ISSN 0021-4043

A QUARTERLY
ON
JAINOLOGY

VOL. XXV OCTOBER 1990 No. 2

Jain Journal

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JAIN BHAWAN PUBLICATION

Contents

Book Review

MARUTI NANDAN PRASAD TIWARI, *Ambika in Jaina Art and Literature*, Bharatiya Jnanpith, New Delhi, 1989. Price Rs. 100.

Among the Jaina deities, Ambika occupies a significant position. This is borne out from the numerous literary references to her. The plastic and pictorial Jaina art portrays this goddess in variegated forms.

Mother goddess in ancient India represented the divinity of fertility and fecundity. In the Vedic-Puranic tradition she was treated as the inherent power of Nature. She was proginator and protector of children. The Jaina and Buddhist religions also gave a prominent position to her. This is discernible from the literary accounts and also from the portrayals in art.

Ambika was associated with Tirthankara Neminatha, the 22nd Jaina pontiff. Like Sarasvati and Cakresvari, Ambika acquired significant position in different regions of the country. Usually shown under the auspicious mango tree, she holds a child in her lap. Sometimes more than one child is shown with her.

So far no separate work on the origin and development of the Jaina Ambika was available. In the present study Dr. Maruti Nandan Prasad Tiwari has traced the origin of this goddess and has dealt with her manifestations in literature and art from the earliest time to the later phases. The author has spared no pains in discussing the iconographic concept, the forms and symbolism, associated with Ambika, in a chronological sequence. The salient regional features in the art of different areas of the country have clearly been brought out. These have been amplified by giving select illustrations from art.

A separate chapter has been devoted to Ambika as found in the pictorial art. Appendices A, B, and C respectively furnish details about the temples of Ambika, the Jaina Texts and their Dates and Eulogies to Ambika. A detailed Bibliography is given in Appendix D.

The present work is a model for further such studies related to important Indian deities. The author and the publisher deserve praise for this prestigious publication, which has tastefully been printed with nice illustrations and get-up.

—Prof. K. D. Bajpai

New Vistas in Prakrit Studies

SATYA RANJAN BANERJEE

Whatever may be the controversy about the formation of modern India where cultural miscegenation has played more parts, it is pretty certain that our modern India is, in many ways, a continuation of ancient India, whose impact on modern Indian life and society cannot, therefore, be ignored, even though the modern India is not lagging behind with the progress and development of science and technology. Modern India is again an offshoot of the three streams of thoughts as handed down to us from the Vedic down to the present day.

Ancient India is represented by three languages Sanskrit, Pali, and Prakrit including Apabhramsa, and the documents and literatures written in these three languages. Sanskrit mainly stands for Vedic and classical literature and culture, Pali for Pali language and literature in which the sermons and teachings of Buddha are recorded, and Prakrit stands for Prakrit language and literature where the doctrines and teachings of Mahavira are embalmed and treasured up. In course of time, it so happened that Sanskrit stood for Hinduism, Pali for Buddhism and Prakrit stood for Jainism, though at a much later stage both the Buddhists and the Jainas adopted Sanskrit as a vehicle for the propagation of their doctrines. These three languages and their literatures have great impact on the languages and literatures of modern India. As these languages developed and matured, they constantly turned to Sanskrit and Prakrit for further development. They enlarged their vocabulary by incorporating Sanskrit and Prakrit words into their systems.

The modern languages which are the offsprings of the three, and mainly of Prakrit through Apabhramsa are Bengali, Assamese, Oriya, Bihari languages (such as, Maithili, Magahi, Bhojpuri, Sadani, Chattisgarhi, Avadhi, Bagheli, Chotanagpuri), Hindi (including Janapadi, Khadiboli, Bangaru, Brajabhasa, Bundeli and Kanauji), Punjabi (including Dogri and Hindki), Rajasthani (including Marwari, Jaipuri, Ajmeri, Malwi, Bhili, Saurastri etc.), Gujarati, Marathi (including Konkani and Halbi), and some of the Pahadi languages (such as Nepali, Garhwali, Kumauni, Pahadi, Chameali, Kului etc.), Sindhi (including Kacchi). Its influence went, as far as, to Ceylon, and Sinhalese (including Maldivian) is an offshoot of Pali. As these languages are directly derived from Prakrit

through Apabhramsa with Sanskrit at their back, they are fundamentally Sanskrit-Prakrit in structure, and it is through these languages, most of the classical culture was transmitted to modern India. It is a fact to be noted that even Kashmiri, though belongs to Dardic group, is greatly influenced and nurtured by these three languages. Though linguistically and even culturally India has languages from other three language families, such as, Dravidian, Austric and Sino-Tibetan, the languages belonging to these three groups are Tamil, Telugu, Kanarese and Malayalam from the Dravidian side, Kolarian or Munda groups represented by Santali, Mundari, Ho, Bhumija, Khadiya, Korku, Juyang Sabar and Gadab, and the Khasia and the Nicobari from the Austric side, and Shan, Ahom and Khamti from the Thai branch, Meithei, Lushei, Manipuri from the Tibeto-Chinese branch, all these languages are also more or less influenced by the Indo-Aryan languages and culture of Northern India. The importance of the study of all these languages can hardly be ignored. But at the same time it is to be noted that the greatest bulk of Indian life and society is influenced by Sanskrit, Pali, and Prakrit. Here I shall deal only with Prakrit and its impact on Indic studies.

1. Position of Prakrit among Indian Languages :

Before we deal with the subject, it is necessary to know the position of Prakrit in the present context of India. Let us see first what Prakrit can offer us.

The Indo-Aryan language of Northern India is broadly divided into three periods : Old, Middle and New. The old Indo-Aryan (=OIA) is represented by Sanskrit (i.e. both Vedic and classical), Middle Indo-Aryan (=MIA) by Prakrit (and also by Pali and other Inscriptional languages), and New Indo-Aryan as one of the MIA languages, belongs to the middle period of the India group of the Indo-Iranian sub-branch of the Indo-European family of languages. It is therefore, immediately connected with the OIA on the one hand and remotely with the Iranian, and still more remotely with the Indo-European on the other.

In fact, the word Prakrit is used by Indian authorities to include a number of languages or dialects traces of which are found in the religious, literary and dramatic literature of the Jains and non-Jains, beginning from about the 6th or 5th century B.C. down to the 10th or 11th century A.D. or even later than that, covering a period of more than fifteen hundred years. It is very difficult to surmise at present whether the term Prakrit as employed by the Indian grammarians and rhetoricians in their respective treatises included Pali and Inscriptional languages as

well. It is generally considered that the Indian authorities, perhaps, excluded them from their considerations. As a result the modern linguists have employed the term Middle Indo-Aryan as opposed to the Indian term Prakrit by maintaining a parity with the old and New stages of Indo-Aryan languages. Hence the MIA does not only include Prakrit as described by the grammarians and rhetoricians, but also Pali and other Inscriptional Prakrits, such as, the edicts of Asoka, the pillar edicts of Kaluvaki and Heliodora, the copper plate inscription of Kalawan and the Hathigumpha inscription of Kharavela, the Kharosthi documents from Niya region, and the Gandhari or Khotanese Dhammapada from Chinese Turkestan. Besides these, there is another type of language which, belonging to the middle period, is known by the term 'Hybrid', 'Mixed' or 'Popular Sanskrit', mainly cultivated and nurtured by the Buddhists, and also partly followed by the Jains and the Hindus as well. The middle Indo-Aryan also includes the Buddhist literature in Gatha dialects and the Apabhramsa and the Avahattha. In a nutshell, the MIA covers all the languages and dialects of India which lie between the Vedic and classical Sanskrit on the one hand and the New Indo-Aryan on the other. So linguistically the term middle Indo-Aryan is wider and it seems that perhaps by Prakrit is meant all these languages of MIA. Even excluding Pali and the Buddhist Hybrid Sanskrit and Gatha dialects, the extent of Prakrit or MIA from 600 B.C. to 1100 A.D. is so vast and great that the role of Prakrit, as an additional source to Vedic and classical Sanskrit literature can hardly be ignored.

2. The Beginning of Prakrit Studies in Europe :

When the Europeans started studying Sanskrit sometime in the middle of the 17th cent. A.D., they did not have any idea about Prakrit, a language which was current in ancient India side by side with Sanskrit, at least, from the 6th Cent. B.C. onwards. And for a long time till the translation of Sir William Jones (1746-1794) was published in 1789, there was no record, at least, in the Western world that they knew Prakrit. When the translation of *Sakuntalā* by Sir William Jones was published in 1789, they came to know the existence of Prakrit from the title page where it was captioned "translated from the original Sanskrit and Prakrit" into English. This was as far as we know till today, the earliest reference to Prakrit as a separate language in the book of the western world. Whether it has any impact on the Western world to increase the curiosity of the western people to know about Prakrit, it has at least, accrued one result quite clearly that Henry Thomas Colebrooke (1765-1837), a Sanskrit scholar, wrote two articles ('The Sanskrit and Prakrit Language' and 'The

Sanskrit and Prakrit Poetry') on Prakrit published in the *Asiatic Researches* in 1801 and 1808 respectively. In these articles he has practically given some information about Prakrit language and a survey of its literature, where books like *Gāthā Saptaśatī*, *Setubandha*, *Gauḍavaha* and similar other Prakrit texts are mentioned. However, these two articles have a great impact on the scholars, in subsequent times, Colebrooke's later article—'Sketch of the Religious Sects of the Hindus' (1832) also contains information about Prakrit and Jaina sects. In 1827 Horace Hayaman Wilson's (1784-1860) 'Select Specimens of the Theatre of the Hindus' was published. There he puts the question whether the Prakrit "represents a language that was even spoken or is an artificial modification of the Sanskrit language, derived to adopt the latter to peculiar branches of literature" (p. Lxv). And he answered hesitatingly that "the latter seems to be the most likely".

However, after this, there appeared a sensational work in 1837. It was the work of Christianus Lassen whose book, *Institutiones Linguae Pracriticae* (Bonnae ad Rhenum) had given for the first time the characteristic features of Prakrit in a modern linguistic method. He also had given some chapters of Vararuci's, *Prākṛta-Prakāśa* and some portions of Kramadisvara's *Prakrit Grammar*. It is a voluminous work containing 581 (=488+93) pages. Because it was written in Latin, very few people could consult it in a proper way. This book has a supplementary by Nicolaus Delius whose *Radices Pracriticae* (1839) gives the Prakrit roots where he has consulted mainly the roots of Vararuci's *Prakṛta-Prakāśa* and Kramadisvara's *Prakrit Grammar*. These two works are such that they are regarded as compliment and supplement to each other.

Then followed the edition of Prakrit prepared by different scholars. Though there was no systematic plan as to which of the texts or which klnd of the texts is to be edited first, simultaneous effort was going on to publish several Prakrit texts as they came in the hand of scholars. J. Stevenson's translation of *Kalpasūtra* along with a short exposition of the *Nine Principles of Jainism* (=*Navatattva*) in appendix appeared in 1847. Though he has translated the book from a manuscript, the reading of the text does not really differ very much from the text of the present day. The most monumental work done for the first time is Albert Weber's edition of *Bhagavatī-sūtra* (1866-67). This edition has shown the beacon light for the next generation and tells us how to edit a Prakrit text from a collation of several manuscripts. Then followed several other editions, of which Weber's *Saptaśatī* (1870), H. Jacobi's original work of the *Kalpasūtra* (1879) and *Acārāṅgasūtra* (1889), Siegfried Goldschmidt's *Setubandha* (1846), Bühler's *Pāialacchīnāmamālā* (1879), R. Pischel's

Siddha Hemaśabdānuśāsana (1877) are noteworthy. So far scholars were engaged to some extent in editing Jaina Canonical and some Prakrit texts.

In the meantime another branch of Prakrit literature drew the attention of scholars. This time it was grammar. The first complete Prakrit grammar that was edited by E.B. Cowell is Vararuci's *Prākṛta-Prakāśa* published in 1854. This edition of Cowell was criticised by A. Weber, and the effect of criticism was such that Cowell had to revise the edition in the light of the suggestion given by Weber, and the next issue was published in 1868. Since then Cowell's edition of Vararuci's *Prākṛta-Prakāśa* has been regarded as an authentic edition even till today, though there are several other editions of Vararuci's *Prākṛta-Prakāśa* with different commentaries, such as, Baladeva Upadhyaya's edition with the commentaries of Vasantaraja and Sadananda (1927), Ramapani Vada's commentary (1946), Raghunatha's commentary (1954), Vidya Vinodacarya's commentary (1975), the edition of Cowell with Bhamaha's Vṛtti has still been popular and well-consulted. After Cowell comes Richard Pischel (1849-1908) whose contributions in the field of Prakrit grammar and language is a landmark of Prakrit studies. In 1874 his little book *De Grammaticis Pracriticis* (Vratislaviae) offered some aspects of Prakrit which were not only unique at that time but also remarkable. His edition of Hemacandra's *Siddha-Hema-Sabdānuśāsana* in two parts (Vol-I, 1877, Vol-II, 1880) is still a true and best critical edition of Hemacandra's Prakrit grammar. It was subsequently followed by his magnum opus, *Grammatik der Prakrit Sprachen*, Strassburg, 1900. Later on several scholars have published several Prakrit grammars of different authors, such as, the Prakrit grammars of Trivikrama, Laksmidhara, Simharaja and so on.

The field of Prakrit lexicography is also explored in the 19th century. Buhler's edition of Dhanapala's *Pāialacchināmamālā* (1879) has fulfilled a vacuum in the Parkrit lexicographical studies. In a similar way, Pischel's edition of Hemacandra's *Deśīnāmamālā* (1880) has really fulfilled a vacuum which can only be explained in terms of eloquent words. This *Deśīnāmamālā* is a store-house of *deśī* vocables, nearly over eight thousands, which are not only important for Prakrit studies alone, but also for Indian Philology as a whole. It has recorded words of Indo-Aryan origin side by side with 10th/11th centuries Dravidian vocabularies. Recently a *Deśī-Sabda-Kośa* (1988) is published by the Jain Vishva Bharati, Ladnun. This is in a sense the first of its kind in modern times.

However, for nearly one hundred and fifty years the discoveries of Prakrit have been immense. It covers the Jaina canonical literatures of both Svetambara and Digambara Jains, the *Niryuktis* and *Cūrṇis* of the canonical texts, the Prakrit *mahākāvyas*, lyrics, historical *kāvyas*, narrative literature (*kathānaka-kāvyas*), grammar, metres, rhetorical works, and lexicographical treatises, and similar other works of repute. In a sense, a vast amount of Prakrit literature has been discovered throughout the centuries, where scholars, editors and authors have shown their critical acumen and long standing perseverence for unearthing lost and precious works of Prakrit literature. The amount of Prakrit literature discovered so far can go on at par with Sanskrit literature as a whole. It has produced works in all departments of human knowledge. Today Prakrit has reached to such a state that it needs revaluation of the studies done so far.

3. Revaluation of Prakrit Studies :

Though lots of work are done in the field of Prakrit, a critical assessment of the whole terrain of Prakrit literature is necessary, so that we can go ahead with our future programme. We shall discuss this problem step by step.

(*i*) *Jaina Canonical Literature :*

Like the *Rāmāyaṇa* and the *Mahābhārata*, the critical editions of the Jaina Svetambara and Digambara canonical texts with full critical apparatus are still a desideratum. Some Institutions, like L.D. Institute, Ahmedabad, Prakrit Text Society, Ahmedabad, Jain Vishva Bharati, Ladnun, Rajasthan, and similar others are preparing some critical editions of the Jaina Agama texts, but they lack perspective. A thorough plan for critical editions of the 45 *Agama* texts is necessary.

