Introduction

Although it has long been recognized that supply was the basis of Alexander's strategy and tactics,[1] a systematic study of the Macedonian army's logistics has never been undertaken. This neglect has been unfortunate since it has caused some erroneous assumptions about Alexander's generalship, especially in the Gedrosian campaign. Indeed, Tarn devoted only a fragment of a sentence to the problem: "as for commissariat, supplies were collected in each district as conquered and used for the next advance."[2] In fact, we hope to show that generally the opposite was the case. Because of the restricted capabilities of the methods of land transportation available to Alexander, only a limited amount of supplies could be carried from one district to the next. Hence, Alexander would have to arrange the collection of provisions in advance, and this was done with the local officials, who regularly surrendered to him before the army marched into their territory.[3] Tarn's simplistic view is not surprising, however, for the picture that emerges from the ancient authorities is that Alexander never needed any logistic planning at all, but secured his provisions as he went in some mysterious, automatic sequence. Burn denied that Darius attempted to cut Alexander's communications in Lydia because "Alexander's army was not, like a large modern force, to be paralyzed in a few

1. J. F. C. Fuller, *The Generalship of Alexander the Great* (London, 1958) 52–53.
2. W. W. Tarn, *Alexander the Great*, Vol. 1 (Cambridge, 1948) 13.
3. See below, p. 41.

weeks for lack of food and motor-fuel."[4] However, it will also become apparent that while Alexander did make full use of local resources, sometimes it was necessary to import food and water by sea—often from great distances—to support his men and animals.

Berve[5] devoted a short section of his important work to logistics. Unfortunately, since he did not treat the topic systematically, his observations are of little value. He believed that the passages in Curtius and Diodorus[6] referring to the supplies Alexander ordered to be brought to him in Carmania from Parthia, Areia, and Zarangaea record an actual event and indicate an extensive logistic organization that was also employed in Sogdia and Bactria. However, it was physically impossible for pack animals to have carried supplies from those regions to Carmania, since they would have consumed all the supplies they were carrying long before reaching Alexander (see below, Chapter 1), and hence the passages are of no value in reconstructing Alexander's logistic system.

Fuller[7] understood that supply is the basis of strategy and tactics and that the Macedonian army could seldom have been supplied by foraging alone. Nor could Alexander have achieved his many rapid marches or traversed desert areas without a highly efficient logistic organization. Although Fuller deserves credit for recognizing the problem, he did not attempt to find any solutions.

Unlike some of his historians, Alexander himself was deeply aware of the importance of military intelligence and securing adequate provisions for his army. Even as a child Alexander seems to have displayed a precocious interest in the length of Persian roads and the nature of the journey into the interior of Asia.[8] An incident preserved by Vitruvius illustrates Alexander's understanding of the difficulties of provisioning cities (or armies which are moving cities) when remote from cultivable land. The relevant passage is worth quoting:

4. A. R. Burn, "Notes on Alexander's Campaigns 332–330 B.C.," *JHS* 72 (1952) 82.

5. H. Berve, *Das Alexanderreich auf prosopographischer Grundlage*, Vol. 1 (Munich, 1926) 191–192.

6. C. 9. 10. 17; D. 105. 7.

7. Fuller, op. cit., 52.

8. P. 5. 1; Plut. *de Fort. aut Virt. Alex.* 342C; Polyb. 12. 22. It was a commonplace among historians in antiquity that Alexander studied military strategy and the gathering of intelligence as a child, and given who his father was and the type of environment in which he grew up, this is not remarkable. Cf. J. R. Hamilton, "Alexander's Early Life," *GR* 12 (1965) 123; Green, 37f.

Alexander, delighted with this type of plan, inquired at once, if there were fields in the vicinity, which could supply that city with provisions of grain. When he found this could not be done except by sea-transport, he said: "Dinocrates, I see the unusual form of your plan and I am pleased with it, but I perceive that if anyone leads a colony to that place, his judgement will be criticized. For, just as when a child is born, if it lacks the nurse's milk, cannot be fed or led up the courses of growing life, so a city without fields and their produce abounding within its walls cannot grow, nor become populous without an abundance of food, nor maintain its people without provisions."[9]

The success of Alexander's expedition, the longest military campaign ever undertaken, was in no small part due to his meticulous attention to the provisioning of his army. This becomes all the more apparent when one remembers the ease with which the Macedonians traversed terrain such as the Anatolian Plateau and Palestine in summer, the Sinai in early autumn, the Dasht-i-Kavir, and the Zagros Mountains. Other armies following the same routes often lost a large portion of their men from starvation and dehydration alone. The Macedonians' successful passage of such regions contributes just as much to Alexander's achievement as his strategy at Issus, Gaugamela, or the Jhelum.

