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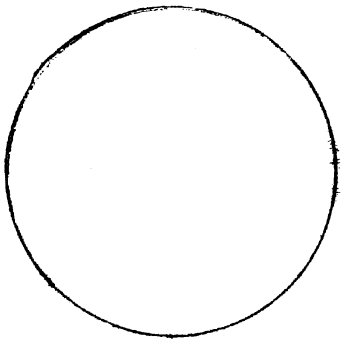

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Notes and Errata to THE COPERNICAN 'REVOLUTION' FROM A MATHEMATICAL POINT OF VIEW

in the diagrams-

plates 1 and 3- W is the angle through which the heavenly body seems to have travelled to an observer on the earth.

plate 1- Westward - eastward becomes eastward - westward (that is, clockwise motion is westward, counterclockwise, eastward).

Line of Apsid.. becomes Line of Apsides

It is a peculiarity of my diagram that the inner planet's epicycle passes through the earth, but we must remember that Ptolemy's Martian epicycle does something similar to this in that it passes through the earth from time to time in its course on the deferent. What we are confronting in such a problem is the limitation of a purely mathematical hypothesis.

plate 2- All motion is counterclockwise.

plate 3- W in the eccentric becomes w_1.

Once again, clockwise motion is westward, counterclockwise, eastward.

in the text

p. 40 para. 3 This is a circular definition, but unavoidable in the Ptolemaic scheme.

p. 45 para. 3 add ..at apogee rather than perigee when it is in conjunction with the sun, or vice versa, at perigee rather than apogee when it is in opposition with the sun.

1. Part II answers enough of the questions Part I suggests to come to its conclusions. But, since the heavens present us with more facts than part I chooses to reveal, there necessarily remain more and important distinctions in the way the two contending hypotheses treat of them from a mathematical point of view. (In particular, to use the words of part I, irregularities are, in turn, irregular; Ptolemy must introduce the equant, Copernicus the tiny epicycle.) This, in addition to the questions suggested by Part I which are yet unanswered, are the subjects of further consideration.

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SPECULATIONS ON THE INTENT OF THUCYDIDES

First Prize Freshman Essay, 1962

by David Lachterman

Preface

What is the purpose of written history? I propose to investigate that question in terms of one historian of antiquity--Thucydides. An inquiry such as this must rely on the evidence of the text; nevertheless, evidence of this sort in Thucydides is scanty and ambiguous. Consequently, once we have discerned what in the text is germaine to the question we must interpret and speculate in hopes of finding a reasonable solution to the problem. At the same time, however, we must consider serious alternatives to any one solution.

I have confined my inquiry to the prologue to Thucydides' History. There Thucydides anticipates three questions that the reader might raise: why did he choose to write the history of this particular war, what effort does he intend to make vis-a-vis the reader, and what is his purpose in writing the History? I shall discuss these questions in turn, presenting in each case what seems to me to be Thucydides' answer.

I. Thucydides anticipates and answers the reader's first question in the opening statement of the History. The two clauses - ἀρξάμενος εὐθὺς καθιστάμενου (beginning as soon as they took up arms) and ἐλπίδας μέγαν τε ἔσεσθαι καὶ ἀξιολογώτατον τῶν πρόσθεν (expecting it to be great and most worthy of an account than the events of the past[1]) - imply that the choice of this particular war was advantageous on two counts. The first clause

suggests that what we shall read is contemporary history; that is, history that has been recorded while it was being made. The force of this becomes clearer when Thucydides remarks a bit later that 'Homer lived long after the Trojan War' and when we remember (as Thucydides must have done) that Herodotus was born only four years before the battle of Thermopylae. Hence, Thucydides had an unique opportunity to observe and to participate in the very events he described. He seems to suggest here that the accuracy of an historical account is influenced by the amount of time that separates the historian from what has taken place. Had Thucydides chosen to write the history of events in the past, he would not have had the same opportunities for gathering his material and testing his evidence. It was to his own advantage to compose the history of 'current events' rather than to probe retrospectively into the past. When direct observation was impossible, he could consult the actual participants in any enterprise rather than their descendants as Homer and Herodotus surely must have done.

Not only was it to his advantage to compose the history of current events; the nature of those events demanded his attention and guaranteed the significance of his account. Thucydides expected this war to be 'worthiest of an account'. I should like to spend some time considering the actual meaning of this phrase before examining its implications.

This word ἀξιολογώτατον is most puzzling. Marchant[2] cites its presence in this particular clause as an instance of the illogical comparative in Thucydides. We have a superlative followed by what appears to be the genitive of comparison. Hence, we read 'worthiest of an account than the events that took place previously'. In English this is clumsy and, in fact, incorrect. I have been informed

that the same is true for the Greek. Unless, however, we call τῶν προγεγενημένων the genitive of class (which from the argument that follows it certainly is not), we cannot avoid this translation. The thought here seems to be that not only is this war more noteworthy than all previous wars, but worthier than any future wars. The superlative is a category that, at first sight, is alien to history. Since the historian must deal with particulars, he uses 'more' and 'less', 'before' and 'after'. Here we encounter something different. This war is the greatest war, beyond comparison, in a sense, with the wars of the past and of the future.

Marchant[3] remarks that this statement "involves a very great exaggeration of a fact ascertainable and it is unlikely that Thucydides would make such a sweeping statement". This suggestion does not seem very appropriate in the light of Thucydides' subsequent arguments. In his mind, it is no exaggeration to say that the Peloponnesian war was the greatest of all wars.

What does Thucydides regard as justification for this expectation? He first argues that "both states were at the height of their military power and that all the Hellenes had or were planning to take sides". Thucydides employs the greatest portion of his prologue for the purpose of demonstrating the feebleness of antiquity. I suggest that this demonstration be regarded as an illustration of the growth and motion of the city-states in the direction of this conflict.

Thucydides seems primarily concerned in the so-called Archaeology with disparaging the claims of previous enterprises to greatness. The past was handicapped not only by

the want of money, but also by the want of technology and community of spirit. The Persian War, which involved most of Hellas, was the greatest undertaking prior to the Peloponnesian War, yet it was swiftly decided in four battles. However, Athens and Sparta emerged from the conflict as the two most powerful states in Hellas.

Thucydides' point seems to be that the contending city-states did not reach their full maturity until the beginning of the Peloponnesian War. He regards their previous efforts in war as preparatory to this greatest war. Thus, Thucydides' purpose is not simply to disparage the past, but rather to illustrate in the past the impediments that had to be removed before the greatest war could be fought.