(*ii*) *Jaina Non-Canonical Literature* : *Niryukti and Cūrṇī :*

The critical editions of *Niryukti* and *Cūrṇī* have not yet been published abundantly. Though scholars like L.D. Barnett, A.M. Ghatage, etc. have studied some aspects of *Niryuktis*, these commentatorial literatures have not generally attracted the attention of scholars. As *Niryuktis* and *Cūrṇīs* have preserved some earliest documents of some words and their explanations with meanings used in the Jaina canonicial texts, these are to be edited carefully and critically so that the text may be dependable. There are quite a large number of this literature, the names of some of which are given below :

Ācārānga-Nir., Sūtrakṛtānga Nir., Vyavahāra-Nir., Daśāśruta-Nir., Bṛhatkalpa-Nir., Uttarādhyayana-Nir., Āvaśyaka-Nir., Daśavaikālika-Nir., Ogha-Nir., Piṇḍa-Nir., and Ṛṣibhāṣita-Nir..

Ācārānga-Cū., Sūtrakṛtānga-Cū., Bhagavatī-Cū., Jīvābhigama-Cū., Niśitha-Cū., Mahāniśītha-Cū., Vyavahāra-Cū., Daśāśruta-Cū., Bṛhat-kalpa-Cū., Pañca-Kalpa-Cū., Jītakalpa-Cū., Uttarādhyayana-Cū., Āvaśyaka-Cū., Daśavaikālika-Cū., Ogha-niryukti-Cū., Nāndī-Cū., Anuyogadvāra-Cū.

(*iii*) *Prakrit Rāmāyaṇa and Mahābhārata :*

The Prakrit *kāvyas* with the theme of the *Rāmāyaṇa* and the *Mahābhārata* are written. Though a few like the *Paümacariyam* of Vimalasuri in Jaina Maharastri, the *Paūmacariu of* Svayambhudeva, and the *Paumasiricariu* of D(h)ahila in Apabhramsa are published, there are still some interesting works which are to be critically edited. Some works in the name of *Padmacaritra* by Abhayadevasuri, by Devabhadrasuri, and by Vijayasena, and some in the name of *Padmapurāṇa*, and some in the name of *Rāmāyaṇapurāṇa* are to be critically assessed and published. Apart from Dhavala Kavi's work, *Harivamśapurāṇa*, there are plenty of texts on the *Māhābharata* theme yet to be published.

(*iv*) *Prakrit Purāṇa, Caritāvalī, Paṭṭāvalī etc.* :

The Prakrit *Pūrāṇas* and *Caritāvalis* are nothing but the lives of the twenty-four Tirthankaras and other *Salākā-puruṣas.* Though a few are published, there is a vast amount of literature on the lives of Jaina Tirthankara's lying unedited and unpublished for a long time. Several authors have written independent books on the lives of the twenty-four Tirthankaras, but most of them are still in the manuscript form. Chronologically they are not very old, or rather, most of them belong after the 10th or 12th century A.D. But they are good and worth studying in one sense that they have preserved the lives of the Tirthankaras as were current in their times. At least, we will be able to get the ideas of those Tirthankaras which were current thousand years ago from now. These books will reveal some of the facts which are essential for human knowledge and better understanding. In a similar way, the *Paṭṭāvalis* will also be ransacked, edited for understanding the socio-economic condition of India in those days.

It is a fact worth-noting that for writing the history of ancient India the study of the Prakrit *Purāṇas*, *Caritāvalis* and *Paṭṭāvalis* is necessary. It is worthwhile to remember that the Jaina canonical texts, written in Ardhamagadhi—the last compilation of which ended by 450 A.D. are seldom thoroughly and constantly consulted by the historians for the history of ancient India, perhaps, because of the language bar. It is a general charge against the chronology of Indian history, but the Jainas have fairly (and in some cases accurately) kept the chronology in their *Paṭṭāvalis*, and a good chronological order of Indian history supplemented by contemporary sources may fairly be drawn up. Many of our historical notions, ideas, and events may be revised with the help of those *Caritāvalis* and *Paṭṭāvalis* mostly written by the Jainas. To conclude we can say that we shall be surprised to think that the materials the Jainas have treasured up in their literature will evoke envy of the scholarly world, if these *Caritāvalis* and *Paṭṭāvalis* are properly edited and translated.

(*v*) *Prakrit Kāvyas :*

The Prakrit *kāvyas* of all kinds—epics, lyrics, *kośas*, narrative, deductive, historical are so vast and varied that most of them are lying unedited in the *Bhāṇḍāras* of Jaina Institutes. These literatures can go on at par with Sanskrit so much so that in contents, themes and ideas, these literatures will occupy a unique position among the literatures of the world. Some of the books are lost. We should try to recover them, and for that, investigation of Prakrit manuscripts is necessary. For example, the *Taraṅgarota* of Padaliptacarya is a lost work, but its small version is available. The abridged version, *Saṃkhitta-Taraṅgavaikahā* by Nemicandra in Prakrit, at least, gives us the context of the lost *Taraṅgarota*, just as we have the context of lost *Bṛhatkathā*. Though we may not get many lost works, we can however, re-search the Jaina *Bhāṇḍaras* for getting some of the rare and ancient texts of Prakrit. The value of Prakrit *kāvyas* and tales is emphasized by Winternitz thus :

"The mass of narratives and books of narratives among the Jainas is indeed vast. They are of great importance not only to the students of comparative fairy-tale love, but also because, to a greater degree than other branches of literature, they allow us to catch a glimpse of the real life of the common people. Just as in the language of these narrative works there are frequent points of agreement with the vernaculars of the people, their subject-matter, too, gives a picture of the real life of the most varied classes of the people, not only the kings and priests, in

a way which no other Indian literary works, especially the Brahman ones, do." (*History of Indian Literature*, pp. 545-46).

(*vi*) *Prakrit Scientific Literature :*

(a) *Vyākaraṇa :*

About the scientific literature written in Prakrit, very few works have been edited. In the domain of Prakrit grammar lots of works are unearthed, but they are very late in origin. The characteristic features of Prakrit as given in most of the works are new and do not always conform with the usage. But one thing is interesting in them that the Prakrit grammarians have sometimes included some of the vernacular words which are regarded as Prakrit. For example, in the *Caryāgīti*, an old Bengali text, some of the words are found in the works of some grammarians ; e.g., *āṭhi*—Pkt. *aṭṭhi* '*seed*' (R.T.I.3.9.), *keha*—Skt. *kīdṛśa* (R.T. III. 1.6.), *khāḍā*—Pkt. *khaṇḍa* Skt. *khaḍga* (R.T. III.2.3.), *gru*—*Pkt. gomia Skt. gomika* (R.T. II.2.24.) ; which probably goes back to *gaulmika*, an officer-in-charge of a *gulma*, a small part of an army, *cār*—*cāri* Skt. *catur* (R.T.III.1.31.), *cikhila*—Pkt. *cikhilla* (Kramadisvara's *sūtra cikhilla picchile*), *chādan*—Pkt. *chāṇḍaṇia* (7 *chādaṇi*) —Skt. *sandānita*, 'fetters', (R.T.III.1.3.), *tin*—Pkt. *tiṇṇi* (R.T.III.1.3.), *nāc*(*h*)—Pkt. *nacchā*, *lacchā* Skt. *rathyā*, cf. Beng. *lāch*, *nāch*, cf. *nāc*(*h*)-*duar* (front door) (R.T.I.3.5.), *pirthimi* (Beng. diat)—*pṛthumi* (* 7 *prithumi*) Skt. *pṛthivī* (R.T.III.3.4.), *be*(*y*)*aḍā*—Pkt. *viaḍḍha* Skt. *vitradi*, obstinate, (R.T.I.3.10.), *maḍā*—Pkt. *maḍaa* Skt. *mṛtaka* (R.T.II.2.29.), *meye* (daughter)—Pkt. *māiā* Skt. *mātṛ-kā* (R.T.II.2.24.), a woman, then a daughter.

The study of Prakrit grammar is very essential for understanding the development of Indo-Aryan vocabulary. There are some aspects even of Sanskrit words which are preserved by Prakrit grammarians. For example, in Hemacandra's Prakrit grammar, some remarks have been made in the *Vṛttis* of some *sūtras* which give us some new information about the development of some words ; e.g., *taraṇi* is both masculine and feminine in Sanskrit, but in Prakrit it is used only in the masculine (*taraṇi-śabdasya puṃ-strī-liṅgatvena niyamārtham upādānam*—under *pravṛṭ-śarat-taraṇayah puṃsi* I.31). Hemacandra says that the word *pathin* has three developments-*patha*, *pathi* and *pantha*. The word *patha* is used in Sanskrit as a last member of a compound, such as, *rājapatha*, whereas *pathi* is also used in a compound, but as a first member, e.g., *pathibhraṣṭa* or in a word like *pathika*. *Pantha*/*panthā* is a weakgrade form of *pathin* used in declension. This piece of information

is given by Hemacandra in his Prakrit grammar (*panthaṁ kira desitteti tu pathi-śabda-samānārthasya pantha-sabdasya bhaviṣyati*— under I.88). About the word *mahilā*, Hc. says that the *i* of *mahilā* becomes *e* making it *mahelā* in Prakrit. After that Hc. adds in his commentary that *mahelā* could also be a Sanskrit word like *mahilā*, and therefore the Prakrit word *mahelā* may also directly come from Sanskrit *mahelā* instead of *mahilā* (*mahilā-mahelā* iti tu *mahilā-mahelā-bhyām śabdābhyām siddham.* under I.146). *Mahilā* is recorded in Monier-William's *Sanskrit-English Dictionary* where he has quoted the *uṇādi*-suffix (1.55) to derive it from the root *maha* (cf. *mahilāropya* the name of a city in the South). He has also recorded the word *mahelā*, as if, related to *mahilā*. Though these two words are found in Monier-William's Dictionary as well as in Hemacandra, these two words are not in great use in Sanskrit literature. The most interesting is the word *mora* 'peacock', which is a Prakrit word from Sanskrit *mayūra*, which has two forms in Prakrit *mora* and *maūra*. In fact, *mora* is a further development from *maūra* by euphonic combination. Hc. thinks that *mora* could be a Sanskrit word as well (*mora-maūra iti tu mora—mayūra—śabdābhyām siddham* under I.171). Monier-William has, of course listed this word in his Dictionary as a word given by Indian lexicographers. He has mentioned a word *moreśvara* (*bhaṭṭa*) as the name of an author. It appears that the word is of Prakrit origin incorporated in Sanskrit, and the origin of the word must be very late, the reason being that no author has used this word earlier. These are some of the words which indicate how far the Prakrit grammar is useful even for the study of Sanskrit.

Prakrit grammatical treatises have given us characteristic features of several Prakrit dialects and sub-dialects. Excluding Maharastri, there are four main Prakrit dialects, such as, Sauraseni, Magadhi, Paisaci (including Culikapaisaci) and Apabhramsa, the last phase of Prakrit language. All the Prakrit grammarians have considered Maharastri, a Prakrit par excellence, as the standard Prakrit. The grammarians have not mentioned in their treatises that they are discussing the features of Maharastri, but from their indirect references, such as, *śeṣam mahārāṣṭrīvat*, we infer that the Prakrits, they have described, are nothing but Maharastri, otherwise their general term is Prakrit as *atha prākṛtam.* About the dialects it can be said that they have given only those features which are departures from general Prakrit or Maharastri as the case may be, indicating thereby that the other features of Prakrit or Maharastri will also be found in other dialects as well. It is only from the Prakrit grammarians we know the characteristic features of dialects and sub-dialects.

With regard to the sub-dialects, Prakrit grammarians are divided into two groups. One group, headed by Vararuci, Hemacandra, Trivikrama, Laksmidhara, Simharaja has not practically said anything on the sub-dialects of Prakrit. They have described mainly Prakrit (or Maharastri), Sauraseni, Magadhi, Paisaci and Apabhramsa. It is only Hemacandra who has added Culikapaisaci to the list. The other group, headed by Purusottama, Kramadisvara, Ramasarma Tarkavagisa and Markandeya has given the features of sub-dialects. Linguistically they all belong to the eastern school of Prakrit grammarians. The sub-dialects described by them are Sakari, Candali, Sabari, Takki or Dhakki. Audhri, Abhiri, Pracya, Avanti, Bahliki, Kaikeya, Paisaci, Saurasena Paisaci, Pancala Paisaci, Nagara Apabhramsa, Upanagara Apabhramsa, Vracada Apabhramsa, and so on.

It is difficult to get the features of these sub-dialects, particularly when there is hardly any inscriptions or any Sanskrit dramas where the features of minor sub-dialects are available. How could these eastern grammarians get these features in their respective treatises ? It is difficult also to verify them, if there is any form which seems to be irregular as far as Prakrit is concerned. It is to be noted also that the Prakrit grammarians who have described these features all belonged between twelveth and seventeenth century A.D. It is also to be noted that this period was the time when the modern provincial languages, today known as New Indo-Aryan languages, developed. These NIA languages did not, perhaps, get the modern names as they are today. As a result the features as described by these grammarians do not have any place in any Sanskrit dramas written after the 10th/11th century A.D. The names of the languages seem to be the names of places as were current at that time. For example, Dhakki could be the language of Dhaka, as Audhu, the language of Audhra, i.e. Orissa, and so on. The conception of Prakrit at that time was perhaps that any language debased from Sanskrit was regarded as Prakrit, and hence they have all included them in their treatises. In fact, some of the characteristics of these minor sub-dialects are very much akin to the older stages of the present NIA languages ; e.g. *cikhilla* is regarded as a Prakrit word by Kramadisvara in his Prakrit grammar (*cikhilla picchille* V. 99) and this *cikhilla* is found in the *Caryāgīti* (*cikhila māghe na thāi*, V. 2). So also *keha* for *kīdṛśa* and *aṭhi* for *aṭṭhi*, *cār* for *catur* are all regarded by Ramasarma as Prakrit words, but they are found in fact in Bengali. Only this much can be said that these words are interesting either as the earliest forms of old NIA languages or as Prakrit words used in these languages.

In the whole terrain of Sanskrit dramas, the major dialects which are found used are Sauraseni and Magadhi. Even Maharastri is not frequently found in the dramas unless it is a verse or a song. It is only in the *Mṛcchakaṭikam* we have some sub-dialects, such, as Dhakki or Takki, Pracya, Avanti, Candali and Sakari. But unfortunately the features of these sub-dialects given by grammarians do not tally with the texts of the *Mṛcchakaṭika.* Though the features of the sub-dialects are not very many to form a separate language, they sufficiently represent some features which characterise them as a separate language. The question is how these grammarians could collect the features of their sub-dialects. In this connection it can also be said that how Vararuci could ignore the sub-dialects of the *Mṛcchakaṭika,* when he belonged to the 5th or 6th cent. A.D. much long after the composition of *Mṛcchakaṭika*? We have not yet tried to solve this problem of the features of Prakrit as found in Sanskrit dramas before the advent of Vararuci.

It appears from all these anomalies that a thorough study of all these sub-dialects as given by later Prakrit grammarians should be investigated. How far the sub-dialects used in the *Mṛcchakaṭika* be regarded as embodying the features of these dialects is to be investigated. In the field of Prakrit grammatical studies there are still some lacunae which should be filled up by proper research substantiated by documentary evidence. It will not be out of place here if I casually mention that the names of dialects and sub-dialects given by Sanskrit dramaturgists and rhetoricians in their respective treatises are another problem which could be difficult to solve. The difficulty lies in the fact that the names of the speakers used some languages as prescribed by them are not always found in the existing Sanskrit dramas, except a few speaking Sauraseni and Magadhi. We will be surprised to know that *dhīvara* (fisherman) will speak Magadhi is not sanctioned by any Sanskrit dramaturgists. But at a much later time in the 14th Cent. A.D. in Singha Bhupala's (1330 A.D.) *Rasārṇava-Sudhākara* it is said that *dhīvara* will speak in Magadhi (*dhīvaradyatinicesu māgadhī ca niyujyate*). Whether Singha Bhupala was carried out by *Sakuntalā* or by some other grammars is only a speculation. But Bharata in his *Nāṭyaśāstra* has not really mentioned about *dhīvara* speaking Magadhi. However, it is necessary that these aspects of Prakrit dialects and sub-dialects are to be re-investigated in the light of the documentary evidence.

