# The Andalusi dome:

# Medieval global science from the perspective of Ṣāʿid al-Andalusī's *Ṭabaqāt al-Umam*

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## 1. Introduction: The global Middle Ages at the edge of the globe

When the Umayyad troops first settled in the Iberian Peninsula, one of their first decisions was the minting of coinage—an invaluable piece of material evidence that provides clues into the earliest phases of Islamic rule. (Figure 1) The very first round of dinars, minted in Latin so as to impress in the native Iberians the new political order, featured on its front a lone star, with an abbreviated Latin inscription of the *tawhīd*: "In the name of God, there is no God but God alone, none like Him". This star might have been an allusion to Hesperius—the Western Star—symbolizing the fact that Islam had reached the very edge of the world. (Manzano Moreno 2011, 57) In these coins the Islamic conquerors were already signaling the historical character of what al-Andalus would become: the island of the West, surrounded by the enemy at its north and the Ocean at its west, where a profound sense of precarity would give birth to an equally profound sense of their own place in the globe.

*Figure 1*. Indiction XI, gold solidus-dinar from 94 AH / 712-13 CE (Tonegawa Collection). On the left (reverse), "INDCXI" (INDictione XI), with margin "HDFRTINSPNANNXCIII" (HIC SOLIDUS FERITUS IN SPANIA ANNO XCIIII: "This solidus was minted in Spannia in the year 94"). On the right (obverse) we see the Western star, with the marginal inscription "INNDNINDSNSDSSLSN" (IN NOMINE DOMINI NON DEUS NISI DEUS SOLUS CUL NON: "In the name of God, there is no God but God alone, none like Him").

At the geographic center of this island of the West, Ṣāʿid al-Andalusi would write in 1068 AD what some historians have considered the "first universal history of science" (Plessner 1956; Khan 1991; Samsó 1992). Such a history, reconstructed in the format of a *tabaqat*, attempted to describe the contribution of the world "nations" (*umam*) to the natural sciences (*sciences of the ancients*), scoping the Chinese, Indian, Chaldean, Greek, Roman, Turk, Jewish, and of course Arab, nations, and much others. In a certain obvious sense, then, Said's *Ṭabaqāt al-umam* (from now on the *Ṭabaqāt*) can be considered a poster child of a "global" history of science, which considers all, or most, of human scientific achievement, and provides an inclusive account of its history.

In this paper, I want to think critically about the globality implicit in Said's history of science. Its universality, I claim, is only one side of the coin. The other, equally important, side is, like our gubernatorial dinar, the Western star: al-Andalus' positionality as a remote, singular member of the *dār al-Islām*. Al-Andalus' conscious position as the island of the West introduces perspective as a crucial component to understand the specific contribution of the *Ṭabaqāt* in its own medieval, Islamicate context. The *Ṭabaqāt*, then, is a universal history of science in the service of an Andalusi attempt to situate itself as part of Islamicate natural science. I will locate this attempt, however, beyond Said's own beliefs, in the context of Andalusi society at large and its connections with the broader Islamicate world. These three dimensions—the global, the regional, and the local—interact in Said's work to provide a rich portrait of (Andalusi) medieval science that, while providing a crucial case study for global approaches to the medieval period, it resists being reduced to them.

A look at Ṣāʿid's text suggests a different way of looking at medieval science; not as a globe, but as a *dome*. A celestial dome is the visible interior of the upper hemisphere of the celestial sphere. A dome, then, is a celestial sphere but from the perspective of an observer, and thus an observer looking up only has access to a limited portion of the state of the celestial bodies. Medieval actors engaging in their scientific world were similarly limited in their access to the globe. Material and cultural circumstances prevented them from reaching certain locations, thus perceiving their world from their own characteristic perspective. This limited reach of medieval societies, far from being a simple failure of connections, is constitutive of what science they practiced and how it evolved. In this sense, medieval science is both local and plural. Contrary to the picture of the globe, of which there can only be one, there is at least one dome per observer. Thinking of medieval science as a dome, then, preserves the locality of connection, but also the plurality of nodes that we follow when we trace those connections.

From the perspective of a dome, however, the observer also sits at the center of the world. This, I argue, is also the perspective adopted by Ṣāʿid in his *Ṭabaqāt*, portraying al-Andalus as the inheritor of the history of science, thus inheriting to an extent the entire scientific effort of humanity. To understand why such a tract could have been written it is imperative we take a close look at its local context, considering the position of Andalusi science within the rest of the Islamicate world and tracing the Andalusi textual tradition where the work makes an

intervention. To see the shape of the *Ṭabaqāt*, we will have to consider the world from its own perspective, and draw its shape both in terms of what it includes and excludes. As I will argue, the *Ṭabaqāt* is both a victim and contributor to an Andalusi textual tradition—*faḍaʾil*—that positioned the Peninsula at the fore of Islamicate culture.

The first—albeit not literal—reference to the *Ṭabaqāt* as a universal history of science comes from Asín Palacios' *Abenzaham and his Critical History of Religious Ideas*, where he described it as "the first original synthesis on the evolution of human culture", where it succinctly compiles "the contribution of each [human] race to the progress of scientific ideas" (1927, 284–85). This reading of the text has remained consensual in the historiography up to this day. Plessner (1956, 235) also refers to it as a "world history of science", a characterization taken up by Khan (1991). Samsó (1992, 19), following Asín Palacios, attributes it the place of the first "universal" history of science. De Callatay (2017, 291) reflects, I think, the current consensus around the idea, stating that the *Ṭabaqāt*'s "pioneering position in the historiography of science from a world perspective needs no further elaboration".

Given this place of the text in the historiography of science, it is quite remarkable that it has not yet been analyzed in the context of global perspectives on the medieval period. The "Global Middle Ages" framework (GMA) is an approach to the medieval period that emphasizes processes of connectivity across regions of the world, with the aim of decentering Europe from medieval narratives and of dispelling ideas of the period as a population of disconnected silos that only truly interacted with one another after the advent of modern colonial Empire. Here, I want to consider the *Ṭabaqāt* as a case study of the GMA, introducing the work in the conversation of globality and connectivity in the medieval period. Since the GMA will be in the background throughout my argument, I will provide a brief introduction to the framework before discussing the *Ṭabaqāt* proper and concluding this introductory section.

As I said earlier, GMA is an approach that puts its focus on the interconnectivity of the different regions that characterize the medieval period. While the concrete approach varies significantly from writer to writer, there are several characteristics that are common across them. The first is the rejection of eurocentrism in the study of the period. As Frankopan puts it in the opening article to the first issue of the *Journal of Medieval Worlds*, "The Medieval World as presented by modern scholarship is one that is exclusively and aggressively centered on western Europe, to the exclusion by fault or design of other parts of the world" (2019, 8).

A common thread underlying much of the work in this subfield is to narrate the histories of medieval societies guided by interaction and exchange. Moore's work is characteristic of this approach, with a vision of the Middle Ages as a period of "intensification", where societies would come in increasing contact with one another, promoting economic and population growth, as well as the development of new ideas. (See e.g. Moore 2003) From this point of view, the medieval West is as much the result of its own development as the contributions from the other societies it interacted with. As Park (2024, 498) puts it, this "expanded view also helps dismantle

the silos of regional history that have marginalized the contribution of non-Western societies and fosters a more equitable understanding of history that values the roles played by all groups in shaping our collective past". In this way, intensification is sometimes read as a perspective that introduces inclusive narratives into the Middle Ages.

It is important to note that, for GMA, "global" is not a literal characterization of the processes occurring in the period. Since America was not, for the most part, included in the networks of interaction and exchange of the Afroeurasian block, we should instead see the global as a "dynamic", as Heng (2021, 16) puts it in her introductory monograph: "forces pushing toward the formation of larger scales of relation". These scales need not be total, but they might nevertheless be unprecedented, as they were along the Silk Road or the Trans-Saharan trade network. What matters is that there is, in Heng's (2021, 17) words, a "drive towards planetarity". Such a drive may—perhaps—be present in other periods, or the drive may never be fulfilled, but we might nevertheless use it as a lens to understand new forms of connection that arose in medieval societies.

The problem here comes in making the nature of these connections concrete. One may wonder what we gain by considering together processes like the creation of a Viking settlement in Newfoundland (which Hansen (2020) sets as the beginning of globalization and the closing of the "global loop") with the trade routes connecting East Asia and East Africa (Heng 2019). This has led medievalists like Berend (2023, 296) to contend that lumping such diverse phenomena together "detract[s] from, rather than enhance, our understanding of these phenomena". If we understand globality in the thin sense that I mentioned above, then it becomes difficult to specify in what way the medieval period is "qualitatively different" to Antiquity (2023, 299).

Similar considerations have been offered with respect to the use of "medieval" as a category that encompasses 1000 years of history (broadly 500-1500 AD) for the entire world. Such a flat category may, in fact, impose the Eurocentric modes of thinking that we were intent on abandoning in the first place. Ragab has provided a critique in this line, in the context of the history of science, and argues that "the move away from a Eurocentric approach cannot be achieved by centering other places or attempting to produce parallel narratives" (2024, 491). In a similar line but a slightly different context, Varisco has rejected wholesale the characterization of medieval to the Islamicate world between the 7$^{th}$ to the 15$^{th}$ centuries AD—grouping all those developments in such a massive region of the world into a "millennium of middleness", as Freedman and Spiegel (1998, 678 cited by Varisco) put it, is "anachronistic, misleading, and disorienting". (Varisco 2007, 386).

I find many of these criticisms compelling. The GMA, like any other theoretical framework, should be judged in terms of what *new* understanding it provides of the phenomena of interest. In our case, what have we learned about "medieval" societies that we didn't know before adopting the new lens? In this respect, attending to new forms of interaction and exchange is bound to bear fruit. There is no question that the period spanning from 500 to 1500 AD

witnessed the emergence of innumerable connections that would shape the societies of the time and the centuries to come. I think the question arises when we group all those processes into the same category and render everything into a nail that we can make fit with our hammer of connectivity. In this sense, Berend's criticism rings the most analytically useful, as it forces us to set as a benchmark whether our chosen frameworks expand our understanding of the concrete.

In the pages that follow, I ask precisely that question: How does a global perspective illuminate—and fail to illuminate—the first "universal" work on the history of science, which also happened to be written during the medieval period?[1] By looking at the *Ṭabaqāt* through the lens of the global, I will argue that to properly understand the contribution of this work, we should consider not just the connections it draws, but also the disconnections that characterize it. Here I am borrowing Biedermann's (2021) notion of (dis)connected history. For Biedermann, connection and disconnection are two sides of the same historical development, and thus we can always narrate the same process from the point of its connections, as well as the failures of connection that occur through the same event. My argument, however, will be different in one respect. Biedermann takes a synchronic approach to (dis)connection, meaning that every process is always at once connected and disconnected, and it is up to the historian to choose what perspective to narrate from. I take a diachronic approach, in the sense that processes of connection and disconnection follow, and thus help explain, each other. I will show put this in practice with a concrete example in Section 4.2.

