

The State of Mathematical Sciences in the Central Maghreb during the 8th–9th Centuries AH / 14th–15th Centuries AD

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Abstract:

This study seeks to provide an overview of the state of mathematical sciences in the Central Maghreb during the 8th–9th centuries AH / 14th–15th centuries AD. The aim is to identify the place of mathematical sciences within scholarly life, as well as the main factors and influences that contributed to their development during this period. Chief among these was the impact of the Andalusian elite who chose the cities of the Central Maghreb as their new home. The scholarly traditions of Tunisia and Morocco also made significant contributions, in addition to the campaign of Abu al-Hasan al-Marini into the Central Maghreb, during which he was accompanied by an army of scholars. As a result, mathematical knowledge in its various branches witnessed a remarkable revival in the urban centers of the Central Maghreb, particularly in Tlemcen. Prominent mathematicians emerged there, such as al-Ābilī, Abū ‘Uthmān Sa‘īd al-‘Uqbānī, Ibn al-Qunfudh al-Qusanṭīnī, and al-Qalaṣādī, who contributed to the advancement of mathematical knowledge through both teaching and authorship. Their fame extended beyond the Central Maghreb, ensuring the continuity of scholarly and mathematical exchange among the intellectual centers of the Islamic West.

Keywords: al-Ābilī, central Maghreb, mathematical proof, mathematical sciences, Sa‘īd

1. Introduction

The scientific movement in the Central Maghreb flourished during the 8th–9th centuries AH / 14th–15th centuries CE. This is clear from the spread of educational institutions and the rise of many scholars who preserved and advanced knowledge through study, teaching, and writing. They played a key role in disseminating a wide range of sciences that shaped intellectual life. Special attention was given to the rational sciences—such as logic, medicine, astronomy, and especially mathematics—because of their relevance to social and religious matters, including legal issues like zakāt and inheritance. Mathematical sciences gained particular prominence, as shown by the fame of Central Maghrebi scholars beyond the Zayyanid state.

This study examines mathematics in the Central Maghreb during this period, focusing on study, teaching, and authorship. It also explores the role of Central Maghrebi scholars in preserving, transmitting, and producing mathematical knowledge. The study is structured around three main themes:

- The place of mathematical sciences in Central Maghrebi scholarly life.
- The main factors influencing the development of mathematical sciences.
- The contributions of Central Maghrebi scholars to the advancement of mathematics.

2. The Place of Mathematical Sciences in the Scholarly Life of the Central Maghreb

Mathematical sciences (see Note 1) and their branches—arithmetic (see Note 2), algebra (see Note 3), commercial transactions (see Note 4), inheritance law (see Note 5), and geometry (see Note 6)—held an essential place among the rational sciences, as well as in other fields that relied on mathematics, including the religious sciences. Because jurisprudence dealt with Muslims' daily affairs—marriage, family, trade, land division, and inheritance—jurists had to master arithmetic, which helped them solve the complex issues of inheritance, especially fractions (Jalloudi, 2022, p. 366). From this need emerged a new discipline: algebra and al-muqābala (Quriyān, 2011, p. 244).

The sighting of the crescent and the determination of the qibla promoted trigonometry, while Arabic linguistics encouraged combinatorial analysis, and trade stimulated arithmetic methods (Ablaagh, 1996, p. 33). Geometry, applied in motion and mechanics, was used in building fortresses, bridges, canals, and in designing mirrors, astronomical instruments, and automata (al-Akfānī, 1990, p. 190).

Central Maghrebi scholars of the 8th–9th/14th–15th centuries recognized the practical value of mathematics, a view shared by jurists. Ibn al-Qunfudh al-Qusanṭīnī (d. 1407) stressed its importance in both rational and religious sciences: “Half of the religious sciences, namely inheritance law, is based on arithmetic” (al-Qusanṭīnī, 2007, p. 177). He also noted that acts of worship, such as prayer and zakāt, require numerical knowledge.

Ibn Khaldūn similarly praised geometry for its intellectual and practical benefits, emphasizing its clarity and order in disciplining the mind and reducing errors. As his teachers said, “Geometry for the mind is like soap for clothing—it cleans and purifies” (Ibn Khaldūn, 2016, p. 398).

