In Nha, I.-S., Orchiston, W., and Stephenson, F.R. (eds.), 2017. *The History of World Calendars and Calendar-making. Proceedings of the International Conference in Commemoration of the 600th Anniversary of the Birth of Kim Dam.* Seoul, Yonsei University Press. Pp. 113–122.

THE PROBLEM OF THE DATE LINE IN MEDIEVAL JEWISH SOURCES

Sacha Stern
Department of Hebrew and Jewish Studies, University College London
Gower Street, London WC1E 6BT, United Kingdom.
sacha.stern@ucl.ac.uk

Abstract: The date line is an imaginary line on the Earth, running from north to south, which demarcates a change of the date for whoever crosses it. Its location is arbitrary and dependent on international consensus. The date line is not an objective reality, but an anomaly resulting from the globalization of the seven-day week and calendars.

Medieval Jewish scholars were the first to conceive the date line and to discuss its location on the globe. The date line was first mentioned and discussed in Judah ha-Levi's *Kuzari* (Spain, 1130–1140); he located it at 90º east of Palestine. His argument was criticized in 1310 by Isaac Israeli (Toledo), in his calendar treatise *Yesod Olam*; Israeli rejected the concept of a date line, and proposed instead a geographical model for global time. This model, however, was upset by the later discovery of the New World. Consequently, in his astronomical work *Neḥmad ve-Naim* (1601–1613), David Ganz (Prague) rejected Israeli's theory, and left the problem of the date line unresolved.

Non-Jewish scholars, in particular Christians, took much longer to address the problem of the date line. It was briefly mentioned for the first time by a Christian scientist, Nicole Oresme, in the fourteenth century; but it was not seriously discussed by Christians until much later, following the development of world circumnavigation and European colonization of America and the Pacific Ocean in the sixteenth and seventeenth centuries.

In this paper, an attempt is made to explain why, in the Middle Ages, the date line remained a specifically Jewish concern. This may have reflected a Jewish interest in precise calendar reckoning and in theoretical legal problems, but was also related to an ideology that viewed time, and more particularly the weekly Sabbath, as an objective and global reality.

Keywords: date line, Jewish, medieval, Christian, Judah ha-Levi

1 INTRODUCTION

1.1 The Date Line: Convention and Globalization

The date line, or 'International Date Line' as it is commonly known nowadays, is an imaginary line on the Earth, running from North Pole to South Pole, that demarcates a change of the date for whoever crosses it. It functions similarly to a line between time zones, which demarcates a change of the hour. In principle, the date line is straight and corresponds to a meridian, but in practice, like the limits of time zones, it meanders a little along geo-political boundaries. The location of this line is arbitrary, and dependent entirely on international convention. By an agreement reached during the International Meridian Conference that was held in 1884 in Washington, D.C, it runs through the middle of the Pacific Ocean, at approximately 180º from the meridian of Greenwich, but as Bartky (2007) has demonstrated, this conference was only one stage in a complex and drawn out process that involved a host of political, geographical and cartographical factors, and the location of the date line has continued to vary ever since.

The dependence of the date line on international consensus is important to emphasize. The date line is not an objective reality, but a purely man-made concept. Time zones are also man-made, but arguably less so. Let us take for example the point in time when it is 9 a.m. in Greenwich, and thus 9 p.m. along the date line, 3 p.m. in Bengladesh, and 3 a.m. in Chicago. The division of the day into twenty-four hours, and the precise way these hours are reckoned, are evidently man-made and dependent on convention. But nevertheless, it remains objectively true that at this point in time, it is day-time (morning) in Greenwich, night-time (late evening) in the Pacific, day-time (afternoon) in Bengladesh, and night-time in Chicago. Day and night, morning and afternoon, are indeed objectively real. However we choose to sub-divide the day (whether in 24 hours, or any other arbitrary division), and hence, in however many time zones we choose to divide the globe, it remains objectively true that as one circles the Earth at any one time from east to west (or from west to east), the times of the day will change.

The date line, in contrast, is much less anchored in any objective reality. It responds entirely to the human, social practice of counting and differentiating the days, and of attempting to do so in a global, uniform way. Schemes for counting and differentiating days are generally arbitrary and largely dependent on consensus. The seven-day week, most prominently, is completely unrelated to astronomical (or any other) reality: nothing in reality, other than human consensus, can dictate that days should run in cycles of seven and that these cycles should begin on any particular day.

The same applies, to a lesser degree, to calendars, which organize the days into larger structures of months and years. Although most calendars have some basis in astronomy (solar, lunar, or both), they are also dependent on conventional norms, such as the precise definition of the beginning of the day, month, and/or the year. This makes it impossible to determine objectively where any date line should be located.

An objective date line would only be conceivable in the context of a purely natural calendar. This would apply, for example, to an Islamic calendar, or any other lunar calendar, that would depend strictly on the first sighting of the New Moon crescent, and where the evening when the New Moon is sighted would mark the beginning of the month. In such a calendar, the date line would represent the boundary on the globe between those regions where the New Moon was first sighted on one evening and where (typically, further to the east) the Moon was not sighted until the following evening; consequently, the dates of the month in both regions would be one day apart. This natural, lunar date line would necessarily change (i.e. be located elsewhere on the globe) every month, as from month to month the boundary between sighting and non-sighting is never in the same place. In practice, however, Islamic calendars do not strictly adhere to lunar sighting for the determination of the beginning of the month, so that this movable date line remains no more than theoretical (see http://www.islamicmoon.com/global_hijri_calendar.htm; accessed 23 May 2017). Although this date line would be objective, in the sense that it would not depend on any arbitrary agreement, it would not be free of human agency, inasmuch as it would depend on when people happen to have sighted the New Moon. It might be possible to do away with human agency, and define this date line on the basis of when and where the New Moon has met astronomical conditions of first visibility (regardless of whether the Moon was actually seen). These conditions, however, would have to be agreed upon in advance by scientific consensus.