The purpose of this study is to attempt to solve two problems: How did Alexander secure provisions for his army throughout Asia? And how did the availability, acquisition, distribution, consumption rates, and transport of provisions affect Alexander's strategy, tactics, and the timing and direction of his army's marches? The following method will be used to answer these problems. The first step will be to reconstruct the Macedonians' logistic system to discover its capabilities and limitations. To begin, the army's consumption rates of food and water will be calculated, based on the known nutritional requirements of men, horses, mules, and camels. Of course, the army's gross consumption will vary with the numbers of troops, followers, cavalry, and baggage animals, and these aspects will receive special attention. But their precise numbers do not affect the army's *consumption rate* (the weight of food and water consumed per individual per day), which remains constant no mat-

9. 2. Preface 1–4.

ter how many personnel and animals are with the expedition. The minimum weight of the noncomestible supplies carried by the army (for example, tents, military gear) will also be calculated. Next, the efficiency of the various methods of transport used by Alexander will be measured in terms of the weight they can carry, their consumption rate of food, and the rate of speed they can achieve. Last, the relationship between the maximum weight of supplies capable of being transported by the army and the army's consumption rate of provisions under varying conditions of replacement will be expressed mathematically. This last procedure will produce a model of the Macedonians' logistic system, adjustable for different terrain, numbers of personnel, and animals.

The second task will be to apply this model to the human and physical geography and the climatic conditions of Alexander's route as they existed in his day. Far from being a mere line drawn on a map, each of the routes followed by the Macedonians is the result of a conscious decision by Alexander to best fulfill his army's strategic and logistic objectives. I hope to reconstruct Alexander's routes in eastern Iran, Afghanistan, and Turkestan with more accuracy than has been done previously and, more importantly, to discover the logistic and strategic reasons for Alexander's choice of these routes. To construct the routes I will use the geographical information provided by recent archeological, geographical, and paleoecological research as well as the ancient sources of Alexander's career and the bematists' measurements preserved in Pliny and Strabo. Occasionally, comparative information provided by other early armies that were supplied by the same methods as Alexander's and that traveled in the same areas can be used to help restore the Macedonian route.

Fortunately, all the countries through which the Macedonians traveled have received extensive, detailed geographical studies. First, each route followed by the Macedonians has received accurate, detailed descriptions by the nineteenth- or early twentieth-century travelers gathering military intelligence, which in those times consisted of the same type of intelligence needed by Alexander: climatic conditions, how long the mountain passes remain blocked in winter, harvest dates (which depend on climate), the easiest roads, which routes are the best provided with water and forage, the location of large areas of cultivable land, and the logistic

problems of an army moving through the region. These travelers present a striking contrast with their modern counterparts speeding along all-weather highways in air-conditioned and heated vehicles, over routes which bear little or no relation to those taken by the Macedonians. The observational skills of these early travelers are unsurpassed, and they are still considered to be essential sources of information by modern geographers.[10] I have tried to obtain at least two independent travelers' reports for each section of Alexander's route, especially in critical areas such as Central Anatolia, Palestine, the Sinai, and the Gedrosia. I have never found the observations of any of these geographical sources to be inconsistent or contradictory to any other source, and they fully merit the confidence that modern geographers place in them.

In addition to travelers' reports there are the magnificent modern geographical handbooks for each Near Eastern country, notably the excellent British Naval Intelligence series, and the works of Humulum, Olufsen, and Spate. These works utilize the data scientifically compiled for decades, and sometimes for even a century, by teams of trained geographers, soil scientists, botanists, zoologists, geologists, ecologists, climatologists, economists, regional scientists, and epidemiologists.

Moreover, intensive surveys are now being conducted by archaeologists to reconstruct the ancient human geography of many regions along Alexander's route. These sources are especially important because of the direct relationship between human settlement, agricultural production, and the location of military routes capable of supporting large numbers of men and animals. Indeed, few travelers observing the desolate salt-encrusted moonscape of the central Tigris–Euphrates Valley today realize that this was an intensively urbanized and agriculturally productive region in Alexander's era. Such a reconstruction is only possible after years of intensive surveys, excavations, and detailed analyses conducted by soil scientists, paleobotanists, and trained archaeologists.

The combined use of these three groups of modern sources for

10. Naval Intelligence Division, Great Britain, *Persia* (1945) 601–602. These early travelers have journeyed through, and described, virtually every route passable by man in each region traversed by the Macedonian army. In trying to determine which routes were followed by Alexander, I compared the merits of the different routes in each region as described by these travelers and analyzed the other sources discussed below.

each section of the Macedonians' route provides a firm geographical basis for interpreting the ancient sources of Alexander's expedition.

