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Macroseismic data from historical sources

1.1 Description and evaluation of documentary source material

It is self-evident that any work based on documentary research can only be as comprehensive as its sources allow. Limitations on the factual data available determine the thoroughness of the investigation and the value of the conclusions that are possible. The objects of our concern, earthquakes, are specific events whose occurrence is significant: but so equally is their apparent lack of occurrence. The completeness of our information therefore assumes a great importance, and this in turn is the main burden on our sources and our responsibility in their interpretation.

Although seismologists are aware of the value of historical data and alert to their inherent limitations, the effect of these limitations is seldom examined systematically. Clearly a number of chance factors influence the survival of data, not least being the chance survival or destruction of documents containing information. Other factors are more constant and they must be investigated before we can assess how complete and representative a sample of seismic activity has been recorded, both in terms of its distribution (geographical and temporal) and its apparent intensity.

Fortunately, Persia has a relatively well documented history and a variety of source materials are to hand. The characteristics of these works, where relevant to their value as sources of macroseismic data, are noted in the course of this chapter, which aims to indicate the extent of the material made available and to discuss its suitability for our purposes. It is not necessary to describe works individually; their comparative merits and defects emerge from the use made of them. The same applies to secondary sources, such as specialist studies on Iran's history, geography and archaeology, or scientific publications. Many of the problems associated with the sources are dealt with in the endnotes to chapter 3.

1.2 A perspective on historical data

The transmission and survival of macroseismic data depend very largely on historical or geographical circumstances, which are not necessarily consistent for all regions over different periods of the past. We must therefore review our data in the light of the circumstances in which they were recorded. Despite its literary wealth, we are dealing with a long span of history of a society that has remained, until recently, essentially static in comparison with western Europe and sporting a low level of literacy: this is a factor for continuity. The vast extent of the country and its peculiar physical characteristics have served to make the different regions more or less isolated from each other, but linked by routes predetermined by natural features and thus of high antiquity. Similarly, the local urban centres have often played an important and independent role in the unfolding of events, in a region whose history has been turbulent, violent and subject to sudden change; earthquakes have only caused some of the scars on the battered features of the record of Persian history. In the analysis that follows some importance is attached to the role both of the cities and of the routes in the survival of data. This role may be formulated by analogy with modern seismographic stations: we need to be aware of their location and sensitivity and of how adequate is the publication of their records. Furthermore, we must look beyond the individual stations to the characteristics of the whole network, not only with regard to the distribution and sensitivity of the instruments, but to whether they report individually or transmit their data to a central organisation for processing. Finally, we have to know whether the stations have operated continuously, or only at certain periods.

As for the cities, it is an assumption, borne out by modern experience, that the larger towns are the main sources of information about earthquakes and that events occurring within the immediate vicinity of such a town are likely to be recorded, while those happening in remoter regions may well remain obscure. Thus it has been observed that the distribution of earthquakes reflected in historical sources is often closely related to the distribution and density of settled population, and not necessarily a function of the magnitude of the shocks themselves. The bias in volume of information available for the towns as against outlying rural areas may not only distort the picture of an individual event and the true location of its meizoseismal area, but also in more general terms, affect the apparent pattern of seismic activity throughout the whole region. For the period in which we rely exclusively on macroseismic data, this is clearly an important consideration.

The cities were linked by routes that were loosely defined, not restricted by a road surface but only by a series of fixed points. The links with the surrounding countryside, both at and in between stages, were close: the scope for exchanges along the route therefore correspondingly wide, unlike a modern motorway that is detached from the land it crosses. In addition, there were many sections of parallel or multiple routes, suitable for travel at different seasons, or for animals or activities of different types, for pasturage, trade or more rapid communications. This busy network facilitated the oral spread of news, albeit slowly, depending on its importance. In the case of an earthquake, which can have considerable impact on a local level, perhaps with wider repercussions, the spread of details reflects the number of people affected or interested. Whether or not the news was recorded in writing (and thereby given a better chance of survival) is a function of both the size of the earthquake and also its location, depending primarily on the geographical proximity of an urban centre to the epicentral region. The record may then become part of the local history of the district, provided a local historiographical tradition exists; this is generally associated with its political independence. In cases where details of an earthquake have not survived in local histories, but in more general works written elsewhere, this also reflects the relative importance of the town or region concerned and the ease with which news of it has travelled. This is why earthquakes near Ray (743) were recorded by authors in Constantinople, and why events near the Oxus (819) were noted in Baghdad or those in the Persian Gulf (1497) were of interest in Cairo.

We therefore expect macroseismic data to be more readily available for places situated along the major routes and particularly the cities at the termini or intersections of the route system. As the urban centres and the routes between them fluctuated in importance, their political and commercial fortunes responding to historical developments, we must be aware of these changing circumstances (and their influence on the distribution of recorded earthquakes) throughout the period under survey.

It is possible to divide this period into four sections of unequal length, on the basis of the predominant type of source material available. The first, from the seventh to the mid-thirteenth century, is defined by the fact that almost all our data derive from *Arabic* sources. The second division, up to the end of the sixteenth century, is in marked contrast to the first, *Persian* works becoming the main source of information. In the third division, covering the seventeenth and eighteenth centuries, *European* sources, particularly contemporary travellers' accounts, provide increasingly valuable evidence of earthquake occurrence in Persia; and finally, British *diplomatic archives* and European and Persian *newspapers* make available a very comprehensive sample of data from the nineteenth century onwards. The review ends around 1925, a convenient date marking the fall of the Qajars and the start of Iran's lurch into the modern world under the Pahlavis. Instrumental data are of course available before this date, but they are still unreliable and macroseismic data continue to be invaluable. There is obviously a measure of continuity between these periods, each standing for the addition of a new category of source material rather than the replacement of one type by another, so that ultimately all the different groups of sources contribute information. Nevertheless, it is convenient to maintain the divisions, as various characteristics of each can also be seen to influence the amount and quality of data that have survived. A brief description of these periods is intended to give a background to the occurrence of historical earthquakes, and also to illustrate some of the criteria conditioning an analysis of the raw material provided by the sources. There is in most cases a clear

correspondence between the distribution of recorded earthquakes and prevailing historical circumstances; particular attention should be paid to the factors assisting or prejudicing the survival of data for those areas whose historical seismicity is inadequately known, as they throw light on the gaps in the record.