Although some scholars recognized mathematics’ value in astronomy, commerce, inheritance, architecture, carpentry, and other crafts, it seems the discipline did not receive the attention it deserved. At that time, mathematics had become a model of scientific rigor in Europe (Ibn Khaldūn, 2016, p. 365). In the Central Maghreb, however, there was little integration between mathematics and other sciences or technical and artistic practices. Its demonstrative structure declined, and the discipline remained largely pedagogical, with texts relying on simplified explanations, definitions, excessive examples, and frequent digressions (al-Ba‘zāfī, 2007, p. 169).

This is illustrated in the words of al-‘Uqbānī in his commentary on *Talkhīṣ A‘māl al-Hisāb*: “...we did not deal with anything beyond the demonstrations of its problems by geometrical methods. For this reason, we did not add to the proofs of its propositions except what was strictly necessary, such as pointing out a remark or providing a preliminary demonstration upon which the proof of a problem was built” (al-‘Uqbānī, 1997, p. 219).

This may explain why al-Ghubrīnī remarked: “The attention given to mathematics was weak, and only a few excelled in it” (al-Ghubrīnī, 1981, p. 227). Ibn Khaldūn likewise noted the decline of arithmetic: “As for the later scholars, it was abandoned among them, for it was no longer in circulation” (Ibn Khaldūn, 2016, p. 395).

This situation was mainly due to the dominance of religious sciences—especially jurisprudence within the Mālikī school—which continued to be supported by both the authorities and the wider public. Consequently, rational sciences, including mathematics, received less attention than the transmitted sciences. Interest in reasoning and debate declined, which weakened the spirit of critical inquiry. As a result, scholars in the Maghreb, and particularly in the Central Maghreb, focused on the branches of mathematics that served practical ends, especially those related to the religious sciences (Jalloudi, 2022, p. 367). Their concern was mostly utilitarian, and their work remained largely theoretical.

Ibn Khaldūn also attributed this decline to political instability (see Note 7) and the weakening of economic activity, which reduced the need for mathematics in fields such as irrigation, navigation, road building, and architecture (Ibn Khaldūn, 2016, p. 394).

Nevertheless, this does not negate the attention that Central Maghrebi scholars gave to mathematics in the 8th–9th centuries AH / 14th–15th centuries AD. Owing to its dual importance—both for its utility in the religious sciences and for its intellectual discipline—mathematics retained a key position among the rational sciences in the Central Maghreb (Ṭālibī, 2011, p. 59). Within the curricula of Central Maghrebi madrasas, mathematics was studied and authored alongside other subjects, unlike the natural sciences, especially medicine, which received less focus. Cities such as Constantine, Tlemcen, and Bejaia became the main centers for the study of mathematical sciences during this period.

It is noteworthy that the city of Tlemcen became a major destination, sought from afar, for its reputation in the sciences of geometry and arithmetic, and for the opportunities it offered in their instruction (Quriyān, 2011, p. 244). A clear illustration of this is provided by Maṣṣūr ibn ‘Alī ibn ‘Abd Allāh al-Zawwāwī al-Bijājī, who, in recounting his journey to Tlemcen, wrote: “Then I directed

my course toward Tlemcen, desiring the sciences of Arabic as well as geometrical and arithmetical knowledge” (Ibn al-Khaṭīb, 1974, p. 428).

In the same vein, al-Qalaṣādī referred to the rational sciences he studied in Tlemcen, explicitly mentioning arithmetic, algebra and al-muqābala, and geometry (al-Qalaṣādī, 1978, pp. 100–101). Ibn Khaldūn also reported that al-Ābilī and Muḥammad ibn al-Najjār studied and taught the Books of the Mathematical Sciences (Kutub al-Ta’ālīm) in Tlemcen (Ibn Khaldūn, Riḥlat Ibn Khaldūn Sharqan wa-Gharban, 2004, p. 59).

