to the extreme limits of the geographical zone considered in the present study and represented in the accompanying map.

Identification of Ptolemy's "Stone Tower."—As far as longitudes are concerned, the proportion alluded to has already been shown to exist as far as **Sera Metropolis**, lying on Ptolemy's 177° meridian of eastern longitude = 111° 36' E. of Greenwich, and therefore pretty near to the easternmost limit of the *habitabilis*. It remains, then, to show that the same proportion exists up to the westernmost limit of our field, and this I will do by applying the test to the meridian of Ptolemy's so-called "Stone Tower,"

which is also that of his **Kanagora** (identified with Kanauj or Kanoje, in India). The result is as follows :—

LONGITUDE.

	Ptolemy's.	True.
Aganagara (Hanoi)	169° E.	105° 48' E.
Lithinos Pyrgos ("Stone Tower")	135°	
	Diff.	34°

to which, applying formula (a), $34^\circ \times 0.725 = 24^\circ 39'$

Remains long. of **Lithinos Pyrgos** 81° 9'

As the meridian of **Lithinos Pyrgos** is the same as that of **Kanagora** (Kanoje), for which the true long. E. of Greenwich is about 79° 50', we see that the error is only about 1° 19' on the whole distance Hanoi—Kanoje, including some 26° degrees of longitude. But, as we shall soon see, the **Lithinos Pyrgos** is—who would ever have suspected it? —**ILCHI**, **ILTSI**, or **KHOTEN**, the true longitude of which is 80° E., a yet closer approach to our calculated result.

If the **Lithinos Pyrgos** be really Khoten, this ought to be proved by a close coincidence in latitude as well; and this is exactly what I am now going to show.

LATITUDE.

	Ptolemy's.	True.
Aganagara (Hanoi)	16° 20' N.	21° 1' N.
Lithinos Pyrgos	43° 0'	—
	Diff.	26° 40'

to which, applying formula (λ), $26^\circ 40' \times 0.6 = + 16^\circ 0'$

whence, corrected lat. of **Lithinos Pyrgos** 37° 1'

Now, this is, within one single minute, the latitude of Khoten, given by the latest authorities as 37° N.

This surprising exactness at once reveals to us that the **Lithinos Pyrgos**, or so-called "Stone Tower," must have been one of Ptolemy's fundamental stations carefully established by observation, whether astronomical or otherwise. A perusal of the first book of his geography shows, in fact, the pains he took in rectifying Marinus' estimate of

the distance from the passage of the Euphrates to the "Stone Tower" (**Lithinos Pyrgos**), and from the latter to **Sera Metropolis**. This proves that both the latter belonged to his list of fundamental stations. On the strength of Ptolemy's assumption that the "Stone Tower" was situated near the parallel of **Byzantium** (real lat. 41° N.), and of the coincidence in meaning between it and **Tāshkand** (real. lat. $42^{\circ} 58'$), most authors hitherto identified it with the latter place; though Heeren and Rawlinson located it much more eastward—the former near Ush, and the latter at **Tāsh-Kurghān** (true lat. $37^{\circ} 46'$ N.), which are places situated much nearer to **Khoten** than the far-away **Tāshkand**. Indeed, the intersection of the meridian of Ush with the parallel of **Tāsh-Kurghān** would fall only a few miles to the north-west of **Khoten**, our identification.

It is easy to show that Ptolemy's "Stone Tower" could not be situated so far west as **Tāshkand**. Let us take, in fact, his longitude of **Marakanda** (**Samarkand**), which he gives as 112° , the real one being about 68° E. Greenwich, and let us observe that the same longitude is assigned by him to the central mouth of the Indus. The average longitude of the mouths of the Indus named by him is 112° ; the real one would be about $67^{\circ} 15'$, that is, within $45'$ of the meridian of **Samarkand**. This proves Ptolemy's estimate of the position in longitude of **Marakanda** with respect to the central mouth of the Indus so surprisingly correct, as to dispel any doubt that might be entertained on this score. This point settled, we see that Ptolemy assigns long. 135° to his "Stone Tower," that is, he places it 23° further east than **Marakanda**. Now the real longitude of **Samarkand** being about 68° , and that of **Tāshkand** 69° , we see at once the impossibility of identifying the latter place with the **Lithinos Pyrgos**, despite the coincidence of meaning in the two names.