I use the word impediments here with some care. Paragraph fifteen has ἐπεγένετο κωλύματα μὴ αὐξηθῆναι, where the best translation for κωλύματα is impediments or hindrances. Hellas was forced to wait until all was in readiness, until the actors were armed with every resource and skill and the cast had taken their places[4] before she could stage the greatest war.

Thucydides is very much concerned with impressing upon the reader the fundamental antagonism between Athens and Sparta. Paragraph six of the prologue, where mention is made of the habits of dress among the Athenians and Lacedaemonians, and paragraph ten, in which the splendor and pomp of Athenian architecture is contrasted to the inornate appearance of Sparta, both illustrate the polarity of the two states.[5] We are no longer dealing with a petty quarrel between neighbors; the Peloponnesian War was to bring together two states opposed by nature in almost every respect. Thucydides'

brief remark "the one strong by land and the other by sea" is an understated summary of this polarity.[6]

When Thucydides expected this war to be much worthier of an account than any event in the past, the war promised to be the supreme test of the rival city-states. Not only would it be the test of military efficiency; moreover, the integrity of each state as well as the strength of its political structure would be challenged. Obviously, we cannot disengage the suggestion of finality from this idea of a supreme test. In other words, Thucydides construed this war as the final arbiter of the political destiny of Hellas.

The sentence following ἀξιολογώτατον κτλ. confirms Thucydides' suspicions: "for it produced the greatest change (κίνησις) among the Hellenes and part of the Barbarians and, as we may say, affected the greatest part of mankind".

One might argue that the war between the two greatest city-states was inevitable. Separated geographically by an inconsiderable distance, in thought and habit they stood at opposite poles. Yet both bore the name Greek. To achieve any understanding of that name and of the experiences associated with it we must understand the character of their conflict. No other single event illumined the meaning of 'Greek' as this one did. No other war defined the issues so clearly, nor set the stakes so high. Future wars might bring more bloodshed, but not more understanding.

The Peloponnesian War was, necessarily, an unique occurrence in Hellenic history. As such it was a 'particular'; nonetheless, some scholars[7] have suggested that Thucydides attempted to show universals in the singular. For Thucydides, they contend, the Peloponnesian War brings to light the

universal war. History, on their view, becomes philosophic, and the historian, a philosopher of a sort.

This argument presupposes that there is such a thing as the nature of war which is common to all wars and, furthermore, that one war can be at the same time both unique and exemplary. If these assumptions are correct, then the logos of the greatest war will be the logos of war as such.

When Thucydides sets out to describe the greatest war, he makes no mention of any desire to reveal something about the nature of war itself. This fact, however, is not conclusive in itself. What we must discuss is Thucydides' notion of greatness. The past, according to Thucydides, was not great either in respect to its wars or to anything else. Hence the history of the past is recounted only for the sake of demonstrating its feebleness. Once he has established the transcendent greatness of this particular war, he can dismiss whatever falls short of it. He does not feel obliged to speak of what is not great except incidentally.[8] The account of the greatest war, then, is not a description of war as such; indeed, when we have understood the greatest war it becomes unnecessary to consider any other war.

Thucydides does not appear to have any comprehensive notion of the nature of war as such. The statements he attributes to various speakers, which might be construed as his own opinions, seem proof to the contrary: τὸν παρόντα τοῦ πολέμου ... κατά (Bk. I, P 78); ἥκιστα γὰρ πόλεμος ἐπὶ ῥητοῖς χρεών ... (Bk. I, P 122). Indeed, the only 'nature' that Thucydides explicitly describes is human nature.

This discussion does not pretend to be exhaustive. The

argument that history describes the universal in the singular cannot be discounted so easily. Its full importance, however, extends beyond the confines of this paper inasmuch as it raises the question of the relationship of history to philosophy. The point that I wish to make is that this argument rests on two presuppositions which stand in need of rigorous verification. It is necessary to prove that Thucydides supports a concept of 'the nature of war as such' and that he takes any interest in subject matter that lacks transcendent greatness. I have suggested that his choice of the Peloponnesian War as the theme of his History was influenced by the nature of that conflict itself and not by any abstract concerns. This war was worthiest of an account; whatever Thucydides' purpose might be in writing the History, this theme would best serve him.

II. The second consideration of this inquiry is the historian's attitude towards his readers. This discussion must necessarily treat both the historian's position and the role (or roles) that he assigns to the reader.

Most of our information concerning this issue is to be found in the three concluding paragraphs of the prologue. This section is the agent of transition from Thucydides' sketch of ancient history to his account of the Peloponnesian War. However, it does not merely fill a gap in the narrative; in content it is certainly among the most important portions of the text. I propose therefore to treat each paragraph separately with some care before offering any suggestions as to the meaning of the whole. In doing so, I shall make the assumption (with some warrant) that Thucydides is addressing the readers of

the future no less than his contemporaries.

The first paragraph begins with a statement of completion -- τὰ μὲν οὖν παλαιὰ τοιαῦτα ηὗρον (such things have I found out about the ancient days), a warning -- χαλεπὰ ὄντα πάντῃ ἐξῆς τεκμαίρεσθαι πιστεύσαι (although it is difficult to trust every piece of evidence) and an accusation -- οἱ γὰρ ἄνθρωποι τὰς ἀκοὰς τῶν προγεγραμμένων, καὶ ἢν ἐπιχωρίων σφίσιν ἢ ὁμοίως ἀβασανίστως πρὸς ἀλλήλων δέχονται. (for men received the accounts of the things that have happened whether they be about their own country or about any other without examination). Thucydides' researches into the past have come to an end; he must now impress upon us the limitations of such an undertaking. The crucial word in this clause is πιστεύσαι ; the historian cannot trust all the evidence he has compiled, yet at the same time we are to understand that whatever evidence he has accepted is 'trustworthy' -- not absolutely accurate or true. I shall have more to say about this later.

Thucydides' accusation carries weight in two directions: first, his contemporaries are too quick to endorse hearsay reports of the past; second, the citizens of the future will make the same mistake in regard to the age which Thucydides has described. The charge would not be as serious if Thucydides had omitted ἀβασανίστως. This is the truest source of man's culpability in these matters.