Likewise, Béjaïa also played a significant role in the field of the *ta’ālīm* (mathematical sciences) thanks to its teachers of arithmetic. The city was among the earliest centers to embrace the numerical sciences, particularly arithmetic and number theory, through the use of *ghubār* numerals, well before the rise of the 7th/13th century. This tradition continued in the following centuries, making Béjaïa a center of attraction and a destination for students of knowledge not only from across the Maghrib but even from Europe (Sīdī Mūsā, 2001, p. 219).

This was largely due to the methodology of its school of mathematics, shaped in the 7th/13th century by scholars such as Muḥammad b. Muḥammad b. Abī Bakr al-Manṣūr (Quriyān, 1434H/2013, p. 151). A striking example of its influence can be seen in the figure of Leonardo of Pisa (Fibonacci), one of the most brilliant European mathematicians of that era, who is celebrated in European history as a pioneer and towering figure of medieval mathematics (Brunschvig, 1988, p. 387) (Hadvy, 1417H/1996, p. 67).

3. General Factors in the Development of the Mathematical Sciences during the Period

Historical texts show that the growth of mathematical sciences in the Central Maghreb was shaped not only by local scholars but also by the Andalusian elite who settled in cities such as Tlemcen, Béjaïa, and Constantine. These elites brought advanced knowledge in the rational sciences and actively taught and practiced them

(Hājiyāt et al., 1984, p. 437).

From the 6th/12th century onward, Maghribi mathematical texts became more numerous, reflecting Andalusian influence. Abū al-Qāsim al-Qurashī (d. 580H/1184), who taught in Béjaïa, helped train a generation of scholars, including Sa‘īd al-‘Uqbānī, who praised his master’s innovative method for inheritance calculations, avoiding fractions (al-Safī, 2009, p. 169).

Political factors also played a role. During Abū al-Ḥasan al-Marīnī’s campaign in 732 AH / 1332 CE, scholars accompanied the army, spreading knowledge alongside military action. The Tunisian poet al-Raḥawī described them as an “army” of scholars to emphasize their number and influence (Ibn Khaldūn, 2016, p. 282).

“An army of benevolence, justice, and piety—
By God, it was nobler and mightier.”

Ibn Khaldūn himself, as an eyewitness of the campaign upon its arrival in Tunis in 748 AH / 1347 CE, listed in his *al-Ta‘rīf* the names of several of these scholars. Similarly, Ibn Marzūq al-Tilimsānī in his *al-Musnad* (al-Tilimsānī, 2011, pp. 266–269) described these scholars with attributes denoting their intellectual brilliance, particularly in the rational sciences, including mathematics. Among them, for example, were:

- **Abū ‘Abd Allāh Muḥammad al-Ābilī** (d. 757 AH / 1356 CE), referred to as *ustādh al-ta‘ālīmī* (master of the mathematical sciences) (al-Tilimsānī, 2011, p. 266).
- **Abū ‘Abd Allāh Muḥammad ibn al-Ṣabbāgh** (d. 750 AH / 1349 CE) of Miknās, who accompanied Abū al-Ḥasan to Ifriqiya and was described as “distinguished in both the transmitted and rational sciences” (al-Tilimsānī, 2011, p. 268; Ibn Khaldūn, 2004, pp. 57–58).
- **Abū ‘Abd Allāh Muḥammad ibn al-Najjār** (d. 749 AH / 1348 CE), titled *shaykh al-ta‘ālīm* (master of mathematical sciences) (Ibn Khaldūn, 2004, p. 59; al-Tinbukī, n.d., p. 525).
- **Abū ‘Abd Allāh Aḥmad ibn Marzūq**, author of *al-Musnad* (Ibn Khaldūn, 2004, p. 96).

Undoubtedly, the mathematical sciences in the Central Maghreb benefited from both local scholars traveling to major learning centers

in the Islamic West and from scholars who settled in cities like Tlemcen, Constantine, and Béjaïa. Both Maghrebi and Tunisian scholarly traditions helped advance the teaching of these sciences in the region (Kanzi, 2019, p. 82). For example, Abū ‘Abd Allāh al-Sharīf al-Tilimsānī (d. 771 AH / 1370 CE) studied under Ibn ‘Abd al-Salām al-Tūnisī and mastered many rational sciences, including logic, arithmetic, astrology, geometry, music, medicine, anatomy, and agriculture (al-Tilimsānī, 1986, p. 173), becoming a leading authority in the field.