The state of the Muslim authors' understanding of seismic phenomena, which varied from a rational, though incorrect, scientific interpretation to one of superstitious ignorance, is mainly irrelevant to this study. Ample evidence exists of Muslim cosmologists' views on the causes and nature of earthquakes, which reflect the ideas of classical Greek writers, particularly Aristotle, but their discussion is mainly philosophical.[1] A rational viewpoint is seldom applied to the discussion of individual events, a rare example being some of al-Biruni's references to earthquakes (al-Biruni: 20–3). At the other end of the scale, earthquakes were regarded with primitive religious awe and were discussed, occasionally, in purely theological terms. There are hardly any works devoted exclusively to earthquakes, exceptions being the works of al-Suyuti and his continuators, al-Dawudi and al-Shadhili, who cover the period up to 1588, and of al-Jazzar, who was writing in 1576. A much later work by al-Qusi comprises events in all parts of the world up to 1907, but for the early period he gives no information that is not found in the better-known historical sources.[2]

A poor understanding of the nature of earthquakes does, however, inevitably lead to some irrelevancies or confusions in early accounts. This is particularly evident in the tendency to associate the occurrence of an earthquake with some other event, when such a relationship is in fact coincidental. The departure from Iran of Muhammad Riza Shah Pahlavi on 16 January 1979 and the occurrence the same day of a relatively large magnitude earthquake northeast of Qayin, killing a few hundred people, is such a coincidence. Similar associations occur in historical sources, particularly with the death of prominent people, and can often be used to confirm the accuracy of the dates given, though sometimes such correlations merely confuse the issue.[3]

In the same way, but more importantly, earthquakes are frequently reported along with other natural phenomena, such as an eclipse: a recent example of how this might arise is the coincidence of the Tabas earthquake of 16 September 1978 and a total eclipse of the moon later the same night. One more beneficial result of this type of association of events, particularly common in superstitious societies, is that earthquakes that might otherwise have gone unrecorded are mentioned in the sources. Heightened perception and recording of earthquake activity may thus extend to undamaging shocks or tremors that coincided with other natural phenomena or with important local political events. This factor has to be taken into account when assessing the gravity of the shocks themselves. The collective reporting of such diverse elements is particularly characteristic of Arabic chronicles, to which we may now turn.

It is emphasised that the discussion throughout is concerned only with sources that have actually been read, and not with works that may strictly speaking be available but have not in fact been used by the present writers.

1.3 The Caliphate period (622–1258)

This is more precisely defined as the early Islamic period, from year 1 of the Muslim era up to the sack of Baghdad by the Mongols in 1258 (the pre-Islamic period is treated separately, see below, § 3.2). The chief characteristic of this long period that allows it to be taken as a whole is the fact that Persia and Iraq were part of a unified empire, even if by the end the unity was only theoretical. Iraq being the heartland of this empire, almost all our information about earthquakes comes from Arabic sources, mainly historical chronicles. Very little has survived of native Persian works and their contribution to our data is small.

The systematic treatment of events in Arabic annals gives the data for these centuries a certain uniformity. Earthquakes are recorded factually and, because of the repetitive nature of the annalistic style, usually by a number of sources. The later chronicles generally provide an accumulated record of all previous events, certainly the most important ones. Of these works, the most notable is that of Ibn al-Jauzi (lived in Baghdad, d. 1200), who provides a comprehensive and invariably detailed record of events, forming the basis for most later compilations, such as that of al-Suyuti (of Cairo, d. 1505). The preservation of often summary data in a stereotyped format by generations of annalists promotes the survival of information, while removing much of its immediacy. Earthquakes are often reported baldly, along with eclipses, comets, shooting stars, floods, famines and plagues as 'events'. The only form of embroidery is provided by occasional suggestions of the supernatural at work, with stories of other freak phenomena, resembling much of the 'damned' data collected by Charles Fort (1973). The joint description of earthquakes along with other phenomena, such as meteorite falls,[4] strong winds, hail or thunderstorms, can give a confusing impression of the destructiveness of the shock itself;[5] nor is it always certain that the different effects were indeed simultaneous. Similarly some Arabic authors, such as Ibn al-Athir (of Mosul, d. 1233), often describe different earthquakes together in a collective account of all the events in a year, making it difficult to disentangle their separate effects, their sequence and the areas over which individual shocks were experienced. These defects are small, however, beside the overall thoroughness and regularity of reporting of earthquakes by Arabic historians; all positive statements, however inadequate, are of value and can be assessed critically (Melville 1978: 184–94).