We might recall at this point Herodotus' statement: "For myself, my duty is to report all that is said, but I am not obliged to believe it all alike -- a remark which

may be taken to apply to my whole history." Here we have what seems to be a similar warning; however, closer examination reveals that this is not so. Herodotus, although he does not feel compelled to trust every piece of evidence, does intend to report all that he has heard or learned. In his case, we are not to expect a rigorous examination of the evidence, whereas with Thucydides this is his manifest intention. In fact, Thucydides does not leave us to our own devices in this matter; instead he immediately reports three historical errors of the sort that he must surely despise. What is remarkable about these three instances of inaccuracy that he lists is that they all appear in the work of his predecessor Herodotus[9]. Not only does Thucydides accuse mankind as a whole of indolence; he also censures a particular historian in no uncertain terms.

The final sentence of the paragraph is dramatic and impressive: "so careless is the search for truth for many, so quickly do they accept whatever comes first to hand"; its significance is more elusive than manifest. It is clear, I suppose, that ἀταλαίπωροι echoes ῥᾳθυμότατοι in the first sentence. Here however the condemnation seems even stronger; the aggressors have not merely accepted the erroneous accounts of others, rather they themselves have inaugurated the possibility of falsehood through their impatience and remissness. The reference is not to Herodotus alone, but to all those for whom the search for truth is a matter of indifference. They embrace what is at hand without taking any pains to authenticate the claims made or the facts presented. This much is explicit; the difficulty arises when we consider the phrase "the search for truth". Presumably

Thucydides has undertaken that search in regard not only to ancient history but also to the Peloponnesian War. As to the former, we have already been informed that it was impossible for Thucydides to make out the facts plainly. In that case it was on the basis of a trust, achieved after a long and sedulous examination of the evidence, that Thucydides drew his conclusions. We must assume that the forthcoming account will be marred by the same defect and at the same time ennobled by the integrity and honesty of the historian's effort. Necessarily, the historian's proximity to the achievements he is about to describe will allow him to ascertain more of the facts; even so, the exact truth is inaccessible[10]. Indeed, Thucydides seems to be arguing that truth as such is always inaccessible in history. Quite obviously, the facticity of history is too widely diffused, too susceptible to the distortions of time, to be available as a whole to any one researcher. Yet this does not signify the ultimate betrayal of the historian's effort. The search for the truth must be made, not superficially but tirelessly and scrupulously, in spite of the prior realization that insofar as the object is unattainable the search itself is condemned to failure. The search will not be barren of accurate and meaningful results, as Thucydides' History illustrates so well. It is to those investigators who have been inhibited in their efforts by this presentiment of failure that Thucydides' remark is directed. The reader has been forewarned, but he has also been encouraged to respect the historian's intrepidity and to appreciate the diligence of his inquiry.

In the second paragraph of this group, Thucydides

articulates, in a most striking fashion, the grounds of his quarrel with poets and logographers. We soon realize, however, that this quarrel has the aspect of a bitter rivalry. Ὅμως must refer to the previous paragraph in which Thucydides describes the limitations of historical research. Hence, we read: "In spite of this, a man on the basis of the evidence presented, by thinking the same sort of thing as what I have described would not be far wrong, rather than by trusting either the poets who have sung about these things with great embellishments, or the logographers who have sought to make their compositions more attractive to their listeners than truthful"[11]. Thucydides assures the reader that his account is reliable; at the same time, he accuses his 'competitors' of perverting the truth for the sake of literary or rhetorical ornamentation. The sentence continues: "Their accounts cannot be tested by them; and most of the facts in the lapse of ages have passed into the region of romance. At such a distance of time he must make up his mind to be satisfied with conclusions resting upon the clearest evidence which can be had".[12] Jowett's translation appropriately emphasizes ὄντα ἀνεξέλεγκτα (being no longer open to question) and ηὑρῆσθαι ἡγησάμενος .. ... ἀποχρώντως (it is enough to believe the facts to have been discovered...).

The explicit reference throughout is to Thucydides' account of ancient history. **Implicitly, however, his** remarks are addressed to the readers of the distant future. These readers will occupy the same position in relation to the Peloponnesian War that Thucydides and his contemporaries occupied in relation to the Trojan War. In addition, Thucydides might well expect the present war

to be celebrated by poets and chroniclers. Consequently, we must read this sentence as though Thucydides were speaking directly to us, alive twenty-five centuries after his death.

The passage of time obscures the facts of history. Someone who studies the past can have no direct knowledge; he must rely on the evidence of the past preserved for him by the men of any age he wishes to study. Even so, such records cannot be tested or questioned. Much of history is transformed into legend and romance. Furthermore, as Thucydides points out, the chroniclers and poets to whom the preservation of historical fact has been entrusted are not trustworthy. This is the dilemma of historical understanding as Thucydides sees it. An historian contemporary with the achievements he describes can never ascertain the absolute truth; anyone separated from those same achievements by the lapse of time is confronted by a wasteland, dotted here and there with reliable evidence. Thucydides proposes the only solution to this problem: whoever wants to understand the past must believe that he has been given the facts drawn from the clearest evidence which can be had.

This is the ostensible significance of the passage. I think, however, that Thucydides has told us a great deal more about the effort of the historian. Two words characterize this passage: πιστεύειν and ἡγεῖσθαι (to trust and to believe). Trust is all that the historian can expect of his readers. Thus, the limitation noted above is reciprocal. Since an historical account cannot be verified, the historian must convince the reader that he has achieved the greatest degree of accuracy possible

in such an enterprise. Thucydides would have the historian elicit the belief of the reader. The historian can never be absolutely sure; the reader even less so. Nonetheless, they must meet on the common ground of trust. This concept is central to Thucydides' notion of the historian's effort. The reader must be persuaded that each conclusion articulated in the History rests on a foundation of trustworthy evidence[13]. While the historian attempts to persuade his audience with reference to his own account, he must also convince them that what others have said or written is unreliable. Thucydides' purpose in derogating the poets and chroniclers is to win the exclusive sympathy of his audience. Insofar as those writers have endeavored to persuade, they are Thucydides' rivals in a rhetorical contest. The victor's reward is belief.

The last paragraph in this section is perhaps the most memorable. It includes a possible answer to two of the questions we posed at the outset of this paper. Here I shall deal with its significance in relation to the question of effort.

Thucydides first deals with the speeches. He reports the difficulty involved in recollecting the exact words of each speaker. In the face of this obstacle, he "represented the various speakers as uttering the sentences that seemed to me appropriate to the particular occasion, as I believed that they would have best expressed what it was necessary to say." The historian must strive to represent the thought of each speaker as accurately as possible. Thucydides chose to present τὰ δέοντα (the necessary things)[15].