It can be said that this problem needs further clarification and investigation to evaluate the minor sub-dialects as given by the Prakrit grammarians, where each author of Prakrit grammar is to be analysed

from the historical and comparative point of view as far as the Prakrit language is concerned.

(*b*) *Kośa :*

As regards the Prakrit dictionaries (*abhidhānas/kośas*) a good historial and etymological dictionaries of Prakrit language is a long-standing desideratum. Recently Bhandarkar Oriental Research Institute has undertaken a project on the line and whether any volume of that dictionary will come out shortly is our expectation only. Haragovinda Das T. Seth's *Pāiasaddamahaṇṇavo* though good for all practical purposes, is neither historical nor etymological in the real sense of the term. *Abhidhānarājendra* (1910-25) an encyclopaedia on Jainology in seven big volumes of quarto size with double columns by Rajendra Suri can be updated. There are many Prakrit dictionaries (*kośas*) in manuscript forms and these Prakrit *kośas* are to be edited for this project of Prakrit dictionary, as is done in the case of Historical Sanskrit Dictionary by the Deccan College, Poona.

(*c*) *Chandah* :

In metre, there are plenty of Prakrit books, and some of them are very old. H.D. Velankar has edited quite a lot of books on Prakrit metres, such as *Svayambhūcchandah* by *Svayambhū*, *Vṛttajātīsamuccaya* of Virahanka, *Gāthālakṣaṇa* of Nanditadhya, and *Kavidarpaṇa* of an unknown author. All these works are not very old, but the metres they have described are of old nature. At a later time the *Chandānuśāsana* of Hemacandra (1088-1172 A.D.) is a good work on Prakrit metre (including Sanskrit). In the 15th century Ratnasekhara wrote a book on Prakrit metre, named *Chandahkośa* in Apabhramsa. Though very small in size (74 verses only), this book covers a variety of Prakrit metres. The *Prākṛta-Piṅgala* of Pingalacarya, though very late, contains a large number of Prakrit metres including illustrations. Though two editions of this book are published (Asiatic Society and Prakrit Text Society), this book needs further study as far as the development of Prakrit metres are concerned.

It is true that by this time several works on Prakrit metres are published, but a historical research on Prakrit metres is still a desideratum. The time has come now to have a thorough study on Prakrit metres. The metres used in Several Prakrit *kāvyas*, lyrics etc. are to be studied thoroughly. A dictionary of Prakrit metres may be a welcome idea,

and it will be a real contribution to the knowledge of Indo-Aryan language and literature. It might be a good idea to see whether in the early stages of NIA languages some of the Prakrit or Apabhramsa metres have handed down to us. It will not be a case of exaggeration to say that the *Caryāgīti* or *Dohā Kośa* or the *Ḍākārṇavatantra* and Tulasidasa's *Rāmāyaṇa* and the *Ovi* meter of Marathi might have some links with the Apabhramsa metre. But it will be a good guess to see that some links might be established, if a thorough and critical investigation is made.

(*d*) *Alaṃkāra :*

Though there is only one *alaṃkāra granṫha* in Prakrit, named *Alaṃkāra-Dappaṇa* of an unknown author, published in the Marudhara Kesari Abhinandana Grantha (Jodhpur) edited by Bhanwarlal Nahata with Hindi translation, it will be our effort to see whether similar types of *alaṃkāra* works in Prakrit are available. We must be very alert in search of this Prakrit *alaṃkāra* literature. It is our guess that the Jainas might have done something in the sphere of *alaṃkāra* literature as well, as they have done in other spheres also. In this connection the remarks of Winternitz are worth mentioning. "The Jains have extended their activities beyond the sphere of their own religious literature to a far greater extent than the Buddhists have done, and they have memorable achievements in the secular sciences to their credit, in philosophy, grammar, lexicography, poetics, mathematics, astronomy and astrology, and even in the science of politics. "(*Ibid.*, pp. 594-95).

(*e*) *Textual criticism :*

In the end it can be said that time has come to formulate some rules or norms for Prakrit textual criticism. The Prakrit literatures are so vast and varied, and dialectally so profuse that it is high time now to have a norm for Prakrit textual criticism. There are some problems which an editor of Prakrit faces when he edits a Prakrit text. As a Prakrit text is inundated with dialects, like Maharastri, Sauraseni, Magadhi, Paisaci, Apabhramsa and so on, an editor finds it difficult to consider the linguistic features of any one of the dialects as genuine. The difficulty lies in the fundamental features of any dialect. For example, if a text is in Sauraseni, it is expected that, at least, the two vital features of Sauraseni must be present and they must be uniform also. These two fundamental features of Sauraseni, as enunciated by Prakrit grammarians, are—(i) the intervocalic non-conjunct *t* becomes *d*, (cf. Hc. IV 260), and (ii) the intervocalic *th* becomes *dh* (cf. Hc. IV 267), e.g. Skt. *kathayati—kadhedi.* These two simple features of Sauraseni are not uniformly maintained in

the texts of Sauraseni. In Kundakunda's works and in Rajasekhara's *Karpūramañjarī*, these two points are not strictly followed. In their books, after two or three verses, or sometimes in the same verse, the *dh* is retained in one reading, or *dh* becomes *h* in the other. Therefore *kadhedi* has another reading *kahehi*. This is the moot point in our editorial discipline. It is true that Hemacandra has accepted *h* in place of *dh* as an optional form in Sauraseni (Hc. IV 267 & 68), the earliest literature gives us the idea that it was *dh* which was historically earlier (e.g. Vedic *idha* and CI. *iha*), and later on this *dh* becomes *h* in Maharastri (cf. Hc. I. 187). It appears from the *sūtras* of Hemacandra that *h* is a Maharastri influence on Sauraseni at a later stage. So the optional rule for the prescription of *h* in place of *dh* in Sauraseni is not to be considered as a true feature of Sauraseni, otherwise the rule that *th* becomes *dh* in Sauraseni becomes redundant. Sometimes the editors are blinded with the readings in the manuscripts as more important than the grammatical features. If the readings in the manuscripts are given prominence and whatever is written in manuscripts is to be considered as right, then the characteristic features of a particular dialect as given by the Prakrit grammarians (and also linguistically correct), then what is the utility of the grammarians or of the linguists as far as the text is concerned. It has always been a question who is to be depended upon—grammarians or the manuscripts ? This controversy has been going on since Theodor Block wrote his *Vararuci und Hemacandra* (Guttersloh) in 1893. Pischel also in his *Grammatik der Prakrit Sprachen* (1900) has raised this question and has carefully evaded the answer. In 1924, Walter Engene Clark raised this problem once more in his article *Māgadhī and Aradhmāgadhī* (JAOS, 81-121). He has discussed the point at great length, but without any definite result. In my article 'Prakrit Textual Criticism' (*Jain Journal*, January 1988/95-96) I have concluded as follows :

"It is not easy to answer the question, particularly when most of the scholars think that any kind of linguistic phenomenon is possible in Prakrit. Perhaps under the tacit influence of this so-called ideas, some of the Prakrit forms have been incorporated in some editions which sometimes baffle and betray some of the basic notions of Prakrit language including dialects as *enunciated by* Prakrit grammarians. It is true that Prakrit grammarians are not very old, and most of the authors belong at a time when the language was almost stereotyped like Sanskrit. As a result the Prakrit features as embalmed and treasured up by the grammarians vary from author to author, except a few general forms which are common to all. The texts of Prakrit manuscripts are not always uniformly common ; the variations are such that it is difficult to follow any particular reading from the Mss. The copyists are not always learned, more

so, they may not have any knowledge or a very limited knowledge of the language and hence every possibility of making mistakes. The phonetics of the language is not always regular. Sometimes the copyists add something to the Mss. to improve upon the text. It is, therefore, not an easy task to edit a Prakrit text, as is normally the case with Sanskrit or with Pali."

Apart from dialectal there are some orthographic difficulties as well, and sometimes the peculiar way of writing *n* and *ñ*, *y* and *th*, *ṣ* and *ph*, *jh* and *bh* and many conjuncts makes us responsible for a wrong selection. Unless one is thoroughly conversant with the calligraphy of manuscripts, one can not do any justice to the reading of a Prakrit passage. The other linguistic problem connected with orthography is the use of *l* in Prakrit. In Simharaja's *Prākṛtarūpāvatāra* edited by Hulzsch (1909) gives us *l* in those words where the other Prakrit grammarians give *l*. In a similar way there are problems on *n* and *ṇ*, and on *y* and *v* in Prakrit manuscripts, particularily when they are written in Bengali script. The problem of *y-śruti is not yet settled.*

Apart from all these problems, the great difficulty lies in the selection of Prakrit readings from the MS. If the grammatical texts are edited wrongly, the grammatical feature is bound to be wrong. For example, in Cowell's edition of Vararuci's *Prākṛta-Prakāśa* under the *sūtra id-iṣat-pakva-svapna-vetasa-vyajana-mṛdangangāreṣu* (1.3), the example of *īṣat* is given as *isi*, but in his footnote another reading *īsi* is given as a varient. In fact, *isi* with short *i* is a wrong reading selected by Cowell in the main body of the text, (because the *sūtra* means the first a *of īṣat* become *i*). But there is no *sūtra* by which the first long *ī* becomes short and that reading with long *ī* is also given in the footnote. It is in fact, the long *ī* is in use (cf. *īsīsi cumbiāim* etc. in *Sakuntalā*, Act I, prologue). As Cowell has given the alternative reading in the footnote, this should not be taken as a printing mistake. Example need not be multiplied.

In conclusion, it can be said that with the progress of Prakrit studies and the printing of Prakrit texts, it is high time now to value or revalue the Prakrit studies in the light of the suggestions given above.

The foregoing discussion is neither intended to describe nor to disparage the works done before, but only to suggest the works to be done in future for the betterment of Prakrit studies.

Jain Theory of Skandhas or Molecules

N. L. JAIN

Skandha : Definition of a Specific Term

Primarily, the postulate of two classes of matter *aṇu* (atom) and *skandha* (molecules) based on basic conceptual structure of matter is most important among the many classifications. The molecules of the current times are now equated to *skandhas*. They are comparatively gross and perceivable. They could therefore be studied and described in an intelligible way. They are treated first in preference to finest *aṇus* or atoms. They are like trunk of a tree supporting the material universe.

The term *skandha* is a typical and specific term in Jaina philosophy representing a unit of matter different from atoms but composed of them. The scriptures define the term quite clearly with the following points :

(i) Molecules are aggregates or combination of atoms.[1] They are non-natural modifications dependant on other objects.[2]

(ii) They are gross and fine in forms. Some of them are visible to the eye while others may not be visible.

(iii) The molecules in the matter are in a state of motion caused internally or externally.[3]

(iv) They can be taken by hand, received or bonded with others and handled as desired.[4]

(v) There are smaller molecular entities too like those formed from aggregation of two atoms. They may not be satisfying (iv) above, still by interpolation, they are also called molecules—of course fine ones.[5]

1 Kundakundacarya ; *Pancastikaya*, Bharatiya Gyanpith, Delhi, 1975, pp. 65-70.
2 Kundakundacarya ; *Niyamasara*, Jain Publishing House, Lucknow, 1931, p. 15.
3 Nemicandra Cakravarti, *Gommatasara-Jivakanda*, Raichand Jain Granthamala, Agas, 1972, p. 267.
4 Jain, S. A., Reality, Vir Sasan Sangha, Calcutta, 1960, p. 151-54.
5–7 *Ibid.*, pp. 150, 51, 54.

(vi) They are characterised by the sound, bonding, division, fineness, grossness, shape, darkness, shadow, sunshine, moonlight, motion and touch, taste, smell and color etc.[6]

(vii) There are infinite number of molecules. They can be classified in many ways.

(viii) They are produced by association, dissociation and a mixed process. The sense perceptible ones are produced by the mixed process.[7]

(ix) Those molecules are supposed to be embodying all characteristics of the place of matter to which they belong.

(x) They are active and may be transformed or modified in various ways.

The Buddhists have one word for matter—*rūpa* consisting of two varieties : primary elements or *mahābhūtas* and secondary elements or *utpādarūpa*. Both of them are called *rūpa-skandhas* consisting of atoms and molecules. However, the Buddhist's atoms, combined atoms, or primary elements are equivalent to *skandhas* of the Jainas as they are made up of 7-10 small constituents. Thus, for them, matter is nearly molecular. The *utpādarūpas* have been described to be fifteen, sixteen or twentyfour in number all molecular species.[8] The Vaisesikas postulate atomic theory but they do not have a separate or common term for atomic aggregations. Those are called effects by them, their nomenclature depending on the number of atoms participating in aggregation like diatomic, triatomic etc.[9] The composite-constituent concept of inferential nature in this connection has been discussed by Prabhacandra.[10]

Current scientists have the term molecule for atomic combinations. However, the molecules are chemically bonded in contrast to many physically bonded *atomic* aggregates. The Jain term *skandha* includes, however, both types of bonding physical and chemical as well. The current examples may be mixture of inert gases in air, molecules of hydrogen or oxygen elements or water. The *skandhas*, thus, include all types

[8] Chaudhuri, A., 'Concept of Matter in Early Buddhism' in *KCS Fel. Vol.*, Rewa, 1980, p. 426.

[9] Prasastapadacarya, *Prasastapada Bhasya*, Sanskrit Univ., Kashi, 1977, p. 78.

[10] Prabhacandracarya, *Prameyakamala Martanda*, Nirnayasagar Press, Bombay, 1941, p. 605-19.

of aggregation of elements, molecules, compounds or mixtures. This Jain term is, therefore, more general than the term molecule of the scientists. These molecules have the capacity, however, to get dissociated into its constituents.

Classification of Skandhas

The *skandhas* are innumerable. The scholars felt the need of classifying them for their proper studies. They have been classified in many ways. The first classification consists of their two varieties—gross and fine, sense perceptible or otherwise. This is based on commonsense view. The other classifications are based on that of matter as such and summarised in *Table 1*. They are not illustrated except in the fourth one where the criteria of eye-perceptibility has produced a discrepancy in current terms pointed out by myself[11] and A.K. Jain.[12] There is one more point regarding the illustrative meaning of the sixth category of fine-fine class. Kundakunda illustrates it with finer particles than karmic aggregates. Javeri supports it by saying that action particles are made up of innumerable number of ideal atoms. He means that even this type of aggregate will be finer than the fifth category. This may include dyads, triads etc. However, G.R. Jain[13] illustrates it by the current atomic constituents like neutrons etc. However, because of aggregate, it will be *skandha* or molecule in Jainological terms. This will be approximately 10^{-13} cm. in size according to Yativrsabha—a size representing the current nuclear size.[14] This suggests that Jain's illustration should be taken meaningful. This, however, creates another problem in explaining the various properties of canonical atoms to be discussed separately. Jain and Sikdar[15] have made a basic mistake in assuming the sixth category as atomic despite the "*khandha hu chappayara*" statement of Kundakunda. This should be rectified and the resultant discussion be modified accordingly.

[11] Jain, N. L., *Amar Bharati*, 1985.
[12] Jain, A. K., *Tulasi Prajna*, Ladnun, 12, 4, 1987, p. 40.
[13] Jain, G. R., *Cosmology, Old and New*, Bharatiya Gyanpith, Delhi, 1975, p. 65.
[14] Yativrsabha Acarya, *Tilloyapannatti*, Jivraj Granthamala, Sholapur, 1955, p. 13.
[15] Sikdar, J. C., *Concept of Matter in Jain Philosophy*, PVRI, Varanasi, 1987.