Similarly, an objective date line would be conceivable in a solar calendar in which the year begins at the point of (for example) the true astronomical spring equinox. In this calendar, however, the date line would still depend on an element of convention, as it would be necessary to reach agreement on when the day unit begins. If midnight (however defined) were taken, for example, as the beginning of the day unit, then time zones where the equinox occurred before and after midnight would differ in their dates by one day. Again, in such a calendar the date line would vary from year to year, and would thus be 'movable'.

World calendars, however, are not natural or based purely on astronomical phenomena: they are also governed by social criteria, which range from practical convenience and tradition to economic, political and religious demands. With respect to the week, therefore, but also to most world calendars, there is no natural location for the date line on the globe. It could even be argued that since dating, i.e. counting and differentiating days, is a man-made pursuit, the very concept of a date line is artificial and has no grounding in objective reality.

In societies where local calendars are used, i.e. where the use of a calendar is confined to a specific region, a date line is unnecessary: for the date will be the same within the confines of that whole region. The very concept of a date line, in this context, is therefore irrelevant. A date line only becomes necessary when an attempt is made to use the same calendar, or the same week, around the entire globe.

This highlights, again, the artificiality and cultural dependency of the date line. The date line—where people on either side of it are one day apart—is often cause for puzzlement. It is, indeed, a kind of anomaly, which only arises from the globalization of the seven-day week and what we call 'world calendars' (see Barrows, 2010; Birth, n.d.).

1.2 A Brief History of the Date Line

The concept of a date line is a relatively late comer in the history of human civilisation. It is not attested before the later Middle Ages; and it is not until the early modern period, with the development of world circumnavigation, that the date line came to be treated as a serious, practical issue. In this paper, I wish to show that medieval Jewish scholars were the first to conceive the date line and discuss its location on the globe, long before Christians and others thought of it or gave it their attention. The specifically Jewish interest in this concept is striking and will need to be explained.

The earliest known mention and discussion of the date line is in a treatise popularly known as *Sefer ha-Kuzari*, written in Spain by the Jewish scholar Judah ha-Levi, in the 1130s. As we shall see below, Judah ha-Levi located the date line 90º east of Palestine. His argument was criticized in 1310 by another Spanish Jewish scholar, Isaac Israeli, in his major calendar treatise *Yesod Olam*. Israeli rejected entirely the concept of a date line, and proposed instead a geographical model of global time. This model, however, was based on a Ptolemaic notion of the world, which was later upset by the discovery of the New World. The new world order made its impact in 1601–1613, when the Jewish scholar David Ganz, in Prague, realized that Israeli's model had become untenable. He discussed again the problem of the date-line, and left it unresolved.

As we shall see, this dialectic progression remained completely internal to Jewish scholarship, without Muslim or Christian scholars gaining any awareness of it. The Muslim, Syrian scholar Abulfeda, in the prolegomenon to his *Geography* (completed in 1321), observed correctly that a person travelling round the globe eastwards would gain a day, and another travelling westwards would lose a day, in relation to a third person left at their point of departure (Reinaud, 1848: 4–5). However, he did not progress from there to notion of a date line, which had been formulated already by Jews nearly two centuries earlier.

On the Christian side, the first scholar to mention, quite briefly, the possibility of a date line was the French scientist Nicole Oresme, later in the fourteenth century. But as we shall see, the problem was not seriously addressed and discussed by Christians until after the development of world circumnavigation in the sixteenth century, first by another French scholar, Nicholas Bergier, in his *Archemeron* (1617). I am not aware of the date line appearing in any other source, outside Europe and the Near East, in the medieval period (at least before the seventeenth century).

2 MEDIEVAL JEWISH SCHOLARS ON THE DATE LINE

2.1 Judah ha-Levi (c. 1130–1140)

As stated, the earliest known theory of the date line appears in Judah ha-Levi's *Book of Refutation and Proof in Support of the Despised Religion*, commonly known under its Hebrew title *Sefer ha-Kuzari*, which he wrote in Judeo-Arabic (Arabic written in Hebrew characters) sometime in the 1130s, in Muslim Spain. This book is an apologetic work of Jewish philosophy, in which the author defends the Jewish faith and its superiority over other religions; the passage relevant to the date line (2:20) is incidental to the rest of the work. Judah ha-Levi's account of the date line is confusing and at times obscure. I shall paraphrase, interpret, and re-arrange his argument, rather than quote it verbatim and in order.

Judah ha-Levi starts by arguing that the beginning of the day of the Sabbath must be calculated from the Sinai desert, or alternatively from Palestine, for two distinct reasons: (1) this is where the Law was given, and (2) this is where the calendar began after the six days of Creation, when Adam began to count and name the days. By this he appears to mean that the original Sabbath began in either Sinai or Palestine, and from there ran its course westwards, as he goes on to explain below. The 'original' Sabbath refers, somewhat inconsistently, to two distinct historical times: either the giving of the Law at Sinai (1), or the Creation of the world (2). He also implies that the location of Palestine, at the 'centre of the world', is inherently significant:

> The beginning of the Sabbath must be calculated from Sinai, or rather Alush, where the Mannah first descended (Exodus 16 and Numbers 33: 13–14)"… Palestine … lies in the centre of the world … Palestine, the place where the law was given, and where Adam at the end of Sabbath was transferred from Paradise. It is there where the calendar began after the six days of creation. Adam, then, began to name the days …" (after Hirschfeld, 1905: 93–94).

