

Bhāskara II | Encyclopedia.com

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(b. 1115)

astronomy, mathematics.

Bhāskara II has been one of the most impressive Indian astronomers and mathematicians, not only to modern students of the history of science but also to his, contemporaries and immediate successors. An important inscription discovered at Pātnā, near Chalisgaon in East Khandesh, Mahārāstra, by Bhāu Dājī, and reedited by F. Kielhorn (*Epigraphia Indica*, 1 [1892], 338–346), records the endowment, by Soīdeva the Nikumbha, on 9 August 1207, of an educational institution (*matha*) for the study of Bhāskara's works, beginning with the *Siddhāntaśiromaṇi*. There is further reference in this inscription to Soīdeva's brother and successor, Hemādideva, who was a feudatory of the Yādava king of Devagiri, Siṅghana, whose rule began in 1209/1210. The following genealogy is given in the inscription.

Trivikrama belonged to the Śāndilya *gotra*—which indicates that he and his descendants were Brāhmanas. His son was Bhāskarabhatta, who was given the title of Vidyāpati by Bhojarāja (the Paramāra king of Dhārā from ca. 995 to ca. 1056). The next four generations were respectively Govinda, Prabhākara, Manoratha, and Maheśvara; the last was the father of Bhāskara II. Bhāskara's son, Laksmīdhara, was made chief of the Panditas by Siṅghana's predecessor, Jaitrapāla (1191–1209); and Laksmīdhara's son, Caṅgadeva, was the chief astrologer to Singhana himself. It is confirmed in Bhāskara's works—e.g., in the concluding verses of the *Siddhāntaśiromaṇi*—that his father was Maheśvara of the Śāndilya *gotra*; it is further added that he came from the city Vijjadavida (Bijāpur in Mysore), which was probably named after the Kalacūri king Vijjala II (1156–1175). If this identification is correct—since the *Siddhāntaśiromaṇi* was written in 1150—Bhaskara II must have been in Vijjala's capital while the latter was still *dandanāyaka* of the Cālukya kings, Jagadekamalla II (1138–1150) and Taila III (1150–1156). We further know from Trivikrama's *Damayantikathā* that he was the son of Nemāditya (Devāditya?) and the grandson of Śrīdhara; and there exists a popular astrological work by Maheśvara, Bhāskara II's father, entitled *Vrtaśataka*

Bhāskara II is the author of at least six works, and possibly of a seventh as well:

1. *Līlavatī* (see Essay XII).
2. *Bījaganita* (see Essay XII).
3. *Siddhāntaśiromaṇi* (see Essay IV).
4. *Vāsanābhaṣya* on the *Siddhāntaśiromaṇi* (see Essay IV).
5. *Karaṇakutūhala* (see Essay IV).
6. *Vivarana* on the *Śisyadhīvraddhidatantra* of Lalla (see Essay V).
7. *Bījopanaya* (see Essay IV).

The *Līlavatī* and the *Bījaganita* are sometimes taken to be parts of the *Siddhāntaśiromaṇi*; the ascription of the *Bījopanaya* to Bhāskara II is questionable.

1. The *Līlavatī* is a work on mathematics addressed by Bhaskara II to a lady (his daughter or wife?) named Līlavatī. It contains thirteen chapters:

1. Definitions of terms.
2. Arithmetical operations.
3. Miscellaneous rules.
4. Interest and the like.
5. Arithmetical and geometrical progressions.
6. Plane geometry.

7–10 Solid geometry.

11. On the shadow of a gnomon.

12. Algebra: the pulverizer (*kuṭṭaka*). This is the same as chapter 5 of the *Bījaganita*

13. Combinations of digits.

The *Līlāvātī* has been commented on many times:

1. *Karmapradīpikā* of Nārāyaṇa (fl. 1356).
2. *Vyākhyā* of Paraśurāma Misra (1356).
3. *Vyākhyā* of Parameśvara (fl. 1400–1450).
4. *Ganītāmrtasāgarī* of Gangādhara (ca. 1420).
5. *Vyākhyā* of Laksmīdāsa (fl. 1501).
6. *Ganītāmrtakūpikā* of Sūryadāsa (1541). See K. Madhava Krishna Sarma, *Siddha-Bhārātī*, part 2 (Hoshiarpur, 1950), 222–225.
7. Buddhivillāsini of Ganeśa (1545). Published. See below, Sanskrit text of the *Līlāvātī* no. 14.
8. *Kriyākramakarī* of Śāṅkara (fl. 1556).
9. Vivarana of Mahīdhara, alias Mahīdāsa (1587). Published. See below, Sanskrit text of the *Līlāvātī* no. 14.
10. *Mitabhāsinī* of Raṅganātha (1630).
11. *Nisrstārthadūtī* of Munīśvara, alias Viśvarūpa (1635).
12. *Ganītāmrialalharī* of Rāmākrsna (1687). See P. K. Gode, “Date of Ganitārtalahaś of Rāmākrsna:’ in *Annals Of the Bhandarkar Oriental Research Institute*, **11** (1930), 94–95
13. *Sarvabodhinī* of Śrīdhara (1717).
14. *Udāharana* of Nīlāmbara Jhā (fl. 1823).
15. *Ṭīkā* in Kannada of Alasīṅgārya, alias Alīśīṅgarāia
16. *Vyākhyā* of Bhaveśa.
17. *Udāharano* of Candraśekhara Patanāyaka.
18. *Ṭīkā of Dāmodara(?)*.
19. *Vilāsa of Devīśahāya*
20. *Bhūsana of Dhaneśvara*. Refers to Sūryadāsa (1541).
21. *Ṭīkā* (in vernacular) of Giridhara.
22. *Vyākhyā* of Keśava.
23. *Ṭippana* of Mukunda.
24. *Vṛtti* of Mosadeva.
25. *Subodhinī* of Rāghava.
26. *Ganakabhūsana* of Rāmacandra, son of Śoṣaṇabhaṭṭa.
27. *Kautukalīlāvātī* of Rāmacandra, son of Vidyādhara.
28. *Ṭippana of Rāmadatta (?)*.
29. *Manoraṅjana of Rāmākrsnadeva*.
30. *Ṭīkā of Rāmeśvara*.
31. *Ṭīkā of Śrīkantha*.
32. *Ganītāmrtavanī of Sūryamani*.
33. *Udāharana of Vīreśvara*. Refers to Laksmīdāsa (1501).
34. *Udāharana of Vīveśvara*.
35. *Ṭīkā of Vrndaṅvana (?)*.

In addition to these and a number of anonymous commentaries, there are others in Marāṭhī and Gujārātī. A modern Sanskrit commentary (aside from those which accompany some of the editions listed below) was published by candra Śekhara Jhā under the title *Vyaktavilāsa* (Benares, 1924).

There are also numerous editions of the Sanskrit text of the *Līlāvātī*

1. Calcutta, 1832.
2. Tārānātha Śarman, ed. (Calcutta, 1846).
3. Baptist Mission Press (Calcutta, 1846; 2nd ed., Calcutta, 1876).
4. With the *Vivaraṇa* of Mahīdhara and a Telugu commentary by Tadakamalla Venkata Kṛṣṇarāva, Vāvilla Rāmasvāmin Śāstrin, ed. (Madras, 1863).
5. Jīvananda Vidyāsāgara, ed. (Calcutta, 1816).
6. Sudhākara Dvivedin, ed. (Benares, 1878).
7. Edited, with his own Sanskrit commentary, by Bāpūdeva Śāstrin (Benares, 1883).
8. Bhuvanacandra Basak, ed. (Calcutta, 1885).
9. Edited as an appendix to Banerji’s edition of Colebrooke’s translation (Calcutta, 1892; 2nd ed., Calcutta, 1927).
10. Edited, with a Marāṭhī commentary, by Vināyaka Pānduraga Khānāpūrkar (Poona, 1897).
11. Sudhākara Dvivedin, ed., Benares Sanskrit Series, no. 153 (Benares, 1912).
12. Rādāvallnbha, ed. (Calcutta, 1914)
13. Edited, with his own Sanskrit commentary, by Muralīdhara Thākura, as Śrī Harikrsna Nibandha Manimālā Series, no. 3 (Benares, 1928; 2nd ed., Benares. 1938).
14. With *Buddhivilāsini* of Ganeśa and Vivarana of Mahīdhara, Daāitreyā Āpte, ed., Ānandāśrama Sanskrit Series, no. 107, 2 vols. (Poona, 1937).
15. With Sanskrit commentary, edited by Dāmodara Miśra and Payānatha Jhā, as PrācīnācaryaGranthāvalā Series, no. 8 (Durbhanga, 1959).
16. With Sanskrit and Hindī commentaries of Lasana Lāla Jhā edited by Śuresa Śarman, as Vidyābhavana SamaskṛtaGranthamālā Series no 62 (Benares, 1961).