Table 1 Various Classifications of Skandhas or Molecules by Jainas

Nos.	Classes	Names
1	2	Gross and Fine
2	3	*Skandha, Skandhdeśa, Skandhapradeśa*
3	3	Transformable by internal, external or mixed causes
4	6	Gross-gross, Gross, Gross-fine, Fine-gross, Fine, Fine-fine
5	23^{3}	23 *Vargaṇās* (detailed later)
6	530^{16}	With respect to five qualities as primary and secondary (detailed later)

The second classification is based on matter in general where three out of four varieties should be *skandhas*. Accordingly, the canonical sizes should be less than one-fourth the size of a *skandha*.[16] Here, one is unable to guess about the meaning of *skandha* whether it is diatomic or polyatomic. If it is diatomic, the *skandhdeśa* will be atomic and the third class will be sub-atomic. In other words, the canonical atom should be divisible which seems undesirable. This suggests the Jain's illustrative equations of these terms are not correct. Javeri, on the other hand, takes a real view of defining *skandha* with grosser bodies and the other terms being its conceptual divisions and *skandha* by themselves.[17] The *skandha-pradeśa*, in this way will mean a single molecule of an element or compound consisting of number of atoms possessing the property of the *skandha* itself. The other classifications have already been described elsewhere. They seem to be more philosophical than scientific.

Methods of Formation of Molecules or Skandhas

The formation of molecules takes place by combination or aggregation of atoms according to the theory of Bonding proposed by the Jainas and discussed elsewhere.[18] When small number of atoms combine, they form sense-imperceptible molecules. When many atoms or molecules combine, they form gross molecules. It is stated in literature that combination takes place by three methods.[19]

[16] Vacak Syama, Arya, *Prajnapana Sutra-1*, AP Samiti, Beavar, 1983, p. 31.
[17] Javeri, J. S., *Atomic Theory of the Jainas*, Jain Visva Bharati, Ladnun, 1975.
[18] Jain, N. L., *Chemical Theories of Jainas*, Chymia, 11, 1, 1961, p. 11.
[19] Jain, G. R., *op. cit.*, p. 140.

(i) By division or dissociation of molecules of bigger size to smaller ones.

(ii) By association or sharing of atoms together.

(iii) By a mixed process of association and dissociation.

The dissociation may take place by internal or external causes as in radioactivity or process of ionization. We also know today that it may also take place thermally, by application of pressure or bombardment. It is said that these methods are akin to the three types of valency or bonding of current science subject to certain modified version of traditional opinions.

Umasvami and Pujyapada[20] have pointed out that sense-perceptible molecules are formed by the mixed method of association and dissociation. The latter has illustrated this point by saying that a fine molecule may be split and its parts may combine with other bigger molecules to form a gross molecule. However, Shastri[21] has raised a point whether Umasvami's aphorism should mean a mixed process or two individual processes. Grammatically, the dual number in the aphorism should mean two processes rather than a single one, otherwise, there should be singular number in the aphorism. There must be some specific aim in this composition the commentators have not elaborated. However, it is quite common to have visible molecules by combination of atoms or fine *skandhas*. Shastri seems to be right to seek how division as a single process can yield gross molecules. There are, however, a number of examples today to prove this. Sulphur Dioxide or Carbon Dioxide are canonically invisible gases and they, on thermal or electrical decomposition, give solid visible sulphur or carbon *skandhas*. Jain[22] has exemplified these processes by formation of hydrochloric acid and ionisation of air representing combination and division respectively. Hence visible *skandhas* are formed bothways and the corresponding aphorism should mean two individual processes. However, examples of molecular formation by combination of the two processes are also available. Thus, aphorism concerned seems to be superfluous in view of aphorism '*bheda-samghātebhyah utpādyante*'. This point requires closer examination.

[20] Jain, G. R., *op. cit.*, p. 146.

[21] Shastri, JML., 'Jain Sastron-me Vaijnanik Sanket, *Pt. Jaganmohanlal Shastri Sadhubad Granth*, p. 228.

[22] Jain, G.R., *op. cit.*, p. 146.

Conditions for Formation of Skandhas or Molecules

Normally, the various types of motions of the molecule-forming atoms are elastic in nature. They are not only irregular but they are non-bonding also. This poses a problem as to how the bonding takes place and molecules are formed. This may be assumed that the bonding takes place due to contact and collisions among the atoms and bonding entities. The contact may be partial or whole. It is said that the contact by whole leads to homogeneous molecules like milk water and hot iron. But, of course, only contact does not lead to molecular formation, it must be forcefully colliding and bond forming. There is collision, but it may lead only to change in speed only.[23] Different atoms combine when there is sufficient difference between the velocities of the combining atoms. This could be either internal or induced. This causes inelastic collision leading to bonding.

Besides contact and bonding collision, difference in the nature of the bonding atoms (positive or negative) also plays an important part in bonding. This causes natural bond. This could also be formed in presence of metallic catalysts like containers and micro-organisms and changes in conditions like temperature (and now-a-days pressure too). The production of natural sparks, burning of planets, eruption of volcanoes are examples of natural bonding. Formation of clouds, rainbows, hail-storms, lightning etc. are also other forms in which molecules are formed though they represent physical aggregation in most cases. Thus, we have physical, physico-chemical and chemical bonding molecules under different conditions. We thus find that the conditions of bonding mentioned in literature are nearly the same as are known today to every High School student. However, many more agents like light etc. are now available for this purpose.

Functions of Molecules or Skandhas

The molecules have three major functions to perform. The first is physical or physico-chemical. The molecules of our body, mind and other organs are there for proper functioning of our life. Current scientists have found the basic unit of the living as protoplasm which has a company of molecular structures including nucleic acids. But how this company of non-living molecules bring about life ? This is the problem and a dividing line between science and philosophy.

[23] Nemicandra Cakravarti, *op. cit.*, p. 267.

The second function of the molecules may be taken as spiritual or suprasensual. The living beings have feeling of pleasure, pain etc. These depend on physical environment and changes therein which is all molecular. These actually effect the sensing system of our bodies leading to the corresponding sensations. These environments are very fine and consist of even the *karma* particles. Besides, our own actions and their effects also lead to a variety of reflex actions and reactions producing characteristic aura around the body. Thus, the molecules not only create our lives, but they effect its course also indirectly. All our tendencies towards better thoughts and actions are governed by the quality of *karma* molecules getting in and out of bodies. We require better type of molecules for better lives.

The above functions are related with our lives directly. However, the most important aspect of *skandhas* is their capacity to maintain, modify and form newer and changed objects of different types of molecules. This capacity is the base for development of modern amenities. The purification of water by alum, production of butter from milk, purification of metals by borax and alkalis are examples of utilitarian changes of chemical nature. The capacity of *skandhas* has been studied by the scientists extensively and as a result, we have a world full of entertaining materials. Could we say these materials will not lead to our spiritual development ?

Bhagavatī and Umasvami mention the six embodiments (earth to *trasa kāya*), five bodies, speech, mind and respirations as the effects of *skandhas*. They also mention 14-16 manifestations of *skandhas* with some variations with *Uttarādhyayana* 16[24] and Umasvami 14[25]. These consist of some physical energies and some properties in which changes are observable. They are discussed under the physical contents.

Properties of Skandhas

All fine and gross *skandhas* have all the general and special properties of matter. There are eight general and six specific properties. These have already been described. Besides, it may be mentioned that each molecule has cohesive or adhesive force inherent in it so that it could combine with its own or different type. There is a variety of action, or motion including

[24] Sadhvi Candanaji (ed. & tr.), *Uttaradhyayana*, Sanmati Gyanpith, Agra, 19/6, p. 380.

[25] Jain, G. R., *op. cit.*, pp. 122 and 130.

rotation, vibration and translation. Translatory motion has highest force for chemical bonding. There are some technical terms used in this connection like *parispanda* and *parivarta* etc. which have been explained by Sikdar.

Description of Specific Skandhas

The finite variety of *skandhas* can be seen to exist in four specific forms—earth, water, air and fire. Kundakunda mentions them as *dhātus*. The four *mahābhūtas* of the Buddhists and four types of basic atoms of Vaisesikas remind us of some conceptual similarity. It may be suggested that they represent the various states of matter rather than the specific *skandhas*. Thus, the earth represents the solids, water the liquids, air the gases and fire the various forms of energies. This statement is supported by the fact that the seers have enumerated a variety of earth ranging between 21-40. However, this becomes a little doubtful when one finds that they have classified water, air and fire only in their naturally occurring forms. How they could overlook the enormous variety of liquids like oil, butterfat, *āsavas* etc. and gases is a matter of surprise and clarification. Another fact stated in canons is that all these *skandhas* are termed as living during their growth and development.[26] Their hardness or adhesiveness has been taken as sign of livingness. However, they turn non-living when heated or cut. We will describe them as in canons.

The Earth

The earth, representing the class of solids, is characterised by different degree of hardness. It has valuables under and over it. *Ācārāṅga*[27] and *Mūlācāra*[28] have classified the earth in the first instance followed by others later. The description is based on its assumption of being one-sensed. It has been classified in four categories of earth, earth-body, earth-creature and earth-soul. Out of them, the first and second are clearly non-living, the third has been called living because of its being substratum for living entities, it is non-living. The fourth variety seems to be only living about which no clarification is available. Currently, it is debatable whether living characteristics apply to earth as a class. However, it has been shown to have many types.

[26] Muni Nathmal, *Dasavaikalika : Ek Samiksatmak Adhyayan*, S. T. Mahasabha, Calcutta, 1967, p. 113.
[27] Santi Suri, *Jiv Vicar Prakaran*, Jain Mission Society, Madras, 1950, p. 23-25.
[28] Battakeracarya, *Mulacara-I*, Bharatiya Gyanpith, Delhi, 1984, p. 177.

The earliest earth classification is traceable in *Daśavaikālika* (i. e. 427 B. C.). It mentions only three types—*bhiti*, *śilā* and binding materials. Later on these types have been expanded. Scriptures mention its two broad types: soft and hard. The soft one has five or seven-coloured varieties as shown in *Ācārāṅga* and *Prajñāpaṇā*:[29]

Red, green, yellow, white, black earths (*Ācārāṅga*)

Red, green, yellow, white, black, *pandu* and *paṇak* earths (*Prajñāpaṇā*)

Perchance these refer to various colored soils found in nature. The hard types are shown in *Table 2* as found in literature. Though there seems to be a large amount of similarity in these types, still some addition and deletions forecast many informations. The *Acārāṅga* earths contain all solids, the 14 gems being additional to the list totalling 35. In the second classification of about 250 years later, not only gems get included in the list but their number also increases from 14 to 18. Moreover, mercury is also added to metals. This is an exception to the class of solids. This suggests that mercury was discovered or put to use between 300-500 B. C. Though Santisuri follows *Prajñāpaṇa*, but it has curtailed the number to 21 by condensing the gems to 3 types and seven metals to one type. Some new substances like chalk and soda have also been added with the exclusion of diamond and pebbles etc. Amritacandra Suri[29] follows *Mūlācāra* with 21 substances and 15 gems making 36 earths. It excludes mercury and soda but includes copper sulphate. The last two classifications add pewter in metals which is actually an alloy. Amritacandra Suri has made the Masargalla variety into two varieties.

On Chemical examination of these various earths, it is seen that they contain elements, compounds, minerals, mixtures and gems known during different canonical periods. The earths are said to be the carrier of a variety of valuables. *Daśavaikālika* mentions 24 valuables including some trees and medicinal plants but excluding cereals and pulses.[30]

Gold has an important status among all the solids, used for coins, ornaments and medicines. It is anti-poison and all proof. Its purity is

[29] Vacak Syama, Arya, *op. cit.*, p. 31.
[30] Kundakundacarya, *Astapahud*, Jain Sansthan Mahavirji, 1970, p. 177.

judged by heat resistance, beating, rubbing and drilling. It was assumed that when lead was converted into gold, many factors including vital force worked. It is obtained by heating its ore with salt and borax. Other metals are also obtained similarly. Artificial gold has also been mentioned in *Niryuktis.*[31] Tempering is one of the ways to improve the quality of iron. Descriptions about other earths or metals is not available in canons.

The above description about solids seems to be quite small and incomplete when compared with the current knowledge. Still it proves the ancient scholars did observe what was existing. The Vaisesikas[32] have only three types of earth-soils, stones and minerals and immobiles (vegetable kingdom). The Jainas do not have this last category. *Table 2* suggests Jainas advancement over Vaisesikas in this regard. The Buddhists have not much to offer in this matter.

The Water Class

Like earth, water represents liquid *skandhas.* They are divided in two classes—fine and gross. No examples of fine variety are available. However, gross water could be of three types—*pānīya* (water), *pān* (alcohols) and *paṇak* (medicinal waters). Fludity is the chief characteristic of this class. Ordinary water has two variety overground and underground. They have been sub-classified in different Agamic periods as shown in *Table 3.* The *Prajñāpaṇā* gives the best classification with 16 varieties of water liquids including all the three major varieties. *Mūlācāra* and Amritacandra have nothing special. Santi Suri has seven varieties on which earth rests. There are two types of creatures found in water-air-bodied and waterbodied.[33] The normal water is purified by boiling or by using alum. It is said that the ascetics should use the water cooled after boiling. The pure water becomes substratum for micro-organisms when kept for 12-24 hours. Fermented or lemon waters are acidic which increases on keeping them longer due to further fermentation

[31] Kundakundacarya, *op. cit.*, 36 p. 224.
[32] Prasastapadacarya, *op. cit.*, p. 89.
[33] Muni Nathmal, *op. cit.*, p. 117.

Table 2 Various Types of Earths

	Uttarā-dhyayana	*Acārāṅga*	*Mūlācāra* *Tattvārthasāra*	*Prajñāpaṇā*	Santi Suri
	40	35	36	40	20
1.	Soils	Soils	Soils	Soils	Soils
2.	Stones	Stones	Stones	Stones	Stones
3.	Slabs	Slabs	Slabs	Slabs	...
4.	Pebbles	Pebbles	Pebbles	Pebbles	...
5.	...	...	...	Kirelak	...
Metals					
6.	Iron	Iron	Iron	Iron	Gold etc.
7.	Copper	Copper	Copper	Copper	
8.	Lead	Lead	Lead	Lead	
9.	Silver	Silver	Silver	Silver	
10.	Gold	Gold	Gold	Gold	
11.	...	...	...	Mercury	Mercury
Alloys					
12.	Pewter	...	Pewter	Pewter	...
Non-metals					
13.	Diamond	Diamond	Diamond	Diamond	...
Mineral/Compounds					
14.	Salts	Salts	Salts	Salts	Salts
15.	Usam	Usam	Usam	Usam	Soda Sulphate
16.	Yellow Orpiment	Yellow Orpi	Yellow Orpi	Yellow Orpi	Yellow Orpi
17.	Vermillion	Vermillion	Vermillion	Vermillion	Vermillion
18.	Realgar	Realgar	Realgar	Realgar	Realgar
19.	Ant. Sulph.	Ant. Sulph.	Ant. Sulph.	Ant. Sulph.	*Sauviranjan*
20.	Mica	Mica	Mica	Mica	Mica (5 color)

	Uttarā-dhyayana	*Acārāṅga*	*Mūlācāra* *Tattvārthasāra*	*Prajñāpaṇā*	Santi Suri
21.	Sand	Sand	Sand	Sand	...
22.	Fine-sand	Mica-sand	Mica-sand	...	Sand
23.	...	...	...	Chalk	...
24.	...	...	Copper Sulphate	...	...
	Natural Substances				
25.	Coral	Coral	Coral	Coral	Coral
	Gems				
26.	*Gomed*	*Gomed*	*Gomed*	*Gomed*	...
27.	*Rucak*	*Rucak*	*Rucak*	*Rucak*	Gems
28.	*Sphaṭik*	*Sphaṭik*	*Sphaṭik*	*Sphaṭik*	*Sphaṭik*
29.	*Lohitākṣa*	*Lohitākṣa*	*Lohitākṣa*	*Lohitākṣa*	Jewels
30.	*Marakata*	*Marakata*	*Bappaka*	*Marakata*	...
31.	*Masargalla*	*Masargalla*	*Masargalla*	*Masargalla*	...
32.	*Bhujmodak*	*Bhujmodak*	*Bhujmodak*	...	...
33.	*Anka*	*Anka*	*Anka*	*Anka*	...
34.	*Indranīl*	*Indranīl*	*Indranīl*	*Moch or Nīl*	...
35.	*Candra-prabha*	*Candra-prabha*	*Candra-prabha*	*Candra-prabha*	...
36.	*Vaidurya*	*Vaidurya*	*Vaidurya*	*Vaidurya*	...
37.	*Jalakānta*	*Jalakānta*	*Jalakānta*	*Jalakānta*	...
38.	*Sūryakānta*	*Sūryakānta*	*Sūryakānta*	*Sūryakānta*	...
39.	*Candana*	...	*Candana*	*Candana*	...
40.	...	*Maṇikānta*	...	...	...
41.	*Gairik*	...	*Gairik*	*Gairik*	...
42.	*Pulak*	...	*Pulak*	*Pulak*	...
43.	*Saugandhika*	...	*Saugandhika*	*Saugandhika*	...
44.	*Hansagarbha*	...	*Hansagarbha*	*Hansagarbha*	...
45.	...	...	*Pandurang*	...	...
46.	...	...	*Rūcakānka*	...	...
47.	...	...	*Puṣparāga, Baka*	...	...
48.	...	...	*Rucakānka*	...	...

where alcohol of vinegar is produced. These waters should not be used as common drinking waters. The *Prajñāpaṇā* description about the sources of water are quite statisfactory. But they describe only solid and liquid water. The gaseous water does not find any mention.