The major extant ancient sources for the life of Alexander are Arrian, Curtius, Diodorus Siculus, Plutarch, and Justin. Strabo occasionally supplies valuable geographical information. None wrote less than three hundred years after Alexander's death.[11] Arrian probably wrote during the reign of Hadrian or Antoninus Pius, and he attained the governorship of Cappadocia under the former emperor. Arrian's two major sources were Ptolemy, son of Lagus, and Aristobulus. The latter, a contemporary of Alexander, was well known as an apologist even in antiquity, and he presented a highly flattering account of the king, glossing over many incidents that portrayed him in an unfavorable light. Ptolemy also wrote a highly favorable account of the king in the early years of his reign to help secure his rule in Egypt as Alexander's only legitimate satrap and successor. Ptolemy probably used for his sources only his memory and personal notes, and perhaps the partially published work of Callisthenes (Alexander's court historian who was killed in Bactria or shortly after). On a superficial level, Ptolemy appears to have been a dry, military historian who never distorted his account. It is now recognized, however, that he does indeed distort the record, especially when he was personally involved. Arrian's account is generally devoid of geographical and chronological errors and inconsistencies, and his concise narrative is the basis for the geographical reconstruction of Alexander's expedition. He is, however, occasionally terse to the point of obscurity, and at such times Curtius is often of assistance in giving a fuller description from which a coherent reconstruction of events is possible.

Curtius, Diodorus, and Justin (who abridged Pompeius Trogus) contain many similarities, and it is generally acknowledged that they often follow the same source or tradition, which is commonly called the Vulgate. Unfortunately, the identity of this common source remains unknown; nor, given the limitations of our evidence, is it ever likely to be discovered. Occasionally, some primary

11. This account of the sources is based on Ernst Badian, "Alexander the Great, 1948–1967," *CW* 65 (1975) 37–56, 77–83; Eugene N. Borza, "Cleitarchus and Diodorus' Account of Alexander," *Proc. Afr. Class. Assoc.* 2 (1968) 25–45; L. Pearson, *The Lost Histories of Alexander the Great* (New York, 1960).

sources for the Vulgate tradition can be dimly discerned in Curtius and Diodorus. Those recognized include Cleitarchus, Aristobulus, Callisthenes, and both Nearchus and Onesicritus for geography. At one time, indeed, it was thought that this tradition was based on Cleitarchus, but it is now apparent that there is insufficient evidence to prove such an identification. Diodorus, the earliest extant source, wrote under Caesar and Augustus; and Curtius, in the first century A.D., perhaps wrote under Claudius or Vespasian. Pompeius Trogus wrote in the Augustan era, and Justin made an epitome of his *Historiae Philippicae* perhaps in the third century A.D.

Curtius often provides extremely valuable geographical material whose impressive accuracy has been confirmed by modern geographical research. Not only is his geography accurate and consistent (his few mistakes are also shared by Diodorus, indicating that their source was at fault), but his descriptions of the difficulties encountered in marching through specific regions of the expedition are identical to those described by modern travelers.[12] One cannot expect detailed geographical material from Diodorus' briefer account, yet he too sometimes provides valuable information lacking in the other authors. His account of the expedition to Ammon is the most detailed and coherent of all the sources.

Plutarch used a wide variety of sources for his account—he mentions the names of twenty-four authors altogether—including Onesicritus, Aristobulus, and perhaps Cleitarchus, Callisthenes, and Chares.[13] Like Arrian, his account is generally apologetic toward Alexander. As he informs us in the beginning of his life of Alexander, Plutarch had no intention of writing history, but rather planned to delineate character and depict models for behavior consistent with the moral values, beliefs, and attitudes of his own society. We are not surprised, therefore, when he mistakes Bactria for India,[14] nor are we annoyed at his almost complete lack of geographical consistency in the latter part of his biography. To give accurate geographical descriptions was not his intention.

At one time it was thought that Arrian was our best source and

12. See below, pp. 84, 101.

13. For the best account of Plutarch's sources, aims, and methods, see J. R. Hamilton, *Plutarch Alexander: A Commentary* (Oxford, 1968) li f. Plutarch wrote in the late first or early second century A.D.

14. See Chap. 4, n. 76.

that Curtius and Diodorus were less reliable. This was because Arrian presented generally favorable information about Alexander (since his account was based on apologetic and favorably biased sources such as Ptolemy, Aristobulus, and Nearchus), while Curtius and Diodorus included unfavorable incidents. It is now recognized, however, that these source evaluations were based on the subjective views of modern interpreters (such as Tarn) who wished to idealize Alexander and that they do not, therefore, reflect the intrinsic merits of our sources. In fact, there is worthless information in our "best" source (for example, Ptolemy's talking snakes during Alexander's return from the Oracle of Ammon) and valid information in so-called disreputable sources. Green observes:[15]

> Yet the uncomfortable fact remains that the Alexander-romance provides us, on occasion, with apparently genuine material found nowhere else, while our better-authenticated sources, *per contra*, are all too often riddled with bias, propaganda, rhetorical special pleading, or patent falsification and suppression of the evidence. . . . The truth of the matter is that there has never been a "good" or "bad" source-tradition concerning Alexander, simply *testimonia* contaminated to a greater or lesser degree, which invariably need evaluating, wherever possible, by external criteria of probability. This applies to all the early fragmentary evidence quoted in extant accounts as well as, *a fortiori*, to the authors of those accounts themselves.