Indeed, the main purpose of this entire passage is to demonstrate the centrality and importance of Palestine over all other lands, and at the end of his discussion of the date line, Judah ha-Levi thus concludes:

> … thus does the knowledge of the 'Sabbath of the Lord' and the 'Festivals of the Lord' depend upon the land which is the 'inheritance of the Lord,' and has, as thou didst read, the other names of 'His holy mountain' (Ps. 99: 9,), 'His footstool' (ibid. 5), 'Gate of heaven' (Gen. 28: 7). For the law shall go forth from Zion' (Micah 4: 2), etc. (Hirschfeld, 1905: 97).

According to this argument, therefore, the original Sabbath commenced in Palestine at sunset, which was then noon in the extreme west (90º west of Palestine), and midnight in 'China' (270º west of Palestine). In actual fact, the meridian 270º west of Palestine cuts across the Korean peninsula. Judah ha-Levi's error in calling it China reflects his limited knowledge of the Far East, but also serves the convenience of using schematic rather than real geographical coordinates. Thus, after beginning in Palestine, Sabbath began in the regions west of it, and finally in China, 18 hours later than in Palestine. Consequently,

> … Sabbath does not come in until the Sun has set behind Sinai, and so on to the remote west, and round the globe to China, which is the extreme end of the inhabited world. Sabbath begins in China eighteen hours later than in Palestine, since the latter lies in the centre of the world. Sunset in Palestine, therefore, concurs with midnight in China … (Hirschfeld, 1905: 93).

If one were to carry this argument to its logical conclusion, in India Sabbath should have begun 21 hours later than in Palestine, and the date line —24 hours later—should have been Palestine itself. Judah ha-Levi, however stops at China, in a rather inexplicable way.

He argues, indeed, that there must be a date line, a place that is "… at the same time extreme west and beginning of east … [otherwise] it would be impossible for the days of the week to have the same names all over the world." (Hirschfeld, 1905: 95). This place, however, must be 'China', as it is "… the beginning of the inhabited world." (ibid.). This is where the date line lies. The area beyond China (i.e. west of it, between China and Palestine) is treated as east of Palestine:

> China … was the extreme limit for the day to be called 'Sabbath', because the region further on is only called east of the place where the days began to be counted. A place, however, must exist that is at the same time extreme west and beginning of east. This is, for Palestine, the beginning of the inhabited world, not only from the point of view of the law, but also from that of natural science. (ibid.).

Judah ha-Levi concludes:

> But the latitude[1] in which differences in the nomination of the day become apparent amounts to eighteen hours, neither more nor less. The inhabitants of one meridian still call the day Sabbath, whilst those of another are past it, and so on until eighteen hours after the time when the Sabbath began, and the sun culminated in Jerusalem. It is then when the name Sabbath comes to an end. (Hirschfeld, 1905: 96).

This means that when it is sunset at the conclusion of Sabbath in China (whereupon in Palestine it is Sunday noon), Sabbath ends in its last place on Earth.

The author does not do much to justify this end point and location of the date line, which contradicts the notion expressed at first, that the day begins in Palestine. He seems to be motivated, however, by several considerations: firstly, that the region that he calls 'China' is the beginning of the inhabited world—although the relevance of this to the date line is not fully explained—secondly, that it seems counter-intuitive that immediately to the east of Jerusalem the date should be different, so a zone to the east should be included with it;[2] and thirdly, that the China date line could help to explain an obscure Talmudic passage, which would then constitute for Judah ha-Levi a legal source. The Talmudic passage in question is *bRosh ha-Shanah* 20b, part of which reads:

> … if the moon was born before midday, it is known that it will be seen close to sunset; if it was not born before midday, it is known that it will not be seen close to sunset.

Yet there remains a profound, unresolved contradiction between the Sabbath 'starting' in Palestine, and the date line lying 90º east of it, in 'China'.

This text is the earliest attestation we have of a concept of the date line; but it is poorly explained, the argument is confused and in disorder, the language imprecise, and the conclusions contradictory. Judah ha-Levi is famous as a poet and a philosopher (the latter, as in the *Book of the Kuzari*), but he is not known as an astronomer or a scientist. This raises the suspicion that the argument presented here is actually not his own, but one that he borrowed from an earlier Jewish source, and that he had trouble replicating it faithfully. That his earlier source was Jewish is evident from the emphasis on Jerusalem, the Sabbath, and other Jewish elements that underpin the whole argument. Although this earlier source cannot be identified—the notion of the date line is absent, for example, in the extant astronomical and calendrical works of the great Catalonian scholar Abraham bar Ḥayya, one generation earlier—one could tentatively suggest, for example, the eleventh-century Spanish Jewish astronomer Isaac ben Barukh Albalia, who is much quoted by Abraham bar Ḥayya and his successors, but whose own calendrical work (written in 1065) is unfortunately lost (see Stern and Burnett, 2013: xiii–xxi). At one point (Hirschfeld, 1905: 94), Judah ha-Levi polemicizes against "… recent astronomers, thieves of science …" who resorted to speculation rather than to 'prophecy' and designated China as the beginning of the day (and not Palestine). The identity of these astronomers is not disclosed; but if they were discussing the date line, they would have reached the same conclusion as Judah ha-Levi—China, or 90º east of Palestine—though without Judah ha-Levi's contradiction.