It is evident that the great mathematician Ibn al-Bannā’ al-Marrākushī (d. 721 AH/1321 CE) strongly influenced the mathematical tradition in the Islamic Maghrib. From the early 8th century AH/14th century CE, most teachers and authors in Central Maghrib’s mathematical sciences were graduates of the Marrakesh school. Among them, al-Ābilī contributed to the growth of rational sciences, particularly mathematics, in cities such as Bijāya and Tlemcen (Ibn Khaldūn, *Riḥlat Ibn Khaldūn Sharqan wa-Gharban*, 2004, p. 37). ‘Abd al-Raḥmān Ibn Khaldūn (d. 808 AH/1406 CE) highlighted al-Ābilī’s strong training and teaching in rational sciences (Ibn Khaldūn, 2004, pp. 67, 68, 90, 91, 105). Many scholars benefited from him, including Ibn Khaldūn himself, Abū ‘Abd Allāh al-Sharīf, and Abū ‘Uthmān Sa‘īd al-‘Uqbānī, who further advanced rational and mathematical sciences through teaching and writing.

Most families producing skilled mathematicians in the Central Maghrib, such as Banū Marzūq, Ibn Qunfuḍ, al-‘Uqbānī, and al-Maqqarī, belonged to scholarly lineages. Rulers also supported rational sciences due to their links with legal matters like zakāt and inheritance laws, crucial for social regulation. Consequently, this period saw the rise of several influential scholars in the Central Maghrib, particularly in Tlemcen, the Banū Zayyān capital, including Abū ‘Abd Allāh al-Sharīf, Sa‘īd al-‘Uqbānī, and Aḥmad b. Muḥammad b. Zakarī (d. 899 AH/1494 CE).

4. Contributions of Central Maghrib Scholars to the Development of Mathematical Sciences during the Period

Before examining the main contributions of Central Maghrib scholars to mathematics, it is important to note their level of involvement and the scope of their work. One striking feature is the

uneven distribution of mathematicians across cities. Of the twenty-eight prominent scholars, about eighteen were based in Tlemcen, which became the leading center for mathematics, especially in the 9th century AH/15th century CE. This prominence reflected the decline of other centers such as Tunis, Fez, Marrakesh, and Granada due to political conditions. Constantine had only four recorded mathematicians, and Bijāya six, despite its earlier role as a pioneer in mathematical sciences, suggesting reduced interest there, though teaching persisted in its institutions.

It should be noted that many mathematicians in the Central Maghrib were also jurists specializing in inheritance, property, and land division. This prompted them to seek mathematical knowledge (Yamānī, 2017, p. 144). Primary sources show that their contributions varied between teaching and writing. By the mid-8th century AH/14th century CE, some scholars focused solely on teaching mathematics, without producing written works. Among them, al-Ābilī played a key role in advancing mathematical knowledge and passing it on to his students.

4.1. Scholars of the Central Maghreb and Their Contributions to the Mathematical Sciences

Given the importance of mathematical sciences in daily and social life, and their role in developing correct reasoning, arithmetic—considered the gateway to mathematics and taught early in children’s education—was widely circulated (Ibn Khaldūn, 2016, p. 396). Teachers typically demonstrated arithmetic on tablets or paper (al-Manūnī, 1996, p. 328) and also used mental calculation, or “air calculation,” to solve large sums without writing. This method was useful for merchants, illiterate market-goers, and even educated individuals when writing tools were unavailable (al-Manūnī, 1996, p. 328). Instruction also relied on dialogue, debate, and gradual engagement with problems (Yamānī, 2017, p. 158).