Calculating the 23° of Ptolemy's longitude on the base of the longitudes of the central mouth (**Kariphron**) of the Indus (Ptol. long. 112° = real long. $67^{\circ} 15'$) and of the central mouth of the Ganges (Ptol. long. $146^{\circ} 30'$ = real long. $89^{\circ} 30'$), we obtain $14^{\circ} 50'$ as an equivalent of

Ptolemy's 23° , which added to $67^\circ 15'$, the longitude of **Kariphron**, gives us $82^\circ 5'$ as the corrected longitude of the "Stone Tower."

This result is within $56'$ of that obtained at the outset from **Aganagara** and **Kamberikhon**, i.e. $81^\circ 9'$. Both point out with sufficient approximation where Ptolemy's "Stone Tower" should be looked for. In calculations I have adopted **Khoten**, and its meridian, 80° real long as equivalent to 135° Ptol., the longitude of his "Stone Tower"; and thus corrected his error in excess in the reckoning of its distance from **Samarkand**. This rectification will serve also to correct his distance errors on the stations between the **Indus** and **Kanoje**, and between the latter place and the **Ganges**.

Though we have shown the accuracy of our formula (λ) in the rectification of the latitudes assigned by Ptolemy to places north of his 8th parallel (**Cape Temala**), and the proportion existing in latitude all over that zone, it will be found, as a result, that most places west of the **Ganges** will yet prove to be, after that formula has been applied, somewhat north of their true position. This is due to a local error made by our geographer in the delineation of the course of the **Ganges**, to which he attributed a direction much more northerly than it really is, thus causing a displacement towards the north-east of all towns situated on its banks and in the neighbourhood. I have shown and corrected this error in the map only for those towns lying on trade routes between the **Ganges** and **Tibet**; as the small space available would not allow of extending the correction to all those represented in that portion of the map. What strikes one more than anything else in the examination of Ptolemy's geography north of his parallel of **Temala**, is the proportion maintained all over the field in his latitudes. Surely these must have been determined by astronomical observation, or by accurate computation from the length of the sun-shadow and other means. More lacking in accuracy are, as might be expected, his longitudes. The stations at which a high degree of approximation has been attained in this respect are few and far between, and the longitudes

of the intervening places had thus to be reckoned on the uncertain base of the estimated road distance travelled. This is the cause that while we find sufficient proportion maintained between the longitudes of Ptolemy's fundamental stations from the "Stone Tower" to **Sera**, we detect local errors in the intervening region, which must be corrected if the identification of the places included within its limits is to be arrived at with any degree of success. For this purpose the map has been divided into vertical zones by base meridian-lines (in red), between which Ptolemy's error in longitude was carefully determined and corrected by a particular formula for each zone. A double set of scales shows how the general error was determined between the fundamental stations and apportioned among the secondary ones.

The process will appear clearly enough on the map, and needs no further explanation here. The following is a list of the base meridian-lines adopted, and of the corrections to be applied to the places lying within each particular zone determined by them.