The date line of 90º east of Palestine was endorsed by Jewish scholars in the twelfth and following centuries, and is still advocated by some Jewish scholars today.[3] It is implicit in Zeraḥia ha-Levi's commentary on the Babylonian Talmud, written in Provence only a few decades later in the mid-twelfth century (Zeraḥia ha-Levi, *Sefer ha-Maor* (or *Ha-Maor ha-Qatan*), on *bRosh ha-Shanah* 20b—the same Talmudic passage referred to above). Nowadays, Judah ha-Levi's date line is commonly attributed to Zeraḥia ha-Levi; however, the concept of the date line and its definition are only implicit in the latter's argument, which is solely concerned with the sighting of the Moon and the determination of the new month. Zeraḥia ha-Levi does not cite Judah ha-Levi, but may well be relying on him. He spells out, like Judah ha-Levi, that the day begins in Palestine; but the date line 90º east of it (for which he implies the more precise definition of 90º east of Jerusalem, as opposed to Judah ha-Levi's vaguer 'east of Palestine'), is only implicit in his argument. Later in the twelfth century, in his glosses to Zeraḥia ha-Levi's commentary (known as *Katuv sham*), Abraham ben David ('Raavad') of Posquières rejects the notion that the day begins in Palestine, and writes instead, very briefly, that the day begins 'in the east'—effectively brushing away Judah ha-Levi's contradiction, but retaining a similar date line.

2.2 Isaac Israeli (1310)

In contrast to Judah ha-Levi, the Jewish scholar Isaac Israeli was an accomplished scientist whose *magnum opus* in Hebrew, the *Yesod Olam* (composed in Toledo, in 1310), was a monumental work on the Jewish calendar also containing substantial sections on mathematics, astronomy, and other calendars.[4] In one passage of this work (2:17), the author addresses the question of the

date line. He criticizes Judah ha-Levi's theory, and puts forward his own alternative.

The author begins by noting the contradiction, in the *Book of the Kuzari*, between the beginning of the day (located in Palestine) and the date line (at 90º east of it), which leads to the absurd result that the eastern half of the inhabited world, between Palestine and China, has no date assigned to it at all:

> Behold, they [Judah ha-Levi and Zeraḥia ha-Levi] contradict themselves by saying that from Jerusalem or the 'navel of the earth' the naming of the day begins … and likewise that in the extreme east the naming of every day of the week ends.
>
> Shall they say that the Sabbath does not begin for those in the eastern half of the inhabited world either before it begins at the navel of the earth in Jerusalem, or afterwards? – this is a lie and a great mockery.

This contradiction is arguably an easy target for criticism; but Isaac Israeli goes much further, and rejects entirely the very concept of a date line. In his mind, it makes no sense that two people standing in proximity to each other, but with the date line running between them, should consider the date or day of the week to be different:

> Further, one must argue against them in this respect, and say:
>
> How can it be that Levi, who lives in the navel of the earth,[5] should be now at midday of the Sabbath, whilst Judah, his neighbour slightly away from him to the east, should disagree and say: 'Not at all! We are now in the previous day!' – can there ever be any mockery or madness such as this?
>
> In truth, I would generally say that it is completely impossible and unfeasible for people standing together on the same day and seeing together the sun to be calling some of them the day 'such-and-such a day of the week', whilst at that time the others call it the day before or the day after.

Consequently, Isaac Israeli concludes that there is no date line at all. Instead, he argues that the day begins in the eastern extremity of the inhabited world, wherever exactly this may be, and ends in its western extremity. He is presumably assuming a Ptolemaic model of world geography, in which the inhabited world stretches from China in the Far East to Spain in the far west (Ptolemaic world maps remained dominant in the West throughout the Middle Ages; see Mittenhuber, 2010).

Although the date must change somewhere in the uninhabited hemisphere (west of Spain and east of China), in Israeli's perspective this is a vast ocean, and the location of this change is therefore irrelevant and in no need of determination.

Unlike Judah ha-Levi, who bases his date line on a biblical, cosmological argument (the Creation of the world, Adam's naming of the days, and the giving of the Law at Sinai), Isaac Israeli employs a commonsense, pragmatic approach. By doing away with the concept of the date line, Isaac Israeli is effectively putting forward instead a geographical (or 'human-geographical') model of global time, which is determined pragmatically by the extent of human inhabitation around the globe (as it was then known). The date, after all, only concerns humans. It makes sense that all humans should reckon the same dates and days, which is possible given that they only occupy a limited segment—a half, actually—of the earthly sphere. The day can therefore begin at the easternmost point of human settlement, and end in its westernmost point. Assuming the day begins at sunset, then during the twelve-hour period that elapses between sunset in the east and sunset in the west, throughout the inhabited world, sunset will always bring in, whenever it occurs, the same date and day of the week.

2.3 David Gans (1601–1613)

The discovery of the New World, at the end of the fifteenth century, threw into question the entire model that Isaac Israeli proposed. Yet it took about one hundred years for a Jewish scholar, David Gans, to come to this realization. David Gans (1541–1613) was a leading Jewish historiographer and astronomer of the early modern period, who spent most of his active life in Prague, where he encountered the great astronomer Tycho Brahe and other scientists under the patronage of the Habsburg emperor Rudolph II. His main astronomical work, written in Hebrew under the title of *Neḥmad ve-Naim* (printed in Jessnitz in 1743), makes frequent reference to the discovery of the New World, in Chapters 93–97, starting with 'America' (North America) and 'Peru' (South America), and ending in Chapter 97 with New Guinea, a more recent discovery that Gans was particularly interested in, as we shall presently see (Stern (2016).

The discovery of the American continent upset the medieval worldview in more than one way, but also put into question Isaac Israeli's human-geographical model of global time. It became unclear, indeed, whether America should be considered an extension of Europe, thus marking the end of the day in the west, or an extension of China, thus marking its beginning in the east. More fundamentally, the existence of inhabited lands around the entire globe now rendered the date line a necessity, as there was no place on Earth where the date line was irrelevant or in no need of determination; and with the development of world circumnavigation, the determination of the date line was becoming increasingly a practical necessity. The absence of an uninhabited

oceanic hemisphere further defeated Isaac Israeli's argument, in that it was no longer possible to treat the Far East as the natural beginning of the day: in theory, the date line could now be located anywhere around the globe.