Throughout the speeches in the history the speakers are concerned with the classical topics of rhetoric: justice and injustice, honor and expediency. We may infer from this that Thucydides patterned the speeches on rhetorical models. We are not to believe, however, that he engineered the speeches solely to fit his own purposes.

Thucydides acquits himself further with regard to his treatment of the actual events of the war. His information was gained either first hand or from others of whom he made the most scrupulous inquiry.

Thus far in the paragraph Thucydides has explained his methods; in the final sentences he characterizes his account for the benefit of the reader. We have encountered τὸ μυθῶδες in the previous paragraph; here Thucydides predicts that the 'unromantic' character of his methods will be displeasing to the ear. Hence, the reader should not expect to be entertained by flights of poetic fancy. The occurence of τὸ μὴ μυθῶδες plainly refers us back to Thucydides' previous assertion that most of the facts have passed into the realm of legend and romance. We are being told that this account will be as free as possible from the rhapsodic unintelligibility of the poets and chroniclers.

"However, it will be enough for whoever wishes to examine the clear element of the things that have happened and of such and such-like things that may be expected to happen again according to human nature to judge this work useful. This has been composed as an eternal possession, not as a prize essay to be heard offhand". In this remarkable conclusion, Thucydides clarifies the roles he

has assigned to the reader. The words σκοπεῖν (to investigate) and κρίνειν (to judge) characterize these roles.

As has been stated above, the reader cannot have direct knowledge of the past. Nonetheless, he can study and examine the evidence and accounts in which the facts are presumably preserved. The reader must, according to Thucydides, make an effort to understand; the 'clear element' will not be quickly and easily apprehended. It will be there for the reader to find -- if he has the desire and industry. On this point Thucydides' rivalry with the poets and logographers reappears. The compositions of the latter are, in Thucydides' opinion, specifically designed to entertain. Thus, the reader of poetry and chronicles will have an easy time of it. With Thucydides' History this will not be the case; the responsibilities of the reader will be great. Jowett's translation 'to have before the eye' emphasizes the difference in the demands made on the audience by Thucydides and his rivals. Thucydides wishes his readers to be students, not dilettantes.

At the same time, however, the reader must undertake a second role. He must be a judge of the merits of Thucydides' account. He must decide whether Thucydides has, in truth, made it possible to apprehend the clear element. This returns us to the concept of persuasion. Essentially, the task of the reader is to judge the effectiveness of the historian's rhetoric. If he has been convinced that the evidence Thucydides presents is trustworthy, then he will judge the work useful. Thucydides would press an even greater responsibility on him, as he suggests in the last

sentence. ἡ ἀνάγνωσις implies a rhetorical contest of a sort that must have been popular during Thucydides' day. The reader must decide whether to believe or to ignore Thucydides' claim that his rhetoric is eternally persuasive.

In analyzing this passage I have intentionally omitted any mention of several of the phrases which have a profound significance. These will be considered in the discussion of the historian's role.

I have suggested that Thucydides sees the historian's effort as an attempt to persuade. He must strive to convince his readers that his facts are more accurate and that his account is more reliable than those of his rivals and, hence, more useful in discerning the clear element of history. The reader, in his turn, must be both student and judge. He must labor to understand the clear element as presented by Thucydides and, at the same time, judge the contest in which his belief is at stake.

III. The discussion of purpose that will follow is based, in part, on an interpretation of ἱκανὸν ἔσεσθαι in paragraph twenty-two. I would supply μοι here so that the phrase should read 'it will be enough for me'. This interpretation emphasizes the concern of the historian for the employment of his work. Indeed, it becomes an unmistakable hint of some end that Thucydides had in mind when he undertook the composition of the <u>History</u>. What end this was is the subject of our present inquiry.

The first answer that suggests itself is that the

apprehension of the clear element is the goal of the History. In other words, the reader will judge it useful if he is able to discern, with its aid, the clear element. The eternal possession thus becomes a somewhat neutral thing, inasmuch as its effectiveness may be said to end when this goal is attained. As a matter of fact, κτῆμα implies something nondescript. The History is a thing to be possessed by anyone who wishes to know the facts concerning an age in the past. On this view, the History is a sort of encyclopaedia of evidence and fact, occupying much the same position as an encyclopaedia does in our day: that is, it is always there on the shelf, whenever we need it.

This interpretation is betrayed, I think, by the phrase καὶ τῶν μελλόντων ποτὲ αὖθις κατὰ τὸ ἀνθρώπινον τοιούτων καὶ παραπλησίων ἔσεσθαι ..... (Bk. I, Paragraph 22). Not only will the diligent reader ascertain the clear element of what has happened; he will also be able to project himself into the future and observe there the same sort of things as have happened already. Our possession is not merely encyclopaedic; it is prophetic as well.

This objection, however, may be challenged on very substantial ground. The advocates of causational theories of history can make a very strong case for themselves on the basis of Thucydides' History. Therefore, we must investigate the notion of cause as it appears in his work. If we find that Thucydides' goal is to present the clear element in terms of cause, then we shall have to reconsider the view of the History as purely intellectual achievement. However, this

discussion cannot possibly be complete or definitive; at best, we may begin to clarify the idea of cause that Thucydides seems to support.

The argument that interests us in this connection would assert that the History is a thing to be studied, not for any practical application, but for an intellectual grasp of the facts in history. The proponents of such an argument are perhaps especially fond of paragraph twenty-three of the first book in which Thucydides states: "Why they broke it (the treaty) and what were the grounds of their quarrel I will first set forth, that in time to come no man may be at a loss to know what was the origin of this great war". This is a conspicuous declaration of some interest in cause. In the following sentence Thucydides introduces an all-important distinction between αἰτία and πρόφασις. The former refers, in this passage, to the 'publicly alleged reasons' for the war; the latter, to the 'real, though unavowed, cause'. This distinction prevails through-out the History in much stricter terms. I think αἴτιον refers to the occasion of a thing's coming to be; that is, it explains the external exciting cause. Thus, in the passage above, the episodes at Epidamus and Corcyra gave the Lacedaemonians occasion to prepare for war. Πρόφασις, on the other hand, is used of internal motive, or, in general, of any cause that has its source within rather than without the actor. Thus, αἰτία would answer the question 'Why did the war begin at this particular time?', whereas πρόφασις would answer 'Why did the war begin at all?'.