	Ptol. long.	Diff.	Real long.	Diff.	Correction applied.
(1) Meridian of the "Stone Tower" (Khoten) and Kanagora (Kanoje) ¹ ...	135° —		80° —		
(2) Meridian of Kambersikhon	146° 30'	11° 30'	89° 30'	9° 30'	0·826 (δ)
(3) Meridian of Cape Temala (Negrais)	157° 20'	10° 50'	94° 22'	4° 52'	0·45 (γ)
(4) Meridian of Cape Takola (Takôpa)	158° 40'	1° 20'	98° 19'	3° 57'	2·9625 (β)
(5) Meridian of Balongka (Chump'hôn)	162° —	3° 20'	99° 12'	0° 53'	0·725 (α)
(6) Meridian of Akadra (Hatien)	167° —	5° —	104° 21'	5° 9'	
(7) Meridian of Aganagara (Hanoi)	169° —	2° —	105° 48'	1° 27'	
For localities east of Aganagara (Hanoi) ...	—	—	—	—	

¹ The meridian of Kanoje (79° 50' E. Greenwich, true) was adopted in the map.

The correction between the Cape **Takola** and **Balongka** meridians was required only locally for some places on the Gulf of Siām, and so was that between the **Balongka** and **Akadra** meridians. The corrections involved here were operated graphically, and represented on the map. The same may be said of similar corrections in the Gulf of Martaban, on the coast north of Cape Negrais, and on the Cochin-Chinese and Annamese coasts, in each of which cases the course that Ptolemy's coast-line would assume, were the local error left unrectified, is duly shown in red outline. Northwards of the Gulf of Siām, the intermediate errors between the meridians of **Akadra** and **Takola** are so slight as not to need any special correction different from that given by formula (a), by which the real longitude of **Takola** was originally determined. Hence the correction indicated by this formula was indistinctly applied to all positions in the zone between those two meridians lying northwards and southwards of the Gulf of Siām, even down as far as Sumatra. It may thus be seen that all longitudes of Ptolemy's places lying eastward of the meridian of Cape **Takola** or **Takôpa** (Cape Papra), that is, eastwards of long. $158^{\circ} 40'$ Ptol. = $98^{\circ} 19'$ E. Greenwich, can be fairly corrected by that single formula. The most grave error is that made by Ptolemy between Capes **Temala** and **Takola**, in assigning them a difference in longitude of $1^{\circ} 20'$ only, against $3^{\circ} 57'$ real. This proved at first a great drawback to the identification of their true position. But as soon as I had made sure as to the real latitude of Cape **Temala** and fixed its position, I obtained the correct longitude of Cape **Takola** from the base-point, **Akadra**, by a simple calculation, as follows :—

	Ptolemy's.	True.
Akadra (Hatien). Long.	$167^{\circ} 0'$	$104^{\circ} 21' \text{ E.}$
Cape Takola (Takôpa). „	$158^{\circ} 40'$	
Diff.	$8^{\circ} 20'$	

By formula (a) $8^{\circ} 20' \times 0.725 = 6^{\circ} 2'$
 remains, correct long. of Cape **Takola** $98^{\circ} 19'$

This result is correct within three minutes of the longitude of Cape Papra or Cape Takôpa, on the western coast of the Malay Peninsula, just above Junkceylon Island. This cape, which I found confirmed by a calculation of latitude, was beyond any possible doubt Ptolemy's Cape Takola, is really in long. $98^{\circ} 16'$; but I thought it was unnecessary to make the slight correction of $3'$, as being of no consequence whatever on the results of this inquiry.

Having now dealt with the region situated to the north of the parallel of Cape Temala, and shown how Ptolemy's positions of places therein were rectified, it remains to speak of the region southwards of that parallel. The rules given in the upper zone for longitudes apply also here, with the exception of the islands in the Gulf of Bengal, for which there seems to be hardly any rule or order, but which will be briefly dealt with in the sequel. It remains, then, to explain the corrections that latitudes need in this lower zone. In it we find sufficient proportion south of the parallel of Akadra; hence, all this section is easily corrected by reference to Akadra and Aganagara as base-points, that is, by formula (ϕ). The only anomaly lies between the parallels of Akadra and Cape Temala, due, as we have seen, to the shortening of the southern coast of Annam and western coast of the Malay Peninsula between those two parallels. This is easily corrected, however, by dividing the interval between the parallel of Akadra (Hatien), lat. $4^{\circ} 45'$ Ptol. = $10^{\circ} 22'$ N. true, and that of Cape Temala (Negrais), lat. 8° Ptol. = 16° N. true, in proportion to their difference in latitude: lat. $3^{\circ} 15'$ Ptol. = lat. $5^{\circ} 38'$ true, whence the formula of correction for Ptolemy's latitudes in this section—