If we attempt to take a closer look at the teaching methods of mathematics in the Central Maghreb, it becomes clear that they were largely based on the preparation of treatises in numerical sciences to be taught to students. Moreover, some mathematicians adopted the method of composing didactic poems (*arjūzāt*) to facilitate the memorization and mastery of arithmetic by versifying it (Filālī, 2002,

p. 471). For instance, ‘Abd al-Wāḥid b. Aḥmad al-Wansharīsī (d. 955 AH/1549 CE) composed a poem on the Summary of Arithmetic Operations, while Ibn Marzūq al-Ḥafīd (d. 842 AH/1438 CE) versified Ibn al-Bannā’s Summary of Arithmetic Operations into a didactic poem (al-Tilimsānī, 1986, p. 211).

Central Maghrebi scholars largely based their teaching on earlier works and those of contemporary scholars from the Islamic West, using them for reading, explanation, and commentary. In his *Muqaddimah* (chapter “Classification of the Sciences”), Ibn Khaldūn mentioned important Maghrebi mathematical works, including *Fiḥ al-ḥisāb* by Ibn Mun‘im al-‘Abdarī (d. 626 AH/1228 CE), *al-Kāmil* by al-Aḥḍab, and *Raf‘ al-ḥijāb* by Ibn al-Bannā’ (Ibn Khaldūn, 2016, p. 396).

The works of Ibn al-Bannā’ al-Marrākushī (d. 721 AH/1329 CE) became central references for teachers and researchers in mathematics. His *Summary of Arithmetic Operations* was highly regarded for covering problems from whole numbers to fractions and roots. It inspired many commentaries and didactic poems, with over thirteen written on it (Kanzī, 2019, p. 88). The most notable was Ibn al-Bannā’s own commentary, *Raf‘ al-ḥijāb ‘an Talḥiṣ A‘māl al-ḥisāb*, which led to his more advanced works in algebra and number theory. This commentary was the last major work in the Maghrebi mathematical tradition to receive wide attention. Ibn Khaldūn praised it, noting:

“Among the finest arithmetic treatises of our time in the Maghreb is the book of al-Ḥaṣṣār al-Ṣaghīr. Ibn al-Bannā’s Summary organizes its principles precisely, explained in his commentary *Raf‘ al-ḥijāb*. This work is challenging for beginners because of its rigorous proofs, but it is magnificent and highly esteemed. Its difficulty lies in explaining the rationale behind operations, which is harder than performing them. Reflect on this.” (Ibn Khaldūn, 2016, p. 396)

Ibn Haydūr also remarked on it, describing it as “a small volume of great benefit” (al-Manūnī, 1996, p. 331). Ibn al-Bannā’ also authored *al-Ḥaṣṣār al-Ṣaghīr*.

Among the works widely studied and valued by mathematicians in the Central Maghreb were those of Ibn al-Yasamin (see note 09). The

most notable is Ibn al-Yasamin's *Urjūza* on Algebra (see note 10), which helped students memorize algebraic methods, define the six types of equations in algebra and *al-muqābala*, present them in order with solutions, and perform calculations with algebraic objects (Qarqūr, 1432/2011, p. 88). Other important works included *Mukhtaṣar al-Jabr* by Ibn Badr al-Ishbīlī, *Mukhtaṣar al-Ḥūfī* on inheritance calculations (*farā'id*) by Aḥmad b. Muḥammad b. Khalaf al-Kalā'ī al-Ishbīlī (d. 588H/1192 CE), and the Tlemcenian poem *Tabṣirat al-Bādī wa-Tadhkirat al-Shādī* by Abū Ishāq Ibrāhīm b. Abī Bakr (d. 697H/1297 CE) (Filālī, 2002, p. 470), praised as unmatched in its field.

These works were complemented by *The Elements* (*al-ʿAnāṣir* or *al-Uṣūl*) by the Greek mathematician Euclid, founder of the Alexandrian School. Euclid compiled the known geometrical knowledge based on the assumption of a flat Earth, which became known as “plane geometry.” He also introduced the axiomatic method, where certain propositions are assumed and others follow logically—for example, that only one line parallel to a given line can pass through a point outside it. This work was translated into Arabic and widely studied by Muslim scholars through teaching and commentary. Among those who taught it in Tlemcen was al-Sharīf al-Tilimsānī (Ṭālibī, 2011, p. 58).