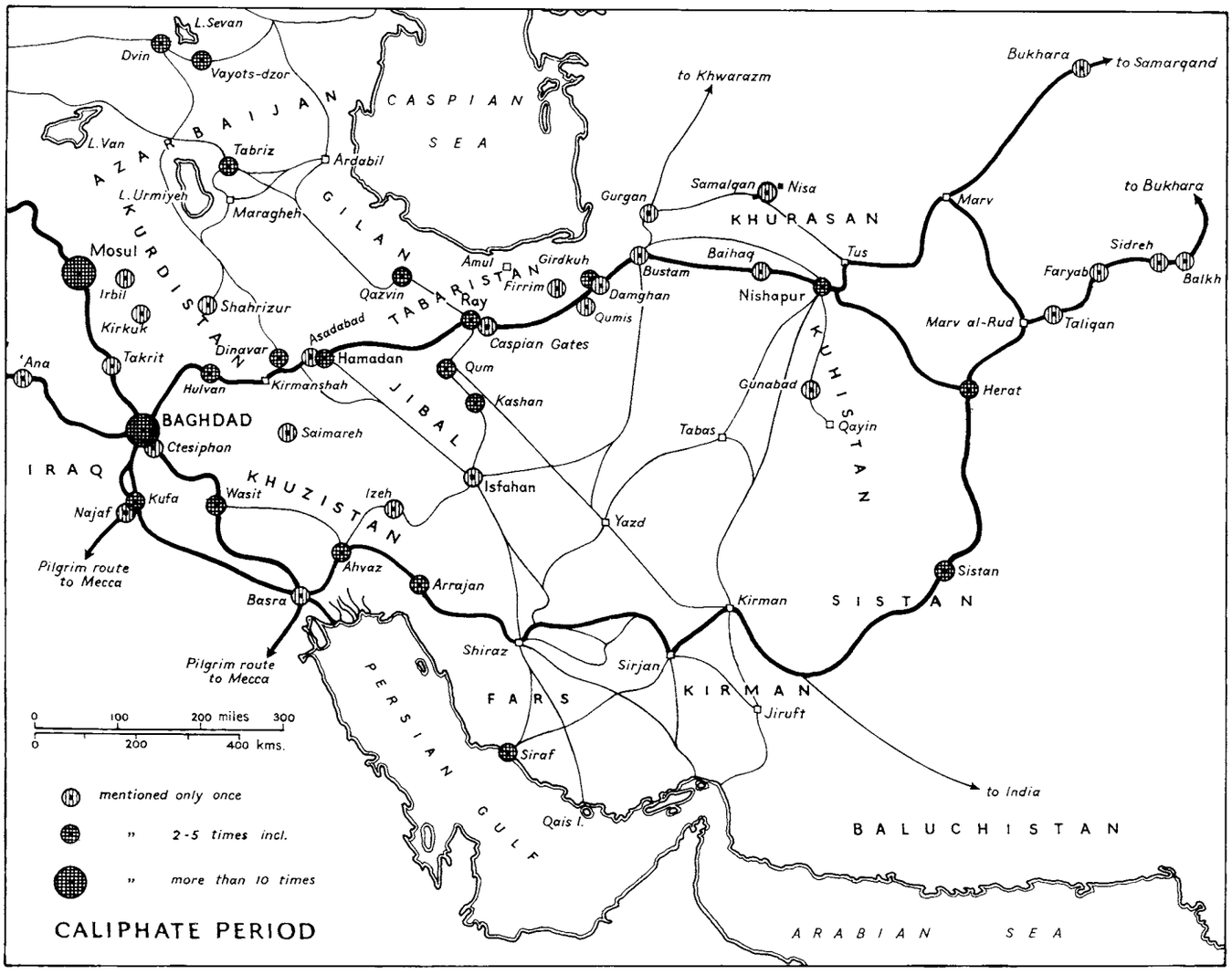
There are three broad subdivisions in the period we are considering. Very little information has survived from the earliest period, partly doubtless because of its antiquity, but mainly for the lack of a pre-existing tradition of historical writing, which took time to emerge. The Byzantine model was adopted, as in many other fields, and Byzantine annals themselves have some data for this early period. The shift of capital from Damascus to Baghdad in 763 was of great importance for the re-emergence of the Iranian plateau from its comparative obscurity. At the same time, centralisation of the empire at

Baghdad made it the ultimate destination of all important news from the provinces, supplied by merchants or the official postal and intelligence system. From the end of the eighth century all major routes emanated from, or rather led to Baghdad, serving the commercial and political needs of the capital. Authors in Iraq were thus well placed for access to information; and Arabic was the dominant vehicle for all forms of expression and cultural evolution. This period of expansion, of comparative security and stability, encouraged the development of prosperous commercial centres and supported a large, predominantly settled population. All these circumstances were conducive to the survival of macroseismic data.

Political fragmentation of the empire began as early as the ninth century and was established fact by the eleventh, when the first wave of nomadic invaders swept from the east across Persia. From the mid-eleventh century onwards, various branches of the Turkish Saljuqs dominated Iran. There was perhaps an increase in nomadism and a greater separation of the different regions of the country, but the underlying structure and coherence of the empire provided a thread of continuity until the Mongol invasions in the early thirteenth century.[6]

The distribution of earthquakes recorded in the Caliphate period closely reflects these conditions. Figure 1.1 shows the location of places mentioned as having been affected by earthquakes, the number of times this occurred and their relationship with the main routes of the period. It is most striking that almost without exception, the places named are directly situated on one of the arteries to the heart of the eastern Islamic world – or so near one as to be effectively within the route's catchment area of news and information. The network is drawn on the basis of details given by Muslim geographers of the ninth and tenth centuries, as summarised by Le Strange (1905). The figure also indicates the relative

Figure 1.1. The main routes under the Caliphate and the places affected by earthquakes during this period. The figure indicates how many times earthquakes were reported at each place and the close connection of these locations with the main lines of communication. Note the bias towards information for Iraq. The figure does not distinguish individual earthquakes nor their likely epicentral location, for which it should be viewed in conjunction with figure 5.2.



importance of the main regional centres along the way, as loosely defined in terms of their size and political or commercial influence. Such fluctuations in the state of the routes or towns as modify this general picture sufficiently to affect the survival of data, are noted below.

It will be observed that almost all the earthquakes recorded for Persia occurred in the region traversed by the main Khurasan highroad. This was the most important and most frequented of the five highways leading to Baghdad, the caravan route that brought products from China and India along the natural corridor between the foothills of the Alburz and the fringe of the central *kavir*, before turning southwest to cross the Zagros and descend into the Tigris–Euphrates valley. The importance of this route, both for trade and pilgrim travel, remained constant and news of the districts it crossed would be of current interest throughout the period. It seems reasonable to conclude that almost all the events of any significance in the places along the way would have been recorded. The details that have survived, a further stage of natural selection, must be of the most destructive earthquakes, particularly in the major cities of Ray and Nishapur: though not necessarily of the largest magnitude shocks in their respective provinces. Nishapur has a tradition of high seismic activity in the early period, but no details of these events have survived (Melville 1980).