There are also many translations of the *Līlāvātī*. A Kannada version is supposed to have been made by Bhāskara II's contemporary Rājāditya, who flourished, apparently, under the Hoysala king Visnuvardhana (111–1141). There also exists a Hindī translation, and the various commentaries in Gujarātī, Marāthī, and Telugu have already been referred to. Three Persian translations are known. That made by Abū al-Fayd Faydī at the request of Akbar in 1587 was published at Calcutta in 1827; another was done by Dharma Narāyan ibn KalyānmalKāyath ca. 1663 (H. J. J. Winter and A. Mirza, in *Journal of the Asiatic Society of Science*, **18** [1952], 1–10); and the third was made in 1678 by Muhammad Amīn ibn Shaykh Muhammad Sa'īd. There are also two English translations. That by J. Taylor was published at Bombay in 1816, and that by H. T. Colebrooke in his *Algebra, With Arithmetic and Mensuration: From the Sanscrit of Brahmagupta and Bhāscara* (London, 1817). The latter was republished by Haran Chandra Banerji as *Colebrooke's Translation of the Līlāvātī* (Calcutta, 1892; 2nd ed., Calcutta, 1927).

2 The *Bījagnita*, on algebra, contains twelve chapters:

1. On positive and negative numbers.
2. On zero.
3. On the unknown.
4. On surds.
5. On the pulverizer (*kuṭṭaka*)
6. On indeterminate quadratic equations.
7. On simple equations.
8. On quadratic equations.
9. On equations having more than one unknown.
10. On quadratic equations having more than one unknown.
11. On operations with products of several unknowns.
12. On the author and his work.

The commentaries on the *Bījaganita* are all relatively late, and they are far fewer in number than those on the *Līlāvātī*

1. *Sūryaprakāśa of Sūryadāsa* (1538). See K. Madhava Krishna Sarma, in *Poona Orientalist*, 11 (1946), 54–66, and his article in *Siddha-Bhārati*, part 2 (Hoshiarpur, 1950), 222–225.
2. *Navānūra* (or *Bījapallava*, or *Bījāvataṃsa*, or *Kalpalatāvarāra*) of Kṛṣṇa (1602). See M. M. Patkar, in *Poona Orientalist*, **3** (1938), 169. Published. See below, Sanskrit texts nos. 13 and 16.
3. *Bījaprabodha of Rāmākṛṣṇa* (1687). See P. K. Gode in *Annals of the Bhandarkar Oriental Research Institute*, **10** (1919), 160–161, and **11** (1930), 94–95.
4. *Bālabodhinī* of K'rpārāma (1792).
5. *Vāsanābhaṣya* of Haridāsa.
6. *Bījāvala* of Nijānanda.
7. *Kalpalatā of Paramaśukla* (most likely Kṛṣṇa's work?).
8. *Bījāvivarana* of Vīresvara (?).

The Sanskrit text has been frequently published:

1. Calcutta, 1834; rev ed., Calcutta, 1834.
2. Calcutta, 1846.
3. Partial edition with a German translation by H. Brockhaus, "Über die Algebra des Bhāskara," in *Berichte über die verhandlungen der Königlich Sächsischen Gesellschaft der Wissenschaften Zu Leipzig, Philosophisch-historische Klasse*, **4** (Leipzig, 1852), 1–46.
4. Calcutta, 1853.
5. Gopinātha Pāthka, ed. (Benares 1864).
6. Bāpūdeva Sāstrin, ed., 2 parts (Calcutta [?], 1875)
7. Jīvinanda Vidyāsāgara, ed. (Calcutta, 1878).
8. Edited, with his own Sanskrit commentary, by Jīvānītha Śarman (Benares, 1885).
9. Edited, with his own Sanskrit Commentary, by Sudhākara Dvivedin (Benares, 1888).
10. Edited, with a Marāthī translation and commentary, by Vināyaka Pānduranga Khānāpūrkar (Poona, 1913)
11. Edited, with his own Sanskrit commentary, by Rādhāvallabha (Calcutta, 1917).
12. Edited, with Sudhākara Dvivedin's Sanskrit commentary and one of his own, by Muralīdhara Jhā, as *Benares Sanskrit Series*, no. 154 (Benares, 1927).
13. Edited with the *Navānkura* of Kṛṣṇa, by Dattāhṛeya Āpte, as *Anandānśma Sanskrit Series*, no. 99 (Poona, 1930).
14. Edited, with his own Sanskrit and Hindī commentaries, by Durgāprasāda Dvivedin (3rd. ed., Lakṣmaṇapura, 1941; the preface is dated Jayapura, 1916).
15. Edited, with Jīvanātha Śarman's Sanskrit commentary and with his own in Sanskrit and Hindī by Acyurānanda Jhā, as *Kāśī Sanskrit Series*, no. 148, (Benares, 1949).
16. Edited, with the *Bījapallava* of Kṛṣṇa, by T. V. Rādhākṛṣṇa Sāstriri, as *Tanjore Sarasvati Mahal Series*, no. 78 (Tanjore, 1958).

There are two Persian translations of the Bījaganita, one anonymous and the other by ‘Atā allāh Rashīdībn A’ḥmad Nādir for [Shah Jahan](#) in 1634/1635. An English translation of the latter by E. Strachey, with notes by S. Davis, was published at London in 1813. It was also translated into English directly from the Sanskrit by H. T. Colebrooke in Algebra, *With Arithmetic and Mensuration*... (London, 1817).

3. The *Siddhāntaśiromaṇi*, which was written in 1150, consists of two parts—the Grahaganitādhyāya (or Gaitādhyāya) and the Golādhyāya—which are sometimes preserved singly in the manuscripts. The first part, on mathematical astronomy, contains twelve chapters:

1. On the mean longitudes of the planets.
2. On the true longitudes of the planets.
3. On the three problems involving diurnal motion.
4. On the syzygies.
5. On lunar eclipses.
6. On solar eclipses.
7. On planetary latitudes.
8. On the heliacal risings and settings of the planets.
9. On the lunar crescent.
10. On planetary conjunctions.
11. On conjunctions of the planets with the stars.
12. On the *pātas* of the sun and moon.

The second part, on the sphere, contains thirteen chapters:

1. Praise of (the study of) the sphere.
2. On the nature of the sphere.
3. On cosmography and geography.
4. Principles of planetary mean motion.
5. On the eccentric-epicyclic model of the planets.
6. On the construction of an armillary sphere.
7. Principles of spherical trigonometry.
8. Principles of eclipse calculations.
9. Principles of the calculation of the first and last visibilities of the planets.
10. Principles of the calculation of the lunar crescent.
11. On astronomical instruments.
12. Descriptions of the seasons.
13. On problems of astronomical computations.

The chapter on the sine function is placed differently in different editions. The *Golādhyāya*, then, is to a large extent an expansion and explanation of the *Ganitādhyāya*.

The following commentaries on the *Siddhāntaśiromaṇi* are known (besides various anonymous ones):

1. *Mitākṣarā* (or *Vāsanābhāya*) of Bhāskara II himself (see 4, below). Published. See below, under Sanskrit texts.
2. *Ganitattvacintāmaṇi* of Lakṣmīdāsa (1501).
3. *Śiromaniprakāśa* of Gaṇeśa (b. 1507). Published in part. See below. Sanskrit text of *Grahaganitādhyāya*, no. 4.
4. *Marīci* of Munīśvara, alias Viśvarūpa (b. 1603). Published. See below, under Sanskrit texts.
5. *Tīkā* of Rāmakṛṣṇa (fl. 1687).
6. *Tīkā* of Cakracūdāmaṇi (?).
7. *Vyākhyā* of Dhaneśvara.
8. *Vyākhyā* of Harihara (?).
9. *Tīkā* of Jayalakṣmaṇa (?).
10. *Lakṣmīnāthī* of Lakṣmīnātha Miśra (?).
11. *Bhāṣya* of Maheśvara (?).
12. *Vāsanā* of Mohanadāsa (?).
13. *Vyākhyā* of Raṅganātha.
14. *Tīkā* of Vācaspati Miśra (?).

