

3. Kitb f usul hisb al-hind and its Hebrew translation.

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variants used for his name were Djabah [5], Halebi [6], or al-Kiya [7]. He evidently came from a place called Jili (Djilan), a village on the south of the Caspian Sea.

It has been stated that ibn Labbān was a Jew but there is no evidence for this [8]. He was the teacher of al-Nasawī (ca. 1030) who also wrote on mathematics [9]. Unfortunately, almost nothing has come down to us of ibn Labbān's biography. However, some of his mathematical works are extant as well as others in astrology and astronomy.

2. EXTANT WORKS OF IBN LABBĀN.

The following works of ibn Labbān are known [10]:

1. al-ziğ al-jami'.
2. kitāb al-mudkhal fī šinā 'at aḥkām al-nujūm;
3. kitāb al-ašturlab wakaifiyat 'amalihi wa'tibārihi 'ala't-tamām wal-kamāl;
4. risalāt al-ab'ād wal-ajrām;
5. tağrīd uşūl tarkīb al-juyūb;
6. kitāb fī uşūl ḥisāb al-hind.

The last one is the subject of this work and will be described at length in the next section.

3. KITĀB FĪ UŞUL ḤISĀB AL-HIND AND ITS HEBREW TRANSLATION.

This treatise, "Book on the Foundations of Hindu Reckoning", is extant in Arabic in only one manuscript [11]. There is also a Hebrew commentary [12], *Iyyūn hā 'iqqārim*. The latter is treated in this study.

The Hebrew version gives not only much translation from the Arabic but also gives a very full explanation as well as a commentary upon the fundamental operations as given by ibn Labbān.

The Hebrew text is the work of Shālôm ben Joseph 'Anābī who lived in Constantinople. He completed this commentary sometime between 1450 and 1460. Other of his works extant

are on the syllogism, the foundations of the Torah, and a commentary on the *Physics* of Aristotle [13].

The Arabic text is divided into two major books: the first is concerned with the fundamental operations using the decimal system while the other takes up the pure sexagesimal reckoning.

The Hebrew manuscript comprises the following twelve chapters: 1. numerals, 2. addition, 3. subtraction, 4. multiplication, 5. addition of the multiplication, 6. division, 7. remainder in division, 8. square root, 9. what comes from the root, 10. cube root, 11. what comes from the cube root, 12. checking by casting out nines. The first eight chapters are analogous to the first eight of the first book in the Arabic [14]. The twelfth Hebrew chapter is in the ninth and tenth (the last) sections of the first Arabic book. The subject of the tenth chapter of the Hebrew is found in the sixteenth section of the Arabic, book II. In most of the appropriate Hebrew chapters, an appendix discusses operations with the sexagesimal system. In this way, an attempt was made to cover the two books of ibn Labbān [15]. It is evident, therefore, that the integral sexagesimal system was in use by some people at this time.

The appreciation of the integral decimal system in the history of reckoning encountered quicker acceptance than has generally been supposed. This is seen in the reckoning treatise of al-Nasawī, the pupil of ibn Labbān. From the two extant texts of ibn Labbān's arithmetic, it is obvious that the author had written them in such an abbreviated style that it was difficult to understand when studied alone. Al-Nasawī's [16] text is essentially an elaboration of that of his teacher; it is very clear and practical and may be used without oral teaching.

4. IBN LABBĀN'S ARITHMETIC IN BRIEF.

a) *Addition* (Chap. 2).

Ex. 5627

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The two amounts are written, like order to like, one above the other. Addition is begun on the left instead of on the right