A certain amount of information is available for the region between Ray and Azarbaijan. Qazvin was of some importance as a military centre for operations in the Caspian provinces and from its position on the ancient route across north Persia into Asia Minor. This route was eclipsed, at least till the late eleventh century, by the greater attraction of Baghdad and the Holy Cities beyond, to the southwest, and Qazvin although prosperous was not politically important. Seismic activity in the area is confined to events affecting Ray (864, 1177), the exception (1119) being recorded by a local source. It is unlikely that other events in the region would have been monitored, though the surviving record may give an accurate idea of the frequency of shocks seriously damaging in the town itself. The same may be said of Tabriz, which was of little size or importance until the tenth century. It became capital of Azarbaijan in the eleventh, but continued to share this position with Maragheh and Ardabil throughout the Caliphate period. The lack of macroseismic data for these towns may reflect an absence of genuinely destructive events there, for both were generally more important centres than Tabriz, though the sources for information on Azarbaijan are extremely poor for most of the period. The record of a destructive shock in Tabriz (in 1042) coincides with the passage of the traveller Nasir-i Khusrau along this route, which had again become more international with the spread of the Saljuqs west into Anatolia. Thereafter, though earthquakes in the city were undoubtedly more frequent than can be accurately determined,[7] the chances of other genuinely destructive events not being recorded are small. Another secondary route of some importance completed the triangle Baghdad–Ray–Tabriz, linking the latter with the Khurasan highroad between Hamadan and Kirmanshah, thus passing through Dinavar (Minorsky 1964: 94). News from Azarbaijan and Tabriz would also reach Baghdad via Mosul (as in 1042), though the geographers do not mention such a route.

In contrast with the Khurasan road, those on the southern skirts of the desert are roundabout tracks, linking up regions of secondary importance (Minorsky 1964: 57). Nevertheless, the Gulf ports and the Tigris–Euphrates valley were busy sources of supply; the close connection of Wasit and Basra with the capital made detailed news readily available there. In such favourable circumstances, the few earthquakes recorded below Baghdad must reflect the low seismicity of the region at this time. In the Persian Gulf, details of events at Siraf (978, 1008) illustrate the influence of historical conditions on the survival of information. Described in the ninth century as the chief emporium for trade with China and India, the port reached a peak of prosperity in the tenth century, rivalling Shiraz and Basra. Al-Mas'udi (d. 956) refers to the high seismicity of this district, but such references cease in the eleventh century, when sources no longer throw light on affairs in the Gulf, which suffered a decline. This was occasioned in part by the collapse of Buyid authority in southwest Persia and also by the successful efforts of the Fatimids in Egypt to divert the Gulf trade into the Red Sea.[8] By around 1110, the island of Qais or Kish had become centre of the Gulf trade and Siraf was totally eclipsed. Although the local network of routes between Shiraz and the Gulf ports saw some changes in the eleventh and twelfth centuries (Aubin 1969: 36), these were of little consequence for the survival of news about the area. This would have reached Baghdad by the sea route, via Basra, as in the past; but the political upheavals and economic decline of southern Persia after the last half of the eleventh century would prejudice the transmission of all but the most extraordinary information.

In the southern Zagros, Shiraz had early on replaced Istakhr as capital of Fars and was developed in the ninth century by the Saffarids (Lockhart 1960: 43). Although the province, and by extension its capital, had no particular interest in the southeast, it did gravitate to the west.[9] It was the longest lived of the three Buyid capitals (the others being Ray and Baghdad), and particularly in the late tenth century, under 'Azud al-Dauleh, great importance was attached to developing land links between Shiraz and Mesopotamia, via Khuzistan. This involved building bridges and improving roads, and Arrajan (near modern Bihbahan) was developed as a major commercial city.[10] Abu Dulaf (*c.* 950) refers to the frequency of earthquakes at Izeh (Malamir), and though no details of these early events have survived, it is no accident that earthquakes there and at Ahvaz and Arrajan (1052, 1085) are recorded in Baghdad in the later Buyid period.[11] As for Shiraz, there is no reference to earthquakes in local sources and this, despite the decline of Fars in the late eleventh and the twelfth centuries, may be taken to indicate that none of any significance occurred in the immediate vicinity of the city. There is no record of any damage to the major buildings erected in the pre-Mongol period.[12]

On the western side of the desert, alternative routes connected Shiraz with Isfahan, whence roads led north to Ray

and to Hamadan. From the head of the Gulf, routes through Khuzistan also reached Isfahan – one was followed by Abu Dulaf and another by Nasir-i Khusrau – while ancient tracks throughout Luristan linked the former Sasanian centres and continued much frequented in the Caliphate period (Siroux 1949: 2, 11). Despite this wide network of routes, no information has survived of a major earthquake in the central Zagros (which corresponds roughly to the Jibal province), with the exception of the Saimareh event of 872. It is possible, however, to qualify this apparent seismic quiescence. In the first place, Arab geographers of the tenth century refer to the high seismicity of the Jibal, especially round Hamadan.[13] To the west of the region, Baghdad, which we may regard as a very sensitive organ of perception, was frequently affected by shocks which caused little damage and are likely to have originated in the Zagros. Some of these may have occurred to the north of the Khurasan highroad, in Kurdistan, in which case they may also have been reported in Mosul.[14] For many of these Jibal events, there is no indication of a precise epicentral region or area of maximum damage. It is clear that the excellent record of earthquakes in Baghdad (seventeen in all) is due to historical factors rather than the high seismicity of its position (see figure 1.1). Shocks mentioned in Hamadan are similarly not always destructive there, and may be the result of more distant events. Further to the east, routes trending north–south were of less importance than those following the dominant axis of trade east–west, and their connection with Baghdad was clearly less direct. The towns of Qum, Kashan and Isfahan show little evidence of being affected by earthquakes; on the rare occasions they are mentioned, the connection is with events in the Alburz, not the Zagros (856, 958). Isfahan became particularly important under the Buyids (mid-tenth to mid-eleventh century), when it was on a par with Ray, and the Saljuqs later made it a capital city and created many fine buildings there. The absence of macroseismic data for Isfahan undoubtedly reflects a genuine lack of serious events there, while the chances of destructive shocks in the remoter regions to the southwest (such as Chahar Mahal) being reported either locally or in Baghdad during this period are negligible.