4.2. The Scientific Output of Mathematicians of the Central Maghreb

Mathematicians in the Central Maghreb gained prominence in the second half of the 8th/14th century, mainly through their writings. They enriched the field of mathematics, though much of their work consisted of commentaries or abridgments of earlier or contemporary texts, such as al-Ḥūfī's *Mukhtaṣar* or Ibn al-Yasamin's *Urjūza*. Their writings often relied on the works of Ibn al-Bannā' al-Marrākushī. Among the most notable original contributions of this period are the works of Aḥmad b. Qunfudh al-Qusantīnī (d. 810H/1407 CE).

• **The Works of Aḥmad b. Qunfudh al-Qusantīnī (d. 810H/1407 CE):**

Aḥmad B. Qunfudh Al-Qusantīnī is regarded as one of the most productive mathematicians after Ibn al-Bannā' al-Marrākushī. He authored five purely mathematical treatises, including Ḥaṭṭ al-niqāb 'an wujūh a'māl al-ḥisāb, a commentary on Ibn al-Bannā's Mukhtaṣar al-a'māl al-ḥisābiyya (al-Qusantīnī A., 1976, p. 82). Besides its mathematical content, this work is also an important source for the history of mathematics in the Islamic West.

His Mabādi' al-sālikīn is a commentary on Ibn al-Yasamin's Urjūza on algebra and al-muqābala, in which he introduced mathematical symbols to help students better understand equation solutions (Riziwī, 2015–2016, p. 308).

He also authored Tuhfat al-nāshi'īn fī sharḥ rajaz Ibn al-Yasamin on algebra and al-muqābala, where he incorporated symbols into the Arabic equation system and is considered the first to use zero as a second term in an equation. He employed mathematical terminology distinct from Ibn al-Bannā' al-Marrākushī and used symbolic notation for roots, algebraic equations, and chapter topic lists (al-Qusantīnī A., 1430/2009, p. 194). Additionally, he composed al-Talkhīṣ fī sharḥ al-Talkhīṣ.

• **The Works of Sa'īd B. Muḥammad Al-'Uqbānī Al-Tilimsānī (d. 811H/1418 CE):**

Sa'īd al-'Uqbānī made notable contributions to mathematical sciences, especially in arithmetic and algebra. He wrote a commentary on al-Ḥūfī's work on inheritance (*al-farā'id*), using common fractions to emphasize the role of inheritance law in Islamic jurisprudence. In it, he explained classifications and principles through logical reasoning, mathematical proofs, and computational methods. Al-Sanūsī praised it as extraordinary: "It is an explanation before which the minds of the brightest scholars halt in awe. No one has seen, nor will they ever see, anything like it, before or after—God knows best." Ibn Farḥūn similarly remarked: "Among his writings is a commentary on al-Ḥūfī's work on inheritance, upon which no equal has ever been written" (Farḥūn, n.d., p. 394).

Another of his important mathematical contributions is his *Sharḥ Urjūzat Ibn al-Yāsamīn fī al-jabr wa al-muqābala*, which stands out as one of his most significant achievements. In this work, he transcended the confines of inheritance law and engaged with pure mathematics, simplifying and explaining algebraic concepts in his own distinct style (Yamānī, 2017, p. 148).

Equally significant is al-‘Uqbānī’s commentary on Ibn al-Bannā’s *Talkhīṣ A‘māl al-ḥisāb* (al-Tilimsānī, 1986, p. 106). Beyond mathematics, it is a valuable source for the history of mathematics in the Central Maghreb, especially during the Zayyanid period. Al-‘Uqbānī’s work stands out for its systematic use of mathematical proofs to resolve doubts and verify propositions, relationships, and computational methods. For instance, he applied proof by induction in the chapter on addition, proof by contradiction in the chapter on division (for factorizing numbers into primes), and, though less frequently, geometrical proofs with references to Euclid’s propositions (Qarqūr, 1432/2011, pp. 87–88).