Before we discuss the Macedonian army's logistics, a word must be said concerning the difference between modern and ancient crop yields and fertility along the route. Few studies exist specifically concerning the agricultural productivity and paleoecology of the regions along Alexander's route in the late fourth century B.C. It is significant, however, that in two areas that have been intensively studied, the Negev Desert and the Tigris–Euphrates Valley, the respective yield rate was five times and twenty times higher than today, and the extent of cultivated area was about ten times greater. A similar situation existed in the Lower Helmand Valley, the Lake Seistan region, and the Indus Valley.[16] Frequently, where no studies

15. Green, 479.

16. For the Negev see Michael Evenari, *The Negev: Challenge of a Desert* (Cambridge, Mass., 1971). For the Tigris-Euphrates Valley see Thorkild Jacobsen and Robert McC. Adams, "Salt and Silt in Ancient Mesopotamian Agriculture," *Science* 128 (1958) 1251–1258; Robert McC. Adams and Hans J. Nissen, *The Uruk Country-*

on paleoecology exist, the relative agricultural productivity of a region along Alexander's route can be determined by the existence of cities and extensive irrigation complexes dating to his era, often in areas that are now desert or wasteland. The superior techniques of ancient farmers in arid regions should never be underestimated: their amazing abilities to produce abundant yields by using sophisticated complexes of cisterns, canals (often placed underground), catchment basins, and barrages are just recently becoming appreciated (and imitated) by modern farmers. Geographical and historical sources are unanimous in stating that the climate throughout all areas of the Near East has not changed from Alexander's day to our own.[17]

I hope to show the problems Alexander encountered in the marshaling, transportation, and distribution of provisions—often in deserts and barren terrain—did not have simple solutions, and prodigious long- and short-range planning and preparation were necessary before the army could advance stage by stage. These preparations included the forming of alliances, often combined with the installing of garrisons or the surrender of hostages, to insure the establishment of magazines of provisions in desolate regions, the provisioning of the army by the fleet that sailed beside it in barren terrain, the division of the army into several units when supplies would be difficult to obtain, forced-marching to conserve supplies, and the synchronizing of the march with the harvest dates throughout the conquered regions. Not only were considerations of supply

side (Chicago, 1972) 55f.; Franklin Russel, "The Road to Ur," *Horizon* 14 (1972) 90–103. The progressive salinization and alkalization of the once fertile areas of Mesopotamia, owing to the evaporation of irrigation water and the consequent precipitation of salts and alkalies, is perhaps the greatest disaster in Near Eastern history. For the Lake Seistan and Lower Helmand Valley, see below, p. 91f. For the Indus Valley, see below, p. 107.

17. L. I. Hlopina, "Southern Turkmenia in the Late Bronze Age," *EW* 22 (1972) 213; John Gray, *Archaeology and the Old Testament World* (New York, 1962) 4; Martin A. Beek, *Atlas of Mesopotamia* (London, 1962) 9; David Oates, *Studies in the Ancient History of Northern Iraq* (London, 1968); Louis Dillemann, *Haute Mésopotamie orientale et pays adjacents* (Paris, 1962) 67; K. W. Butzer, *Quaternary Stratigraphy and Climate of the Near East* (Bonn, 1958); W. B. Fisher, *The Near East, A Physical, Social, and Regional Geography* (London, 1961) 63f. One will note various spellings for Asian placenames in works cited in this study. I have used those spellings most common to English writers in this text. Since geographical sources are not consistent in their use of diacritical notations for place names, they will not be used here.

important to the Macedonians, but also the climate and geography of their route. Often, the army's movements were determined not so much by political or military events as by the severity of the winter, amount of snowfall (in Persis), or rainfall (in the Gedrosia), or other geographical factors. To a large extent these conditions dictated when the army would delay, when it would march rapidly, which route it would take, and, hence, the very nations Alexander would conquer.

Of course, not all of Alexander's tactical and strategic decisions were based solely on logistic considerations, but it is only the possible relationships between his movements and the army's provisioning problems that will be considered in subsequent chapters. Furthermore, this study is offered only as a beginning for the analysis of these relationships, not as a final answer.