Table 3 Various Types of Water in Jain Canons

Uttarā-dhyayana 5	*Daśavai-kālika* 5	*Mūlācāra Tattvārthasāra* 6	*Prajñāpanā* 21	Santi Suri 7
Overground Waters				
Dew	Dew	Dew	Dew	Dew
Ice	Ice	Ice	Ice	Ice
Mist	Mist	Mist	Mist	Mist
Hails	Hails	Hails (solids)	Hails	...
Waterdrops on greengrass	Waterdrops on gr. grass	Waterdrops on gr. grass	Waterdrops on gr. grass	Waterdrops on gr. grass
Underground Water				
Udaka	*Udaka*	*Udaka*	Pure *Udaka*	Rain water
...	...	...	...	Dense water
...	...	...	...	Water, well, river
...	...	...	...	etc.
...	...	...	Cold	...
...	...	...	Hot (spring)	...
...	...	...	Alkaline	...
...	...	...	Slight acidic	...
...	...	...	Acidic	...
...	...	...	Salt/sea water	...
...	...	...	Wine (*Varuṇa*) water	...
...	...	...	Milk (*Kṣīra*) water	...
...	...	...	Butter (*ghṛta*) water	...
...	...	...	Sweet (cane) water	...
...	...	...	*Rasodaka*	...

The old literature does not contain much about alcohols and medicinal waters. These form the subject of other faculties. However, it has been pointed out that they should not be used for better health and spirits. Amritacandra has described alcohol as a source of many micro-organisms and it causes intoxication and idleness.[34] Butter is also produced by a similar process. One does not have much description about liquid oils. However, butter and oils form a class of liquids which are water insoluble. Many other liquids are water soluble. They are described to some extent in Ayurvedic texts.

It seems from the above that there were three types of liquids in use in olden times. The number of liquids is enormous today. Their properties vary. The earlier description of general properties show that quite a good number of properties of liquids are found in cannons. The Vaisesikas[35] have sea, river, dew and ice water with many other varieties not mentioned. This is much less than what is described in Jain literature. The Buddhists have also a similar case as with the earths.

The Air or Gaseous Skandhas

As earlier, the air should represent the gaseous class of substances. They move obliquely. Formerly only colorless gases might be known which could not be visible to the eye but other senses could sense them by their blowing, flowing or smell. It seems, however, that no other gas except air was known in canonical periods. That is why only various types of air are described in this category. The earths and water fare a little better in this regard.

Air has been classified differently in different periods as shown in *Table 4*. The *Daśavaikālika* classifies it in seven types—a common sense view. But there is a peculiarity. Air from mouth is also included in it which is now taken as chemically different from normal air in the sky. Other airs may be called non-violent airs or breezes. *Prajñāpaṇā* has a better classification of air consisting of seventeen varieties depending on direction, velocity, action or physical state. Santi Suri has eight varieties which include air from mouth and some other *Prajñāpaṇā* varieties. It has excluded all directional winds. Battaker and Amritacandra have seven varieties excluding mouth air. All these categories do not include air from nose without which our life would be in danger.

[34] Amritacandra Suri, *Purusarthasidhyupaya*, D. J. S. N. Trust, Songarh, 1978, p. 61.
[35] Prasastapadacarya, *op. cit.*, p. 96.

Perchance, this could be taken as included in mouth air though it is compositionally different. Of course, if the concept of *prāṇas* as substance is taken, respiration may include it.

Some properties of air find mention in canons. It has been said the air helps combustion while whirl-wind obstructs it.[36] It is inhaled and exhaled by the body. Its material of molecular nature can be proved by its obstruction or subjugation.[37] *Bhagavatī* mentions its property of expansion and contraction. There are many types of micro-organisms in air. Their properties have come to science quite late in Pasteur's time.

Table 4 Various Types of Airs in Jaina Canons

	Uttarā-dhyayana 6	*Mūlācāra Tattvārthasāra* 7	*Prajñāpaṇā* 19	Santi Suri 8	*Daśavai-kālika* 7
	Wind blowing	Wind blowing	Wind blowing	Wind blowing	Fan air
1.	Upwards	Upwards	Upwards	Upwards	Leaves air
2.	Downwards	Downwards	Downwards	Downwards	Air, breeze
3.	Whirlwind	Whirlwind	Whirlwind	Whirlwind	Air, cloths
4.	Singing air	Singing air	Singing air	Singing air	Air, hand
5.	Dense air	Dense air	Dense air	Dense air	Air, feather
6.	Breeze, pure air	Breeze	Breeze	Breeze	Air, mouth
7.	—	Rarefied air	Rarefied air	Rarefied air	—
8.	—	—	Air from mouth	Air from mouth	—
9-16.	—	—	Air of 8 directions	—	—
17.	—	—	Stormy air	—	—
18.	—	—	Air destructive	—	—
19.	—	—	Wind in waves	—	—

Though air is *skandha*, but there is no mention whether it is a mixture or compound. The canons contain meagre physical or chemical properties of it. It is now known that there are many gases besides air, some

[36] Kundakundacarya, *op. cit.*, p. 442.
[37] Jain, S. A., *op. cit.*, p. 146.

colored and others colorless. They could be liquefied and solidified. They could be put to large number of uses.

The Vaisesikas[38] also have obliquely moving air which is recognised by touch and inferred by a hot a cold touch, production of sound and vibrations and by causing lighter bodies to float in sky. Despite mentioning its innumerable varieties, they have pointed only inhaling and exhaling air present in all parts of the body. Its obstruction has also been mentioned. It is said that it causes biochemical processes to proceed and the body to run, a fact not mentioned by the Jainas. The Buddhists have air as a primary matter with not much details about it.

The Fire or Taijasa Skandhas

The fire or *taijasa skandhas* represent various types of energy particles. Some of them like light are visible by sense of sight while others are perceived by senses other than sight. Basically sun-rays or fires are called *taijasa.* They are hot by nature—a point not mentioned in literature but observed physically. That is why sound energy has not been called *taijasa.* The *Prajñāpaṇā*[39] classifies these *skandhas* in two—fine and gross forms. It is the gross variety that has been classified in canons and shown in *Table 5.* The flames (with or without light) are the known forms of gross fires. *Daśavaikālika*[40] gives seven forms of fires while *Prajñāpaṇā* describes at least twelve forms. Others mention their own numbers. But if one takes pure fire as fire produced without fuels (i.e. by striking stones, rods or bamboos and gems (fire-burning through glass or gems) and star burning, electric lightning etc. are all included in the *ulkā* variety, then there is not much difference in the varieties of fires by different authors. It may be guessed that those mentioned ones are not the only fire *skandhas,* but there may be many others as the authors use the term etc. They have done so in case of water and earths also.

The above *taijaṣa skandhas* have three aspects : heat and/or light and electric lightning which is produced by difference in charges. Thus, it may be inferred that the term *taijaṣa* has included energies (of today) known during the canonical periods. The important point to be noted here is that the electric lightning or its forms in the sky have been taken as fire *skandhas.* These are natural forms of electricity. All these are described in Physics rather than Chemistry of today.

[38] Prasastapadacarya, *op. cit.*, p. 118-20.
[39] Vacak Syama, Arya, *op. cit.*, p. 46.
[40] Muni Nathmal, *op. cit.*, 26, p. 112.

Table 5 Various Types of Fires in Jaina Canons

Uttarā-dhyayana	*Daśavai-kālika*	*Tattvārthasāra*	*Prajñāpaṇā*	Santi Suri
Burning coal without smoke	Burning coal without smoke	Burning coal without smoke	Burning coal without smoke	Burning coal without smoke
Straw/ cowdung fire	Straw/ cowdung fire	Straw/ cowdung fire	Straw/ cowdung fire	Straw/ cowdung fire
Flame	Flame	Flame	Flame	Flame
Ulkā	*Ulkā*	...	*Ulkā*	*Ulkā*
Pure fire	Fuelless fire	Fuelless fire	Fuelless fire	Fuelless fire
Electric lightning	...	...	Electric lightning	Electric lightning
...	Halfburnt	...	Halfburnt	...
...	wood fire	...	wood fire	...
...	Common fire	Common fire	...	...
...	...	...	Star fire	Star fire (*kanak*)
...	...	Lamp fire	Lamp fire	...
...	...	...	Fire by rubbing	...
...	...	...	Gem fire	...
...	...	...	Nirghat fire	...

Shastri[41] has raised a point on the nature of *taijasa* body, fourth out of five bodies, living beings possess. It is the cause of heat, activity and digestion in the body. It is said to be fire invisible, devoid of impediments, caused by supernatural powers and luminating others while luminous by itself. It consists of an aggregate of infinite real atoms which are infinite times the number of atoms in the earlier bodies. Due to dense packing, it becomes finer. This luminous body is made up of energy *skandhas* or *taijasa vargaṇās*[42] whose size is between *āhāraka* (heat ?) and *bhāṣā vargaṇās*. This point has been commented upon earlier. Jain and Javeri[43] have called it electrical or electromagnetic in nature. This is found in every living beings from birth to death. Perchance heat or *āhāra* is converted into this energy for the body to be active and living. It may itself be inactive but it makes the others

[41] Shastri, J. M. L., *op. cit.*, p. 228.
[42] Nemicandra Cakravarti, *op. cit.*, p. 268.
[43] (a) Jain, G. R., *op. cit.*, p. 57 ; (b) Javeri, J. S., *op. cit*, p. 116.

active. Thus, the *taijasa* body is thermal or electrical form of the fire *skandhas*.

Akalanka[44] has described this body in thirteen ways. Accordingly its luminosity is as white as conch. It produces anger and happiness in the living and creates burning and combustion in others. Its size is innumerableth part of an *angula*, i. e. less than 10^{45} cm. It is infinite and universal. It has a max. age of 66 *sāgaropama*—a unit difficult to define at current state of our knowledge. These points are based on the *skandha* nature of *taijasa* body and require deeper studies for comparative evaluation.

Thaker[45] has raised one more point regarding the livingness of light and electricity. Current Science points out their non-living nature though the canons tell us these could be both ways. For example, air is necessary for life and lamps cannot burn without it. In contrast, electric lamps burn only in an airless atmosphere.

The Vaisesikas[46] presume *taijasa* atoms with hot touch and white glistening color. They consist of four forms—fuel fire, sky fire, biochemical fire and mineral fire. Out of these, the Jainas have only the first two. The biochemical fire or heat is produced in the body by which it functions. The *taijasa* of Jainas has been taken as heat energy. They, however, have electrical *taijasa* body too in addition. The mineral fire is nothing but gold obtained from minerals. This is not acceptable to the Jainas who also do not agree to the exclusive nature of hot touch to the fire skandhas which include gem fire also. Bauddhas have *taijasa* as a *skandha* with hotness causing cooking of materials.

Conclusion

The above description of molecular theory and specific *skandhas* of Jainas confirm, once again, that the theoretical concepts in this regard stand on better footing. The description of visible or gross world seems to be quite incomplete and small in comparison to our current knowledge. It must however be admitted that *Prajñāpaṇā* gives the best details of the period. Another fact emerging from the above is that the canons have differing or modified contents in nearly every specific case. It is, therefore, very necessary to collect and coordinate the material to present it in a uniform way.

[44] Bhatta, Akalanka, *Rajavartika-1*, Bharatiya Gyanpith, Delhi, 1954, p. 153.
[45] Shanti Suri, *op. cit.*, p. 29-32.
[46] Prasastapadacarya, *op. cit.*, p. 97.

Jain Theory of Measurement and Theory of Transfinite Numbers

NAVJYOTI SINGH

[From the previous issue]

Jain Theory of Measurement and Hierarchy of Actual Infinities

Notion of measure is central to Jain ontology and to an overall intellectual enterprise of Jain theoreticians. The Jains had a passion for giving measures of plural facets of reality right from the early days of Jainism. Integral part of their cosmological concern was measures of various facets of geographical, geological and astronomical realms.[41] Measures of various classes of souls with respect to their spatial extent, temporal stability and population was a unique and passionate concern of Jain thinkers.[42] It is only in this context that the theory of physical infinities and transfinite numbers was evolved by Jain theoreticians.

Reality for Jain thinkers was characterised by a unified simultaneous presence of apparently contradictory fact of change and the fact of permanence of change.[43] Permanence and change (origination, cessation) together characterised substrate of real and it was dialectics of the two that formed basis of Jain philosophical thought. This essential dialectics of permanence and change was apprehended with the concepts of *dravya* and *paryāya*.[44] *Dravya* was the principle of continuity which remains unchanged through the changes and *paryāya* was the principle

[41] Jain cosmos was divided into 3 sections (a) *Urdhvaloka*—astronomical realm (b) *Adholoka*—geological realm (c) *Tiryakloka* geographical realm. For details of this cosmological division see *Ganitanuyoga*.

[42] *Satkhandagama*, its commentary *Dhavala* and *Nemicandra*'s *Gomatasara*. Most ancient attempt to this end can be found in *Bhagavatisutra* and *Anuyogadvarasutra*.

[43] Central Jain ontological dictum was/utpadavyayadhrauvyayuktam sat/'real is endowed with origination, cessation and persistence', *Tatvarthasutra*. Also *Pravacanasara* [23].

[44] Hemacandra formulates it as central epistemological dictum in *Pramanamimamsa*/ pramanasya visayo dravyaparyayarthika vastu/ 'object of knowledge are entities having *dravya* as well as *paryaya* aspect'.

and sophisticated sensitivity towards relations of actual infinities compared to a simplistic dictum that all infinities are equal. Now we will reconstruct *alpabahutva* or order of actual infinities embodied by *dravya-s*.

According to Jain cosmological dogma whole space (*ākāśa dravya*) is divided into cosmos (*loka*) and non-cosmos (*aloka*) which envelops cosmos.[49] It is only in the cosmos part of space that other 5 *dravya-s* are to be found.[50] Non-cosmos part of space (*alokākāśa*) being only an empty place, completely empty place. Thus all the 5 *dravya-s* are bound within cosmos only. Within this boundedness of cosmos infinite *paryāya-s* exist and can happen. This is a reason why actual infinity as embodied in total space or *ākāśa dravya* is higher in cardinality than the actual infinity embodied by other five *dravya-s* and cosmic space (called *lokākāśa*). All *dravya-s* except time have being in bodies with spatial extension and are called *āstikāya*.[51] In other words all dravya-s except time are measurable in spatial units. Time according to Jain thinkers is incommensurable with space and has an independent measure orthogonal to space.[52] At an instant all spatial entities in cosmos share one and the same moment and at next moment whole cosmos shares one and the same next moment.[53] Time in a sense witnesses all changes in all the infinite things in cosmos as it is beginningless and endless. In this precise sense actual infinity of time has higher cardinality than the actual infinity contained in the cosmos at an instant. And *dharma*, *adharma*, *jīva* and *pudgala* are contained in totality at an instant in the cosmos.[54] Hence, cardinality of time is higher than the cardinality of actual infinities embodied in *dharma*, *adharma*, *jīva* and *pudgala āstikāya*

[49] *Sthanangasutra* [2.152].