Al-‘Uqbānī’s book is divided into two main parts. The first part, *On the Known Number*, has fourteen chapters. The opening chapter presents algorithms for operations on natural numbers—addition, subtraction, multiplication, division, *jabr* (completion), and *ḥaṭṭ* (reduction). The second chapter applies these operations to fractions after defining them, and the third chapter explains extracting roots of natural numbers, whether perfect squares or not, before addressing operations with irrational numbers (surds).

The second part has two chapters. The first covers proportion and its use in the double false position method (*ṭarīqat al-khaṭa‘ayn*) for solving first-degree equations. The second chapter, algebraic in nature, introduces basic algorithms in algebra (Rafāf, 2006–2007).

• Works of Abū al-Ḥasan al-Qalaṣādī (d. 891/1486)

Settling in Tlemcen and studying under its scholars, al-Qalaṣādī became the last major authority in arithmetic and inheritance law (*ḥisāb* and *farā’id*). He authored many works in mathematics, including *Tuhfat al-Nāshī’in ‘alā Urjūzat Ibn al-Yāsamīn* on algebra and *muqābala*; *al-Qānūn fī al-Ḥisāb* and its commentary *Inkishāf al-*

Hijāb ‘an Qānūn al-Ḥisāb, covering number theory, arithmetic operations, roots, and solving unknowns.

He also wrote *Kashf al-Asrār* ‘an ‘Ilm Ḥurūf al-Ghubār, a concise 36-folio guide in arithmetic and algebra for beginners, as well as *Kashf al-Jilbāb* ‘an ‘Ilm al-Ḥisāb, *Ghuniyat Dhawī al-Albāb fī Sharḥ Kashf al-Jilbāb*, *Risāla fī Ma‘ānī al-Kasr wa-l-Baṣṭ*, and a commentary on al-Ḥūfī’s inheritance treatise, later used by Muḥammad al-Sanūsī. Other works include *Kitāb al-Ghunya fī al-Farā’id*, *Kulliyyāt al-Farā’id wa-Sharḥuhā*, *al-Ḍarūrī fī ‘Ilm al-Mawārīth*, and *al-Mustawfī li-Masā’il al-Ḥūfī* (al-Qalaṣādī, 1978, p. 33).

Works of A polymath, described by Ibn al-Qāḍī as “a rationalist, an expert in inheritance, and a skilled mathematician” (Ibn al-Qāḍī, 1971, p. 141), al-Sanūsī authored several important works. His major commentary on al-Ḥūfī’s treatise, *al-Muqarrib al-Mustawfā*, was his earliest and most extensive work, written to aid understanding of al-Ḥūfī’s *farā’id* manual and incorporating the teachings of his teachers, especially al-‘Uqbānī. He also wrote a commentary on Ibn al-Yāsamīn’s *Muqaddimāt fī al-Jabr wa-l-Muqābala*, as well as *Sharḥ Ikhtisār Ri‘āyat al-Muḥāsibī*.

- **Muḥammad b. Yūsuf al-Sanūsī (d. 895/1494)**
- **Works of Aḥmad b. Muḥammad b. ‘Abd al-Raḥmān Ibn Zāghū al-Tilimsānī (d. 845/1442)**

Ibn Zāghū wrote a commentary on al-Tilimsāniyya in inheritance law (al-Tilimsānī, 1986, p. 42). His student, al-Qalaṣādī, also mentioned another of his works in this field, *Muntahā al-Tawḍīḥ fī ‘Amal al-Farā’id min al-Wāḥid al-Ṣaḥīḥ* (al-Qalaṣādī, 1978, pp. 102–103).

5. Conclusion

In conclusion, mathematics received considerable attention in both teaching and writing in the Central Maghreb during the 8th–9th centuries AH / 14th–15th centuries CE, unlike the natural sciences, particularly medicine. Its importance lay in sharpening the intellect and promoting a clear scientific methodology. Consequently, urban centers, such as Constantine, Béjaïa, and Tlemcen became leading

hubs for mathematical studies, while Fez and Tunis declined due to political instability and Spanish and Portuguese incursions.