By setting the global within its local perspective, I consider Ṣāʿid's globe as a dome, where al-Andalus reaches to the limits of its horizon while sitting at its center. Section 3 of this paper sets the basic coordinates of this dome, taking a look at Ṣāʿid's implied geography in the *Ṭabaqāt*. I ask: What is Ṣāʿid's globe like? What picture of the Earth and its peoples does he put forward? To do this, I will consider the *Ṭabaqāt* in the context of medieval Islamicate geographical thinking. In it, I will argue that Ṣāʿid does present us with a certain universal vocation, albeit constrained within a conception of the climate that conditions the science that each nation can practice. Section 4 introduces perspective into this picture, asking how the Andalusi position within the Islamicate world shapes the sources of the *Ṭabaqāt*, as well as its image Peninsular science more broadly. I consider Ṣāʿid's own scientific work in astronomy as

[1] I will, unfortunately, not speak to the problem of the category of "medieval" itself. This is a problem that is made extra difficult within a global point of view, since the intended audience of the text is meant to move beyond regional niches (or at least one would hope so), and reformulating the little language we have in common will only make communication more difficult. This is not to say that I adopt the usage of medieval terminology without reservations. Much like the term "global", the term medieval flattens relevant individualities across regions and periods that we should ultimately aim to characterize and understand. Given my region of interest here (the Iberian Peninsula during the 11th century AD) I could perhaps choose to adopt Hodgson's (1974) periodization, and refer to this as the "middle" period of the Islamicate world. But this would hardly improve things, and it ironically showcases how difficult it is to find perfect periodizations. For these reasons, and to maintain the eyes on the ball of the medieval global framework, I maintain the standard medieval terminology.

an expression of this positionality, to make the point that the Andalusi perspective is importantly explained by disconnection vis-à-vis the Eastern Islamicate world.

But before I do all this, I will briefly introduce the author of the work, as well as his political and cultural context, and provide a first sketch of the *Ṭabaqāt*. The objective of the coming section is to set the stage for the following discussion, while providing a basic familiarity with the book and its purpose.

## 2. Ṣāʿid al-Andalusī and the *Ṭabaqāt al-Umam*

### 2.1 Ṣāʿid al-Andalusī

Abū al-Qāsim Ṣāʿid ibn Abū al-Walīd Aḥmad ibn Abd al-Raḥmān ibn Muḥammad ibn Ṣāʿid ibn ʿUthmān al-Taghlibi al-Qūrtūbi, or Ṣāʿid al-Andausī, was a *qāḍī*, historian, astronomer, and patron of the sciences in 11th-century Toledo. Ṣāʿid was born in Almeria in 1029 AD, and traveled through al-Andalus to study under religious scholars and mathematicians such as ibn Ḥazm (d. 1064), Abū Muḥammad al-Qāsim ibn al-Fath (d. 1059), Abū al-Walīd Hishām ibn Hishām ibn Khālid al-Kinānī, or al-Waqqāshī (d. 1096), Abū Jaʿfar Aḥmad ibn Khamīs ibn ʿĀmir ibn Damj (d. 1063), and Abū Isḥaq ibn Ibrāhīm ibn Lub ibn Idrīs al-Tūjībī (d. 1062).[2] Khan (1991, 518) suggests that Ṣāʿid might have moved to Toledo to study under al-Waqqāshī, where he probably worked as a legal (*fiqh*) scholar, being appointed as *qādī* in 1068 by the taifa king of Toledo al-Maʾmūn (d. 1075). Ibn Bashkuwāl tells us that Ṣāʿid died in Toledo in 1070.

Having lived from the 1029 to 1070, Ṣāʿid was a thorough expression of what Samsó and Forcada (2025) call the "golden half-century" of Andalusi science. This golden half-century was the result of the dissolution of the caliphate of Cordoba into multiple city-states (called taifas, from the Arabic *ṭāʾifa*, meaning party or faction) after the civil war that led to the deposition of Almanzor's son ʿabd al-Raḥman "Sanchuelo" ("little Sancho"). While the caliphate disappeared as a political power, its allure and symbolism persisted, and the remaining taifas adopted the caliphal patronage of the sciences, sometimes vying for scientific supremacy and even giving birth to true philosopher-kings. A famous example is Zaragoza's taifa king al-Mūʾtaman, who composed a mathematical compendium—the *Book on Completion and Perspective* (*Kitāb al-istikmāl wa-l-manāẓir*)—that demonstrated for the first time Ceva's theorem. The Toledan king al-Maʾmūn was also a patron of the sciences, and as a result Toledo would become the astronomical center of al-Andalus during Ṣāʿid's lifetime. As we will see, this bore immense fruit for Ṣāʿid and the practitioners around him.

[2] The date and place of Ṣāʿid's birth, as well as the mentors that Ṣāʿid himself does not mention in the *Ṭabaqāt*, are from ibn Bashkuwāl's (d. 1183) *Al-ṣila fī tārīkh aʾimmat al-Andalus wa-ʿulamāʾihim wa-muḥaddithīhim wa-fuqahāʾihim wa-udabāʾihim* ("The Supplement to the History of the Leaders of al-Andalus, their Scholars, Hadith Transmitters, Jurists, and Men of Letters"), see (1955, 231).

The 11th-century Andalusis were well aware of the exceptional character of their time. In fact, the *Ṭabaqāt* spends considerable time providing an explanation for the flowering of the sciences of its time. Ṣāʿid traces the scientific productivity to caliph al-Ḥakam's book collection, which after its destruction by Almanzor and the subsequent civil war was "scattered" through al-Andalus.

> This is why one may find few segments of old scientific books that were saved when the library of al-Hakam was destroyed during the reign of al-Mansūr ibn abū ʿĀmir. Everyone of the people of al-Andalus who so desired showed what was in his possession of these ancient scientific works. From then on, interest in learning the ancient sciences kept growing little by little and the capitals of the taifas increasingly began to look like scientific centers. The present state, thanks to Allah, the Highest, is better than what al-Andalus has experienced in the past; there is freedom for acquiring and cultivating the ancient sciences and all past restrictions have been removed.[3]

As a man of his time with considerable standing in his city, Ṣāʿid was also an instrumental patron of the sciences, particularly of observational astronomy.[4] It was under his wing that al-Zarqālī (d. 1100) would go on to become one of the most recognized astronomers of the Islamic West. But al-Zarqālī was just one more member of a wider group of astronomers and instrument-makers that our historian provided with resources and mentorship. As we will see in Section 4, in the last two years of his life after the completion of the *Ṭabaqāt*, Ṣāʿid worked alongside al-Zarqālī and the rest of his team on what would become the Toledan Tables.

Beyond supporting the astronomers of his period, Ṣāʿid was also interested in astronomy himself, and contributed with at least one work on *Sindhind* astronomy, named *Rectification of the Movements of the Stars and the Errors Committed in Observational Astronomy* (*Iṣlāḥ ḥarakāt al-kawākib wa-ʾl-taʿrīf bi-khaṭaʾ al-rāṣidīn*), where he aimed to correct some of the "errors" (175) of Maslama's adaptation of al-Khwārizmī's tables. He also contributed extensively to history, writing a *Compendium on the history of Arab and non-Arab nations* (*Jawāmiʿ akhbār al-umam min al-ʿArab wa-ʾl-ʿAjam*), as well as a tract on comparative religion (*Maqālāt ahl al-milal wa-ʾl-niḥal*). Unfortunately, the only extant work is the *Ṭabaqāt*, which is also where Ṣāʿid refers to some of his previous work.

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[3] For this paper I will be using Ḥayyāt bū ʿAlwān's (1985) edition of the *Ṭabaqāt*. When citing directly from the *Ṭabaqāt*, I will use Salem and Kumar's (1996) translation, except where I disagree with the translation, in which case I will be referencing bū ʿAlwān's edition directly. For the translation, I am also relying on Llavero Ruiz's (2000) edition.

[4] Although he does not speak about his patronage in the *Ṭabaqāt*, there are other sources that provide us with some details on those activities. The most well-known comes from Isaac Israeli ben Joseph's *Yesod Olam*, book IV, ch. 7, which states that Ṣāʿid "offered what he possessed to his collaborators, providing for them and giving them stipends". See discussion in Richter-Bernburg (1987, 374).

Having already written a "universal" (Arab and non-Arab) history and a work on comparative religion, as well as being an astronomer himself, it is hard to resist the idea that Ṣāʿid was in a considerably competent position to write a work like the *Ṭabaqāt*. Besides his background on history and science, his previous travels through al-Andalus and his network of colleagues and mentees meant that he had a privileged access to the generations of scientists in the Peninsula. As we will see presently, this does not mean that he had access to *everything* going on around him, but as Richter-Bernburg (1987, 381) put it, the limitations in Ṣāʿid's sources might have had more to do with the "fragmentation of al-Andalus, which he himself" deplored. As we begin to look at the *Ṭabaqāt*, it will pay off to consider how this locality informs the reach and perspective of the work.

### 2.2 The *Ṭabaqāt al-Umam*

The *Kitāb Ṭabaqāt al-Umam* (*Book on the Categories of Nations*)[5] is a short treatise on the generations of scientists and their contributions to science in the habitable world, from the earliest information that Ṣāʿid reports having available, until his day in 1068. The book discusses these generations going through a series of nations: the Indians (*al-hind*), the Persians (*al-fars*), the Chaldeans (al-kaldān), the Greeks (*al-yūnān*), the Romans (*al-rūm*), the Egyptians (*ahl-maṣr*), the Arabs (*al-ʿarab*), and finally the Jews (*banū Israʾīl*). In this way, the *Ṭabaqāt* is as much a history as a geography of science, where the nations (*umam*) structure the space, and the generations (*ṭabaqāt*) follow the nations across time.

As a book on generations, the *Ṭabaqāt* falls squarely within the Islamic biographical genre, which Ṣāʿid would have known well given his background in *fiqh*. He adopts in the text an understanding of science in terms of chains of transmission, which he reports to the best of his abilities. He is certainly not the first to provide a history of knowledge through chains of transmission, even in al-Andalus. Al-Zubaydī al-Ishbīlī wrote a book on "Categories of Grammarians and Linguists" (*Ṭabaqāt al-naḥwīyīn wa-l-lughawīyīn*) somewhere in 973-976, and ibn Juljul had written in 987 a history of medicine in al-Andalus through chains of transmission in his "Categories of Physicians and Wise Men" (*Ṭabaqāt al-aṭibbāʾ wa-ʾl-ḥukamāʾ*). Ṣāʿid cites ibn Juljul in his own *Ṭabaqāt* (192). Although he does not acknowledge him as a source, he likely relied on ibn Juljul's work since, as Richter-Bernburg (1987, 394) points out, he provides a very similar account of the decline of the Abbasids and the arrival of Dioscorides' *De materia medica*.

[5] The sources reference multiple, considerably more extensive titles of the work (see Martínez Lorca 2000, 18), although recent editions have stabilized around the title I reference above. Similarly, it is likely that the version we have conserved of the *Ṭabaqāt* is a slimmer selection of the original text. Ibn Ḥayyān (d. 1075), for instance, reported in his *al-Muqtabas* a number of geographical facts about Toledo that he claims he read in the *Ṭabaqāt* and are missing in all of the manuscripts existent today. (See ibn Ḥayyān, *al-Muqtabas V*, ed. Pedro Chalmeta, F. Corriente and M. Ṣubḥ, Madrid-Rabat, *IHAC-Facultad de Letras*, 1979, §§ 185-186, 278-280)

What sets the *Ṭabaqāt* apart is not his discussion of the history of science through chains of transmission, but his focus on the "ancient sciences" (*ʿulum al-qadīm*), which more or less map onto what today we would call natural sciences, including music, astrology, alchemy, magic, and philosophy. It is in this sense of providing a *focused* history of the natural sciences for all the world nations that the *Ṭabaqāt* is the first work of its kind. Although this focus is not absolute, and we can find here and there some discussion of topics such as history and grammar, the ancient sciences occupy the overwhelming majority of the discussion. This contrasts with other historical works of universal vocation like Masʿudi's *Tanbīḥ*, which focuses on human culture from a broader point of view. I will briefly consider the *Tanbīḥ* as a source for Ṣāʿid's text in the next section.