In a lengthy chapter of *Neḥmad ve-Naim* (ch. 161), David Gans explains from many alternative perspectives the problem of the date line and Israeli's solution to it, which he clearly favours over that of his predecessors, Judah ha-Levi and Zeraḥia ha-Levi. But right at the end of the chapter, he discloses that the discovery of the New World, and in particular the more recent, mid-sixteenth century discovery of New Guinea has proved false the beliefs of the early scholars, and undermined completely Isaac Israeli's solution:

> [Isaac Israeli] wrote … that the extreme east is the place where the naming of every day begins – no other place in the world – and likewise, that the extreme west is the place where the naming of every day ends.
>
> He reasoned so because he thought that half the sphere of the earth is submerged in water, as was the opinion of the majority and nearly all the ancient sages ... and that we should not be troubled by the fish of the ocean, how they will call that day…
>
> However, I have already disclosed above that this assumption has been refuted … for remnants [i.e. lands?] have been discovered around the whole sphere of the world ...
>
> … this is the New World that I have mentioned above, and especially in the fourth quarter of the sphere of the earth, where all doubts and quandaries arose,[6] a vast new territory has been discovered: this is the land that is now called New Guinea, which is an island in the ocean close to the Far East by about (...)[7] degrees, a large and wide territory more than half the size of Europe where we dwell.
>
> Accordingly, the opinion of Israeli falls away and has no foundation.

It could be said that for Gans, the discovery of New Guinea put into question Isaac Israeli's concept of 'far east', just as the earlier discovery of the American continent had put into question his concept of 'far west'. But New Guinea is particularly important to Gans, because its close proximity (in longitude) to China created a particular challenge to earlier European beliefs about the easternmost point of human inhabitation. Gans' inflated description of New Guinea as more than half the size of Europe reflects the knowledge of the time, and possibly the confusion of New Guinea with Australia, which had not yet been properly discovered by Europeans in this period. The earliest known map of New Guinea, which was produced in 1600 and the likes of which David Gans may well have seen, represents the island as a massive peninsula joined by an isthmus to an even larger (and partially represented) austral continent (Collingridge De Tourcey, 1906; 30–31). In any event, Isaac Israeli's model had become untenable.

As a result of his critique of Isaac Israeli's model, the problem of the date line remains, for Gans, completely unresolved. He concludes the chapter as follows:

> You must know, my reader, that I raised these questions and quandaries before the great, the eminent counsellors, the Christian scholars who sit before our lord the Emperor Rudolph, may his glory be elevated – wise and learned men with sharp minds, whose intelligence is unfathomable. But after they delved into these questions for several days and discussed them with me, they confessed openly that they knew no correct or satisfactory answer.

Although America had been discovered more than one century earlier, and the world had been circumnavigated more than once in the course of the sixteen century, Gans presents himself in this encounter as if he had been the first to think of this problem. He was not entirely wrong, for as I have already intimated, the problem of the date line was first raised by Jewish scholars in earlier centuries, but only sporadically mentioned by Christians before the seventeenth century. In this passage, Gans avoids presenting the date line as a specifically Jewish issue, but nevertheless he appears to derive some pride at having outstripped, in this area, his Christian rivals.

3 CHRISTIAN SCHOLARS ON THE DATE LINE

3.1 Nicole Oresme (1350–1360)

We now turn to Christian sources. The earliest non-Jewish scholar to mention the possibility of a date line was the renowned French scientist Nicole Oresme. His references to the date line are extremely brief, but sufficient to show that he had reflected on the problem. In the *Questiones Supra Speram* (Question 14), an astronomical work in Latin attributed to him, and written in Paris in 1350–1360, Oresme discusses the phenomenon that, as we have seen above, Abulfeda had already noted a few decades earlier: namely that a person travelling round the globe eastwards would gain a day, and another travelling westwards would lose a day, in relation to a third person left at their point of departure. Unlike Abulfeda, however, he proposes to resolve this paradox through the establishment of what resembles very much a date line:

> From this it follows further that if this [part] were inhabitable, a place would have to be assigned where a change of the name of the day would be made.[8]

This is all he writes about it. Later in his career, in a book written in the French vernacular, this time in the form of a poem (the poem itself is in Latin), in Chapter 2:31 the date line is only

obliquely referred to as a 'distinction' (*distinctio*); I shall return to this passage further below (Lejbowicz, 1988: 112–122 and 140–142; Menut and Denomy, 1968: 518–519; see also Lutz 1973).

Although Oresme was thus aware of the date line, to him it remained no more than a theoretical concept which only deserved a fleeting reference. He made no attempt, for example, to establish where this date line should be located, in contrast the Jewish scholars such as Judah ha-Levi, most likely unknown to him, who had preceded him by more than two centuries with elaborate discussions of the same issue.

3.2 Nicholas Bergier (1617)

Nothing further is heard from Christian scholars about the date line until the early seventeenth century, a few years after David Gans had raised the problem (again) and left it in complete *aporia*. In his *Archemeron, ou Traicté du Commencement des Jours* (Reims, 1617), Nicholas Bergier discussed and became the first Christian to propose a location for the date line, at 180º from Mercator's prime meridian (which was located in the islands of the Azores). This was the first of several proposals, all Eurocentric, over the following centuries, that were to lead eventually to the modern adoption of an international date line through the mid-Pacific Ocean, not that far from Bergier's original proposal.