Other, less densely populated regions offer even less evidence of seismic activity. In southeast Iran there is a lack of data for the whole period, particularly noticeable in the Kirman region. This largely reflects the remoteness of Kirman (formerly Bardasir) and the earlier capital, Sirjan, from Baghdad, although under the Saffarids and to a lesser extent the Buyids, affairs in the province were fairly closely connected with those to the west.[15] The region however remained economically behind Fars until the collapse of the Buyids. Kirman then flourished for a long period under a branch of the Saljuqs (1041–1187), enjoying political stability and commercial affluence; it became the centre of a system of routes north–south from the Gulf (the Oman coast and Hurmuz were under Saljuq suzerainty) to the cities of Khurasan, and similarly eastwards to Sistan and Kuhistan (Aubin 1959). Reflecting this independence, local histories of Kirman are available from the twelfth century, the city being rather better represented in this respect than many other Persian towns. The lack of macroseismic data would seem to suggest that no significant event affected the city itself, as opposed to outlying regions: to the north, local oral tradition preserves the account of an earthquake in the twelfth century in the Kuhbanan district.[16] Local histories of Kirman concentrate on the deeds of the ruling families rather than purely local affairs and it may be that for some reason Kirmani authors were not interested in earthquakes.[17]

Eastwards to Sistan, such information as we have derives, significantly (and for this period almost alone), from a local source. Although apparently more prosperous and more populous in the middle ages than is now the case (Tate 1910), the area was nonetheless remote. Mediaeval geographers give few details about the province, which was connected to Herat and the towns of Kuhistan by local tracks, not comparable with the density of the network in the Zagros. The *Tarikh-i Sistan* records three early events (734, 805, 815) but is then silent on the subject of earthquakes, while continuing its coverage of affairs in varying depth up to the Mongol invasions.[18] The province came into wider prominence under the Saffarids (*c.* 870–911), who dominated much of the eastern Islamic world, and in these circumstances the absence of macroseismic data suggests that a period of prolonged quiescence followed the earlier burst of activity round the Hirmand (Helmund) basin. Mustaufi tells a fable of the destruction of a gold mine in Sistan by an earthquake, perhaps in the late eleventh century, and although worthless as a source of accurate information, legends emanating from such areas are clearly a valid indication of local seismic activity.[19] Local oral tradition is the source for the only earthquake recorded in Kuhistan in this period (at Gunabad in 1238), although others may be referred to under the general term 'Khurasan' – a suggestion made more likely by the assumption that had these events (763, 840, 1066) occurred near a main route, the locality would probably have been specified.[20] The routes in Kuhistan merely link up local centres, except where they connect with the main desert routes leading from Nishapur. Local sources are likely to be the only fund of macroseismic information in Kuhistan, and in the absence of such sources in the early period our data is clearly incomplete.

In Gurgan and the Kopet Dagh, traversed by routes north to Khwarazm and alternative itineraries from Bustam (or Shahrud) to Tus and Nishapur (e.g. those of Abu Dulaf and Nasir-i Khusrau), the survival of data remains fortuitous. The Gurgan shock (874) is recorded in connection with a specific historical incident by a unique source, while notice of the 943 earthquake, clearly of large magnitude, comes in the account of a contemporary traveller and other regional sources of information.[21] These conditions are not generally met, and the subsequent lack of data should certainly not be taken to reflect a total seismic quiescence. The direct route across the Sabzavar plain remained the dominant artery of travel after the eleventh century – the Saljuq caravanserai at Za'faraniyyeh was one of the largest in Persia (Siroux 1949: 16) – and news from further north would be unlikely to reach Baghdad.

These observations about areas of secondary importance

also apply to regions effectively off the route network altogether. Information is particularly deficient for the Caspian provinces of Gilan and Mazandaran, which were politically separate and commercially of minor interest in the Caliphate period. Historical circumstances did not facilitate the transmission and survival of macroseismic data and unfortunately there is inadequate contemporary local coverage of these areas beyond the Alburz. Al-Mas'udi (d. 956) states that Amul and many other towns in Tabaristan (Mazandaran) are subject to earthquakes,[22] but no details of these events have survived. Such information as we have (for Firrim, *c.* 1127) is fortuitous, although as in other remote areas, chance factors are more likely to operate in seismic regions than they are to illuminate relatively quiet zones.

Desert areas yield no information, for obvious reasons. Large shocks originating in the desert might be picked up by the main towns around its borders, but during this period the chances of this are slight. Regional termini such as Yazd and Kirman, but also places like Qayin, Na'in, Kashan and Isfahan were unlikely to record on a local level the feeble effects of a distant shock, which could pinpoint the epicentral region. The only chance of survival for earthquake data would be a traveller's account, or through direct transmission to Baghdad rather than a static local record. Well-worn tracks skirted and crossed the deserts of central and southeast Iran and news could travel with the caravans, especially if vital wells or water cisterns were destroyed. The volume of this traffic is hard to estimate; certainly the tracks from Yazd and Kirman through Tabas to Nishapur were important arteries in the late eleventh and in the twelfth centuries, flourishing under the Saljuqs of Kirman (see above), who greatly developed Tabas itself. Had an earthquake comparable to that of 16 September 1978 occurred in or around Tabas at this period, it is unlikely to have escaped widespread notice. The chances of a smaller earthquake, or one not affecting an important oasis, being recorded remain minimal.

1.4 The Mongol and Turkoman period (1258–1598)

This period is defined on one side by the Mongol sack of Baghdad and on the other by the transfer of the Safavid capital from Qazvin to Isfahan, which introduced a new era. The division exists by virtue of its complete contrast with the preceding Caliphate period. The most fundamental change is that a wide gulf developed between the Arabic world, now centred in Mamluk Egypt and Syria, and the former eastern provinces of the Islamic empire. Persia's affairs evolved separately as a function of internal conditions, with such outside influences as were important coming from the east. This is reflected in the fact that Persian works replace Arabic ones as the main sources of information. The difference is important, because the treatment of natural phenomena in Persian sources is far from systematic. Very few authors, even if covering the general history of long intervals, mention more than one or two earthquakes, and very few events are reported by more than one source. This does make for an individual account of each earthquake, with authentic distinguishing features, often embroidered with stories or other details of human interest. Certain stories, such as events being predicted, with various results, are quite frequent (for example, the earthquakes of 858, 1042, 1549, 1593 and 1721). Allusion is also made to the behaviour of animals (as in 1485, 1608, 1695 or 1875; see below, § 3.4.3). One characteristic feature is the composition of poems about earthquakes which, apart from giving expression to the various emotions aroused by disaster, often contain useful information, such as the precise date of the event or of subsequent restoration work. But the fact that most of our accounts of earthquakes in the Mongol and Turkoman period derive from only one source means that it is generally not possible to confirm or supplement the details provided (Melville 1978: 194–8).