This focus on the natural sciences, however, plays a fundamental part in structuring the *Ṭabaqāt*. Indeed, another element that sets it apart from other biographical dictionaries, and which is not found in any other similar work of its time, is that it distinguishes between two kinds of nation—those that contributed enough to science, and those that did not:

> One *ṭabaqāt* has cultivated science (*al-ʿilm*), given rise to the art of knowledge, and propagated the various aspects of scientific information; the other *ṭabaqat* did not contribute enough to science to deserve the honor of association or inclusion in the family of scientifically productive nations. Members of this group formulated no useful philosophy and generated no practical idea. (al-Andalusī 1996, 6)

In the next section we will ponder in depth about this distinction, as it crucial to understand how exactly Ṣāʿid conceives the humanity whose scientific history he is trying to provide. For now, I just want to draw the basic skeleton of the text. After setting the two kinds of nations, he will spend one chapter[6] to the non-scientific nations, and another to all the scientific nations I listed earlier. The only exception is the Arabs, to which he will dedicate one chapter for general considerations about the Arab peoples, another to the science of Eastern Arabs, and another to the science of the Andalusis.

The chapter on non-scientific nations (*al-umam alatī lam tuʿna bi-āl-ʿulūm*) covers all nations except the 8 that we saw above. Ṣāʿid reserves a special place in this category for the Chinese (*al-ṣīn*) and the Turks (*al-turk*). The Chinese—the "most numerous of nations", with "the richest kingdom [and] largest territory" (al-Andalusī 1996, 7)—surpass any other nations in the crafts, and he notes their perseverance in laboriousness in their work. The Turks, on the other hand, are defined by their ability in combat and the "construction of arms", a perception no doubt due at least in part to the recent history of the Islamicate world. As we can see, while neither of these have shown interest in science, they are nevertheless the object of respect by the author of

[6] It is worth mentioning at this point that the original manuscripts do not contain any chapters. It is instead the more recent tradition since Cheikho's (1912) edition that have adopted the division of the text into 14 chapters, and Salem and Kumar continue this convention. I adopt it in my treatment of the text as well.

the *Ṭabaqāt*. The same thing cannot be said of the other nations, who "resemble animals more than human beings" (*ibid*). Ṣāʿid will dedicate the rest of the chapter to discussing the character of a number of other nations, like black people closer to the equator (*al-sūdān*), as well as the Galicians, Berbers and Slavs, and will have some final lines for all the other nations that are nevertheless "similar in ignorance" (al-Andalusī 1996, 8). The whole framing of Ṣāʿid's discussion in this chapter, which we will tackle in earnest in the next chapter of this paper, revolves around the location of these nations in less forgiving areas of the globe, closer to the north pole for the Galicians, Berbers and Slavs, and closer to the equator for the black peoples.

After dispensing with these nations, the book commences with the history of science proper, opening with a discussion of the Indians. Ṣāʿid shows a profound admiration for the Indian people, crediting them with the very beginning of science, and characterizing them as the "source of wisdom" [*maʿdan al-hikma*] (50). He highlights specifically their achievements in mathematical sciences, including arithmetic, geometry, and astronomy, crediting them with the development of what today we know as Arabic numerals [*ḥisāb al-ghubār*], as well as the *Sindhind* astronomical system, which Ṣāʿid spends some time explaining, after which he mentions his book on the *Sindhind*. (54) While he also attributes the Indians a superlative understanding of medicine, he does not divulge nearly as much information on their discoveries––perhaps a result of Ṣāʿid's own interests. Salem and Kumar (1996, xix) suggest that he received his information on the Indians from abū Maʿshar's *al-ʾUlūf*, which Ṣāʿid cites in the discussion on the Persians.

The chapter on the Persians is usually regarded as less valuable, mostly because our author takes a rather political perspective on this nation and does not say much on their scientific achievements. However, he highlights two foci of scientific interest: medicine and astronomy/astrology. As is the case for the Indians, we find here mostly a discussion on their astrological/astronomical interests, including a mention of a long history of observatories since Ancient times, where they developed what astronomers at his time called the "period of the Persians", meaning a twelfth the period of the *Sindhind*. (62)

This discussion on the Persians is followed by the chapter on the Chaldeans. Here, Ṣāʿid emphasizes the Chaldeans' contributions to "mathematics, natural science and theology" [*al-mihan al-taʿlīmiyyah wa-al-ʿulūm al-riyāḍiyyah wa-al-ilāhiyyah*] (67). He attributes them thorough astronomical and astronomical knowledge, as well as knowledge of magic and talismanic powers. Perhaps consistently, he characterizes Hermes of Babylon as the "noblest" of their scholars and provides some of his supposed works, citing abū Maʿshar as his source, and mistakenly calls him a "contemporary of the Greek philosopher Socrates (*Suqrāṭ*)" (68). He also mentions Hipparcus (d. 125 BCE) (*Burjus*) and Valens (*Wālys*). The chapter on the Chaldeans closes with an acknowledgement of the absence of sources on their astronomical and astrological theories before the *Almagest*. (69) This is an important acknowledgement that we will take up again in Section 4.

The next chapter on the Greek nation is one of the most extensive of the book, only rivaled by the chapter on the Arabs. Along with the Indians, this is another nation whose scientific pedigree Ṣāʿid holds in the highest esteem. He praises them for cultivating all branches of knowledge, including mathematics, logic, natural philosophy, and medicine, and underscores the contribution of five specific philosophers: Empedocles, Pythagoras, Socrates, Plato and Aristotle. (72) Aristotle is the single individual that receives the longest treatment in the *Ṭabaqāt*, and our author reviews his works, including in logic [*al-ashkāl al-thalātha*], mathematical sciences [*al-ʿulūm al-taʿlīmiyya*], or even Aristotle's metaphysical work [*al-ʿulūm al-ʾilāhiya*]. Perhaps not in vein, Ṣāʿid closes the chapter by making him the "leader of philosophers" and citing (without acknowledging authorship) a poem by abū Nawās (d. 194):

> Thus Aristotle became the leader of the philosophers and one who united all the virtues of the scholars.
>
> *No one can object if Allah*
>
> *Assembled the world in one individual.*[7]

The rest of the Greek chapter is also filled with discussion of plenty other philosophers and scientists, from Anaxagoras to Galen. This gives an idea of how thoroughly the Islamicate world of Ṣāʿid's time was imbued in the Greek tradition.

The chapter on the Romans is one of the poorest parts of the book. It starts by providing a political history of the Roman empire up until Constantine and the expansion of Christianity. He starts the discussion of Roman scholarship by stating the supremacy of the Greeks ("no one denies, not even the Romans, that the Greeks have the superiority and the supremacy" (al-Andalusī 1996, 32), and then proceeds to list some "Christians and Sabians" that worked during the Abbasid period (we will discuss the Sabians in the next section). Among these are physicians Bakhtishūʿ and his son Jibriyl ibn Bakhtishūʿ, as well as Yūḥanna ibn Māsawayh, whose books he lists. A student of ibn Māsawayh's introduces an account of the Abbasid translation movement. The chapter concludes with a short discussion of "Sabians", among which are some famous names like Thābit ibn Qurrah (d. 911), and al-Kindi (d. 873).

The chapter on the Egyptians begins with an account of their ancient history. Ṣāʿid speaks about a flood that wiped out their civilization, leading to a "mix of nations" including Copts, Greeks, Romans, Giants (*ʿAmaliqah*). (105) He attributed to pre-diluvian Egyptians a believe in a world "of existence and corruption" populated by monsters before the existence of the human race, and makes Hermes the First as the source of all of their science. (107) After the flood, the Egyptians made their reputation by excelling on all the mathematical sciences, as well as theology, talismans, and burning mirrors, among others. After the flood, Hermes the Second is pictured as one of the earliest scholars, and the discussion focuses on Alexandria. He mentions

[7] *Laysa ʿalā Allāhi bi-mustankarin / an yajmaʿa al-ʿālama fī wāḥid* (Dīwān Abī Nuwās, ed. Ewald Wagner, *Franz Steiner Verlag*, Wiesbaden/Stuttgart, 1958–2003), cited in al-Andalusi (1996, 30).

Proclus, Theon, and Valens, though he apologizes for his lack of specific dates or biographical details for many individual Egyptian scholars.

The next chapter is dedicated to the Arabs. This is by far the most extensive chapter and the one that has been relied on the most as a historical source. The chapter occupies more than half of the text and is divided in three parts. First there are some general considerations about the Arab people, where Ṣāʿid praises their excellent memory, skill in poetry, and knowledge of their language, though he notes that before Islam they were largely uninterested in observational astronomy or philosophy. (113) This, along with the part on the Eastern Arabic, is a valuable section for the well-structured argument it presents about the birth of the Arabic scientific tradition, which is presented as the result of a convergence of all the scientific traditions he has presented so far. Interestingly, however, the chapter ends on a note of decline, where our author claims that science ceased being an issue of priority when the "authority of the caliphs was weakened and they were overcome by women and by Turks" (al-Andalusī 1996, 45), likely a reference to the progressive deterioration of the Abbasid caliphate and its dependence on Turkish forces.

Then, he considers the history of the Eastern Arabs and their scientific achievements. He starts off by accounting for al-Muqaffaʿs translation of Aristotle's *Organon* and Porphyry's *Isagoge*. The discussion moves quickly to a history of the *Sindhind* in the Arabic world, introducing al-Fazārī's adaptation of the *Sindhind* in 773, after an Indian envoy delivered a *zīj* called "Organization of the Necklace" [*Naẓm al-ʿiqd*] to al-Mansūr as a diplomatic gift. He will also mention al-Khwarīzmī, who "adopted the Persian system in formulating his equations and relied on the method of Ptolemy for determining the declinations of the sun", although he will also reference some "obvious errors". (al-Andalusī 1996, 47) The discussion then moves to the translation movement, where Ṣāʿid will praise the figure of al-Maʾmun and his role in the translation of Greek scientific and philosophical manuscripts. A list of generations of Arabic ancient-scientists and their work follows, which includes al-Kindi, al-Rāzī, al-Fārābī, Mūsā ibn Shākir and his sons among al-Ma'mūn's astronomers, alongside Thābit ibn Qurra, al-Battānī, Ibn al-Haytham, and others.

The chapter on al-Andalus shows the extent of Ṣāʿid's familiarity with the scientific history of the Peninsula. His account, although of course incomplete (especially in what touches the pre-Islamic Peninsular tradition, missing figures like Isidore of Seville) and inaccurate at times, has in the final analysis been shown fundamentally correct. He characterizes the period before the emirate as concerned mostly with religious sciences. (155) Towards the 8$^{th}$-9$^{th}$ centuries, however, "persons of vitality and intelligence" start emerging, and he cites some astronomers and mathematicians practicing in al-Andalus until the caliphate of al-Hakam II (r. 961-976). As can be gleaned from the quote from the previous section, the caliphal period is considered by Ṣāʿid as the moment when Andalusi science flourishes, mostly due to the Umayyad patronage. This is reflected in an extensive, systematic account of the generations of astronomers that follow from Maslama al-Majrīṭī (d. 1007), the "chief mathematician in al-

Andalus … and better than all astronomers who came before him" (al-Andalusī 1996, 64). This is followed by a short discussion on Aristotelian philosophy and logic in the Peninsula and a longer account of the history of Andalusi medicine. Ṣāʿid asserts that medicine "was not well understood by the people of al-Andalus and none of its scientists progressed to lead" in the field, a judgement he shares for natural science and theology. (al-Andalusī 1996, 71) However, we find a considerable account of generations of physicians, including Aḥmad ibn Iyās (the first Andalusi physician of note), ibn Juljul (who, as we said earlier, was likely a source for this part of the book), or Ibn al-Nabbāsh among others. The chapter concludes with some names on astrology, a practice which in Ṣāʿid's words "has met some acceptance". (al-Andalusī 1996, 78)

The final chapter provides an account of the history of science among the Jews. They are described as a people more interested in the study of religious law and biographies of prophets rather than philosophy. (200-202) However, Ṣāʿid points out that this religious vocation led them to the ability of doing very precise calculations of the calendar. He also highlights the many Jewish physicians of merit that populated the Islamicate world, with an emphasis on Andalusi Jews such as Ḥasday ibn Isḥaq, whose prominent role in Jewish caliphal culture Ṣāʿid documents well. (203) He also mentions Andalusi Jews who excelled in philosophy and logic, such as Ḥasday's son, abū al-Faḍl Ḥasday ibn Yūsuf ibn Ḥasday. (205)

Although the discussion here has given approximately the same length to each chapter, it is worth reiterating that this is far from the case in the *Ṭabaqāt* itself. The chapters on the Greeks and the Arabs compose about two thirds of the book, and all the others hover around the 1000 words each. Many scholars have pondered why there is such an asymmetry. As I mentioned earlier, Richter-Bernburg (1987) attributes it to the asymmetry in Ṣāʿid's access to the sources. Others, such as (Martinez 1985; Brann 2021), see in the asymmetry a deliberate discursive device that aims to assign greater role to the Arabs, and in particular the Andalusis, in the history of science. I consider this an important question to understand the text, because it greatly determines the function it is meant to serve: Is the *Ṭabaqāt* a sober report on the history of ancient sciences as accessible to an 11th-century Andalusi—or should we see the text also as making an intervention within a project of Andalusi preeminence?