The *Tippantvivarana* of Buddhinaṭha Jhā was published at Benares in 1912.

The list of editions of the text is arranged under three headings: *Siddhāntaśiromaṇi*, *Grahaganitādhyāya*, and *Golādhyāya*.

Siddhāntaśiromaṇi.

1. *Siddhāntaśiromaniprakāśa* (of Gaṇeśa?), with a Marāṭhī translation (Bombay, 1837).

2. *Siddhāntaśiromani*, with the Prakāśa (of Gaṇeśa?), Rāmacandra, ed. (Madras, 1837).
3. Edited, with the *Vāsanābhāṣya*, by Bāpūdeva Śāstrin (Benares, 1866); revised by Candradeva (Benares, 1891); revised by Gaṇapatideva Śāstrin, as Kāsā Sanskrit Series, no. 72 (Benares, 1929).
4. Edited with the *Vāsanābhāṣya*, the *Vāsanāvārttika* of Nrsimha, and the *Marīci* of Munīśvara, by Muralīdhara Jhā, in The Pandit, n.s. **30–38** (1905–1916)—incomplete; the first chapter of the *Grahaganitādhyāya* was reprinted at Benares in 1917.
5. Edited, with a Sanskrit commentary, by Girijāprasāda Dvivedin (Ahmadabad, 1936).

Grahaganitādhyāya.

1. Edited, with the *Mitāksarā*, by L. Wilkinson (Calcutta, 1842).
2. Edited, with the *Mitāksarā* by Jivānanda Vidyāsāgara (Calcutta, 1881).
3. Edited, with a Marāthī translation and commentary, by Vināyaka Pānduraṅga Khānāpūrkar (Poona, 1913).
4. Edited, with the *Vāsanābhāṣya* and the *Śiromaniprkāśa* of Gaṇeśa, by Dattātreya Āpte, as Ānandāśrama Sanskrit Series, no. 110, 2 vols, (Poona, 1939–1941).
5. Edited, with the *Vāsanābhāṣya* and his own Sanskrit commentary, by Muralīdhara Thakkura, as Kāśī Sanskrit Series, no. 149 (Benares, 1950)—the first two chapters only.
6. Edited, with the *Vāsanābhāṣya*, the *Marīci of Munīśvara*, and his own Sanskrit and Hindi commentaries, by Kedāradatta Joṣī, 3 vols. (Benares, 1961–1964); this edition does not include the *Marīci* on chapter 1.

Golādhyāya.

1. Edited, with the *Mitāksarā*, by L. Wilkinson (Calcutta, 1842).
2. Calcutta, 1856.
3. Edited, with the *Vāsanābhāṣya*, by Jivānanda Vidyāsāgara (Calcutta, 1880).
4. Edited, with the *Vāsanābhāṣya* and a Bengali translation, by Rasikamohana Chattopādhyāya (Calcutta, 1887).
5. Edited, with the *Vāsanābhāṣya* and a Bengali translation, in *Arunodaya*, **1** (1890), part 6.
6. Edited, with a Marāthī translation and commentary, by Vināyaka Pānduraṅga Khānāpūrkar (Bombay, 1911)—chapters 1–8 only.
7. Edited, with the *Vāsanābhāṣya* and a Hindī commentary, by Girijāprasāda Dvivedin (Lucknow, 1911).
8. Edited, with the *Vāsanābhāṣya* and a Bengali translation, by Rādhāvallabha (Calcutta, 1921).
9. Edited, with the *Vāsanābhāṣya* and the *Marīci* of Munīśvara, by Dattātreya Āple, as Ānandāśrama Sanskrit Series, no. 122, 2 vols. (Poona, 1943–1952).

Aside from the translations into the vernacular mentioned above, I know only of the following two: a Latin translation of the *Grahaganitādhyāya* published by E. Roer in *Journal of the Royal Asiatic Society of Bengal*, **13** (1844), 53–66, and an English translation of the *Golādhyāya* L. Wilkinson, revised by Bāpūdeva Śāstrin, as Bibliotheca Indica, no. 32 (Calcutta, 1861), with the Pandit’s translation of the *Sūryasiddhānta*. See also L. Wilkinson, “On the Use of the Siddhāntas in the Work of Native Education,” in *Journal of the Royal Asiatic Society of Bengal*, **3** (1834), 504–519.