These characteristics of the Persian source material are in large part determined by a preoccupation with either straight political narrative or, more fruitfully, with purely local history, which may itself, however, have an entirely political emphasis. Inclusion of earthquake data in dynastic histories depended on a most favourable combination of circumstances, which rarely operated. Internal conditions in Iran after the Mongol invasions did not facilitate the spread and survival of macroseismic data on the general level. The country remained considerably depressed and depopulated after the invasions, many villages deserted and many towns greatly reduced. There was at the same time an increasing tendency towards nomadism.[23] While it may be argued that a greater mobility of population might encourage the spread of news, at least on a regional level, the decline of a settled, stable population would not assist its survival in written form (cf. chapter 2). Even the capital cities provided only temporary residences for the rulers, who in nomadic manner alternated between winter and summer quarters, or were away campaigning. Authors covering affairs at court were thus faced with a constantly changing geographical backdrop; the independent life of towns or regions at the centre of events was thus only sporadically brought into focus.

The Mongol Il-Khans dominated Persia from centres in the northwest (Maragheh, Tabriz and Sultaniyyeh) until 1335, during which time the entire length of the east–west trade route from China to eastern Anatolia was controlled by related Mongol states; most of this trade passed through Tabriz. Internal security remained poor and the Il-Khanid state quickly dissolved into factionalism before a new order was briefly introduced by Timur around 1380, from his capital at Samarqand. After his death in 1404, Timur's empire was effectively reduced to an eastern portion under his successors in Herat and a western portion under the Turkoman dynasties, centred in Azarbaijan and upper Mesopotamia. Both these succession states were eclipsed by the Safavids around 1502, whose capitals were again in the northwest; but by the end of this period, two of the four imperial cities (Herat and Tabriz) were in the hands of the Safavids' enemies (Uzbegs in the east and Ottomans in the west), while Qazvin itself was felt to be threatened.[24]

The frequent change of capital, lack of centralisation and relative insecurity prevailing in this period are important factors in the distribution of recorded earthquakes. In place of

one long-term focal point, like Baghdad, where information could be accumulated and preserved, there were a number of more or less independent centres. In this respect, the role of the main routes as vehicles for the transmission of data is modified and other factors come into operation. Fragmentation of the country promoted the growth of local centres and local histories. These have often preserved information about areas that would otherwise undoubtedly have escaped notice in more general works. An increase in data for some regions off the main route network or rural districts not intimately connected to a major urban centre partly makes up for the unreliable reporting of earthquakes in dynastic chronicles. However, the amount of useful data found only in later compilations suggests that some sources of information have been lost or not yet identified. The Mosul annalist al-'Umari (d. 1811) is the sole source for about one-third of the events recorded in this period and our data would be seriously depleted without his work, which in many ways resembles Ibn al-Jauzi's and represents the continuing activity of Arabic historians in Iraq. He records events for several areas of Persia, his intermediary sources of information being unclear; he may be reporting oral news transmitted directly to Iraq as well as quoting documentary sources.

In addition to these indigenous histories, a small number of Muslim and European travellers have left accounts of their journeys in Persia (see figure 1.3). Their presence in the country was brief and intermittent, so that the likelihood of their coinciding with a major earthquake was small; furthermore, the accounts of their travels are generally meagre in geographical details about the areas they passed through, often confined to the vaguest indications of the author's movements or a bare list of places visited. Nevertheless, their passage through Persia introduces a further modification to the role of the routes they used, these becoming themselves potential sources of information rather than merely the channels along which news travelled.

Figure 1.2 shows the distribution of places mentioned as affected by earthquakes during the period up to 1600 and the number of times this occurred. The network of routes is based on details given by Mustaufi, who describes the situation at the end of the Il-Khanid period (*c.* 1340), with Sultaniyyeh as capital and the hub of five main highways; the picture is filled out for later periods on the basis of travellers' itineraries, and the traces are thus of the routes from which we would expect information to be available.[25] It is clear that although the distribution of recorded earthquakes is very different from that found in the previous period (figure 1.1), there is still a close coincidence of these places with the main routes.

Of these, two were of primary importance; one east–west across northern Persia, from the Oxus to Anatolia, the other diagonal from the northwest down to Hurmuz in the Persian Gulf. Both these routes went through Tabriz. Information on earthquakes in this city is available throughout the period, despite the fact that the events themselves (1273, 1304, 1345, 1459, 1503 & 1550) do not seem to have been too serious. These data must accurately reflect the seismicity of the time, for any large event should have been recorded had one happened, given the international importance of the city.[26] The rest of Azarbaijan is similarly well covered: lack of information for Maragheh (capital till 1295) and Ardabil, which was much frequented and rose to a new prominence under the Safavids, suggests that no earthquake of any significance affected these places, while the Sarab and Miyaneh district in between does demonstrate some seismic activity. Data for the area west, round lake Van, also reflect the importance of this trade route as well as the high seismicity of the region.

A total lack of information from the regions of Sultaniyyeh (capital 1305–35) and Qazvin (1548–98) suggests a genuine quiescence for the periods of their importance, but not necessarily for the intervening two centuries. Although the routes through these cities were busy, our source material is inadequate to illuminate the apparent gap.[27] The same applies to Ray, which was superseded by Varamin, although the region remained populous; such details as we have are either dubious (1384) or reflect the effects of more distant events (1495). Despite the decline of the area, we would expect large destructive earthquakes there to be reported, though not with the same confidence as in the Caliphate period. If the occurrence of a shock around 1384 be admitted, a period of quiescence before and after it may account for the lack of further data.[28]

The Khurasan road east of Ray undoubtedly maintained its earlier importance, although we have few accounts of it.[29] The area was dominated between *c.* 1336 and *c.* 1380 by the Sarbadars, based on Sabzavar and Nishapur, whose intricate history receives some attention in the sources. The main routes passed to the north, through Gurgan, Jajarm and Juvain (Aubin 1971). Gurgan's importance as a winter pasture for the Turko–Mongol nomads is suggested by the record of three destructive earthquakes there in the fifteenth century (1436, 1470, 1498). Why similar information is not available for other intervals is not clear; perhaps a genuine seismic quiescence preceded and followed this concentrated burst of activity, though after the establishment of the Safavids at the beginning of the sixteenth century the region came under pressure from the Uzbegs and was only marginally under Persian influence.[30] A similar, though earlier paroxysm seems to have affected Nishapur, where three destructive earthquakes (1270, 1389, 1405) are reported in Persian sources. The subsequent seismic quiescence, during the period of activity in Gurgan, should *not* be seen as a function of the city's decline from the fifteenth century onwards or a corresponding dearth of information in contemporary histories (Melville 1980).