$$\frac{5^{\circ} 38'}{3^{\circ} 15'} = 1.733 (\kappa),$$

which will restore to the western coast of the Malayan Peninsula and to the eastern coast of Cochin-China the length they had lost under Ptolemy's manipulation, and make them at once recognizable. The above correction is not sufficient, however, for the upper portion of the Gulf of Siām, the

coast of which, Ptolemy thought, was running parallel to the equator, wherefore he neglected to show its deep incavation northwards. As a result of this, **Pagrasa** and **Samarade** are displaced right into the middle of the Gulf. This purely local error, due entirely to lack of accurate information as to the latitude of those towns, must be corrected as shown in the map; and one will then at once recognize in **Pagrasa** and **Samarade** the towns of **KRAT** (Kraṣ or Krāṣa) and **ŚYĀMA-RASHṬRA** (or *Sāma-ratṭhē*), better known as *Srī Vijaya Rājadhānī*, the most ancient capital of lower Siām.

Formula (κ) will furnish us with a satisfactory proof of its accuracy when tested in the determination of the position in latitude of **Berabai**. The difference in latitude between the latter place and **Akadra** is :

$$6^{\circ} - 4^{\circ} 45' = 1^{\circ} 15' \text{ Ptol.}$$

This multiplied by (κ) becomes $1^{\circ} 15' \times 1.733 = 2^{\circ} 10'$, which, added to the true latitude of **Akadra**, gives us—

$$10^{\circ} 22' + 2^{\circ} 10' = 12^{\circ} 32' \text{ true N. lat.,}$$

which is, within 5', the latitude of **MERGUI** (real latitude $12^{\circ} 27'$). This place becomes, therefore, unmistakably identical with Ptolemy's **Berabai**; and the close similarity between the two names confirms that identity.

The Islands.—It remains now to broach the most difficult subject of the islands, one perhaps that will never be satisfactorily solved, at least so far as the islands in the Gulf of Bengal are concerned. With regard to those east and west of Sumatra, and to the latter island itself, I believe there is reason to be satisfied that they, as will be shown by a look at the map, have been successfully identified. But as to the former, there is hardly anything that can guide us in forming an estimate of the amount of Ptolemy's error. However, I made an attempt at their identification on the assumption that Ptolemy reckoned their position in reference to the coast of Coromandel and Ceylon; this seems natural, as the ships trading between those coasts and Further India would touch at them on their way before reaching either

the Malay Peninsula or Sumatra. I therefore tried to fix them in longitude by dividing the space between Ceylon and the meridian of Cape **Takola** in proportion to their difference of longitudes as given by Ptolemy. Their latitude was established: for the northern ones, in relation to the difference of latitudes between the River **Maisolos** (*Godāvarī*) and **Poduke** (Pondichery); and for the southern, in reference to the latitude of places in Ceylon.

With regard to the three groups of islands to the west of Sumatra, the same process was adopted only so far as it was necessary to establish their longitudes; the latitudes having been left to follow the law of all other places situated south of the parallel of **Akadra**.

Of course, all these islands were very little known in Ptolemy's time; hence the great error in estimating their position.