Bergier was clearly motivated by the development of world circumnavigation (which began already in the early sixteenth century) and by the beginnings of European, more specifically Christian, colonization of America and the Pacific Ocean. One of his stated aims, in the *Archemeron*, was indeed to ensure that Christians around the world observe Sunday and the festivals without confusion on the same date (Michaud, 1843: 21–22). For the first time in history, the date line had become a practical need, and it was only then that Christian scholars became seriously engaged in attempts to resolve the problem.

4 DISCUSSION: A JEWISH CONCERN

The emerging conclusion is that in the Middle Ages, the date line was a specifically Jewish concern. Between the twelfth and early seventeenth centuries, Jewish scholars alone were engaged in raising the problem of the date line and discussing where it should be located; the invention of this concept, indeed, can be attributed to medieval Jews, Judah ha-Levi or likely one of his predecessors. Among the Christians, in contrast, the date line was mentioned only briefly by Nicole Oresme in the mid-fourteenth century; its location was not discussed by Christians until the early modern period. If David Gans is to be believed, as late as around 1600, non-Jewish astronomers (those of Rudolph II's court) had not yet given the subject any thought.

Oresme, his Muslim slightly earlier contemporary Abulfeda (who failed to mention the concept of a date line at all), and even Nicholas Bergier, seem completely unaware of the Jews that had preceded them. This unawareness is quite striking, even if it can be partially explained by the languages, Judeo-Arabic and Hebrew, that Judah ha-Levi and Isaac Israeli had written in (the *Sefer ha-Kuzari* was not translated into Latin until 1660). It remains that Jewish arguments about the date line, which unrolled in dialectical progression from Judah ha-Levi to Isaac Israeli and finally to David Gans, were conducted internally and without any exposure to the non-Jewish world.

Why Jewish scholars were the first to think of a date line and to discuss its location needs now to be explained. I would like to propose, tentatively, three possible reasons (see Sections 4.1–4.3 below).

4.1 Date and Observance of Sabbath and Festivals

My first explanation is that for Jews, the precise definition of the date of Sabbath and the festivals was more important than for Christians or Muslims, because of the strict laws of observance that Jews associated with these days. These laws, indeed, involved complex prohibitions on a large range of works and activities, all carrying the severe penalties of death and annihilation (albeit administered only, putatively, through Divine agency).[9] For this reason, any uncertainty regarding the reckoning of the seven-day week and the days of the Jewish calendar could not be left open but needed to be resolved.

This is not to say that the correct reckoning of days was not also a concern to Christian and Muslims. The date of Easter had long been a matter of contention in the history of the Christian Church, precisely because Easter had to be observed at the right time, and as Constantine the Great had decreed in the early fourth century, all Christians were expected to observe Easter on the same day (see, e.g. Stern, 2012: 380–424). Indeed, as we have seen, it was the correct reckoning of Sunday and the dates of the Christian festivals that primarily, or at least explicitly, motivated Nicolas Bergier's proposal, in 1617, for the location of an international date line.

It should also be noted that the correct observance of the Sabbath and festivals is never invoked, in the Jewish sources that have been surveyed above, as an argument necessitating the determination of the date line. My first explanation remains thus plausible, because of the particular importance attached by Jews to these observances; but it must be endorsed with caution.

4.2 The Date Line: A Theoretical Problem

My second explanation is that medieval Jewish scholars had a traditional proclivity, inspired by their knowledge of the Talmud, for discussing and solving theoretical legal problems. The Talmud stands out for its interest in legal problems that have no practical relevance, either because they belong to the distant past or the eschatological future (e.g. the Jerusalem Temple ritual, which occupies perhaps one quarter of the Talmud—yet the Temple was long destroyed by the time the Talmud was redacted, in late Antiquity), or because they relate to situations that are practically impossible. All this was an inherent part of the culture of medieval Jewish scholars, even of those engaged in scientific disciplines, as they had all been trained in Talmudic study.

The Talmud's valorization of theoretical legal problems may go some way towards explaining why the date line was of particular interest to Jewish scholars. From a medieval perspective, indeed, the date line had no practical application; before the discovery of the New World in the sixteenth century, it was never more than theory. Even if it had been possible to travel around the world, like Abulfeda and Oresme's fictitious characters travelling eastwards and westwards and returning to their point of departure, a date line would still not have been necessary, as it would have been enough for the two men to correct their dates on their return to civilization (or on arrival home). Oresme makes it clear that a date line, i.e. a specific location on the globe where the date changes, would only have to exist if human inhabitation extended continuously around the whole world. Thus, in his *Questiones Supra Speram*, Oresme (for the reference see Note 8) writes that a date line would have to be assigned "… if this [part] were inhabitable." Similarly, in the poem in his later work, the *Livre du ciel et du monde* (2:31), he writes:

> Whence such a distinction would necessarily be made,
> If everywhere around the earth people were living
> And the whole world were governed by the same laws.
> (Menut and Denomy, 1968: 519).[10]

This fleeting reference, however, is all that Oresme has to say about the date line in this treatise. There is no need for him to discuss, for example, where this hypothetical date line or 'distinction' is or should be located. His interest in the date line is limited, because as he points out, the date line would only be needed 'if' people lived everywhere around the Earth; but they do not, and the discussion ends there.

The attitude of Jewish scholars was quite different. Even though Judah ha-Levi located the date line on the edge on the inhabited world, in 'China', this land was sufficiently distant from his native Spain for the date line to belong to the realm of the imaginary. So the date line was purely theoretical, but this did not mean that it was not worth investigating in detail. This problem was not only scientific but also legal, since it defined, albeit in theory, the boundaries of Sabbath observance. Their interest in the date line and in establishing its location might well have been motivated by their traditional, Talmudic interest in discussing and solving theoretical legal issues.