Central Maghrebi scholars played a major role in teaching and authorship. Notable figures include Abū ‘Abd Allāh al-Ābilī, Abū ‘Abd Allāh Muḥammad b. Aḥmad b. al-Najjār al-Tlemcenī, Abū ‘Abd Allāh al-Sharīf, and Abū ‘Uthmān Sa‘īd al-‘Uqbānī. Key texts such as Ibn al-Bannā’'s works, Ibn al-Yāsāmīn's *Urjūza fī al-Jabr wa-l-Muqābala*, and al-Ḥūfī's *Mukhtaṣar fī al-Farā‘id* were widely studied, commented upon, and transmitted, forming the foundation of mathematical education.

The contributions of scholars like Abū ‘Uthmān Sa‘īd al-‘Uqbānī and Ibn Qunfuḍ al-Qusanṭīnī in writing and teaching strengthened the field and ensured the continuity of intellectual activity. Their works circulated widely, preserving and sharing mathematical knowledge across the Islamic West, even in times of political unrest.

Notes:

Note 1: Mathematical sciences (‘ulūm riyādiyya) derive their name from "riyāda" (exercise, discipline), since they train the mind to grasp abstract concepts. They are also called "al-ta‘ālīm" (the demonstrative sciences) and comprise four fields: geometry (forms and measurement), arithmetic (calculation, algebra, equations, transactions, inheritance laws), music (relations of sounds and melodies), and astronomy (motions of planets and stars) (Ibn Khaldūn, Muqaddimah, 2016, pp. 392–399; Zādah, 1988, pp. 179–180).

Note 2: Arithmetic is the practical science of manipulating numbers by addition and subtraction. Addition may be by simple combination (sum) or by multiplying one number by the units of another (multiplication). Subtraction removes a number from another, while division distributes a number into equal parts, whether in whole numbers or fractions (Ibn Khaldūn, Muqaddimah, 2016, p. 395).

Note 3: Algebra is the art of deriving an unknown number from known ones, based on proportional relations. It rests on three foundations: number, root, and "māl" (square or power) (Ibn Khaldūn, Muqaddimah, 2016, p. 396).

Note 4: Transactions (mu'āmalāt) are the application of arithmetic to civic dealings such as trade, land measurement, taxation, and other cases involving known and unknown numbers, fractions, and roots (Ibn Khaldūn, *Muqaddimah*, 2016, p. 397).

Note 5: Inheritance law (farā'id) is a mathematical science concerned with correcting inheritance shares for multiple heirs, ensuring proportions of wealth correspond accurately to legal shares (Ibn Khaldūn, *Muqaddimah*, 2016, p. 397).

Note 6: Geometry studies shapes and continuous magnitudes formed by intersecting lines and their proportions (Ibn Khaldūn, *Muqaddimah*, 2016, p. 398; Zādah, 1988, p. 180).

Note 7: According to Benaṣṣar al-Ba'zātī, the decline of scientific activity in North Africa was due to the plague of 749–750 H/1348–1349 CE, the sinking of the fleet in the mid-8th/14th century which claimed the lives of many scholars, along with political conflicts. These factors weakened intellectual pursuit, spread fear of debate, and diminished interest in refined sciences and arts (al-Ba'zātī, 2007, p. 156).

Note 8: Ibn al-Yāsamīn (d. 601 H/1203 CE), full name Abū Muḥammad 'Abd Allāh b. Muḥammad b. Ḥajjāj al-Adrīnī of Fez, was famous for his mathematical writings: *Urjūza fī al-kifāt*, *Urjūza fī al-jabr*, *Urjūza fī a'māl al-judhūr*, *Talqīḥ al-afkār fī al-'amal bi-rushūm al-ghubār*. He also wrote in literature and poetry, and died in Marrakesh in 601 H/1204 CE (Ibn al-Qāḍī, 1973, p. 423).

Note 9: His works were explained by al-Qalaṣādī, al-'Uqbānī, and Muḥammad b. Yūsuf al-Sanūsī (al-Tilimsānī, 1986, pp. 106, 142–143, 246).

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