Clearly, Ṣāʿid's own limited access to the relevant sources plays a fundamental role in the weight that each nation has in the text. He opens up in several places of the work about those very limitations. For example, in his discussion of Indian science he acknowledges that since "Indians are far from our country and many kingdoms separate us from them, we have very few of their books" (al-Andalusī 1996, 12). Very similar statement show up in the chapter on the Chaldeans (69) and the Egyptians (110); the chapter in al-Andalus also includes an acknowledgement that there might be other scholars he has failed to mention because he has not heard of them (179). So, to some extent, it is clear that the lack of sources is a big reason for why the Arabs (and the Greeks) have a disproportionate role in the *Ṭabaqāt*. But I think this only gets to the surface of the problem: a trend of discoursive Andalusi exceptionalism is precisely why

Eastern sources slowly ceases to make their way to al-Andalus. I will come back to this in Section 4.

And yet, this conversation occurs on the background of a more fundamental asymmetry that sets up the *Ṭabaqāt*: the nations with and without science. These two complementary groups logically embrace the whole world, and thus make up the global perspective that Ṣāʿid intends to give to his history of ancient sciences. If there is such a thing as a global science in his text, it should be able to make sense of the question: Why are there some nations that are capable of producing science, and others that aren't? When we introduced this distinction earlier, it seemed as if Ṣāʿid was dispensing with non-scientific nations with a quick anthropological stroke. As it turns out, this key distinction is rooted in a tradition of geographical thinking that permeates the entire work. If we want to understand in what sense the *Ṭabaqāt* is a global history of science, then, we'll have to look at the globe from a scientific point of view—that is, from the point of view of Islamicate geography. Through this lens, we will be in a better position to judge its anthropology.

## 3. Ṣāʿid's globe

In the previous section, I talked about the *Ṭabaqāt* as not only a history but also a geography of science. Geography, understood as the science of space insofar as it is humanly habited, considers the globe as an environment to be described in terms of human characteristics. In Ṣāʿid's case, the arrangement occurs in terms of nations, which are taken to occupy certain locations within the globe. By assigning the nations to their territories, we can follow the history of the globe (or at least the history of its science) by following the generations of the nations.

Geography and anthropology are thus profoundly linked in the *Ṭabaqāt*. In this section, I will unravel this connection and make it explicit, asking: What is Ṣāʿid's geographic picture of the globe? This will require considering not only its implicit picture of the Earth, but also what human groups have populated it. Because the *Ṭabaqāt* is also a history of science, we will ultimately want to understand how this relationship between geography and anthropology condition the practice of science on Earth. Ṣāʿid's picture of the globe and the peoples that inhabit it is far from flat and horizontal, as one may be encouraged to think when considering processes of globalization. It is instead a layered, hierarchical globe, where writing a global history of science encourages a politics of self-location.

### 3.1 Charting the *oikoumene*

Right at the start of the book, Ṣāʿid declares that "all people on Earth from the East and West, from North and South, belong to the same species [*nawʿan wāḥidan*]" (33). However, those "interested in the history of nations" have identified seven original nations that constituted

all of humanity: the Persians, the Chaldeans, the Europeans[8], the Copts, the Turks, the Indians (and Sinds), and the Chinese (and ʿAmūr). Each of these nations will distinguish themselves essentially by a spatial criterion. So, while all humanity is one species, different groups occupy different places in the globe—which, as we will see in a moment, will play a big role in the observed differences between the nations' scientific output.

For some of these groups, like the Chinese and the Indians, he will not get into much detail regarding their composition; for others, however, like the Persians and Chaldeans, he provides a profuse description of their peoples and geographic location. Take the Persians as an example. This nation was at the center of the inhabited world, with frontiers in Northern Iraq at its west, the Caspian Sea at its north, and Khurasan (a region within Eastern Iran, Afghanistan and Turkmenistan) at its East, with the cities to the north of the Persian Gulf at its southern limit. (33-4) These territories belonged to a united empire, being governed by a single monarch and speaking the same language. Ṣāʿid tells us that, eventually, this language led to Pahlavi, Zend[9], and "other Persian languages". (37)

A look at all other six nations reveals that we are following a geographical criterion of individuation. If we put together all of these people's and their (albeit, at times preposterously vague) spatial limits, we get the domain of the inhabited world, spanning from the Franks at its north, the Berbers ("and other peoples at the Western Atlantic Ocean", 38) at its west, the Sudanese at its south, to finally the Chinese at its east. The inhabited world, then, is not the world *simpliciter*, the former being cut off by two latitudinal limits: The tropic of Cancer to the south and the Arctic Circle to the north. These limits are, of course, approximate, but they roughly correspond to the liminal area of sparsely occupied territories before the expanse of the uninhabited poles and equator.

The region of the world delimited by these lines was the *oikumene*, or inhabited world. (Figure 2) Islamicate geographers had inherited from Ptolemy's *Geography* the idea that life was most favorable within this area, temperatures being too high close to the equator and too low close to the north pole. However, Islamicate geography did not limit itself to dividing the world in terms of tropics. Within the *oikumene*, one can extend six further lines originating from the sun's position in the horizon, delimiting seven angles or climes (*iqlīm*). One can thus travel the inhabited world clime by clime, starting from the first clime at the south in areas like Yemen or Sind, move to the second clime in Meca, then get to Damascus or Baghdad in the third, move up to Khurasan in the fourth clime… all towards the seventh in London. This climatic division was present particularly in the works of the 9th-century school of Baghdad. (Miquel 2001) Al-Khwārizmī's *Ṣūrat al-Arḍ* (833), for instance, lists all of the world's cities clime by clime,

[8] Note that Ṣāʿid does not use this word. He instead refers to the following group of peoples: "al-yūnāniyyūna wa-al-rūmu wa-al-ifranjatu wa-al-jalāliqa wa-al-burjān wa-al-ṣaqālibatu wa-al-rūsu wa-al-burghur wa-al-lān wa-ghayruhum min al-umami allatī ḥawālī baḥri nīṭash wa-buḥayrati māniṭash wa-ghayrihā min al-mawāḍiʿi allatī fī al-rubʿi al-gharbī wa-al-shimāli min maʿmūri al-arḍi" (38).

[9] Here, I am following Cheikho and Llavero Ruiz's correction of "al-dariya" for "al-zandiyya".

starting with what's below the equator, then going from the first to the seventh clime, and then what's beyond the latter.[10] (al-Khwārizmī [1926] 2009)

Figure 2. Map of the oikoumene from the "Book of Curiosities" (Kitāb gharā'ib al-funūn wa-mulaḥ al-ʿuyūn), originally composed in Egypt between 1020-1050. (These folios from Bodleian Library MS. Arab. c. 90, 27b and 28a, copies 1190-1200) Perhaps the earliest extant representation of this geographic concept in an Islamicate context, it presents a circular map of the oikoumene limited by a "surrounding sea" (*al-baḥr al-muḥīt*). Many of Ṣāʿid's groups are represented here: to the furthest south we have the Nubians (al-nūbah), or the Chinese (al-ṣīn) to the east, with of course al-Andalus to the west. The discrepancies (for instance, this map represents England (anqiltirrah) to the north, a group that we don't see referred to in the *Ṭabaqāt*) might be due to the fact that Ṣāʿid was likely basing his geography on Masʿūdī's.

As is characteristic of the science of the period, however, the Greek clime theory coalesced with the Persian tradition, being combined with the *kĭswār* geographical theory. (de Callataÿ 2013) This is a theory of political orientation originating in Sassanid Persia that divides the world into seven "*kĭswār*"s: kingdoms that were originally conquered by 'the ancient kings' (*al mulūk al-awaalūn*). Crucially, these kingdoms had a radial configuration, with six of them

[10] It is interesting that al-Khwārizmī *does* include some inhabited cities below the equator and beyond the first and seventh climes. For example, he lists at least three cities in China's domains below the equator (*mūrīrū, sūsā*, plus another unnamed city—*madīna min bilād al-ṣīn*), and dozens beyond the seventh climes. And yet, we can see al-Khwārizmī's reluctance to deviate from the Ptolemaic model, naming the latter chapter "Mā khalf al-iqlīm al-sābiʿ ilā ʿarḍ sīn-jīm wa-huwa ākhir al-ʿumrān", suggesting that these cities populate perhaps the *frontier* of the seventh climate. What this shows in any case is that, while Baghdadi geography inherited the Greek theory of climes—which took the domains beyond the climes to be strictly inhabitable—they nevertheless modified it, incorporating it in the presentation and eventually giving way to a more descriptive program of "Passages and Kingdoms" in the work of geographers like ibn Ḥawqal. In a word, they *appropriated* (Sabra 1987) the Ptolemaic theory of climes.

surrounding a seventh region called Irānshār (encompassing the region of Iraq, Fars, Khurasan, and others), which thus becomes the center of the world. This ordered, septuple structure of the *oikumene* was the core borrowing into the theory of climes, rendering the fourth clime the most temperate region of the world, with the climate becoming progressively less favorable as one moves away from the center.

But, along with the hierarchical structure, also came a whole set of downstream implications. For Ṣāʿid, it meant particularly that a more temperate climate is more conducive to scientific achievement, and the margins of the *oikoumene* will find the most unfavorable conditions. "Those among them who live in the extreme North, between the last of the seven regions and the end of the populated world to the north, suffered from being too far from the sun … They have lost keenness of understanding and sharpness of perception. They were overcome by ignorance and laziness, and infested by fatigue and stupidity" (English, 7). Those closer to the equator don't have it much better: "Because the sun remains close to their heads for long periods, their air and their climate have become hot … As a result, they lost the value of patience and firmness of perception. They were overcome by foolishness and ignorance" (English, 7).

The idea that the location of a society within the climes affected their character and abilities is not Ṣāʿid's, belonging to the Islamicate geographic tradition. More specifically in the case of the *Ṭabaqāt*, the source for the theory most likely came from Masʿudi's *Tanbīh*, which similarly provides a kind of universal history of culture. In the next subsection I will elaborate on other parallels between both works. This approach to geography would be eventually abandoned in the East in favor of a more descriptive style of "Passages and Kingdoms", especially since the work of ibn Ḥawqal. This divergence is worth noting because, in the next Section, we will see a very similar pattern in the astronomical domain, where al-Andalus would continue on earlier trends that the East had abandoned by the 11th century.

Do we have a sort of "climatic determinism" in the *Ṭabaqāt*? Not exactly. At the very least we can find nations that, even though they live in more favorable climates, they nevertheless did not practice science. These are nations such as the Galicians or Berbers—in the fifth and bordering the fourth climate, respectively—who "Allah … has provided with despotism, ignorance, enmity, and violence". Ṣāʿid himself points out that this is despite their domain being "close to the temperate zones". (English, 8) In contrast, the Indians were the very origin of science, even though some of the huge continent exists in the first climate or even below it. So, it seems that the climatic hierarchy sets something like conditions for scientific achievement, but these can still be impeded or otherwise affected by the social conditions of each society.