4.3 The Date Line: Globalism and Ideology

My third explanation is on the plane of ideology, and relates specifically to Judah ha-Levi, the instigator of the date line's medieval Jewish scholarly tradition. At the beginning of this paper, I pointed out that the concept of a date line only arises when an attempt is made to globalize time reckoning and establish a single reckoning of days —e.g. the week, or a calendar—around the whole globe. Oresme was keenly aware of this: in the passage just quoted, he emphasizes not only that a date line would only be made if people lived all around the Earth, but also, significantly, only if there were 'governed by the same laws'—i.e., if they reckoned the days in the same way. Again, this is only 'if', because really people around the world use many different calendars. For Oresme, cultural relativism, or at least cultural plurality, renders a date line irrelevant.

For Judah ha-Levi, in contrast, there is no cultural or temporal plurality; indeed, he goes as far as claiming that "… there is no difference among mankind about the seven days of the week." (Hirschfeld, 1905: 94)—as if the seven-day week were universally reckoned in an identical way; this is what necessitates a date line, because without it, "… it would be impossible for the days of the week to have the same names all over the world." (Hirschfeld, 1905: 95). That the seven-day week was the same all over the world might have been true, in his period, within the territories of Christendom and Islam (where indeed the Christian and Islamic week agreed with that of the Jews), but not necessarily elsewhere. In Judah ha-Levi's mind, however:

> … the name of the same day of the week should hold good all over the world, and the question could be put both to the inhabitants of China and the West: 'On which day [of the week] did you celebrate the New Year?'. The answer would be: 'On Sabbath'. This notwithstanding that the latter people had finished the feast, whilst the former, according to the geographical position of their country towards Palestine, were still celebrating it. With regard to the name of the days of the week, they had both kept the same day. (Hirschfeld, 1905: 97).

His cultural globalism is not due to ethnographic ignorance or wishful thinking, but rather to a certain cosmological ideology, that is not nec-

essarily 'Jewish' but might be peculiar to him. His globalist claim is justified, indeed, as follows:

> Adam, then, began to name the days, as he did with all that dwelt on earth, and the following generations continued counting in the same way. This is the reason why there is no difference among mankind about the seven days of the week. (Hirschfeld, 1905: 94).

Judah ha-Levi thus conceives of Adam as naming the days, just as, in the narrative of Genesis (2: 19–20), he names the animals and "… all that dwells on earth." Adam's naming of days not only defined Palestine as the beginning of the day (as we have seen Judah ha-Levi arguing above), but also instituted the days of the week as a universal reckoning for the whole of mankind. This, in turn, necessitated a date line, which became already then inscribed, as it were, on the face of the Earth. Adam's naming power had, in other words, the creative effect of establishing a global reckoning days, together with its attending date line, as a permanent world structure.

For Judah ha-Levi, therefore, the date line, like the seven-day week, is not an arbitrary law or a culture-dependent convention, but an objective, global reality that was established at the time of the world's creation. This globalizing, ideological standpoint on time and the creation, which might be unique to him, partly explains why Judah ha-Levi (and hence the Jewish scholars that succeeded him) developed the concept of the date line and discussed at great length its location, long before Christian and other scholars thought of this concept or gave it any serious attention.

5 NOTES

1. Or 'width' (Judeo-Arabic עֻרְץ); he means the width of land between the meridian of Palestine and the meridian of China, equivalent to 18 hours or 270º. His terminology is scientifically inaccurate; for if anything, he is referring to 'longitude' rather than to 'latitude'. Inasmuch as this term is used in a non-technical sense, it is perhaps better translated as 'width'.
2. Judah ha-Levi argues, more fully, that time cannot be different for every single point on Earth, and that it is therefore necessary to create time zones. The zone of Jerusalem extends to the east all the way to China. To quote:

   > … each name [i.e. date] spreads over a geographical 'latitude' [i.e. width of land between two longitudes, or in this context, 'time zone'; as above in Note 1], because it is impossible to fix the horizon for every single point on earth, for Jerusalem itself would have many east and west points; the east of Zion would not be also the east of the Temple, and their horizons, strictly speaking, different, though not noticeable to the eye. This would be the case in a greater degree between Damascus and Jerusalem, and we could not deny that in the former place Sabbath commenced earlier than it does in the latter, and Jerusalem sooner than it does in Egypt. A certain latitude must, therefore, be allowed. (Hirschfeld, 1905: 95–96).

3. Most famously by Abraham Isaiah Karelitz, author of *Ḥazon Ish*, in his pamphlet *Shemoneh Esreh Shaot* ('Eighteen Hours') published in 1943 in the wake of the controversy over the dates of Sabbath and Yom Kippur which had erupted in 1941 when refugees from eastern European *yeshivot* were relocated to Kobe in Japan beyond the 90º meridian. He instructed them, accordingly, to observe the Sabbath on what is commonly reckoned in Japan as Sunday.
4. A critical edition of *Yesod Olam*, with translation and commentary, is in preparation by my colleagues Israel Sandman and Ilana Wartenberg, as part of the ERC project on 'Calendars in late Antiquity and the Middle Ages'. I am grateful to Israel Sandman for his advice on the manuscripts. The text I have used for my translations is based on two of the best manuscripts, ms. Oxford Bodleian Huntington 299 and ms Vatican BAV Neofiti 31.
5. This probably means Jerusalem, as in the previous quotation. In *Yesod Olam* 4:8, however, Isaac Israeli locates the "… navel of the earth …", which he defines there as the longitude upon which the Jewish calendar computation is founded, at "… one hour and 612 parts …", i.e. about 23.5º east of the centre of Palestine (the hour being divided in 1080 'parts').
6. That is, regarding the problem of the date line. Gans is referring to his discussion earlier in this chapter; however, the specific significance of the fourth quarter of the Earth is not clearly explained, and it is difficult to understand why this fourth quarter should constitute a greater challenge to the date line than the third, where America is located.
7. The number of degrees is left blank in the printed edition (which my translation is based on), presumably because of the editor's uncertainty regarding the original.
8. *Ex hoc sequitur ulterius quod si ista esset habitabilis, oporteret assignare locum ubi fieret mutatio nominis diei* (ms Erfurt, Wissenschaftliche Bibliothek Ampl. Q 299, fol. 124r, as transcribed by Zubov 1961). See discussion in Lejbowicz, 1988: 100–101 and 133–139 (I am grateful to Philipp Nothaft for the reference). As Lejbowicz specifies, this treatise (only attested in this manuscript, from fols. 113r to 126r) is attributed to Oresme in the *excipit* (fol. 126r), but Oresme's authorship is not completely certain. This treatise is not to be confused with the very different *Questiones de Spera*, which is attested in four manuscripts