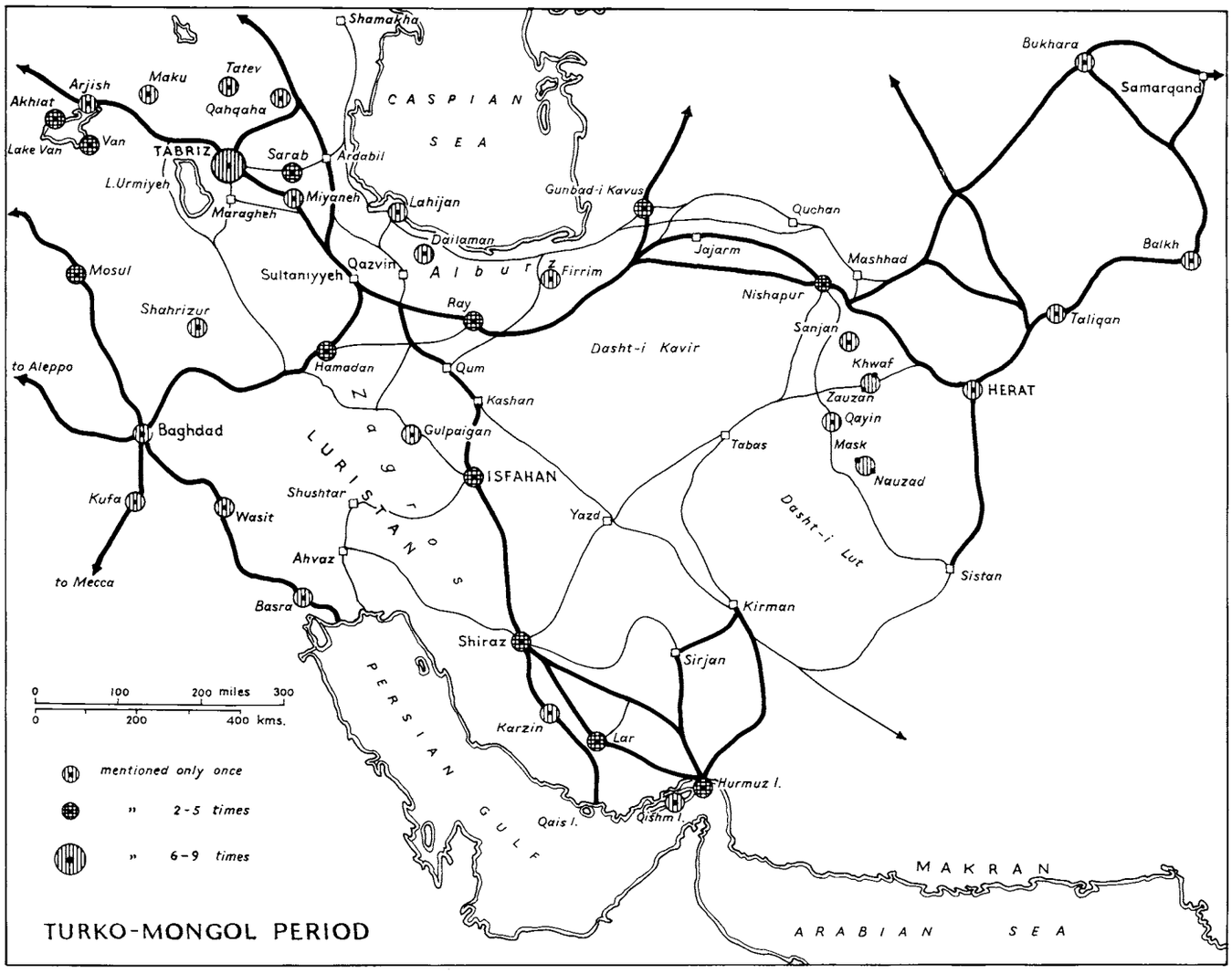
Kuhistan, peripheral to Nishapur and likewise dependent on Herat, yields perhaps the most consistent record of seismic activity during this period, with major events reported in 1336, 1493 and 1549. The two earlier earthquakes are mentioned by local historians, reflecting the vitality enjoyed by the area, in common with the whole Herat province, until the sixteenth century. The later event is recorded by a number of Safavid chroniclers.[31] Mustaufi relates a legend of a cypress tree at Kishmar, west of Turshiz, which protected the district from the earthquakes that frequently occurred all around it. The tree is said to have been felled in the ninth century and it

may be that this action ended the seismic immunity of the Turshiz area. No details of specific events, however, are available before 1903.[32]

The route southeast from Sultaniyyeh down to the Persian Gulf was probably more frequented, certainly so by the few European travellers of the time. In view of the steady trickle of visitors, details should have survived of any destructive shock in one of the towns along this route. No such earthquakes are mentioned and the minor events recorded by al-'Umari for Isfahan and Shiraz are probably representative of the situation in those cities. The former was important throughout the period, more so, as a potential source of macroseismic information, than under the Caliphate. Shocks experienced in Isfahan (1344, 1459, 1495) all originated some distance away and can be used to form some idea of events in the Zagros. The infrequency of earthquakes in Isfahan itself is specifically referred to by Mustaufi (*Nuzhat*: 48). To the south, shocks in and around Shiraz in 1459, 1506 and 1591 leave a similar impression. Lack of information before the fifteenth century cannot be blamed entirely on unfavourable circumstances, for the city was visited and described by Ibn Battuta in 1327 and 1347 and a local history is extant, dating from the same time. Thereafter Shiraz was prominent under the Inju'ids and later the Muzaffarids, during which period the great poet Hafiz was active (d. 1390).