[50] *Uttaradhyayanasutra* [28.7], quoted in *Ganitanuyoga* [p.5], says that 6 *dravya-s* are found in *loka*. And absence of 5 *dravya-s* in *aloka* is said in *Bhagavatisutra* [part 1 pp.230, 231], and the same is quoted in *Ganitanuyoga* [2.44]. See also *Pancastikayasara* [1.3].

[51] *Bhagavatisutra* [Book 3, p.315]. *Pravacanasara* (2.43.2) says that *astikaya* means: having spatial magnitude, *kaya* being collection of space points. *Ibid* [2-45] says that time *dravya* has no space point hence can have no *kaya*. Thus time is called *nastikaya dravya*. Also see *Pancastikaya* [1.4 and 4.102].

[52] This point has been discussed at length by Navjyoti Singh [1984].

[53] *Dhavala* [IV, p. 315] quotes from archaic source about moment of time in a poetic way/*rayananam* rasi iva te kalanu muneyavva/'moment of time is spred over space point like a thread of pearls'. Pearls or space points, are glued together with a thread of moment of time, the same moment of time.

[54] *Sthananga Sutra* [4.493].

dravya-s. Out of these four *dharma* and *adharma āstikāya-s* are coextensive with *lokākāśa*[55] and hence have the same cardinality. This is said as each and every space-point of *lokākāśa* has one point of *dharma* and one point of *adharma* only. But each space-point in *loka* can have many *jīvāstikāya* and *pudgalāstikāya*.[56] Jains contend that within a body of a soul many souls can reside as in one organism of an animal many micro organisms live. In other words *jīva* and *pudgala* admit of superposition much like waves in modern understanding.[57] *Jīva* and *pudgala* are denser than the space which makes room for it. Thus cardinality of *jīva* and *pudgala* is higher than the cardinality of *lokākāśa* but is lower than the cardinality of time as explained earlier. Jain thinkers regarded cardinality of *pudgala* to be higher than the cardinality of *jīva* because one soul is capable of adopting infinite bodies as they believed in the dogma of transmigration of soul or rather undestructibility of soul. In the cycle of transmigration one soul can adopt infinite bodies and infinite souls can adopt infinetely infinite bodies. Thus the cardinality of actual infinity embodied in soul *dravya* has to be less than the cardinality of actual infinity embodied by *pudgala*.

Thus the cardinal hierarchy of *dravya-s* or *alpabahutva* of *dravya-s* is : *Ākāśāstikāya* > *Kāla dravya* > *Pudgalāstikāya* > *Jīvāstikāya* > *Dharmāstikāya*=*Adharmāstikāya*.[58] The lowest cardinality being equal to the cardinality of cosmic space or *lokākāśa*.

For Jain theoreticians each of the *dravya-s* is capable of harbouring infinite modification (synchronic as well as diachronic) and are actual infinities and are all related to each other only in the framework of cardinality. We have formulated rational behind the order or framework of cardinality of actual infininities embodied by *dravya-s*. These actual infiinities are ontological entities representing six global principles of continuity and conservation. They are in a sense global physical actual infinities and their cardinal relations have also been arrived through physical argumentation. To understand entities smaller than global

[55] *Sthanangasutra* [4.495], *Tatvarthasutra* [5.13] and *Dhavala* [III, p. 29, *gatha* 9].

[56] *Sthanangasutra* [1.254] says that at one space point infinite material monads can be found. *Tatvarthasutra* [5.15, 16] compares soul with lamps whose light is the domain of soul. As in a room many lamps can be kept with equal domains so innumerous souls exist in same spatial domain.

[57] It is only because of possibility of superposition that in *asamkhyata pradesi* cosmos *ananta* souls and *anantananta* material monads can be contained.

[58] This hierarchy can be constructed from hierarchy of actual infinities given in *Dhavala* [III, pp. 30-31].

entities of *dravya-s* there is a need for understanding infinitesimal elements of these grand actual infinities. This is imperative for understanding or developing relative measures of infinitely many entities in the world. Deeper probing of infinitesimal elements led to developing more precisely idea of cardinality of infinities. The investigation into infinitesimals led to what can be called mathematical inquiry. This investigation was called by the Jains *alaukika gaṅita*. Understanding of nature and relations of infinitesimals gave rise to what we have called elsewhere Jain theory of measurement. Based on the infinitesimals, mathematics of transfinite number could develop and also theory of measures of various entities in the world. Here we would give one example of how idea of infinitesimal gave rise to a mathematical method of one-to-one correspondence for ordering non-global actual infinities.[59] Jains contended that total number of wretched souls (almost unfit for liberation called *mithyādṛṣṭi jīva rāśi*) though infinite are more than the actual infinity representing past time. *Dhavalā* gives very curious proof for this with the help of a thought experiment. *Dhavalā* says that keep all souls of *mithyādṛṣṭi* in one conceptual pond and all the past in other. Notice that both these ponds have infinite elements. Then remove one element from one pond and correspondingly one element from other. Keep removing one-one element from each pond. We will find that pond of elements of past gets exhausted whereas elements of *mithyādṛṣṭi jīva* ponds remain. As the past has ended but wretched souls remain in present. Thus *mithyādṛṣṭi jīva* has higher cardinality than the cardinality of time instants of past. This is because we see *mithyādṛṣṭi jīva* in present time and they have been always there. If *mithyādṛṣṭi* souls were less than the time-instants of past than they all would have attained liberation by now and there would have been no wretched soul at present. Jains hold that all souls intrinsically are capable of moving higher up in spiritual ladder and attaining liberation. Removing a soul from pond of *mithyādṛṣṭi* is equivalent of moving up in spiritual ladder by the soul through transmigration. This is a fine example of one-to-one correspondence method for determining cardinal relation of actual infinity which was possible because of notion of elements of actual infinity. Finding cardinal relation this way is exact and leads to consistent hierarchy of actual infinities. Any consistent hierarchy of actual infinities needs mathematical theory of transfinites. The Jains developed such a theory on the basis of their understanding of infinitesimal elements of *dravya-s*.

[59] *Dhavala* [III, pp. 28-32].

The Jains considered *dravya-s* to be of two kinds[60] from the point of view of infinitesimals : (a) Those whose elements are rigidly bound to make just one bounded whole. Their oneness can not be broken physically though conceptually they contain infinite elements. These are *dharmāstikāya* and *adharmāstikāya* coextensive with and having this property in common with *lokākāśa*. And (b) those whose elements are not rigidly bound and admit of unending multitude compared to (a) kind of *dravya-s*. These are rest of the four *dravya-s*. This is an important distinction as it is very significant for the distinction of *asamkhyāta* and *ananta* kind of mathematical actual infinities or transfinite numbers. The infinite elements of each *dravya-s* are of two kinds from a mathematical view point because of abovementioned distinction. Infinite elements of rigidly bounded *dravya-s* were called by Jains *asamkhyāta bhāga* (innumerableth elements) and infinite elements of loosely bounded *dravya-s* were called *ananta bhāga*. Both kind of elements were indivisible, only difference being that elements of first constitute actual infinity of lower cardinality than the elements of second. *Asamkhyāta* class of numbers have lower cardinality than *ananta* class of numbers. The elements of *dharmāstikāya*, *adharmāstikāya* and *lokākāśa* were space points (*pradeśa*), that of *jīvāstikāya* were souls, that of *pudgalāstikāya* were material monads (*paramāṇu*), that of *kāla dravya* were moments (*samaya*), and that of *ākāśa* were space points (*pradeśa*). Actual infinity of *dharma*, *adharma* and *lokākāśa* have *asamkhyāta* space-points,[61] that of *jīvāstikāya* have *ananta* souls that of *pudgala* have *ananta* material monads, that of *kāla* have *ananta* moments, that of *ākāśa* have *ananta* space points. According to Jains one soul has an spatial extension because of its *āstikāya* nature and it is a rigidly bounded entity unbreakable into parts. Thus each soul had spatial extension of *asamkhyāta* space-points.[62] In *Table IV* we have outlined elements and hierarchy of actual infinities of ontologically important entities.

[60] *Dhavala* [III, p. 29, *gatha* 9]/dhammadhammagasa tinni vi tullani honli thovani ; vaddhidu jivapoggalakalagasa anantagana/"*dharma dravya*, *adharma dravya* and cosmic space, these three are same and rigid ; and *jiva dravya*, *pudgala dravya*, moments of time, space points at *akasa*, these due to more and more increase are infinite times".

[61] *Tatvarthasutra* [5.7 and 5.13].
Pravacanasara [2.48] says that one space point, space occupied by a material monad, is capable of giving room to monads of all entities.

[62] *Tatvarthasutra* [5.8].

TABLE IV

Hierarchy of Global Actual Infinities in Increasing Order of Cardinality

Dharmāstikāya	(*asamkhyāta* space-points)	Cardinality of *Asaṃkhyāta* number
Adharmāstikāya	(*asamkhyāta* space-points)	
Lokākāśa	(*asamkhyāta* space-points)	
Eka Jīva	(*asamkhyāta* space-points)	
Jīvāstikāya	(*ananta souls*)	Cardinality of *Ananta* number
Pudgalāstikāya	(*ananta* material monads)	
Kāla dravya	(*ananta* time instant)	
Alokākāśa	(*ananta* space-point)	
Ākāśāstikāya	(*ananta* space-point)	

In essence all these *dravya-s* are representable in three kinds of infinitesimals. These are *pradeśa* (space-point), *samaya* (time instant), and *paramāṇu* (material monad).[63] On the basis of these three infinitesimals infinite *paryāya-s* in each *dravya-s* is measurable. In fact all actual infinites are evaluated on the basis of these three infinitesimals by the Jain theoreticians. These three infinitesimals provided analytical link between *dravya* and *paryāya* aspect of reality. They provided foundations of novel Jain theory of measurement. Unlike modern transfinite number theory due to Cantor the Jaina continum had three kinds of infinitesimals and not one.

Pradeśa, *paramāṇu* and *samaya* are uniquely related to each other according to Jains. *Pradeśa* was size of space occupied by one *paramāṇu*[64] and *samaya* was time taken for a *paramāṇu* to transverse from one *pradeśa* to another.[65] Based of these three infinitesimals and the unique relation between them Jains developed standard of measurement of *paryāya-s*, of all entities in the world.

According to Jaina thought only *paryāya* aspect of reality was subject to measurement and no *dravya* aspect of reality. That is, only

[63] *Sthanangasutra* [3.328] / tao acchejja pannatta, sam jahasamae, padese, paramanu/ 'three unpiercables are said to be *samaya* (moment), *pradesa* (space point) and *paramanu* (material monad)'. These three are also called, according to *Sthanangasutra* [3.329-335], *adhijja* (divisionless), *adajjha* (indestructible), *agijjha* (unconsumable), *anaddha* (unhalfable), *amajjha* (middleless) and *apaesa* (spatial extensionless).

[64] *Pravacanasara* [2.45 and 4.8].

[65] *Pravacanasara* [2.47].

changing facet of reality (fact of origination, cessation) is subject to measurements and not permanent (*dravya*) facet of reality. This in fact is a focal dictum of Jain theory of measurement. Change aspect (*paryāya*) could be synchronic in the sense of difference in many things at an instant or it could be diachronic in the sense of transformation of things in time. Synchronic measure is possible either by counting or by spatial distance, area, volume measure where as diachronic measure is possible by time interval measures. The minimal spatially cognisable difference in things (*paryāya*) is the minimum unit of length/area/volume and the minimal cognisable transformation of things (*paryāya parivartana*) in time is the minimum unit of time interval. All other measures will be multiple of the minimum measures and hence would be *samkhyāta* (numberable) measures. Interestingly the minimum unit of space and time measure is constituted out of infinitesimals. The minimum unit of time, called *āvali*, is constituted by *asamkhyāta* (innumerable) instants of time[66] and the minimum unit of length or size, called *ussanhāsanhīya*, is constituted by *ananta* material monads.[67] It is significant that minimum measure of time interval is an actual infinity with cardinality of *asamkhyāta* number whereas minimum measure of spatial size is an actual infinity with cardinality of *ananta* numbers. Why is it that such a distinction of *asamkhyāta* and *ananta* cardinality is drawn for minimum measures ?

Earlier we have shown that distinction between *asamkhyāta* and *ananta* was drawn on the basis of rigidly bounded and loosely bounded actual infinities. Is *āvali*, equal to *asamkhyāta* moment, a rigidly bounded infinity whereas length a loosely bounded infinity ? This is not the case but actual infinities of minimum units of measures are determined from the properties of infinitesimal moment and material monad. Length can be measured on the basis of spatial extension of material bodies only. As any conglomerate of material body is formed out of *ananta* material monads and even a space-point can contain *ananta* monads it is understandable that minimum length is actual infinity of *ananta* cardinality. For the minimum unit of time interval we will have to look into character of *samaya*. We have remarked before that *samaya*, infinitesimal element of time, is time taken by material monad to move from one space-point to another. This is a pragmatic relational definition of

[66] *Anuyogadvarasutra* [*sutra*, 357], *Dhavala* [III, p. 65].
[67] *Ganitanuyoga* [p. 446], *Anuyogadvarasutra* [*sutra* 344].

samaya or *kālāṇu* (atom of time).[68] Since there are *asamkhyāta* space-points in cosmos the time taken by a material monad to transverse whole cosmos would be *asamkhyāta kālāṇu*. *Āvali*, a minimum measure of time-interval, is a time taken for *paramāṇu* to transverse whole cosmos (*lokākāśa*) hence it has a cardinality of *asamkhyāta* number.

Once minimum unit of time interval and spatial distance is founded multiples of it would give numerbale (*samkhyāta*) measures of events in time and space. With minimum units of temporal and spatial expanse as elements, sets of *asamkhyāta* and *ananta* cardinality respectively can also be made. With them duration of existence and size of any entity (or *paryāya*) in cosmos can be measured. The Jains used these measures extensively to draw our description of entities in geological (*adholoka*), geographical (*tiryakloka*) and astronomical (*urdhvaloka*) realm as well as measures for use in trade and statecraft.

Another tenet of Jain theory of measurement was that there are three fundamental standards of measurement.[69] These are : (a) *dravya pramāṇa*—standard of measure of density ; (b) *kṣetra pramāṇa*—standard of measure of space ; and (c) *kāla pramāṇa*—standard of measure of time. These three standards have been formulated on the basis of three infinitesimals. (b) and (c) are understandable as they deal with measure of space and time and hence infinitesimal of space and time. It is *dravya pramāṇa* which stands out for explanation. It needs to be noted that in Jain cosmos *pudgala* and *jīva* provide density to the world. In other words their elements exist superimposed on each other. At a particular space-point numberable, innumerable or infinite material monads and souls can stay. Hence the denseness in the real world is entirely independent of space and time. *Dravya pramāṇa* includes measures of weights and even number specially for qualifying number of souls of various classes.

[68] In fact this definition of atom of time was source of confusion in Jain literature. It is for this reason that many Jain thinkers call this definition a pragmatic (*vyavaharika*) definition. *Pancastikaya* [*gatha* 26]. This is also related to early Jain controversy whether time is an independent *dravya* or not. *Tatvarthasutra* [5.38]. For detailed debate on it, see *Dravyanuyogatarkana* [10.14-19] and commentary on it. This controversy can also be related to confusion in characterising *asamkhyata* as finite number.

[69] There are actually four. The fourth one, *bhava pramana*, is just knowledge of the first three so it serves no practical purpose in theory of measurement. Information on standards of measurement is drawn from *Anuyogadvarasutra* [313-367].