and certainly authored by Oresme, but does not include any reference to the date line. The unlikely relationship between this passage of the *Questiones Supra Speram* and Abulfeda is explored by Lejbowicz (1988: 103–104, n. 11).

9. This punishment is known in Hebrew as *karet*: see Jacobs (1999) s.v. *Karet.* On the laws of the Sabbath (but as applied in modern-day society), see Eisenberg (2004: 130–135).
10. Lejbowicz (1988: 100–101) points out that in Oresme's narrative of the two men travelling round the world, the assumption is, as was appropriate for the fourteenth century, that long-distance travel would be by land (rather than by sea), and furthermore, that travel by land would only be possible if there were continuous human inhabitation around the world. Travel around the world and continuous human inhabitation are thus intrinsically related in Oresme's worldview, but as both these passages show, it is particularly the latter, continuous human inhabitation, that would necessitate for Oresme the establishment of a specific date line.

6 ACKNOWLEDGMENTS

I am grateful to Professors Il-Seong Nha, Richard Stephenson and Jaewan Kim, for inviting me to present this paper at the conference on the 'History of World Calendars and Calendar Making' in commemoration of Kim Dam (Seoul and Yeongju, 28 November—3 December 2016), and to Professor Wayne Orchiston for editing the proceedings. This paper was written as part of an ERC Advanced Grant project at UCL on 'Calendars in late Antiquity and the Middle Ages: standardization and fixation'; the establishment of a date line is, indeed, an important step in the standardization and globalization of world calendars, as I hope this paper partly demonstrates. A draft of this paper was read by Philipp Nothaft and Kevin Birth, and I am grateful to both for their comments, corrections and further references.

7 REFERENCES

Barrows, A., 2010. *The Cosmic Time of Empire: Modern Britain and World Literature.* Berkeley, University of California Press.

Bartky, I.R., 2007. *One Time Fits All: The Campaigns for Global Uniformity*. Stanford, Stanford University Press.

Birth, K., n.d. Standards in the shadows for everyone to see: the supranational regulation of time and the concern over temporal pluralism. In Benyon-Jones, S. and Grabham, E. (eds.). *Regulating Time*. London, Routledge.

Collingridge De Tourcey, G., 1906. *The First Discovery of Australia and New Guinea*. Sydney, William Brooks.

Eisenberg, R.L., 2004. *The JPS Guide to Jewish Traditions*. Philadelphia, Jewish Publication Society.

Hirschfeld, H., 1905. *Book of Kuzari*. London, Routledge.

Jacobs, L., 1999. *A Concise Companion to the Jewish Religion*. Oxford, Oxford University Press.

Lejbowicz, M., 1988. Nicole Oresme et les voyages circumterrestres ou le poème entre la science et la religion. *Archives d'Histoire Doctrinale et Littéraire du Moyen Age*, 55, 99–142.

Lutz, C. E., 1973. A fourteenth-century argument for an international date line. *Yale University Library Gazette*, 47(3), 125–131.

Menut, A.D., and Denomy, A.J. (eds.), 1968. *Nicole Oresme, Le Livre du Ciel et du Monde*. Madison, University of Wisconsin Press.

Michaud, L.-G., 1843. *Biographie Universelle Ancienne et Moderne*. *Volume 4*. Paris, Thoisnier Desplaces.

Mittenhuber, F., 2010. The tradition of texts and maps in Ptolemy's Geography. In Jones, A. (ed.). *Ptolemy in Perspective: Use and Criticism of His Work from Antiquity to the Nineteenth Century*. Dordrecht, Springer. Pp. 93–116.

Reinaud, M., 1848. *Géographie d'Aboulféda. Volume 2*. Paris, Imprimerie Nationale.

Stern, S., 2012. *Calendars in Antiquity: Empires, States, and Societies*. Oxford, Oxford University Press.

Stern, S., 2016. David Gans on the Gregorian reform, modern astronomy, and the Jewish calendar. *Judaica Bohemiae,* 51(1), 127–147.

Stern, S., and Burnett, C. (eds.), 2013. *Time, Astronomy, and Calendars in the Jewish Tradition*. Leiden, Brill.

Zubov, V.P., 1961. Un voyage imaginaire autour du monde au 14e siècle. In *Congresso internacional de história dos descobrimentos. Actas*. Volume 2. Lisbon: Comissão Executiva das comemoracões do V Centenário da Morte do Infante D. Henrique. Pp. 563–573.

http://www.islamicmoon.com/global_hijri_calendar.htm (accessed 23 May 2017).

http://www.thegreenwichmeridian.org/tgm/articles.php?article=10 (accessed 2 June 2017).