Identification of Ptolemy's places on the Chinese Coast.—

I may now conclude this review of the methods of identification pursued with a few words in explanation of the reason why I decided to swing the farther coast-line of Ptolemy's **Magnus Sinus** round the Lui-chau peninsula taken as a pivot, until it came in juxtaposition with the coast of China, instead of allowing it to remain in the traditional position assigned to it by our geographer, and from which none of his commentators and elucidators ever dared to remove it. Evidently I must have arguments for justifying this desecration of the work of our eminently classic geographer. As a matter of fact, my justification rests upon but one single argument, sufficient though, I think, to meet all criticism; and this is, that when the farthest coast of the **Magnus Sinus** is mapped down in the traditional position, *but with its latitudes uniformly corrected according to the formula for places lying northwards of the parallel of **Temala***, and then projected upwards as shown in the map, all its gulfs, rivers, and towns will be found to coincide, or nearly so, with gulfs, rivers, and towns of similar names on the coast of China. When the names are not similar in pronunciation, the meaning conveyed

by the two names in each case is identical. This ought to convince us sufficiently that the coast of China was meant here by Ptolemy and no other. But how was he led to make it turn southwards? Certainly out of homage to the belief, so firmly and generally grounded among his contemporaries, that the coast of **Sinai** turned south, and then running parallel to the equator joined the coast of Africa at Cape **Prason**. Impressed with this belief, he mapped all distances from **Aspithra** onward in a southerly instead of in a north-easterly direction in order to fulfil the dictum of the philosophers of his time, and thus obtain an eastern limit to his *habitalis* and to his **Green Sea**.

That this must have been what actually happened with him, is plainly shown by a look at our map. As regards the reason why I selected Lui-chau as a pivot on which to swing Ptolemy's coast of **Sinai** upwards, it is because I discovered that this was really Ptolemy's **Aspithra**. *Ho-p'ò* (in Chinese) or *Hiêp-p'ò* (in Annamite pronunciation) was, in fact, the ancient name of Lui-chau and of the whole of the homonymous peninsula, as I will show in the illustrative notes of the next section; and any tyro in philology will see that *Ho-p'ò* and **Aspithra** are mere transliterations the one of the other. This striking identification of Ptolemy's extreme station to the east of the Tonkin Gulf—his **Magnus Sinus**—enables us to know exactly where the distortion of his coast of **Sinai** commences, and thus to correct it by bending the coast-line back to its true position as shown in the map.

With this the rectification of the main features of Ptolemy's geography of Further India is complete; and it will now appear how it would have been next to impossible to identify any of his stations in that region without having previously restored the principal among them to their true position. The errors and displacements detected not being uniform all over that zone, the uselessness and impossibility of a general formula that may serve as a panacea for so many different evils, becomes at once apparent. The reason of our success lies, therefore, in

having broken off for once with the old system of treating Ptolemy's work as if it had been the result of a regular trigonometrical survey of the regions in question, in which the only defect was bad mapping due to errors of projection and errors of scale by having underestimated the length of equatorial degrees and misplaced his prime meridian and equator.

It is to be hoped that with the above explanations and the map that accompanies them, our process of elucidation of this portion of Ptolemy's geography will be easily understood, and recognized to be the only practicable and correct one, at least in its main lines. Of course it would be too much to expect intermediate stations to fit in exactly in the place they should occupy ; but it will be seen that the majority of them come within a degree or so of their true position ; a result, I think, that ought to satisfy the most exigent and pedantic of Ptolemy's critics.

The map was drawn on the plane method, and not according to Mercator's system, the chief object being, not to preserve the real shape of islands and continents, but to render the numerous graphical corrections to Ptolemy's latitudes and longitudes easier of application and the more clearly understood. Thanks to the introduction of coloured outlines to represent Ptolemy's geographical features, and of particular contrivances to show the position of his stations as resulting from his data, and the direction in which the corresponding real stations are to be found when there is an error in the former, it is hoped that a clear graphical representation of what Ptolemy's geography is in comparison with what it ought to be, has thus been presented which will enable the reader to form at a glance a judgment and estimate of the differences between the two. For those who desire to verify the position of Ptolemy's stations as laid down in my map, I append tables giving the names and co-ordinates of each as transmitted to us by the great Alexandrian geographer, together with their positions corrected from calculation, and the actual stations corresponding to them whenever they could be identified.