Hence, αἴτιον in paragraph eleven illustrates

the external cause of inferiority, since, to be sure, the participants in the Trojan war and similar enterprises would have the 'lack of money' as a motive for action. Again, in book two, paragraph fifty-nine, -- ἐν αἰτίᾳ ἔχοντα -- indicates the occasion in the sense that the Athenians required a scape-goat for their misery and Pericles was the most likely subject.

One more excellent example of the distinction may be found in the plague commentary (Bk. II, Paragraph 47) where Thucydides remarks that the inflammation seized one ἀπ' οὐδεμιᾶς προφάσεως. In other words, there was no reason to suspect, on the basis of the person's health and internal constitution, that he would contract the sickness. The αἰτία of the plague, on the other hand, was thought to be the poisoning of the cisterns by the Lacedaemonians.

Certainly, in the case of the war, it would be fair to say that both the occasion and the motive were known to the actors. This is evident in the speeches in the first book.[16] Thucydides, then, is not revealing to the reader any cause of which the participants in history were not well-aware. His purpose in discussing cause would seem to be preservation rather than revelation. We do not encounter, in the History, any superhuman agency that causes all human actions.[17]

I would suggest that Thucydides' interest in cause is only a part of his interest in the clear element of history. He supposed that his account would be all the more persuasive if he explained events in terms of occasion and motive. The reader will be more inclined to believe if he thinks he has understood the 'why' of

a thing than if he simply knows the 'what'. In short, the notion of cause must be considered as a part of the historian's effort, not as his goal.

What, then, is the usefulness of written history beyond its presentation of the clear element? I suggest that Thucydides' answer to that question would be phrased in terms of the practical application of the lessons of history. The remainder of this discussion will be devoted to an elaboration of this hypothesis.

Thucydides asserts that the student of his History can examine the 'such and such-like things that may be expected to happen again at some time in accordance with human nature'. The common ground for the past and the future is this human element. Men do not change, however much their situation and circumstances change. History, as a species of the persuasive art, must convince the reader that this is so.

Thucydides reenforces the claim cited above in the speech of Diodotus (Bk. III, Paragraph III). The latter appears only this once in the History and for this reason we may assume that his speech is specifically designed as a defence of rhetoric.[18]

The source of antagonism between Cleon and Diodotus seems to be a divergence of opinion in regard to rhetoric. Cleon charges that rhetoric is injurious to the state. He urges ignorance and modesty upon the citizens, in place of cleverness and license. Diodotus, on the other hand, attacks Cleon's proposition in these terms: "When a man insists that words ought not to be teachers of action, he is either wanting in sense or acting in his own self-interest; he is wanting in sense

if he does not see that it is only through words that we may illumine the unknown future." Thus, the notion of instruction as a function of rhetoric has been articulated for the first time in unambiguous terms. The subject matter of instructive rhetoric, for both Diodotus and Thucydides, is action. Cleon had assailed this proposition in his speech: "When speeches are to be heard, you are too fond of using your eyes, but, where actions are concerned, you trust your ears; you estimate the possibility of future enterprises from the eloquence of an orator, but as to accomplished fact, instead of accepting ocular demonstration, you believe only what ingenious critics tell you."[19] Little wonder that a man who would have the citizens ignorant, should so viciously undermine the value of rhetoric!

We must now consider the precise nature of the achievement of instructive rhetoric. This can best be done by examining two remarkable passages in the History in which Thucydides, relaxing his customary restraint, praises, in no uncertain terms, two individuals: Themistocles and Pericles. The passage which deals with Themistocles seems out of place in the History. It occurs in the Pentecontaetia in which Thucydides planned to outline the history of the Athenian empire prior to the Peloponnesian war. His description of Themistocles' character comes at the end of a long digression concerning Pausanias. It would seem, therefore, that Thucydides included this passage for a special reason.

"He was able to explain the thing which he had in hand, nor did he fail to judge those things sufficiently in which there might be uncertainty. Further, he foresaw most clearly the advantageous and the harmful in what

was unclear, and he was best able, by virtue of a natural capacity, to devise the necessary things with the shortest preparation." The most respectful compliment that Thucydides wishes to pay Themistocles is summarized in the word προείδε (he foresaw). Foresight was, according to Thucydides, his most conspicuous and beneficial trait. This foresight, however, was the product of a natural power. As he remarked earlier in this passage, "Themistocles was the ablest judge of the course to be pursued in a sudden emergency -- οὔτε προμαθὼν . . . οὔτε ἐπιμαθών -- without the benefit of study either before or after." In other words, Themistocles' foresight was an innate power that needed no education or training to realise itself.

In praising Pericles, (Bk. III, Paragraph 65), Thucydides emphasizes the same attribute -- προνοίᾳ . Indeed, he traces Athen's greatness to the foresight and prudence of this one man.

We have one other outstanding mention of foresight in the plague commentary; "As to its probable origin or the causes (αἰτίαι) which might or could have produced such a disturbance of nature, let every man, whether physician or not, give his opinion. I shall describe what sort of a thing it was (οἷόν τε ἐγένετο) and from what things (ἀφ' ὧν) anyone who examines (σκοπῶν) the matter, would have enough foresight not be ignorant, if it should ever strike again. I shall explain these things having suffered the disease myself and having witnessed the sufferings of others." I have been unable to resist the temptation to read into this statement a suggestion of Thucydides' attitude towards the History as a whole. Thucydides himself

suffered the war and witnessed the sufferings of others; moreover, the language of this passage is, in parts, remarkably close to that of paragraph twenty-two, book one.[20]

Interpreting the passage in this way, we find Thucydides disdaining the explanations of cause. His purpose is to set forth what sort of a thing it was and the symptoms by which it could be recognized in the future. Anyone who studies the History, then, will have sufficient foresight not to be caught unawares. As Thucydides indicated with respect to the plague, no art, human or divine, was of any help in combatting the disease. The History, then, is meant to be diagnostic, not curative.

We have seen that the reader of the History must believe that what has happened in the past will happen again in the future; that words are teachers of action; and, finally, that foresight is a man's most praiseworthy attribute. When we combine these findings, what conclusion can we draw with respect to the purpose of history?

If we were all endowed by nature with foresight, as Themistocles was, we would have no need of instruction, either by words, or by any other means; but, we are not all so equipped. Therefore, we must be taught foresight if we are to have it at all. Words, according to Diodotus, are teachers of action; I take this to mean that words prepare us for action by persuading us that such will be the consequences of a contemplated action. Foresight, then, is the awareness of the probable consequences of any action; it is, in short, knowing what it would be best to do in a given situation.