And yet, precisely because of the implications that come with belonging to a given climate, we can see in the sources a kind of politics of self-location. Al-Andalus, for example, was traditionally located at the crossing between the fifth and fourth climates, and so Andalusi geographers made a point of emphasizing their belonging to the fourth climate. This is the case even when, by the 11th century, the Islamicate East would have already abandoned climatic

geographic theory. As Tixier du Mesnil puts it, "By adopting the division [of the oikoumene] into seven zones, the written geography of al-Andalus would allow this land to affirm its belonging to the climate of *dār al-islām* and to transcend the real distance that separated it from the old Eastern core" (Tixier du Mesnil 2014, 96). By charting the globe, then, the Andalusis were actively situating themselves within it, "affirming" their place within the broader Islamicate world. And so we find in the *Ṭabaqāt*:

> Most of al-Andalus is located in the fifth climatic zone; while a part of it, namely Seville, Malaga, Cordoba, Granada, Almeria and Murcia, belongs in the fourth climatic zone. (158) [11]

And so, with al-Andalus edging towards the fourth climate—no less than with Cordoba, Seville, and other jewels of the Peninsula—Ṣāʿid secures for al-Andalus both its place within Islam and the capacity of Andalusis for scientific achievement. Here is where his moderated determinism serves a purpose: Toledo, while "close to the middle of the fifth climate" due to its northern location, is still being governed by "the noblest of the kings of al-Andalus", al-Maʾmūn. (158) Thus, even though occupying "the end of the inhabited world to its West" (158), the Peninsula simultaneously vindicates a central place. The *Ṭabaqāt* paints a picture of al-Andalus that is, geographically at least, liminal: Within the fourth and fifth climate zones, both at the end of the world and its center—This is a positionality that marks not only the geographic discourse, but also the practice of science in the Peninsula of the period.

In what sense, then, is Ṣāʿid's science "global"? There does seem to be, at the least, a certain "drive towards planetarity" (see Heng in Section 1) in the *Ṭabaqāt*: His history of science aims to encompass, if not the entirety of Afro-Eurasia, at least what a close approximation to an up-to-date geographic knowledge of the time would give you. While he seeḤms to be unaware (or he might just deem it unimportant) that there is some news of habitation beyond the climes, he nevertheless follows the key assumption that proximity to the central clime provides most optimal conditions for scientific achievement. We have a globe, then, but it is a globe restricted to its habitable zone (at least in the *Ṭabaqāt*), and this zone—the *oikumene*—is stratified in a way that has deeply consequential effects for science. Given this map of the world, it is understandable that actors would want to locate themselves at its center.

### 3.2 The nation-tree

The Earth, then, is a stratified environment, in the sense that it provides unequal conditions for scientific achievement. While some nations will reap the benefits of their temperate climate, others will have to contend with unforgiving heat or cold, as well as despotic governments that prevent them from the free pursual of the sciences. However, underneath this spatial discontinuity, the *Ṭabaqāt* presents a remarkable temporal continuity.

[11] Here I am deviating from Salem and Kumar's translation of "wa-ṭāʾifatun minhā fī al-iqlīmi al-rābiʿi".

In some sense, this is to be expected. As a book on generations of scientists, the structure of the work presumes that knowledge is something transmitted from master to disciple. Ṣāʿid's main occupation was being a *qādī*, and as such he was deeply familiar with the idea that, unless a chain of transmission can be accredited for a particular report, then the report could not be verified either. Certainly, Ṣāʿid does not attempt to provide a full chain for all known science, and he is explicit in several places about his limited knowledge of the state of science for many nations, as we discussed towards the end of Section 2. And yet, the absence of a full *isnād* does not prevent the work from presenting the history of the nations themselves—along with their sciences—in that same manner. While it is hopeless to reconstruct the full human chain, the reconstruction becomes possible if we take the nations themselves as the links.

The book opens up, as we discussed above, with a statement that humanity is the same "species", but that it also was composed of seven distinct ancient nations: the Persians, the Chaldeans, the Europeans, the Copts, the Turks, the Indians (and Sinds), and the Chinese (and ʿAmūr). This list, of course, overlaps but does not exactly correspond to the list of nations that would eventually come to produce science. While the Turks and Chinese nations remain unaffected but are relegated to the un-scientific category, some of the remaining nations will have branches that lead to our current list. In particular, the Chaldeans will give rise to the Jews and the Arabs, the Egyptians will branch out from the Copts (who include also nations like the Nubians or Sudanese), and from the Europeans, only the Greek and Romans will become scientific. These nations form chains of transmission, leading from the ancient nations to the current ones.

Ṣāʿid's seven ancient nations are directly borrowed from Masʿudī's "Book on Admonition and Revision" (*Kitāb al-Tanbīh wa'l-Ishrāf*), another "universal" history that takes the perspective of nations as its guiding thread. (al-Masʿūdī 1894) It is obvious not only that the *Tanbīh* was a source for the *Ṭabaqāt* (see 76, 77, 84), but that Ṣāʿid knew the work well and it incorporated its basic framework into his history of science. Beyond his borrowing of the seven nations, he also states that they "differ in three distinct traits: behaviors, physical appearances, and languages" (English, 3). These dimensions of variation recur throughout the discussion, echoing Masʿudī's framework. What is remarkable is that, while such framework is more or less implicit in the *Tanbīh*, Ṣāʿid chooses to state it explicitly at the beginning of his own work, setting it as a foundation for the following discussion.

It is no surprise, then, that the way that Ṣāʿid characterizes these nations will also bear resemblance to the *Tanbīh*. The Persians, for instance, are similarly conceived by Masʿūdī as a nation with a special vocation for statescraft (al-Masʿūdī 1894, 105), though this was a picture of the Persians with a long tradition in Islamicate historiography (Khalidi 1975, 92 n5). The Turks are also considered exceptional because of their way of waging war (while being reprimanded due to their proximity to the northern climates (al-Masʿūdī 1894, 24)). Similarly, Masʿūdī also considers India the first nation in history, another one of those beliefs that were entrenched in a tradition dating back from even earlier than himself. (Rosenthal 1947, 73–74)

Masʿūdī's seven nations originate from the Persian *kĭswār* theory that we saw earlier, and incorporates it more directly as an account of the kingdoms from which the current nations originate. As emphasized by Khalidi (1975, 109), the ancient nations constitute in the *Tanbīh* a pool of knowledge that would give rise to the set of languages and religions of his time. (See al-Masʿūdī 1894, 7, 84) Ṣāʿid holds the same belief about the trajectory of these ancient nations. He says:

> These seven nations comprised the entire human race, and they were all Sabians (*ṣāʿbat*), worshiping idols representing celestial objects, including the seven planets and others. Later on, these seven nations were dispersed, their languages branched out, and their religions became different. (al-Andalusī 1996, 5)

So, according to the author of the *Ṭabaqāt*, the entirety of the human race branched off into today's nations. However, we are also told that one thing that united all of those nations was that they were "Sabians". Who are these Sabians[12] for Ṣāʿid? The answer to this question has been provided by a brilliant article by de Callataÿ (2017). In the first instance, Ṣāʿid seems to use the word to refer to a form of paganism that revers the celestial bodies. This coheres with one of the prevalent theories at the time, according to which the Sabians were the Sabians of Harran, who practiced a polytheistic religion and counted with prominent figures such as Thābit ibn Qurra (d. 901).

However, many references in the *Ṭabaqāt* suggest that he is working with a much broader definition. Contemporary nations are also characterized as Sabians, such as the Greeks (71), and a "majority" the Indians (53), as well as some Roman scholars working during the Abbasid period (101). Indeed, de Callataÿ has shown convincingly that Ṣāʿid's Sabianism is more than a form of paganism, and is also associated with an interest for the natural sciences that united all ancient nations in one "common view about the world" (de Callataÿ 2017, 306). This common view was characterized by a strong inclination towards astronomy, astrology, and magic, and in general any knowledge that connected the celestial bodies to the human soul. We are thus told that Greek and Egyptians Sabians such as Pythagoras and Thales of Miletus dedicated themselves to prime natural philosophy (*al-falsafa al-ṭabīʿiyya al-ūlā*), or that the Arab Sabians "attached great significance to the stars and to the ways to represent them in temples". (See 71, 116 respectively) Similar statements can be found for all the other nations.

The question of the identity of the Sabians is crucial to understand the chain of knowledge transmission that is the object of the *Ṭabaqāt*. If the ancient nations transmit the sciences to the current nations, and these nations were all Sabians, that means that there is a common substrate of knowledge—however small—that cuts across all branches. That such

[12] The Sabians are a religion mentioned in the Quran alongside the other peoples of the book (2:62, 5:69, 22:17). The Quran, however, does not associate them with any specific community or belief and their identity was quickly forgotten in Islamicate scholarship. As a result, theories abound as to their identity, even from the Classical period and, of course, Ṣāʿid's time. See de Blois (2018).

substrate relates to astral knowledge is not a coincidence, since the object of transmission is no other than the ancient sciences. What unites the ancient nations and the new is a common thread of interest in the ancient sciences that is preserved in transmission. The non-scientific nations can be seen in this light as nations that failed to preserve, perhaps, the original motivation to study the stars and their relation to the human soul.

The nations of the globe are continuously united by the *isnad*, which preserves a vocation towards the natural sciences but which some nations eventually lose, thus leading to the big two categories of nations as scientific and unscientific. It is tempting at this point to think about how space, in the sense of the geographical distribution of the globe, interacts with time as expressed in the chain of transmission. It stands to reason that the uneven scientific ferment of the globe can favor some nations losing their scientific vocations. However, the text does not provide to my knowledge any clues that may answer that question. What is clear, though, is that the *Ṭabaqāt* presents an anthropological vision that bears the mark of chains of transmission, connecting the nation while making them diverge over time.

Let's conclude this section by revisiting the question about Ṣāʿid's globe. I have presented a contrast between the *Ṭabaqāt*'s geography and its implicit anthropology, arguing that while the former is characterized by discontinuity, the latter presents a remarkable form of continuity. From a spatial point of view, the globe is stratified and hierarchical, delimiting the possibilities of the nations. This strong demarcation shows up even in the ancient nations, which do not go back to any previous kingdom, and are distinct from the start. However, considered from the point of view of their interest in the ancient sciences, the nations were united by a common belief system (diffuse as it might have been), a belief system that is both preserved and built upon generation after generation by the nations that show an interest in it.

In this sense, Ṣāʿid's globe both affirms and complicates ideas of medieval globalism. It affirms ideas (already found in the Quran) about a common humanity, but it is a stratified humanity, where the geographic conditions set a limit to what is possible. This is why those that participated in this conception of the globe—like Ṣāʿid himself—attempted to self-locate within the fourth climate. Indeed, if science is being transmitted and even improved through the tree of generations, it is possible to think of some nations as preserving more of the knowledge of nature, or even surpassing others in such an interest. It becomes possible, in other words, to self-locate in the succession of generations. In the next section we will consider this possibility.

## 4. The Andalusi perspective

When we were discussing the climatic theory, I briefly mentioned that by the time that Ṣāʿid was using it in his *Ṭabaqāt*, it was already being abandoned for a more descriptive "Roads and Kingdoms" approach. This is, in fact, an expression of a much larger pattern in his sources, where the proportion of Eastern Islamicate sources sharply decreases for books composed about 950—leading to puzzling omissions, like the absence of ibn Sīnā (Avicenna, d. 1037) or al-

Bīrūnī (d. 1050). Interestingly, while he rarely fails to acknowledge his limited access to the relevant source material, this gap is never brought up in the book. Why?