With these three fundamental dimensions of measurement it becomes possible to pronounce measure of every conceivable thing. Once notion of actual infinity is founded at ontological level and units of measurement derived from infinitesimals of global actual infinities and further developing of detailed standard of measurement the stage was set to obtain detailed measures of entities of the world. All entities were actual infinities in terms of three distinct infintesimals but a numerable (*samkhyāta*) counting of these actual infinities was possible. In fact this exactly was the Jain notion of *samkhyāta* numbers. Unlike *asamkhyāta* and *ananta* numbers the countable numbers *samkhyāta* were not founded ontologically. Their existence is a posterior existence as they are based on counting actual infinities. Countability of physical actual infinities is an interesting aspect of the Jaina theory of infinities.

But if all entities in the world are actual infinity it is quite a task to develop consistent theory of cardinal hierarchies as it should not violate the order of things as given to us in the external world. Mathematics of transfinite as well as detailed arguments of cardinality of global actual infinities was developed just to fulfill this task by Jain theoreticians. It was a self-imposed project of Jains to develop this hierarchy so that the world of experience is not violated and on the other hand is comfortably reckoned with.

Since notion of actual infinity and notion of infinitesimal elements were evolved on the basis of ontology and measure theory, even the mathematics of actual infinities was rooted on the base of ontology and measure theory. Difference between *asamkhyāta* and *ananta* was made on the basis of ontological reasoning at the same time these classes of actual infinites were mathematically related transfinite numbers. Detailed mathematical typology of *asamkhyāta* and *ananta* were done to account for different physical actual infinities as well as for the sake of mathematical consistency. Mathematical reasoning was developed and adopted solely to relate physically existent actual infinities. It is an externality which gives it a content and not the intrinsic mathematical order as is the case in the modern theory of transfinite numbers, though the intrinsic constraints are not violated. It is only in this context that Jain mathematics of transfinite numbers can be understood.

Most consistent and well developed mathematical reasoning of transfinite numbers is to be found in that section of *Dhavalā* which is concerned with locating cardinality of actual infinity of *mithyādṛṣṭi jīva* of hell in accordance with different standards of measurement. Attempt was to locate cardinality in *alpabahutva* order (order according to being

more or being less) of mathematically exact actual infinities. In Appendix[70] is reproduced that section of *Dhavalā* which gives mathematics of transfinites while locating *mithyādṛṣṭi jīva rāsi* in order of *alpabahutva*. Algebraic transliteration of the prakrit passage is also given in Appendix. In *Table V* is given order of transfinites layed out in the text reporduced in Appendix.

TABLE V

Hierarchy of Ananta-S

$\log_2 \log_2$ (jpa)	Let $=\beta$	class of *asaṃkhyātasaṃkhyāta* (AA)
$\log_2$ (jpa)	2β	
$\log_2 \log_2$ (jaa)	$2\beta+1+\beta=\beta'$	
jpa	$2^2\beta$	class of *jaghanya paritānanta* (jpa)
$\log_2$ (jaa)	$2\beta'$	
$\log_2 \log_2$ (x)	$2\beta'+\beta'=\beta''$	
jpa^2	$(2^2\beta)^2$	
jaa	$2^2\beta'$	class of *jaghanya anantānanta* (jaa)
$\log_2$(x)	$2\beta''$	
$\log_2 \log_2$ (y)	$2\beta''+\beta'=\beta'''$	
jaa^2	$(2^2\beta)^2$	
X	$2^2\beta''$	
$\log_2$(y)	$2\beta'''$	
$\log_2 \log_2$(z)	$2\beta'''+\beta'''=\beta''''$	
x^2	$(2^2\beta'')^2$	
y	$2^2\beta'''$	
$\log_2$(z)	$2\beta''''$	
y^2	$(2^2\beta'')^2$	
z	$2^2\beta''''$	
maa	non quantitative	class of *madhyama anantānanta* (maa)
J	non quantitative	

In *Table VI*[71] is given *alpabahutva* order of most important actual infinities. For various classes of souls a much detailed order of *alpabahutva* not only of infinites but also of finites, as available from *Dhavalā*

[70] Text reproduced from *Dhavala* [III, pp. 21-26].
[71] Constructed on the basis of *Dhavala* [III, pp. 30-31].

is reproduced in *Table VII.*[72] Interestingly in *Dhavalā* while calculating number of souls in various stages of spiritual advancement (*guṇasthāna*),

TABLE VI

Alpabahutva Order of Sixteen Actual Infinities

Order	*multiple/addition**
Vartamāna kāla (present time)<*Abhavya* souls	[*jaghanya yuktānanta*]
Abhavya souls<*Siddha kāla*	[*ananta*: infinitesimal of past]
Siddha kāla<*Siddha jīva* (liberated souls)	[*samkhyāta*]
Siddha souls<*Asiddha kāla*	[*asamkhyāta* : numerable *āvaḷi-s*]
Asiddha kāla<*Atīta kāla* (past)	[+*Siddha kāla*]
Atīta kāla<*Bhavya Mithyādṛṣṭi* souls	[*ananta* : infinitesimal of *bhavya Mithyādṛṣṭi jīva*]
Mithyādṛṣṭi souls<*Bhavya* souls	[+*Bhavya* souls of 13 other *guṇasthānas*]
all *Mithyādṛṣṭi* souls<all *Samsārī* souls	[+*Siddha* (liberated) -souls]
all souls<*Pudgala dravya*	[*ananta*]
Pudgala dravya<*Anāgata kāla* (future)	[*ananta*]
Anāgata kāla<*Sampūrṇa kāla* (all time)	[+*vartamāna* (present)+ *atīta* past]
Sampūrna kāla<*Alokākāśa*	[*ananta*]
Alokākāśa<*Akāśa*	[+*lokākāśa* (cosmic space)]

*Sign '+' marks addition of the quantity on the left side of the inequality would give quantity on the right side where '+' does not occur the quantity in square bracket which multiplied on left side gives right side.

[72] This has been reproduced from Introduction, p. 29, *Dhavala* [III].

TABLE VII

Alphabahutva of Various Categories of Jīva according to Dhavala

Samkhyāta	*Asamkhyāta*	*Ananta*
1. *Sūkṣmasamparāya-samyata*	8. *Deśasamyata*	39. *Abhavya*
2. *Manahparyāyajñānī*	9. *Sāsādana*	40. *Siddha*
3. *Parihārasamyata*	10. *Miśra*	41. *Manah kasāyī*
4. *Kevaldarśanī/jnāñī*	11. *Aupaṣamika-samyaktvī*	42. *Krodha kasāyī*
5. *Yathākhyātasamyata*	12. *Kṣāyikasamyaktvī*	43. *Māyākasāyī*
6. *Chedosthapana-samyata*	13. *Kṣāyopaśamika-samyaktvī*	44. *Lobhakasāyī*
7. *Sāmāyikasamyata*	14. *Suklaleśyā*	45. *Kāpotaleśyā*
	15. *Avadhidarśanī/jñānī*	46. *Nīlaleśyā*
	16. *Srutajñānī*	47. *Krṣṇa Leśya*
	17. *Matijñānī*	48. *Anāhāraka*
	18. *Padmaleśyā*	49. *Ahāraka*
	19. *Pītaleśyā*	50. *Bhavya*
	20. *Manuṣya*	51. *Vanaspatikāya*
	21. *Puruṣavedī*	52. *Ekendrīya*
	22. *Nāraka*	53. *Asamjñī*
	23. *Strīvedī*	54. *Tiryanca*
	24. *Devagatī*	55. *Napunṣakavedī*
	25. *Vibhangajñānī*	56. *Mithyādṛṣṭī*
	26. *Manoyodī*	57. *Kuśruta*
	27. *Samjñī*	58. *Kumati*
	28. *Pañcendriya*	59. *Acakṣudarśanī*
	29. *Cakṣudarśnī*	60. *Asamyamī*
	30. *Caturendriya*	
	31. *Trīndriya*	
	32. *Dvīndriya*	
	33. *Vacanayogī*	
	34. *Trasakāyika*	
	35. *Tejakāyika*	
	36. *Prithvīkāyika*	
	37. *Jalakāyika*	
	38. *Vāyukāyika*	

whole relam of numbers (finite and transfinite) is mapped on to total number of souls which is for some strange reason is choosen as sixteen. In a sense whole realm of number of souls is normalised onto sixteen, thus mapping souls in different stages of spiritual advancement on the number domain of zero to sixteen. *Table VIII*[73] gives this scheme of normalisation. This exercise looks problematic as how can finite and transfinite numbers mapped on to neat domain of finite number.

TABLE VIII

Number of Souls in 14 Stages of Spiritual Advancement

Stage of spiritual advancement	*Number of souls*		*Relative number normalised to 16*	
1. *Mithyādṛṣṭī*	*ananta*		13	
2. *Sāsādana*	*asaṃkhyāta*		7/64	
3. *Miśra*	*asaṃkhyāta*		16/64	15/16
4. *Aviratasamyagdṛṣṭi*	*asaṃkhyāta*		32/64	
5. *Samyatāsamyata*	*asaṃkhyāta*		5/64	
6. *Pramattavirata*	59398206	*saṃkhyāta=8999 9997*		
7. *Apramattavirata*	29699103			
8. *Apūrvakaraṇa*	897			
9. *Anivṛttikaraṇa*	897			
10. *Sukṣmasamparāya*	897		1/16	
11. *Upaśāntamoha*	299			
12. *Kṣīṇamoha*	598			
13. *Sayogīkevalī*	898502			
14. *Ayogikevalī*	598			
15. *Siddha*	*ananta*		2	
Total Jīva rāśi	ananta		16	

[73] This has been reproduced from Introduction, p. 24, *Dhavala* [III].

In this section our attempt has been to lay out context within which Jain theory of transfinite numbers was developed. We have attempted to place *samkhyāta, asamkhyāta* and *ananta* terms in the context of Jain ontology and theory of measurement. If looked in this context, discord between notion of physical actual infinity and mathematical actual infinity stands explained. Regarding confusion in Jain texts, specially *Dhavalā* and *Gomaṭasāra*, on the finitude or infinitude or *asamkhyāta* we can only say that neither of these texts are primarily mathematical texts hence this confusion. For most mathematical and ontological argumentation *Dhavalā* quotes from the lost text called *Parikarma sūtra*. It seems likely that confusion in *Dhavalā* is because of inconsistent interpretation of older Jain ontology and theory of measurement.

Conclusion :

In the history of ideas ancient Jain theoreticians were the earliest to transcend simplistic thesis that all infinities are equal, a thesis which remained unchallenged elsewhere till around 19th century in Europe. The Jains evolved notion of actual infinity on ontological ground. Further, they evolved idea of three-fold infinitesimals which formed the basis of Jain mathematical atomism and layed foundation of theory of measurement. Internal consistency of Jain outlook of universe, which was populated by numerous actual infinities, critically depended on hierarchic order of various classes of actual infinities. Towards this end the Jains developed idea of cardinality of actual infinities. To establish consistent cardinal order physical and mathematical reasoning was employed. Hence Jains did not have mathematics of transfinite numbers detached or divorced from the physical basis of actual infinities. The formal reasoning of Jains was ensouled by the given external world. In a way reasoning was not that of auto-idos (Self-referential). This explains addition of quantities like 6 *rasi-s* and 6 *dravya-s* etc. in evaluating cardinality of mAA and maa, that is, in calculating values of β and Ω.

Two basic kinds of transfinites *asamkhyāta* and *ananta* were postulated because of rigidly bounded and loosely bounded nature of actual infinities found in the world. This distinction is made on ontological and physical basis. After this fundamental distinctions of two kinds of transfinite numbers, Jains developed detailed mathematical relations of 9-fold, 9-fold sub-classes of transfinites. These sub-classification was done to accomodate physical infinities of various kinds actually

found in the world. The mathematical operations developed to handle transfinite numbers was the greatest achievement of Jain theoreticians. Centrality attached to the operation of base 2 indexing and logarithm for cardinality determination and the ordering reminds one of genaralised continum hypothesis of Geroge Cantor. Why and how did Jains evolve base 2 indexing and logarithm operations for handling transfinite needs to be investigated in future. What formal intuition led them to such a step? Besides theoretical consequences of characterising real continum by three distinct kinds of infinitesimals unlike modern outlook which thinks continum to be populated by one kind of infinitesimal, needs to be pursued further. Perhaps it implies radical revision of the mathematical concept of measure and hence modern measure theory.

In conclusion we would say that it is definite that the Jains developed mathematics of transfinite before 800 AD though basic ordering of physical actual infinities could have been developed as early as 300 BC. There remained in Jain tradition a confusion about whether *asamkhyāta* is finite or infinite. This was a confusion of interpretation by Jain thinkers rather than inherent in the content of transfinite mathematics and physics of the Jains. The confusion comes because of interpretation of calculation of which according to one scheme is finite and according to other schemes is infinite.

As far as content of transfinite mathematics go there exists no difference between *asamkhyāta* and *ananta* class of numbers and they are handled similarly but in difference from *samkhyāta* class of numbers. And the difference between two classes of transfinites is due to ontological considerations. Jaina theory of infinities is radically different in context and genesis from the modern western theory of transfinite numbers. It has an explicit ontology and is not reducible to auto idos unfolding out of primitives, like the notion of set or actual numbers.

Appendix

Reproduction of a Section of *Dhavalā* dealing with Mathematics of Transfinite Class called *Ananta*.

एसो सव्वजीवरासीदो किंचूणमिच्छादिट्ठिरासीदो य अणंतगुणहीणो त्ति कथं जाणिज्जदि ? वुच्चदे—जहण्णपरित्ताणंतेस्त अद्धच्छेदणाणमुवरि तस्सेव वग्गसलागाओ[1] रूवाहिवाओ पक्खित्ते जहण्ण-अणंताणंतस्स वग्गसलागा भवंति। जहण्णपरित्ताणंतस्स अद्धच्छेदणाहि दुगुणिदाहि जहण्णपरित्ताणंते गुणिदे जहण्णमणंताणंतस्स[2] अद्धच्छेदणय-सलागा हवंति। एदाओ च जहण्णपरित्ताणंतादो असंखेज्जगुणाओ। तस्सेव उवरिम-वग्गादो असंखेज्जगुणहीणाओ।[3a & 3b] एदाणमुवरि जहण्ण-अणंताणंतस्स वग्गसलागाओ जहण्णपरित्ताणंतस्स अद्धच्छेदणाहिंतो विसेसाहियाओ पक्खित्ते पढम[4 & 5] वारवग्गिदसंवग्गि-दरासिस्स वग्गसलागा भवंति। जहण्ण-अणंताणंतस्स अद्धछेदणाओ जहण्ण-अणंताणंतेण गुणिदे पढमवारवग्गिदसंवग्गिदरासिस्स अद्धच्छेदणयसलागा[6] भवंति। एदाओ जहण्ण-अणंताणंतादो अणंतगुणाओ तस्सेव उवरिभवग्गादो अणंत[7a & 7b] गुणहीणाओ। एदाणमुवरि पढमवारवग्गिदसंवग्गिदरासिस्स वग्गसलागाओ पक्खित्ते[8] विदियवारवग्गिदसं-वग्गिदरासिस्य वग्गसलागा हवंत्ति। पढमवारवग्गिदसंव[9]ग्गिदरासिस्स अद्धच्छेदणाहि पढमवारवग्गिदसंवग्गिदरासि गुणिदे विदियवारवग्गिदसंवग्गिदरासिस्स अद्धछेदणयसला-गाओ भवंति। एदाओ पढमवारवग्गिदसंवग्गिदरासीदो[10a & 10b] अणंतगुणाओ तस्सेव उवरि-भवग्गादो अणंतगुणहीणाओ। एदाणमुवरि विदियवारवग्गिदसंवग्गिदरासिस्स वग्गसलागाओ पक्खित्ते तदियवारवग्गिदसंवग्गिदरासिस्स[11] वग्गसलागा भवंति। एसो वग्गसलागरतसो पढमवारवग्गिदसंवग्गिदरासीदो उवरि[12] एगमवि वग्गट्ठाणं ण चढिदो, तेणेदेसिं दोण्हं रासीणं वग्गसलागाओ सरिसाओ[13] होंताओ वि वग्गसलागाओ जहण्णपरित्ताणंतादो असंखेज्जगणाओ। जदि एसो रासी[14] सव्वजीववग्गतलागरासिणा सरिसो हवदि तो तिण्णिवारवग्गिदसंवग्गिदरासिणा[15a & 15b] वव्वजीवरासी वि सरिसो होज्ज ; ण च एवं। तं कधं ? 'जहण्ण-अणंताणंतं वग्गिज्जमाणे वग्गिज्जमाणे जहण्ण-अणंताणंतस्स हेट्ठिमवग्गट्ठाणेहिंतो उवरि[16] अणंतगुणवग्गट्ठाणाणि गंतूण सव्वजीवरासिदग्गसलागा उप्पज्जदि' त्ति परियम्मे वुत्तं। गुणगारो पि जम्हि जम्हि अणंतयं मग्गिज्जदि तम्हि तम्हि अजहण्ण[17] अणुवकस्साणंताणंतयं-घेत्तव्वं। ण च तदियवारवग्गिदसंवग्गिदरासि-वग्गसलागाओ[18] हेट्ठिमवग्गट्ठाणेहिंतो उवरि× परियम्म-उत्त×अणंतगुणवग्गट्ठाणाणि गंतूणुप्पण्णाओ,× किंतु हेट्ठिमवग्गट्ठाणादो उवरि सादिरेयजहण्ण-परित्ताणंतगुणभद्धाणं× गंतूणुप्प[19]ण्णाओ। केन कारणेण ? जहण्णपरित्ताणंतस्स अद्धच्छेदणाहिंतो विसेसाहियाहि[20] जहण्ण-अणंताणंतस्स वग्गसलागाहि तदियवारवग्गिदसंवग्गिदरासिवग्गसलामाणं[21] वग्गसल-गाओ×हेट्ठिमअद्धाणेणूणाओ× अवहिरिज्जमाणे सादिरेयजहण्णपरित्ताणंत[22] मागच्छदि त्ति।