4. The *Vāsanābhāṣya* or *Mitāksarā* is Bhāṣkara II’s own commentary on the *Siddhāntaśiromani*. A commentary on it, the *Vāsanāvārttika*, was written by Nrsimha of Golagrāma in 1621. Editions of both these works have been listed in the preceding material on the *Siddhāntaśiromani*.

5. The *Karanakutūhala*, which is also known as the *Brahmatuḷya*, the *Grahāgamakutūhala*, and the *Vidagdhabuddhivallabha*, was written in 1183; it gives simpler rules for solving astronomical problems than does the *Siddhāntaśiromani*. There are ten sections:

1. On the mean longitudes of the planets.
2. On the true longitudes of the planets
3. On the three problems involving diurnal motion.
4. On lunar eclipses.
5. On solar eclipses.
6. On heliacal risings and settings,
7. On the lunar crescent.
8. On planetary conjunctions.
9. On the *pātas* of the sun and moon.
10. On the syzygies.

There are, aside from the usual quantity of anonymous commentaries on the *Karanakutūhala*, eight whose authors’ names are known:

1. *Bhāṣya* of Ekanātha (ca. 1370).
2. *Nārmadī* of Padmanābha (ca. 1575).
3. *Udāhana* of Viśvanātha (1612).

4. *Ganakakumudakaumudī* of Sumatiharṣa Gaṇi (1622). Published. See below.
5. *Tīkā* of Caṇḍīdāsa.
6. *Brahmatulyasāra* of Keśavārka (?).
7. *Tīkā* of Saṅkara.
8. *Tīkā* of Sodhala.

For a set of tables based on the *Karaṇakutūhala*, see David Pingree, “Sanskrit Astronomical Tables in the [United States](#),” in *Transactions of the American Philosophical Society*, n.s. **58**, no. 3 (1968), 36–37.

The *Karanakutūhala* has twice been edited: by Sudhākara Dvivedin, with his own Sanskrit commentary (Benares, 1881); and, with the *Ganakakumudakaumudī* of Sumatiharṣa Gaṇi, by Mādhava Sāstri Purohita (Bombay, 1902).

6. Bhāskara II’s *Vivaraṇa* on the *Śiṣyadhśvṛddhidatantra* of Lalla has not been studied or published. There are three manuscripts: in Benares, in Bikaner, and in Ujjain.

7. A short text of fifty-nine verses entitled *Bṛjīopanaya* is attributed to Bhāskara II, The author claims to be that scholar and to have written this work in 1151. A *Tithinirṇayadārikā*; published with it is the only other Sanskrit work to mention it; the author of this text claims to be Śrīnivāsa Yajvan, who flourished in Mysore in the second half of the thirteenth century and wrote a *Śuddhīdśpikā* and a commentary on the *Karanaprakāśa* of Brahmadeva. Both works, despite their acceptance by Mukhopadhyaya and sengupta, are evidently late forgeries.

Kuppanna Sastri has shown that the *Bṛjīopanaya*, which gives rules for computing a correction to the moon’s equation of the center and variation, was most probably forged in south India in the early 1810’s to buttress the position of the partisans of the *drk* system against those of the *Vākya* system. His argument is based on three main points:

- (1) The first correction is astronomically invalid and would have appeared so to the author of the *Siddhāntaśiromanī*.
- (2) The style is completely at variance with Bhāskara’s normal method of exposition.
- (3) There are oblique references in the *Vāsanābhāṣya*, a commentary accompanying the *Bṛjīopanaya*, which is also alleged to be by Bhāskara II, to Raṅganātha’s commentary on the *Sūryasiddhānta*, which was written in 1602 and was published in 1859.

These arguments seem to this writer quite convincing.

The *Bṛjīopanaya* has been published twice: by Cintāmaṇi Raghunāthācārya and Taḍhakamalla Venkaṭakṛṣṇa Rāya at Madras in 1876; and by Ekendranāth Ghosh at Lahore in 1926.

BIBLIOGRAPHY

The following bibliography generally excludes articles that deal only in part with Bhāskara II. It is divided into five sections: General, *Līlāvātī*, *Bṛjīganita*, *Siddhāntaśiromaṇi*, and *Bṛjīopanaya*. All entries are listed in chronological order.

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