In this section, I want to address this problem and consider what it can say about the global Middle Ages. I will argue that the shape of the *Ṭabaqāt*—its characteristic pattern of presence and absence of sources, as well as how they are unraveled in the book—should be explained through *disconnection*, in particular disconnection from the Eastern Islamicate world. In particular, I will frame the *Ṭabaqāt* as both a contributor and a victim of a brewing tradition of Andalusi exceptionalism that led to a progressive severing of connections with its Eastern counterparts.

I will illustrate this idea with an example from Ṣāʿid's own work in astronomy. By the 11th century, the Islamicate East had already abandoned the Indian *Sindhind* system of astronomy. Andalusi astronomy, however, severed scientific communication with the East before the alternatives were fully established, leading to a rebirth of *Sindhind* astronomy, where Ṣāʿid played an instrumental role. Thus, the same disconnections that gave Andalusi astronomy its distinctive shape also gave the *Ṭabaqāt* its distinctive perspective on global science. By considering the scientific world from the Andalusi vantage point, I argue that what Ṣāʿid's work presents not the globe observed from nowhere, but instead the Andalusi dome, charting the scientific world that was accessible from its perspective. This perspective being crucially explained by disconnection, I make the point that disconnection is a fundamental component to Ṣāʿid's global outlook on science.

**4.1 Explaining the asymmetry**

In Section 2 I pointed out the profound asymmetry in how the *Ṭabaqāt* treats each scientific nation. The Iranians, Chaldeans, Romans, Egyptians, and Jews compose a much smaller part of the work, the sources used are scant to say the least and are in some cases marked by flagrant omissions of important figures. This contrasts with the treatment that the Indians, Greeks, and Arabs receive, who not only have longer chapters (though this is much more markedly the case for the Greeks and Arabs), but Ṣāʿid seems to command their history much better.

This suggests at least two possible explanations. There is, first of all, an obvious possibility. A look at not only the relative proportion of material in each chapter, but their *order*, makes it difficult to escape the idea that Ṣāʿid may be implying a certain directionality in his global history of science. He starts with India, the starting point of science, and progresses through the Persians, the Chaldeans, the Greeks, the Romans, the Egyptians and Arabs to end with the science in al-Andalus, to which he devotes the longest chapter. It should be noted that technically the last chapter is not on al-Andalus, but on the Jews. However, the majority of Jews cited and discussed there are Andalusi, suggesting to some that the chapter functions as a kind of "appendix" to the Andalusi section (de Callataÿ 2017, 304; see also Brann 2021, 99)

Spatially, we also travel from the Easternmost scientific nation to the location at its West that seems to be making the latest advances. Looked at from a bird's eye point of view, the structure of the *Ṭabaqāt* seems to impose an arrow to the history of science pointing to al-Andalus. Even the fact that al-Andalus is included in a section on the Arabs suggest a regional transmission within this broader transmission—from the Islamicate East to its West. In a word, we have an implicit *translatio studii* in the generations of scientific nations that culminates in al-Andalus. Martinez (1985) has strongly emphasized this arrow of scientific transmission, interpreting the Ṭabaqāt as essentially "closing" time, as al-Andalus synthesizes and completes the history of science.

Now, though I find it difficult to assert this strong interpretation of supremacism, there is something to the idea that al-Andalus is presented as an inheritor and perfector of what came before it. While Ṣāʿid never explicitly expresses sentiments to this effect, there are places where it becomes clear that he does take Andalusi astronomy to have a preponderant place, for example by characterizing Maslama al-Majrīṭī as "the chief mathematician in al-Andalus during his time and better than all the astronomers who came before him" (al-Andalusī 1996, 64)[13]. His comments with regards to the conditions for scientific practice in al-Andalus that we referenced earlier seem to reinforce the idea that he took Andalusi science to be, at least, among the best in the world.

Another argument in favor of this reading of the *Ṭabaqāt* comes from the way the work sees the Eastern Islamicate world. The medieval Islamicate culture was unusually aware of the cumulative and collaborative dimension of science, in the sense that the development of their own scientific tradition draws from earlier traditions and builds upon them. The *Ṭabaqāt*, as well as all other works like it of the period, are vivid examples of this. As we saw in the first section, Ṣāʿid believed the East to have abandoned an interest in science, having been overrun by "women" and "Turks". But, if the scientific vocation resides now in the Arabs, and its Eastern peoples have lost their interest in science, who would take up that mantle, if not the West—therefore al-Andalus? Here, the role of al-Andalus as the forerunner of scientific progress would be due to the perhaps humbler reason that the East abandoned that role by giving in to political decline.

In contrast to this view that sees Ṣāʿid as advocating for a kind of Andalusi supremacy, one can simply explain away the asymmetry by reference to the sources themselves. While there were virtually no (say) Chinese sources for Ṣāʿid to use, "Arab" texts were his main source of information. He would thus simply report on whatever he has information. This explains not only the asymmetry in his treatment of nations, but also the fact that there are virtually no mentions of Eastern *Arabic* science after about 950, when the Andalusis stopped traveling to the East for knowledge (*riḥla*). The few exceptions that show up in the Ṭabaqāt, such as ibn al-Haytham's

[13] "*kāna imāmi al-riyāḍiyyīna bi-al-Andalusi fī waqtihī wa-aʿlama man kāna qablahu bi-ʿilmi al-aflāk*" (169).

"treatise on burning mirrors" (150), were likely brought back by the pilgrims returning from the *hajj*, which had Egypt as a main stop in the route from the West. (Khan 1991, 524)

This has led Richter-Bernburg to say that even though "Ṣāʿid may, theoretically, have held such views [about al-Andalus's cultural predominance], his presentation is obviously shaped by an actual lack of knowledge rather than a desire to make it fit his image of the history of science" (1987, 379). This explanation has at the very least the benefit of being the simplest. It is certainly the case that Ṣāʿid never expressed explicitly any kind of exceptionalist beliefs, whereas he frequently makes caveats about the lack of sources affecting his reports. One should add here that not only did he likely have a considerably more extensive pool of written sources on Andalusi science—he also informs us that he relied extensively on oral informants about the science of the Peninsula. An abū ʿUthmān al-Baghūnish of Toledo, for example, shows up at least twice in the *Ṭabaqāt*, informing our historian about "his teacher Maslama ibn Aḥmad al-Majrīṭī" (167), but also about Moḥammad ibn ʿAbdūn al-Jabalī's skill in medicine (192) and abū al-ʿArab's knowledge in the same subject (193). Al-Baghūnish is just one among the many oral sources that Ṣāʿid relies on throughout the work. These informants provide an illustration of the asymmetry of Ṣāʿid's sources themselves, but also of his rather candid openness about the origin of his information.

So, what is it? Should we take the *Ṭabaqāt* to be an exercise of Andalusi supremacism in the history of science, or should we instead just take Ṣāʿid at his word and attribute the asymmetry to his sources? I think there is a clear case to be made that both explanations can be true at once, and I argue that we should take his lack of sources to be the *effect* of a trend in Andalusi exceptionalism. This trend that Ṣāʿid was inevitably a part of will give us important clues about the way that al-Andalus saw itself in its Islamicate context, and how those views impacted its scientific trajectory. So, while we may agree with Richter-Bernburg in that we will never know Ṣāʿid's personal views on Andalusi's cultural predominance vis-à-vis the rest of the Islamicate world, we can still see the *Ṭabaqāt* as a work in line with a particular textual tradition—the *faḍaʾil* tradition—thus both reinforcing those kinds of views while also falling victim to them.

The *faḍāʾil* ("merits") literary genre consists of exaltations of particular cities, or regions. In its elevation of a place's peoples, it is closely related to biographical dictionaries, and indeed some of these works will rely on hadiths to religiously ground the pride and place of the treatise's chosen location. (See Elinson 2009, 120 ff.) The genre goes back at least to ʿUmar ibn Shabba's (d. 875) *Faḍāʾil al-Baṣra*, and is followed by plenty other works that elevate cities such as Aḥmad ben Muḥammad Sirkashī's (d. 899) *Faḍāʾil Baghdād*. Soon, these exaltations expand beyond the confines of the city into whole regions, for instance with ibn Zawlāq al-Miṣrī's (d. 996) *Faḍāʾil Miṣr*. In his "Epistle on the merits of al-Andalus and merit of its men" (*Risāla fī faḍl al-Andalus wa-dhikri rijālihā*), ibn Ḥazm ([1030] 1987) provides perhaps the most well-known example of the Andalusi *faḍāʾil* literary genre. Although it is generally considered that the

first work in the genre in al-Andalus, many other Andalusi authors wrote similar tracts in the following centuries, such as al-Saqundī's own *Risāla fī faḍl al-Andalus* (c. 13th century).

Ibn Ḥazm's epistle starts by reporting on a letter written by a Kairouanese courtier, which seemingly reported that Andalusians left no written records of all their "great deeds". He sets out to respond to this claim, and to produce a record of those written works. ([1030] 1987, 171–72) Consistent with other works in the genre, ibn Ḥazm continues by discussing a hadith[14] that in his interpretation prophesized the conquest of al-Andalus. This, he argues, foreshadowed "the generation most deserving of every merit [*al-qurūni bi-kulli faḍlin*], by the testimony of the Messenger of God—peace be upon him—that it is better than every generation after it." ([1030] 1987, 174).

In accordance with such merit, the Cordovan scholar will proceed to list all the contributions that al-Andalus has done to the Islamicate world. The short treatise reports on works on history of al-Andalus, interpretation of the Quran, *fiqh*, grammar, poetry, medicine, theology, philosophy, mathematics and astronomy. Whereas ibn Ḥazm's knowledge of Andalusi works on Quranic and literary sciences is remarkably comprehensive, his list of works on the ancient sciences is brief.

In medicine, he includes the work of vizier Yaḥyā ibn Isḥāq, ibn Ḥazm's own teacher ibn al-Kattānī, as well as abū al-Qāsim al-Zahrāwī (also known as Albucasis), whose *Kitāb al-Taṣrīf* he praises as extremely comprehensive, and ibn al-Haytham's (not to be confused with the Iraqi physicist) works on medicine, who he considers very useful. In philosophy, he will cite again the work of al-Kattani, along with al-Ḥimār's. ([1030] 1987, 185) It should be noted that ibn Ḥazm openly acknowledges his own limited knowledge of the field of ancient sciences. Notably, in the (also very short) section on mathematical sciences, he relies on an informant of notoriety to report that no comparable astronomical tables (*azyāj*) to that of Maslama al-Majrītī and of ibn al-Samḥ (d. 1035), who as we know from Ṣāʿid's own report was a student of Maslama's. Ibn Ḥazm also references "the book of Aḥmad ibn Naṣr", presumably his book on surveying practices (Glick 2005).

Brann (2021, 99) considers Ṣāʿid's *Ṭabaqāt* as a follower of Ibn Ḥazm's "agenda" of *faḍl*, reading the work as a text whose purpose is setting record of Andalusi scientific merit. There is something to be said in favor of this view. As I mentioned earlier, it seems likely that Ibn Ḥazm was, if not Ṣāʿid's teacher, at least a source of intellectual guidance. Ibn Bashkuwāl includes Ibn Ḥazm in the list of his teachers, and it makes sense that Ṣāʿid would resort to his guidance in matters of religious law. The main line of evidence against Ibn Ḥazm being his teacher is that the *Ṭabaqāt* does not describe him as such, while he references other people in this capacity. They should have nonetheless been close, as Ṣāʿid describes speaking to his son al-Faḍl about Ibn

[14] This is Umm Ḥarām bint Milḥān "green sea" dream report, where Muhammad speaks about a dream where his followers were sailing a green sea (likely the Mediterranean), resembling kings in thrones. (Al-Bukhārī, *Ṣaḥīḥ*, *kitāb al-jihād wa-l-siyar*, *bāb ghazw al-marʾa fī al-baḥr*, no. 2877)

Ḥazm's work and describes him as the best legal scholar in al-Andalus (183). Finally, the long chapter on Andalusi science, with its characteristic predominance of the mathematical sciences, could be understood as Ṣāʿid's response to Ibn Ḥazm's lacunae in the field. If the *Ṭabaqāt* is a work of *faḍāʾil*, that would significantly cohere with the observations of people like de Callataÿ and Martinez. Indeed, it would be an unprecedented, planetary, *faḍl* of al-Andalus, placing the merits of its scientists within generations of nations from the beginning of known history.