ण च जहण्ण-अणंताणंतादो हेट्ठिम-अद्धाणं पडुच्च सादिरेयजहण्ण[23] परित्ताणंतगुणं गंतूण सव्वजीवरासिवग्गसलागाओ' उप्पण्णाओ, किंतु अणंताणंतगुणं[24] गंतूण। कुदो ? 'अणंताणंतविसए अजहण्णमणुक्कस्स-अणंताणंतेणेव गुणगारेण भागहारेण वि होदव्वं' इदि परियम्मवयणादो। ण च एदस्स जहण्णपरित्ताणंतादो विसेसाहियस्स असंखेज्जत्तमसिद्धं, संते वएणिट्ठंतस्स अणंतत्तविरोहादो। ण च अद्धपोग्गलपरियट्टेण वियहिचारो, उवयारे तस्स आणंतिपादो। को वा छद्दव्यपक्खित्तरासी ? वूच्चते-तिण्णिवारवग्गिदसंवग्गिदरासिम्हि—

सिद्धा णिगोदजीवा वणस्फदी कालो य पोग्गला चेव।
सव्वमलोगागासं छप्पेदे गंतपक्खेवा ? ।।१६।।

एदे छप्पक्खेवे पक्खित्ते छद्दव्वपक्खित्तरासी होदि। एदस्स अजहण्ण[25] मणुक्कस्स-अणंताणंतस्स जत्तियाणि एवाणि तत्तियमेत्तो मिच्छाइट्ठिरसी। एदं कधं णव्वदि त्ति भणिदे अणंता इदि वयणादो। एदं[26] वयणमसच्चत्तणं किं ण अल्लियदि त्ति भणिदे असच्चकारणुम्मुक्कजिणवयणकमलविणिग्गयत्तादो। ण च पमाणपडिग्गहिओ पयत्थो पमाणंतरेण परिक्खिज्जदि, अव्ववट्ठाणादो।

Terminology for transliteration into Algebraic Language

jpa = *jaghanya paritananta*
jaa = *jaghanya anantananta*
maa = *madhyama anantananta*
$\log_a$ = *Arvaccheda* (*addhaccheda* in Prakrit)
$\log_a \log_a$ = *Vargasalaka* (vaggasalaga in Prakrit)
jaa^{jaa} = Ist *Vargitasamvargita* of jaa = x
2nd *Vargitasamvargita* of jaa = $x^x = y$
3rd *Vargitasamvargita* of jaa = $y^y = z$
J = *Sampurna jiva rasi.*
M = *Mithyadrsti jiva rasi*
A = *Asamkhyata = Madhyama asamkhyatasamkhyata*
a = *Ananta = Madhyama anantananta*

Transliteration into Algebraic Symbols

1. $\log_2(jpa)+1+\log_2\log_2(jpa)=\log_2\log_2(jaa)$
2. $(jpa)^*[2\log_2(jpa)]=\log_2(jaa)$
3a & 3b. $jpa < \log_2(jaa) < jpa^2$
4. $\log_2(jaa) > \log_2(jpa)$
5. $\log_2(jaa)+\log_2\log_2(jaa)=\log_2\log_2(x)$
6. $(jaa)^*[\log_2(jaa)]=\log_2(x)$
7a & 7b. $jaa < \log_2(x) < jaa^2$
8. $\log_2(x)+\log_2\log_2(x)=\log_2\log_2(y)$
9. $(x)^*[\log_2(x)]=\log_2(y)$
10a&10b. $x < \log_2(y) < x^2$
11. $\log_2(y)+\log_2\log_2(y)=\log_2\log_2(z)$
12. $\log_2\log_2(z) < x^2$
13. $\log_2\log_2\log_2\log_2(z)=\log_2\log_2(x)$
14. $\log_2\log_2(x) > jpa$
15a&15b. $\log_2\log_2(z) \neq \log_2\log_2(j)$ or $z \neq J$
16. $jaa^n < \log_2\log_2(j)$
17. $a = maa > jaa$
18. $jaa < \log_2\log_2(z)$
19. $\log_2\log_2(z) < \log_2\log_2(J)$
20. $\log_2(jpa) < \log_2\log_2(jaa)$
21. $jaa^n > \log_2\log_2(z)$
22. $\log_2\log_2(z) - \log_2\log_2(jaa) = (jpa)^*A$
23. $jaa^{jpa} < \log_2\log_2(J)$
24. $jaa^* maa = \log_2\log_2(J)$
25. $z < maa = M$
26. $M < 6$ *Dravya rasi-s*

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Gleanings

Camphor-Scented Temples

SOUMITRA DAS

Little is heard and less seen of the splendid camphor-scented Jain temples of Ranakpur in Rajasthan. Perhaps because it is a bit out of the way when approached from Udaipur or Mount Abu, Ranakpur still hasn't become a popular tourist spot with its accompanying evils of shops selling gimerack, tea stalls, jostling crowds and jampacked parking lots that have lent an air of seediness even to the famous Dilwara temples of Mount Abu.

Set amidst a beautiful valley of the Aravalli range the 15th century temples of Ranakpur are dedicated to Adinath, a Jain deity. After heavy monsoon showers they are surrounded by lush grenery and murmuring brooks that melt into the tranquility of great hushed pools.

At the end of a road that snakes through the range of hills, Ranakpur has retained its pristine glory. Its towering *śikharas* open to the sun like lotus petals. At first glance its principal temple resembles Ankor Vat in Thailand, albeit on a much smaller scale.

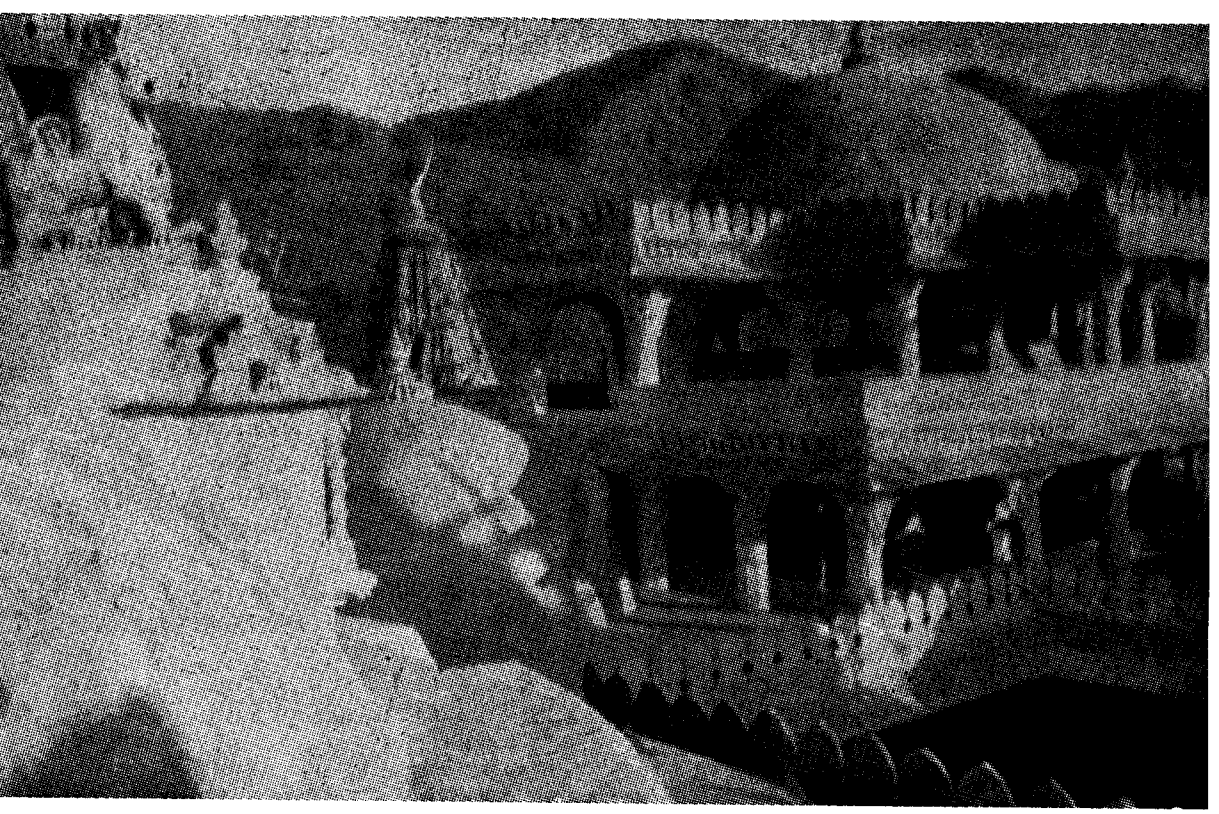
The Adinath temple covers 3,716 sq. mt. A flight of stairs leads into its grotto-like interiors. This is surmounted by the three-storeyed terraced portal. The entrance is exquisitely carved. Inside there is a magical world of gloaming shot with sun beams that pick out marble chiselled with such finesse that it looks as delicate as lace. Yet though five centuries separate us from the age when it was founded, the carvings remain untouched by the hand of time. Perhaps because the environment remains unpolluted.

One can only speak in superlatives of this huge edifice. It has 29 spacious halls and a profusion of columns 1,444 in all, but not one that resembles the other. Some reach a height of 40 ft. supporting the great central dome that is inscribed with circular motifs intersected by figures of divinities arranged like the spokes of a wheel. Besides, it has four huge *maṇḍapas* and four lofty *śikharas* that dwarf the several other stunted ones crowding around them.

Marmorial nymphs and deities of sinuous grace, flowers, mythic and real beasts and abstract patterns sprout from every niche, arch and lintel. Sunlight enamels these cold white carvings in vivid shades of ochre that blend with delicate hues of blue. There is such a welter of detail that what catches the eye is not the height of the temple or how well the plan is laid out but its mesmeric beauty in its totality.

The upper storeys are capped by huge domes and the towers or *śikharas* reach out to the skies. Snow white penants flutter atop them in the breeze. The placid hills encircle them like an amphitheatre. In their stillness they seem to be deep in meditation.

Built during the reign of Rana Kumbha of Mewar it follows the broad lines of the Solanki version of the Nagara temple style and corroborates the general description in *Vastu-sāra* of Thakkura Pheru, according to an article in *Jaina Art and Architecture*. This school had flourished during the Rana's reign and Ranakpur is its flower.



Ranakpur is a *caumukha* temple. Its ground has a pivotal square at the centre with four images of Adinatha in *padmāsana*, each 72 inches in height. Desepite its immense proportions and many columns these presiding deities in their sanctum sanctorums can be viewed from all sides. Which is why both the images and the temple are known as *caumukha* or *sarbatobhadra*.

Besides, there are 76 smaller cells and 84 shrines to minor deities round the temple. There are similar cells in the upper storeys, too. Other deities and the hallowed grounds where the Tirthankaras attained *nirvāṇa* like Astapada, Giranara and Sammetsikhara (Pareshnath Hills in Bihar) have been represented in stone.

Under the temple are innumerable subterranean cells with Jain images. One has to watch one's step while descending into the taperlit gloom.

In its totality the magnificent temple represents the celestial city, the cosmic Mount Meru with its lofty *śikharas* symbolising forests and peaks or even the world cave with its dark *garbhagṛhas* sheltering the icons, in accordance with the Jain cosmic system. This is what its founder Dharanshah had in mind when he planned the temple. He was a minister of Rana Kumbha, apart from being a deeply religious man who became an ascetic at the relatively early age of 32.

In his dream he had seen the Nalinigulamadevavimana an aeria, abode or one of the *kalpas* of Jainism. With the blessings of his Gurul Somasundar Surisvarji, he began the task of building a Dharanabihar temple, or in other words recreating heaven on earth in the year V.S. 1446. Rana Kumbha too was very enthusiastic. He promised to provide the land required for the temple and build a settlement around it. Many artists had thrown in their lot to win this great project but the one whose plan finally won the seal of approval was Sri Dipa who was from Mundara. An inscription on a pillar near the temple's entrance corroborates this.

After 50 years, the temple was finally erected in V.S. 1496 at a cost of what now seems a measly Rs. 99 Lakhs. In the same year Somasundar Surisvarji along with an entourage of 500 monks threw open the four entrance of what was also known as the Trailokyadipakaprasada or Tribhuvanavihara temple as its plan reflected the Jain view. Dharanshah had originally planned a seven-storey structure but he settled for three storeys as he was well-advanced in years.

In his *Rānigpur Caturmukh Prāsād Stavan* dating back to 1499, the poet Megh gives an eye-witness account of the splendour of the settlement of Ranakpur which he compares with Patan in Gujarat. According to the poet, 3,000 Jains lived there.

Another report of Akbar's time speaks of the restoration of the temple and the construction of a Meghnad *maṇḍapa*. There are other beautiful descriptions of the temple. They speak of five or even seven temples in the complex. But now only two of them, apart from the principal temple, stand. These are dedicated to Neminatha and Parsvanatha. The settlement has been wiped out. It is not known how. Their ruins can still be seen on the hillocks. It is said that in Aurangzeb's time the place was plundered. As late as between 1934-45 the temple was again renovated and opened in V.S. 2007.

What we see today is only comparable in its beauty to the more famous Dilwara temples of Mount Abu built a few centuries before it. In fact where symmetry of design, vastness of proportions and setting is concerned the Ranakpur temple is far superior. Hundreds of devotees, many of them in colourful local costumes come to pray here everyday. Bus services to the temple are excellent. The *dharamśālā* there is a worderful place to stay in. And Ranakpur, cut off from the hurly-burly of city life, remains unspoilt.

from The *Statesman*, March 24, 1990.

Registered with the Registrar of Newspapers for India under No. R. N. 12121/66.

Autumn 1990