When foresight is not a natural faculty, it requires an educational foundation which can only be the understanding of what has happened in the past as the result of any action. Thucydides would have the reader believe that the consequences in every case will be the same in the future as they were in the past. The lesson of history, in Thucydides' view, is foresight.

In one sense, foresight is the goal of written history; in another, it is not. For the historian's truest goal is to provide the foundation upon which foresight may be built. The facts and the judgements of history are criteria for action. When it is impossible to have direct knowledge of the consequences of an act (in cases where such knowledge would require the actual performance of the deed), we must accept the testimony of history. If we have been persuaded that the historian's account is trustworthy, then we shall believe that the success or failure of an action in the past is a valid criterion for the present.

We are now in a better position to understand Thucydides' rivalry with one poet in particular -- Homer. We may assume, from the testimony of Plato, that Homer served the Greeks as the final authority for human behavior.[21] However, as Thucydides points out, the function of poetry is to entertain rather than to enlighten. Consequently, we must not base our actions on the criteria of poetry, for these will certainly be erroneous. Thucydides, who terms his History an eternal possession, would have himself named successor to Homer. His goal is to provide for the Greeks and for mankind, inflexibly valid criteria, based on the evidence of history, for action in a political society. The words of Polybius, a later historian,

might serve us here as a fitting conclusion:

> "Had previous chroniclers neglected to speak in praise of History in general, it might perhaps have been necessary for me to recommend everyone to choose for study and welcome such treatises as the present, since there is no more ready corrective of conduct than knowledge of the past. But all historians, one may say without exception, and in no half-hearted manner, but making this the beginning and end of their labour, have impressed on us that the soundest education and training for a life of active politics is the study of History, and that the surest and indeed the only method of learning how to bear bravely the vicissitudes of fortune, is to recall the calamities of others."[22]

NOTES

1. See page 3 for an explanation of this seemingly erroneous construction.
2. E. C. Marchant, Thucydides, Text and Notes, London, 1958, p. 133
3. ibid. p. 134
4. Paragraph 15 has οὐ γὰρ ξυνεστήκεσαν πρὸς τὰς μεγίστας πόλεις ἔτι they had not yet allied themselves with the greatest cities.
5. In the speech of the Corinthian ambassador before the Spartan assembly, this polarity is shown to extend to the very modes of life of the two cities. (Bk. I, Paragraph 70).
6. Book I, Paragraph 19.
7. Notably, Dr. Leo Strauss, of the University of Chicago, in his 1962 Page -- Barbour lecture at the University of Virginia.
8. Thucydides rarely mentions individuals in his account of a particular battle, and then only when the person is a distinguished general.
9. Re: Hipparchus -- Herodotus V, 55
   Voting procedure -- VI, 57
   Pitanate division -- IX, 53

10. Truth as such means the total body of fact concerning a specific period of time. To obtain the truth, one would have to know not only everything that happened, but also, the motives and the causes of every act. The simple fact that one man cannot be in all places at the same time establishes the point.

11. Marchant (p. 148) points out that πιστεύων, νομίζων, and ἡγησάμενος are instrumental rather than circumstantial participles.

12. Benj. Jowett, trans. The Peloponnesian War, N. Y. 1960, p. 33.

13. Aristotle, in the Rhetoric 1357 a 23-35, points out that the materials of the rhetorical proposition are τὰ τεκμήρια and τὰ σημεῖα. Both terms occur in this passage.

14. Omission

15. A good example of what Thucydides intends here is the speech of the Athenian ambassador before the Spartans in Book I, Paragraph 72. The speaker replies to each charge made against Athens by the Corinthians.

16. Especially in the speech of the Corcyreans before the Athenians.

17. As would seem to be the case in Homer and Herodotus.

18. Dr. Leo Strauss has suggested that Diodotus is speaking directly in behalf of Thucydides. It is interesting, in this connection, that Diodotus is the only speaker, other than Thucydides, who uses the phrase φύσις ἀνθρωπεία - human nature.

19. Cleon articulates here the same antagonism between the eye and the ear that Thucydides cited in Bk. I, Paragraph 22.

20. For instance, ποτὲ ἀξίως and σκοπῶν

21. Plato, Republic X, 598E: "Thus, have we not next to scrutinize tragedy and its leader Homer, since some people tell us that these poets know all the arts and all the things human pertaining to virtue and vice, and all things divine?"

22. Polybius, Histories Bk. I, Chapter i.

JEPHTHA'S DAUGHTER

YA, How I rushed out
My clanging timbrel
Sucking the music
From his brazen thighs
Swollen with glory.

The men, laughing, spitting,
Thrusting their spears
Into the ground
Their Hallelujas shreiking
Arrows to his glory.

Yes, then I ran to him
Caressing the sweat of his arms
While he told me he would embrace me
With a thrust even deeper
Than those in my dreams of my glory.

So now I will go up to the mountain
Where I will mourn my virginity
And celebrate his glory.

Joel Greenberg

MANY LONG NIGHTS SHALL PASS

Many long nights shall pass before the rusted moonlight
Again burns shadows on my arms;
For above the clouds of the river
Is the river of the clouds;
And beneath the pain of my pleasures
You pace, arched and spanning,
Bending the mists as the seagulls bend them.

Joel Greenberg

ONE DAY LATER -- A Sketch

I awoke slowly, feeling each stone digging into my back, the air mattress lying next to me after a restless night. I looked up the valley to the west where the last little stars of morning winked and died, leaving behind a cold, clear blue that lightened slowly. The outline of the ridge stood out sharply against the sky, and the trees were intense black points.

In the east was the grey darkness, the sun a dim orange ball that struggled slowly higher, tinting sections of the shifting clouds odd colors of red and orange, clouds not of water but of ash, the hovering end of a million trees, smoke. Always smoke, the air around me smelled even stronger than the day before, and I knew that sometime during the night the fire line had moved closer to camp.

My attention was caught by a figure moving quietly among other forms lying scattered in odd angles over the rough ground, pausing now and then to bend down and shake one of them gently, speak a few words I couldn't hear and move on. He reached me, and motioned towards the cook tent.

"Breakfast ready?"

"Yeah, you coming?"

"Uh huh."

By now I was more awake than asleep, and the dampness and chill of the hour began to invade the warmth of my dewy sleeping bag. I pushed it down over my body, fishing for my levis that resided at the bottom. When I put them on they were warm and not as stiff as they

had been the day before, when I left them out in the air overnight. God! there is nothing worse than a pair of dirty, stiff levis early in the morning. My boots were cold too, the leather laces charred from the past days. I finished dressing with a dirty wool jacket, picked up my axe with the JB carved carefully on the handle and headed for the stream.