Attractive as these readings of the *Ṭabaqāt* are, it is undeniable that—as Richter-Bernburg put it—these are "theoretical views" that we may attribute to Ṣāʿid, and thus it is ultimately impossible to settle this debate. However, I do not think we need to resort to speculating about the author's views to situate his work within this context of Andalusi exceptionalism. At the very least, it is clear that Ṣāʿid takes Maslaman astronomy to be superior to all others, and he spends a long portion of his work detailing all the contributions of Andalusi science. But, beyond this, his lopsided view of the place of al-Andalus within the Islamicate world is overdetermined, not just by (perhaps) his own views, but also the reality of the Peninsula's connections to the East. In their *Prosopographies of ulemas of al-Andalus*, Ávila *et al.* (2014) provide a dataset of the Peninsular ulemas and their travels for knowledge (*riḥlat*). This dataset reveals how, during the Taifa period, travels to the East decrease sharply in comparison to the previous period. The results are displayed in Table 1.

| | Emirate and Caliphate (8th-10th c.) | Taifa Period (11th c.) |
|---|---|---|
| Total travel entries | 1255 | 556 |
| Travels to the East | 1218 | 532 |
| Travels to the West | 37 | 24 |

*Table 1. Riḥlas of Andalusi ulemas until the 12th century. Data from the interactive map "La riḥla de los ulemas andalusíes", accessed May 27th of 2026. (Ávila et al. 2014) The "West" includes all travel destinations from the Maghreb up to Ifriqiya, including Sicily. All other destinations are categorized as "East".*

As can be seen in the Table, travel to the East decreases sharply during the period, both in absolute and relative terms—while the proportion of East to West travel during the earlier periods is about 33:1, in the Taifa period this goes down to 22:1. While the number of years covered in the first period is substantially larger, it should also be noted that the number of Muslims in the Peninsula was also substantially smaller: Al-Andalus would not be a majority Muslim territory until about the 10th century, at least according Buillet's famous (1979) analysis.[15] This decrease is consistent with previous work by Vernet (1950, 264) and Grau

[15] It should be stated that some scholars have questioned Buillet's chronology, but they have also failed to provide an alternative. (See Fierro (2017, 202) for a review of some of the emerging considerations) My argument, in any case,

Monserrat (1957, 257–58), who respectively concluded that during the 10th century 25% of Andalusis from the Ebro Valley travelled to the East, whereas only 11% did so in the 11th. While it is only a local point of view, it is still a relevant, consistent data point, especially given that the region hosted the Taifa of Zaragoza.

These data can provide some explanation for the absence of Eastern Arabic sources in the *Ṭabaqāt* after 950. The sharp decrease in travels to the East in al-Andalus post-Caliphal period led to another decrease in the volume of manuscripts that were brought back to the Peninsula. The few books mentioned by Ṣāʿid were composed (and probably brought back from) Egypt, which being a place of transit on the way to the Hijaz, would have been a convenient stop for those pilgrims with intellectual interests.

But why did the Andalusi scholars stop travelling to the East? This is where the intellectual climate of the Peninsula of intellectual sufficiency (if not superiority) played a crucial role. By the Taifa period, many Andalusi scholars believed that they did not *need* to travel to the East in search of knowledge, and chose instead to either stay in the Peninsula or make short travels to the Maghreb (the last especially during the Almoravid and Almohad periods). Ibn Ḥazm himself did not travel to the East, but so didn't figures such as al-Zarqālī, ibn Rushd, or ibn Zuhr. (Samsó and Forcada 2025, 586) From the biographical information we have, it seems like we should include Ṣāʿid in that list, who instead travelled *through* the Peninsula for his education and settled in Toledo after completing it.

In this sense, Ṣāʿid's perspective on al-Andalus' contribution to Islamicate science is *both* the result of the exceptionalism of the period and his lack of sources. This is because the first contributed to the second: the growing sense of self-sufficiency of Andalusi scholars significantly reduced their contact with the Islamicate East, thus reducing the exchange of ideas that travelled back to the Peninsula during the Taifa period. This does not exclude the possibility that Ṣāʿid held exceptionalist views such as Ibn Ḥazm's—in fact I think it is likely he held some versions of these views, for the reasons I listed—but it shows that the exceptionalist trend went beyond his own beliefs. Andalusi science was itself in a period of relative decoupling from the East, and this affected its perspective on the broader Islamicate world, including its scientific output. In the next section, we will consider how this process of divergence affected Ṣāʿid's own astronomy, and thus Andalusi science more broadly.

### 4.2 Convergence and divergence of East and West

In his *The Sciences of the Ancients in al-Andalus*, Samsó (1992) divided the history of science in al-Andalus into four periods. In the first century since the conquest (711-821), Iberian science was fundamentally the indigenous Latin tradition, strongly influenced by figures such as Isidore of Seville (d. 636). ʿAbd al-Raḥmān II (d. 852) initiated a process of "orientalization" of

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does not hinge on the exact chronology of conversion, and is sufficient to note that the number of Muslims only started picking up much later after the initial conquest.

Andalusi science (822-1031), where the Peninsula would increasingly absorb people, texts and practices from the Islamicate East. This orientalization was responsible for the introduction of the Indian astronomical tradition. Ṣāʿid's period, from 1031 to 1086, is what Samsó calls the "Golden century" of Andalusi science, for reasons I explained earlier. 1086 is the year when the Almoravids invade al-Andalus, setting in motion a process of confluence with the rest of the Maghreb that would give rise to philosophers like Averroes or Maimonides. For this reason, Samsó calls this period (1086-1232) the "century of the philosophers". The last period of Andalusi science is marked by a progressive "decadence" until 1492, led by the Nasrid dynasty of Granada.

A key dimension of Samsó's periodization is Andalusi convergence and divergence with other parts of the Islamicate world. Convergence with the East initiates the blossoming of Andalusi science, but this momentum would be lost as the Peninsula slowly loses its ties. The century of the philosophers is marked by a convergence with the rest of the West, but as the Almohad empire abandons the Peninsula in 1212, the last bastion of Islamicate rule in the Peninsula—the Nasrid emirate—would struggle to compare to the earlier periods. The Taifa period is, then, the inflection point of Andalusi science, when its practitioners start harvesting the fruit of their connection to the Eastern centers and productively conduce them to their own interests.

This is nowhere as clear as in the development of Sindhind astronomy by Andalusi scholars from the 10th to the 11th centuries, and the Toledan Tables were the historical culmination of this process. Following the transit of Sindhind astronomy into al-Andalus we follow the transmission of the Indian scientific tradition into the Western edge of Eurasia, but also how its survival in the Peninsula occurred precisely as a result of its disconnection with the East. In this sense, the Toledan Tables are a privileged case study of the nature of medieval science, where disconnection is a fundamental explanatory dimension of the characteristically medieval scientific plurality.

The Toledan Tables were a compilation of a series of *zījes* that included all sorts of data, including mean motions, planetary equations and latitudes, eclipses, geographical coordinates or astrological tables. They were produced by al-Zarqālī and most likely also Ṣāʿid himself in collaboration with other astronomers, some of which must have been under his patronage. Although Ṣāʿid does not mention them in his chapter on Andalusi science, it seems clear that he must have at least coordinated the observations, if not commissioned or even wrote a part of the work himself.[16] The Tables quickly became standard in medieval European astronomy, and as a

[16] Richter-Bernburg discusses two extant adaptations to the Tables, one ascribed to John of Seville and another by Robert of Ketton, that list Ṣāʿid ("Abensahet", "ebenzaet toletanus" respectively) as the author, along with al-Zarqālī ("Arzachel"). (1987, 375) As Samsó and Forcada (2025, 601) point out, since he does not mention the Tables in the *Ṭabaqāt*, they must have been compiled in the very short span of two years. It is, then, possible that some observations were made in those two years, and afterwards revisions were made. Pedersen (2002, 15 n1) has found traces of revisions from around 1110, giving some credence to the possibility. Overall, I take it as a given that Ṣāʿid

result many adaptations were produced, such as the Tables of Marseille (1141) or the Hereford Tables (1178). Thus, even though the original Tables are not extant, the Latin adaptations give us some idea of its contents and their sources, which have been presented in a thorough edition by Pedersen (2002).

This issue of the tables' sources is of interest to us. One of the characteristic features of the Toledan Tables is its "undigested merge" (as Kennedy (1956, 128) put it) of the Indian and Ptolemaic astronomical traditions. These two traditions were channeled via two Arabic zījes: al-Khwārizmī's *zīj al-Sindhind* (c. 820), based on the Indian methods of the Sindhind tradition (plus other elements from the Persian and Ptolemaic traditions), and al-Battānī's *zīj al-Ṣābiʾ* (c. 900), which draws from Ptolemaic methods. The Sindhind tradition of tabular astronomy arose in Baghdad in the 8th century, drawing from the Indian corpus of *siddhantas* ("doctrines"), most notably Brahmagupta's *Brāhmasphuṭasiddhānta* (c. 628). (Pingree 1998) From this Indian material the tradition took fundamental functions such as the sine, but importantly for our purposes, also the sidereal reference frame. Because positions in a sidereal frame are taken against the fixed stars, recovering tropical quantities requires a separate correction term, a problem absent from the Ptolemaic tradition, which works in the tropical frame.

It seems that these two traditions were blended together into the Toledan Tables indiscriminately, and the result was a virtually unoriginal table riddled with error. (Toomer 1968) Unoriginal, that is, except for a set of tables on the motion of the eighth sphere. These tables on the motion of the eight sphere (PB11 in Pedersen (2002)) provide a series of values of precession of the equinoxes on the basis of the theory of trepidation. The theory of trepidation (Samsó 1994) assumes the need to justify the apparent precession of the equinoxes by constructing a geometrical model of the motion of the celestial sphere (the eighth sphere). These motions are calculated on a sidereal frame, while assuming models of Greek origin via Thābit ibn Qurra's lost *De Motu* in their computations. That such set of tables were produced by the Toledan team itself testifies to the blend of traditions that operated in the al-Andalus of the period.

Ṣāʿid himself was an ardent proponent of trepidation theory, and in the *Ṭabaqāt* he provides the first account of the introduction of the theory into the Peninsula through the introduction of the Sindhind tradition. He reports (131-132) from a work of ibn al-Ādamī (d. 10th c.) that the system arrived to the Islamicate world in the year 773, when an Indian diplomat provided the caliph al-Manṣūr with a book containing the *Sindind* "arithmetic" (*ḥisāb*). Al-Manṣūr then decided to translate it into Arabic, a task he assigned to al-Fazārī, who in turn produced the first known work in the tradition. These tables would be used throughout the Islamicate world until al-Khwārizmī compiled the tables I referenced earlier. Although Ṣāʿid takes the *zīj al-Sindhind* to contain mistakes, he acknowledges the importance it had in the

played some kind of fundamental role in the production of the Tables. I will also make another argument to this effect relating to the Sindhind tradition in this section.

continuation of the Indian tradition in Islamicate (or "Arab", in the context of the *Ṭabaqāt*) astronomy.