Beyond these two centres, routes to the Gulf reached Qais (chief emporium up to 1330) and Hurmuz (or Jarun, on Hurmuz island), the latter going via Lar by the end of the fourteenth century (Aubin 1969). Data for Qishm (1361), Lar (1400, 1593), Karzin (1440) and Hurmuz (1482–3, 1497) reflect the major commercial importance of the routes through this region. Descriptions of their itineraries are given by Ibn Battuta and various Europeans, such as Nikitin in 1471, Newberie in 1581 and Teufel in 1589. Information recorded for these areas, by a variety of sources, must be a fairly complete sample of seismicity of the southern Zagros.[33]

Figure 1.2. The main routes under the Mongol and Turkoman dynasties and those for which details are available from travellers' accounts. The figure shows the places affected by earthquakes during this period. Note the absence of data for Iraq compared with figure 1.1. For the epicentral location of events, see figure 5.2.



In contrast with this region, data are almost totally lacking for southwest Persia, the Tigris–Euphrates valley and the western Zagros, a gap which, compared with the preceding Caliphate period (figure 1.1), can only be seen in terms of historical and geographical circumstances. In Luristan, a local atabeg dynasty maintained the security and upkeep of roads to Isfahan up to the early fifteenth century, but increased nomadism in the area would prejudice the survival of macroseismic data.[34] The latest available account of this overland route is Ibn Battuta's; by the end of the sixteenth century, at the height of the Aleppo trade, accounts are to hand of merchant's voyages from Baghdad down the Tigris or Euphrates to Basra and so by sea to Hurmuz (Steensgaard 1974: 37), but none of these mention earthquakes. Two shocks in this area (in 1430, 1457), at a time when we have no travellers' accounts, are given by al-'Umari, which may point to epicentres in the Zagros. Isolated shocks to the north, in Kurdistan, are mentioned by Arabic sources,[35] but it is clear that the perception of events in the whole of this western zone is greatly reduced from its previous level. Only the Hamadan–Gulpaigan earthquake of 1316 is mentioned by Persian sources; the area was crossed by a secondary route of some importance at this time (Mustaufi, *Nuzhat*: 171–2). Later indications of possibly comparable events in the region are provided by al-'Umari's reports of shocks in Hamadan (1430?, 1495) and Isfahan (see above).

The southeast of Iran again presents a blank. In some respects, this gap is harder to account for than in the Caliphate period. Although by virtue of its location and terrain much of the southeast may be considered remote, its removal from the main stream of events in the Mongol and Turkoman period was by no means as great and its distance in relation to Baghdad is no longer relevant. Kirman witnessed a succession of rulers, notably the Qutlugh Khans and Muzaffarids up to the end of the fourteenth century, who attract attention in the main sources of the period. The former capital, Sirjan, again achieved considerable importance at this time, diverting the main flow of traffic to Hurmuz from the more easterly route through Jiruft (Sabzvaran) and at the same time benefitting from its position on the route from Shiraz to Kirman.[36] Thereafter, details of events in the province are more intermittent, but local dynastic histories continued to be produced. The existence of such works does not of course guarantee their reporting of earthquakes, but on the other hand it is likely that destructive events in Kirman itself would have been noted had they occurred. Information about the trans-desert routes is insufficient to form a precise idea of the frequency of traffic they maintained. Yazd and Kirman, with other desert towns, seem to have remained comparatively prosperous, as noted by Marco Polo (in 1272), Friar Oderic (*c.* 1325), 'Abd al-Razzaq (in 1442) and Nikitin,[37] but the trade that filtered down to the great emporium at Hurmuz was probably of a lesser order than that going via Shiraz and Isfahan, certainly during the sixteenth century.

Sistan is similarly served by local histories throughout the period under review; and furthermore, until the advent of the Safavids in the sixteenth century, was sufficiently within the orbit of Herat for news to be available to the late Timurid historians of the region, as was the case for Kuhistan (see Tate 1910). It seems probable that the implied absence of large earthquakes, particularly before 1500, is genuine, although it may be that hints of such events may be found in local oral legends.

The Caspian provinces, finally, maintained their isolation from the wider circle of affairs in the rest of Persia. The few details of earthquakes issue from purely local sources, of which a number have survived, covering the whole of the period. The southwest corner of the Caspian was traversed in the 1560s and 1570s by British merchants of the Muscovy Company, plying between Shamakha, Ardabil and Qazvin, with excursions to Rasht and Lahijan, the main town of the area.[38] About a century earlier, Barbaro and Nikitin also penetrated the Alburz. These brief voyages have left no information about the seismicity of the Caspian provinces, however, most of the traffic keeping to the south of the Alburz. It remains probable that had any other event comparable to that of 1485 been experienced in Gilan or Mazandaran, it would have received attention in the sources available.

1.5 The seventeenth and eighteenth centuries

The period inaugurated by Shah 'Abbas's transfer of the capital to Isfahan saw increased stability and prosperity in the Safavid dominions as a result of his rule, with a greater degree of centralisation than had been present for centuries. In 1722, this relative tranquility was abruptly disturbed by the Afghan invasions of Persia and the quarter century that followed, embracing the career of Nadir Shah, saw the collapse of political stability, depopulation of the countryside and deterioration of the economic life of the region. Nadir's capital was Mashhad, and after his death in 1747 Persia was divided into separate spheres of influence. His Afsharid successors and the rise of an independent Afghanistan dominated affairs in the northeast and east, while after more than a decade of violence and anarchy order in the south and west was largely restored by Karim Khan-i Zand, whose metropolis was Shiraz. After his death in 1779, there was a protracted struggle for power between his successors and the ultimately triumphant Qajars, who were based on the Caspian provinces and assumed control in 1794; the new capital was Tehran. Superimposed on this political background was the heyday and gradual decline of Persia's position in the world of international and intercontinental commerce, the overland routes through the country slowly yielding to the ocean routes opened up by the Dutch and the English in the early seventeenth century (Steensgaard 1974).

Travel books have been treated as a separate source of information for the whole of the Middle East. Accounts of Persia by about 650 travellers in the period prior to 1900 have been read, of which 160 are from trips that skirted Persia along the peripheral routes of Mesopotamia, the Persian Gulf or Transcaspia, or from European residents who remained static in one place. The itinerary of each of the remaining 490 travellers has been drawn on a 1:8 500 000 scale map (unpublished), with details of the period of each traveller's