The cook's six portable gas stoves were sending out a cheerful roar from the entrance of the tent, the campfire with its three five-gallon cans of boiled coffee glowed deep red, and for once I was glad to see that red. The others were drifting in now, snagging cups from the boxes they were kept in, filling them from the cans on the fire and hunkering down in close little circles. I wrapped my hands around my cup to warm them up, and joined Bill and some of the other men next to the fire.

"What happened during the night?"

Bill looked over and said, "Well, the night crew kept the damn thing from crossing the creek by soaking everything in sight all night, but it moved up the valley about 200 yards, maybe more up above, I can't tell."

I pulled out my cigarettes, took one and handed the pack around to the rest of the group. We relapsed into silence. For the past two weeks we had shared everything we owned, for we were part of the machine that fought a common enemy, and this particular group had been the first part of the machine to go into action. I broke the silence.

"What are we going to try to do today after that mess

yesterday? Same place, if there's anything left? My pumps are in that canyon about three quarters of a mile up the slope."

"Get a little warm for you there yesterday, huh?", said Bill. "From where I was standing I didn't think that you would make it out at all. How many of you came down, anyhow?"

"Thirty-seven, I think. There were seventeen of us in the canyon, me on the two pumps and the rest running hose around; God that stuff is heavy when it's full of water! Just before the fire blew up twenty guys came down from the top where the 'copter had dropped them. They had those damn five gallon back pumps, and had been all day getting to where we were, lugging water all over the damn mountain, and putting out hot spots where they didn't need putting out. Anyway, these poor guys showed up, and right then, before I even had a chance to tell them how to get back here, away we all went like rabbits out of hell. Took us twenty minutes to make a forty minute trip down the mountain. I think we had about a minute to spare."

I saw the tense, strained faces of the others reflect the remembrance of the previous day, when two days work had been destroyed in five horrible minutes. I thought of the roaring hell of the fire as it surged across the line, turning the inch and a half ropes of water from the hoses into steam the instant they hit, exploding the wet brush as if it had been kindling. We had run, up out of the canyon and over the top of the fire as it ate up the mountain, turning our island of safety into a home for the devil.

The spell broke when Dale eased his two hundred pounds

of deceiving plumpness down alongside me, stared into the coals of the fire for a second, then spoke to me in his squeaky tenor voice.

"Jim, can you find your way back up to the pumps, do what has to be done to get them running and have it done before the main group gets up there? We'll move up that canyon about a hundred yards, cool things off and then change position to the next stream up-valley."

"Yeah", I said, "that isn't the problem, because a dried-up stream bed runs parallel to the canyon for at least half the distance, and then there are those four logs to mark the spot where I cut over to find the pumps. The fire couldn't have changed things that much, and those logs are too big to be destroyed overnight. I should still have some gas up there, but I need a couple of wrenches and one plug wrench. Otherwise I'm in good shape, especially after that thirty minute wonder course on the inch-and-a-half pump you gave me."

A ripple of quiet laughter broke out of the group, and I got up, brushing the dust off my levis. Our breakfast consisted of the usual juice, cereal, eggs, hotcakes, bacon, coffee and couple of sweet rolls tucked into a shirt pocket for later. At least the government provided decent food, once it got organized.

After a final cigarette, I told Dale that I was going, tested my axe on the back of my hand and struck off down the valley. In front of me the sun was higher in the smoke, but still was only an orange globe, not the sun that I was used to. I knew that later in the day I would be hating that sun, spilling its warmth on the earth, helping to dry things up even more than they were

now, giving strength to the fire and burning my back while my face scorched. Now though, it was nothing but a disk in the grey.

I crossed the creek, and picked up the elk trail that was marked with the fluttering orange ribbons tied to branches every fifty or sixty feet. Once through the vine maple, the trail wound in among the tall stately trees of the virgin forest, each one a king on its own plot, together a community holding the floor of the forest to the mountain. It would have been magnificent if this had been the first or second time I had been there, but it wasn't. I knew the trail and didn't even look to see where I was going. Instead, I thought of the other side of the creek where the fire was, and of what it looked like now.

I passed the night crew stumbling along back to camp where they would eat breakfast and sleep like dead men, and I raised my hand in greeting. No words were necessary. Further on, the trail fell down through the forest to the creek, and after crossing over, I was in the brush once more. Looking up the mountain I could see now the strides the fire had made, the new fingers of burned forest, the trees lying criss-crossed over one another, their roots burned out, branches turned into smoke. Where once had been a stand of prime spruce and fir, charred logs lay on the heat-split rock.

I found the stream bed I was looking for, and began my climb up to the canyon and my pumps. The fire hadn't reached here yet, and the vine maple formed a roof over my head, giving the effect of a tunnel up the mountain.

It was cool and silent, and strangely peaceful. Then the stream ended, and I scrambled vertically up through the roof of the tunnel onto the first of the four logs that lay as downed giants waiting to be trodden on, useful only in death. Straight up the mountain I climbed, walking the length of each log like a lumberjack, and jumping on the next one. At the end of the last log, my path turned to follow the countour of the mountain, went over a small ridge, and suddenly I was in the burn. Where yesterday had been thick brush, grasping and tearing the clothes, smoke curled up in little wisps, and old stumps glowed evilly deep in their hearts. I walked through the ashes, feeling the heat of the burned ground through the soles of my boots. Then I was at the brink of the canyon, hunting for some way to get down to the stream that tumbled down the mountain. All the old handholds were gone, and what were left were not even worth looking at.

The pumps were in the water where I had kicked them, and there was some hose lying in sodden heaps, scorched in places but still usable. There were gas cans too, lying here and there in still pools, and the smell of gas and oil lingered, contrasting sharply with the acrid sting of the smoke. I dragged the pumps out of the stream, and had them both cleaned up and tested by the time Bill and Dale arrived.

"Well, what do ya think?", I said.
"What did we lose?" Dale spoke as he climbed down to where I was sorting out hose.
"The pumps are all right, and we only lost about eight sections of hose. The rest is usable and things look pretty good. This area is shot though, nothing left

worth worrying about. How did you two come in?"
"From the north-west line.", Bill answered. "We scouted the top and from what I can see, the fire is so close to the meadow up there that it isn't worth sending a crew up. Anyway, it's too dangerous in the forest; trees are coming down all the time without any warning. I wouldn't be responsible for anyone who was up there."