Al-Khwārizmī's *zīj* arrived in the Peninsula during the emirate of ʿabd al-Raḥman II (r. 822-852), who promoted a policy of Eastern acculturation or "orientalization", to put it in Samsó's terms. The emir's policies represented a deliberate attempt at convergence with the cultural centers of the East, leading not only to the introduction of Sindhind astronomy but even the music, clothing, and tastes of Baghdad through the influence of figures like Ziryāb (d. 857). ʿAbd al-Raḥman would send one of his courtiers—ʿAbbas ibn Nāṣiḥ—to the East in search of scientific books, among which was "the *Sindhind* [and other books]", according to ibn Saʿīd. (1964, 45)

The new stage of "Sindhinization" of Andalusi astronomy came when Maslama al-Majrītī adapted the tables into the locality of Cordoba at some point of the late 10th century. The adapted tables also contained a sine table characteristic of the Sindhind, but with a typically Ptolemaic radius of 60, at the same time as other techniques assuming the more characteristically Indian radius of 150. (Pingree 1998, 335–36) Ṣāʿid also tells us that he changed the epoch from the Persian (referring to the Yazdijird III epoch) to the Arabic one. (169) Crucially, the influence of Maslama's school meant that his and his students' procedures were passed onto the astronomers that followed, all the way to Ṣāʿid and his brightest student, al-Zarqālī, who wrote "one of the most complete medieval (and not only Hispanic) texts" on trepidation. (Samsó 1992, 222) Indeed, although we do not conserve the treatise, Ṣāʿid mentions writing a text on trepidation, and given his status as al-Zarqālī's teacher it is likely that he contributed with his student to the production of the table on precession.

In the *Ṭabaqāt*, Ṣāʿid provides a personal note on how he himself developed an interest in the trepidation theory. He did not seem to understand trepidation theory very well until he encountered ibn al-Ādamī's *Naẓm alʿiqd*, a work on Sindhind astronomy that was published by al-Ādamī's student, al-Qāsim ibn Muḥammad ibn Hishām al-Madāʾinī, around 950. This book, says Ṣāʿid, "contains all that was known about astronomy and the calculation of the motions of the stars according to the system of the Sindhind, including certain aspects of the trepidant motions of celestial bodies, *which were never before mentioned*" (1996, 53, emphasis added). This is a very interesting passage, because it suggests that for Ṣāʿid trepidation theory came in the same package as Sindhind astronomy. Indeed, in a later passage where he discusses the work of al-Saraqusṭī (d. 1056), he references a letter where al- Saraqusṭī apparently argues against some "errors" in the Sindhind, to which Ṣāʿid says that he has refuted those claims in his work on trepidation theory—see Section 2. (175)

Thus, one of the latest sources on astronomy that Ṣāʿid is able to consult for both his historical and astronomical work was squarely within the *Sindhind* tradition, while also incorporating what seemed like an innovative theory of trepidation. He confesses being deeply inspired by this work, and it is no surprise that—if Ṣāʿid contributed directly to the Toledan

Tables, as I have argued—the Tables incorporated features of the Indian corpus, as well as a seemingly *ad hoc* inclusion of trepidation theory. In particular, they include a table of sines and declinations (Table B in Pedersen (2002, 946)), a set of tables on the latitudes of the planets (2002, 1309 (Table F)), as well as a table relating the diameter of the Sun and the Moon to their velocities (2002, 1409 (Table J)). All these tables are derived from the Indian tradition as inherited from the chain going through al-Khwārizmī and Maslama. The table on the motion of the eighth sphere (2002, 1542 (Table P)) is thus the only original content from the Toledan Tables, but also an imprint of the trajectory of Indian astronomy into 11th-century al-Andalus.

Paradoxically, however, while trepidation theory and *Sindhind* astronomy took the centerstage in the Westernmost part of the Islamicate world, in the East it was quickly being absorbed—one might even say "bearhugged"—by the latest forms of Ptolemaic astronomy. As Pingree (1998, 333) has put it, the Indian material was even by the time of al-Khwārizmī "an unjustified set of rules, whose bases … had no explanation, and so were necessarily interpreted in light of Ptolemaic astronomy". It is then little surprise that by the time of al-Battānī, and especially ibn Yūnus, the *zīj* tradition now relied exclusively on Ptolemaic astronomy and parameters. It was not completely abandoned, though, as important elements like the sine, cosine, or versine functions remained, but they were absorbed into the now predominantly Ptolemaic picture. By the time of al-Battani, the Islamicate East had already developed at least a fully-developed alternative to the *Sindhind*. (See Pingree 1973) That, of course, does not mean that the Indian tabular tradition disappeared overnight, as al-Ādamī's *Naẓm* shows, but it contrasts starkly with al-Andalus, who took at least another century to adopt the new Ptolemaic paradigm.

Why, then, did this same Indian material survive in 11th-century al-Andalus? We have already seen a possible explanation of "internal" characteristics: The *Sindhind* tradition remained alive in service of trepidation theory, which experienced with Ṣāʿid and his team, especially al-Zarqālī, a short but vigorous revival. Another important element, however, has to do with the absence of connection between the Peninsula and the rest of the Islamicate world during Ṣāʿid's time. As we saw earlier in this section, it seems judging from the *Ṭabaqāt* that our historian-astronomer did not possess much sources from the East after about 950. This suggests that he did not have much access to the slow process of appropriation of Ptolemaic astronomy in the rest of the Islamicate world that absorbed the Indian corpus. As a result, Andalusi astronomy followed a different path of development, where the Indian and Greek tabular tradition continued relatively more hand in hand, especially by the 11th century when the revival of trepidation theory gave the Indian corpus one final push.

We are therefore compelled to understand 11th-century Andalusi astronomy as a product of divergence with the rest of the Islamicate East; a divergence that arises partly because of disconnection. Disconnection explains both the pattern of sources that shape the *Ṭabaqāt*, but also the particular development of tabular astronomy in the Peninsula. It is not surprising that both are linked by the figure of Ṣāʿid al-Andalusī, a proponent of trepidation theory who like

many of his fellow Andalusi scholars did not travel to the East (at least as far as we know). In line with Samsó's periodization, however, this divergence presupposes a previous convergence with the East (a period of "orientalization") which provided the ferment for the astronomy that would later flower in the Peninsula.

This highlights the main idea I want to drive home in this section. Indian astronomy is arguably the furthest point of connection that characterizes 11th-century Andalusi astronomy. In fact, it is through the Andalusi connection that some of these computational techniques would arrive to Europe in the subsequent translations, making the Indian-Andalusi contact a key moment of convergence in Medieval astronomy at large. The interesting paradox of this process is that the revitalization of Sindhind astronomy and trepidation theory that followed depended on a disconnection with the Islamicate East, that originally provided al-Andalus with the Indian corpus. We thus have a kind of globality *through* disconnection, in a paradoxical inversion of the globality framework, which understands the medieval period as the product of interconnection and exchange. Certainly, the Andalusi divergence presupposes a previous convergence with the East. The idea here is not to minimize that condition. However, if we look simply at positive processes of connection, we would be less equipped to explain the diversity of sciences that characterize the medieval period. Somewhat adapting Berend's *ethos* that I cited in Section 1, not only do we want to understand what made the medieval period different, we also want to have some understanding of the diversity of phenomena that characterize the period itself.

I have attempted to show that the specific Andalusi perspective requires a kind of inversion of the ways we think about globality. The Andalusi phenomenon, I argued, depends not only on processes of connection with the Islamicate East, but also a pattern of disconnection that would give rise to its divergence *via-à-vis* its Eastern counterparts. Understanding the specifics of how this divergence came about is crucial also for the sake of understanding global connection, given the selective transmission of Eastern science towards Western Europe in later centuries. (Gutas 2008) 11th-century Andalusi science is a kind of bottle neck connecting two processes of convergence. What connects both ends of this process, though, is a rare moment of disconnection, which we should put front and center to have a systematic understanding of how the medieval period gave rise to unprecedented connectivity, exemplified in this case as a revival of Indian astronomy in 11th-century al-Andalus.

## 5. Conclusion: From the globe to a dome

Let's look back at the gubernatorial coin (Figure 1). The early Umayyad conquerors, in representing the Iberian Peninsula, chose to associate it with a star at the edge of the Western world. But the later Andalusis did not see themselves in this way. Especially by the time that Ṣāʿid wrote his *Ṭabaqāt*, scholars in the Peninsula attempted to locate themselves at the central climatic location, putting themselves on the same level as Damascus or Baghdad. Consequently, scholars like ibn Ḥazm—as well as Ṣāʿid himself, perhaps more indirectly—located Andalusi

production at the center of Islamicate culture, and saw themselves as the inheritor of the merits of the East.

This complementarity is the key ingredient of the dome metaphor I put forward earlier. Viewed from above, al-Andalus was an island in the West; viewed from below, the western Peninsula was not only connected to the center of the world, it was even its inheritor. For a medieval actor, the world is a collection of facts that have to be put together into a consistent representation. What facts get selected is partly a function of the positionality of that actor (especially, as we saw, what sources become accessible to them), and for that reason the actor tends to end up at the very center of that representation. When Andalusis imagined the globe, then, they projected their knowledge onto a representation where they were at the center: As Ṣāʿid described world science, the Arabs, Indians, Greeks, and all the other scientific nations were the drivers of progress—other nations, such as the Chinese, are relegated to a close second. This is, of course, a projection of the particular set of interactions that characterized Islamicate science in its early centuries. In this way, the *Ṭabaqāt* speaks to the broader image that the Islamicate world had of global science.

One of the main points I wanted to drive home is that these projections are the result of a structural feature: the locality of the actor. Certainly, there were individuals that defended their place as a pinnacle of cultural production, like ibn Ḥazm, but it is at least just as important to think about how structural limitations to connectivity configure the shape of how those actors see their place in the globe. The "predominance" of Andalusi science as its actors saw it was the result of their merits, but also a consequence of a history of convergence and divergence with their Eastern neighbors. Al-Andalus is not the only location characterized by these processes of connection and disconnection, and for this reason the points I am making extend beyond Andalusi science. For every actor there is a dome, to the extent that they collate the world accessible from their perspective and project it into a consistent representation.

I have suggested that this carries a sort of inversion in the way we think about medieval globalities. First, we saw that Ṣāʿid's picture of the globe already cuts up the world in a way that conditions what connections can be drawn. The inhabited world (the oikumene) lives only in a band between the Arctic circle and the Tropic of Cancer, but even this area is divided into a series of climates that hierarchically grade how conducive to science a given society is bound to be. These are features that condition scientific achievement and do not strictly determine it (Indians practiced historically exceptional science, and the Berbers did not practice any), but nevertheless the representation persist as a frame onto which the picture is projected.

Finally, I also argued that medieval globality should not be thought of purely in terms of connection. As Berend put it in her discussion of medieval global frameworks, the main objective of a historical framework should be to expand our understanding of concrete historical phenomena. Her point was that it is not clear how there is a distinctive medieval globality that distinguishes it from, say, Ancient globalities. I have taken on a similar *ethos* and questioned how

far pure connection and interaction can take us in understanding the concrete and diverse sciences that populate the medieval period. At least in the Andalusi case, especially as Ṣāʿid perceived it, it is essential to include in our analysis how the Peninsula grew increasingly disconnected with the rest of the world. To understand the shape of Andalusi science, meaning its characteristic set of sources, influences, and so on, we should also see them as the result of divergence from other medieval societies. The Indian case, being the furthest point of connection, was also the most vivid case of how interaction can be kept alive by such a disconnection.

Since the medieval world—at least medieval science—is partly the result of these projections and disconnections, I have suggested we think in terms of domes, rather than globes. Now, both representations are not strictly incompatible. Global medieval science is plural, and understanding such a plurality should be (in my view, in any case) one of the main goals of investigation in the period: By virtue of what connections did this particular tradition come about? What circumstances led to it diverging from the societies it had previously converged with? Thinking in this way, we may perhaps reconcile the undeniable level of interconnectivity of the period, with the equally undeniable role that perspective plays in those connections.

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