"God damn! you two move fast!"

Bill smiled and picked up the radio he had brought along.

"We can't do any more here. Let's leave the hose, pack the pumps and take them back down to the main creek. I'll try and catch the crew on the way up before they get too far." He turned on the radio, listened to the static for a minute, shook his head and turned it off again. "There isn't any use trying to use that thing. Worthless hunk of junk anyhow, just more weight to lug around."

There was quiet for a minute, and down below us we could hear the voices of a new crew climbing up the mountain. They sounded strong and cheerful, with the rough language of men. I looked at Bill, his face covered with two weeks beard, grimy with dirt, his clothes ripped in a dozen places, filthy, and his eyes,sparkling with strange lights that showed the strain of the past two weeks. Dale looked about the same, and I probably did too. We sat there, smoking, silent, and I wondered when it would rain.

F. J. Blachly

ἀθάνατος ἡ ψυχή.

Mais les petits oiseaux,
ayant peu d'expérience du monde,
voyagent avec les esprits
a l'Enfer.
Donc, mon petit oiseau
entre dans le monde.
La nature aime bien
les petites choses,

D. Sherman

REDUCTIO

don't deny love in retrospect
to salvage pride
shipwrecked for loneliness
on a treeless island

does the sun blind you?
like love, as a whisper
all that is heard
for now and ever

at least we thought
for now and the next day
by then, of course, we couldn't tell
who was where

and the dimness touched
me. are you thinking
now and ever
of the way we were

when we smiled at each other
(feel the darkness and the
dim hearts, like rubber balls
on summer afternoons

breaking the still heat into
rhythmic patterns)

i think that i love you
in retrospect
not denial,
but betrayal
not you
but me.

Nancy Linn

THE COPERNICAN 'REVOLUTION' FROM A MATHEMATICAL POINT OF VIEW

by Leon Rottner

At least before our time, the astronomer believed the phenomena presented him in the movement of the heavens were ordered,[1] though, in fact, the appearance of that movement to us on earth is disordered. The astronomer's task, then, was to 'save the appearances', to present us with a mathematical description of how, from some other point of view, all the movement which appears irregular from ours is, in fact, regular. The problem is what that point of view shall be.

However, astronomy turns out to be a very complicated science--irregularities are not simply regular in their recurrence, but have, in turn, their own irregularities. Assuming, therefore, that for every single irregular appearance there exists a single point about which the appearance would be regular, it is, strictly speaking, an over-simplification of the astronomer's task to say that the astronomer strives to locate one, all-embracing point about which all movement is seen to be regular. However, it is clear that what Copernicus says is, in effect, that from the point of view of the sun as center of all movement, the same appearances are more simply produced than with the Ptolemaic system, and the most important primary facts about the phenomena (such as the different nature of the anomalies of inner and outer planets) are immediately deducible.

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The appearances, or the facts of astronomical science which are explained or 'saved', may be summarized

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1. ..Beginning with two postulates; All heavenly movement is circular (1) and each individual circular movement has a regular angular velocity with respect to its center (2).

briefly as follows: (leaving out, for the sake of simplicity, those of the moon, the irregularities produced by the inclination of the planetary orbits to the ecliptic, the zodiacal anomaly, and the zodiacal anomaly's anomaly). For now, the point of view is the common sense one of an observer on the earth.

> We note that, over and above the daily voyage of the sun from East to West, there are four seasons which seem related to the height of the sun in the sky. A cycle of the four seasons is completed in what we call a year. In addition, we find the seasons are unequal in length.
>
> The planets too, have a yearly movement, over and above their daily rising and setting, leading or following the sun in its seasonal (yearly) movement:
> it takes Mercury 88 + days to complete one of these cycles
> Venus 7½+ months
> Mars 2 - years
> Jupiter 12 - years
> and Saturn 30 - years .
>
> Yet, as well as travelling each at different speeds, they seem alternately to slow up, stop, reverse direction, slow up, stop, reassume their original direction, slow up, etc. Two planets, Mercury and Venus, appear to do this through only a limited arc, they elongate. The other three progress and retrograde over a full 180° from the sun.

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We have now to consider two contending points of view, both of which claim to 'save the appearances'. On the one hand there is the Ptolemaic (Hipparchian) system of the world, starting with the earth as center; and on the other the Copernican (Aristarchian), which places the sun in the center of the world's circular movement. Again, summarizing briefly, they explain the appearances in the following manner:

1. To explain the seasons Ptolemy conceives of a 'mean' or fictitious sun travelling regularly eastward on a circle inclined to the circle of the apparent sun's daily westward motion. It completes a revolution on this ecliptic circle in slightly less than a year. Assuming next that the 'mean' sun's circular path is eccentric to the center of the universe, he thereby accounts for the seasons' unequal length. (Ptolemy chooses an eccentric rather than the equivalent eipcycle because, as well as being just as complete an explanation for the apparent sun's irregular yearly movement, it is a more elegant one.)

2. The inner planets[2] revolve about the earth on epicycles, whose centers move regularly eastward with a speed '1', equal to the speed of the 'mean' sun (whose speed is 's'), the planet itself revolving on its epicycle with a speed 'a' in the same direction.

3. The outer planets (those 'above' the sun) revolve about the earth on epicycles whose centers move regularly eastward with a speed '1' in ratio to the speed of the 'mean' sun as the planet's cycles of longitude are to the number of solar years they take place in:

Mars 42:79 or 1:2
Jupiter 6:71 or 1:12
and Saturn 2:59 or 1:30,

the planet itself revolving in the same direction with a speed 'a' on its epicycle, so that '1' + 'a' equals 's'.

4. The sphere of fixed stars rotates westward, and carrying all of the former bodies with it, completes a full cycle in slightly less than a day.

**

1. According to Copernicus, however, all the planets can be said to revolve eastward about a fixed 'mean' sun on what for now we shall call concentric circular orbits. The planet's speeds are greater or less than the earth's speed, which is equal to that of Ptolemy's mean sun.

2. Speed 'a' for the inner planets becomes the speed by which they exceed the earth's speed, which itself is then clearly speed '1'.

3. Speed 'a' for the outer planets is accordingly that speed by which they fall short of the earth's, which must then be '1' + 'a' (equals 's').

4. The sphere of fixed stars remains fixed, as the daily rotation of the earth about its own axis takes over the effects of that sphere's rotation

2. The inner planets are those which Ptolemy places 'below' the sun, that is, between the earth and sun--Mercury and Venus.