Survey of the Work Done on Jain Mathematics

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ABSTRACT—In this article the author has drawn the attention of Scholars on the history of Mathematics towards the original source books on ancient Jain Mathematics. Attempt has been made to compile an almost upto-date list of the works done by various researchers on the subject.

The Jain literature, both religious as well as otherwise is indeed extremely vast and varied. In line with the corresponding literature of the vedic Hindus and the Buddhists, the Jainas have contributed a great deal to different branches of knowledge such as Grammar, Poetics, Koshas, Stories, Religion, Cosmology, Cosmography and indeed all the physical and social sciences known to us today. Language and Literature, Philosophy and Ethics, Fine Arts and Science, History and Culture of India inherited the rich literature of Jainism through the course of development of the original canon over the centuries.

Jain philosophy has propounded not only a unique theory of the soul and karma, but its contribution in the field of Science (Mathematics, Physics, Chemistry, Zoology, Botany, Astronomy etc.) is also very significant. The ancient Jain literature composed in Prakrit (Shorshaini & Ardhamagdhi) and Apbhransha languages contains significant material about the traditional as well as modern Mathematics. A systematic development of mathematical thought may be traced in the available Jain literature inspite of the fact that so many mathematical and conanical texts have either been lost or are still lying unexplored it.[1]

Early Jaina Texts[2] Sūrya prajnapti, Sūtrakritānga, Sthānānga Sūtra (Thānam), Bhagwati, Sūtra (Vyākhyā Prajnapti), Jivābhigama Sūtra Uttarādhyayan Sūtra, Anuyogadvara Sūtra, Jamboodvipa Prajnapati and its commentaries written by Shilānka (9th C. A. D.), Abhaideva Sūri (11th C. A. D.), Hemchandra Sūri (11th C. A. D.) and Malaigiri (12th C. A. D.) contain many important rules and descriptions about eight fundamental operations, frictions, combinations and permutations, law of indices, numbers, decimal place value system etc. A lot of material about plane as well as solid geometry is also available. Tattvārtha Sutra of Umāswami (Umaswati ?) is the first authentic religious work of the Jainas composed in Śanskrit Some available commentaries, namely, tattvārtha-dhigama Bhāsya (Umāswati), Sarvārtha Siddhi (Pujyapāda) Tattvārtha Rājvārtka (Akalank), Tattvārtha Shloka Vartic (Vidyānand) etc, contain many Geometrical formula and list of measurement. Concepts of Newton's first law of motion and law of conservation of energy are also available in rough form.

1. An idea of the un-explored Jain Mathematical Works can be had from the Author's Article on 'Some unknown Jain Mathematical Works' (Hindi) Ganita Bharti (Bulletin of Indian Soc. for History of Mathematics) 4 (1, 2) PP. 61-71 Jan-Apr.-1982.
2. The Dates of these texts are controversial but in any way it can't be prior than 500 B.C. and later than 500 A.D.

Kasāyapāhuda of Gunadhara (150 B. C.), Shatakhandagama of Pushpadanta and Bhuta Bali (Ist C. A. D.) together with Mahabandha, Tilloyapannatti of Yativrashabha (2nd-5th C. A. D), Dhawala of Vīrasen (9th C.A.D.) Jaidhawala of Jinasen (9th C.A.D.), Gommatsāra, Triloksāra & Khapanasara of Nemichandra Siddhanta Chakravarti (10-11th C.A.D.), Samyaggyan Chandrika with Artha Sandristhi Adhikars of Todarmala (17th C.A.D.) contain not only traditional mathematics, but also a detailed description of set theory, theory of transfinite and transidental numbers, theory of relativity etc. in quite a different terminology. The efforts of Prof. L. C. Jain to expose the mathematical aspect of Karma theory, which is parallel to recently developed system, theory are particularly noteworthy.[1]

The work of Jain mathematicians Sridhara[2] (750 A.D. ?), Mahavira (850 A.D.) and Simhatilak Suri (13th C.A.D.) etc. has been considered very significant in the field of Indian Mathematics. So many other mathematical texts and commentries written by Rajaditya (11th C.A.D.), Thakkar Feru (1372 A.D.), Shrasthi Chandra, Mahimodaya, Lalchandra, Madhav Chandra, Hemrāja etc. are yet to catch the attention of research workers in this field. In my opinion all these texts or commentaries are of much significance and may help to solve many historical problems. The details about all these manuscripts have been given by the author in another article.[3]

Evidently ancient Jain literature has considerable materials for the research scholars of History of Mathematics.

In the last fifty years lot of work has been done in this subject by known as well as unknown scholars. Not all this has unfortunately appeared in standard Mathematical publication or in the Journals on History of Mathematics. Major portion of this work is spread over various such magzines and souvenirs etc. which are generally not known to most of the scholars in the mathematical world. Hence the beginners in this field have to waste their valuable time and energy in collecting the information about the previous work done in this direction. In the absence of such information about the availability of relevant literature many researchers lose their interest and thus society in deprived of the knowledge gained by their predecessors. It is with this idea in mind that I have made an humble attempt to prepare a list of the works done by different workers and to present the same here for the convenience of other scholars.

The list as such has no claim for completeness. Any suggestions for fresh additions to this list would be most welcome by the author.

1. Agrawal, M.B. Lal—

I. "महावीराचार्य की जैन गणित को देन"
जैन सि० भा० (आरा)-24-1 पृ० 42-47 (1964)

II. "गणित एवं ज्योतिष के विकास में जैनाचार्यों का योगदान"
आगरा विश्वविद्यालय द्वारा स्वीकृत-शोध प्रबन्ध-पृ० 377, (1972)

III. "जैन साहित्य में गणितीय एंकेतन"
श्री जैन दिवाकर स्मृति ग्रंथ-बीकानेर (1979)

IV. "जैन साहित्य में संख्या संकलनादि सूचक संकेत"—सिद्धा० पं० कैलाश चन्द्र शास्त्री अभि० ग्रन्थ-रीवा—पृ० 402-410 (1980)

1. See Jain, L.C.—Article No. XXIII in the list.
2. His religious belief is still controversial.
3. Jain, Anupam—Articles Nos. V, VI and VIII in the attached list.

	V.	"जैन गणित में श्रेणी व्यवहार" आ० श्री धर्मसागरजी अभिवन्दन ग्रन्थ-कलकत्ता-पृ० 646-662	(1982)
2. Bag, A.K.	I.	'Mathematics in Ancient and Medievel India Chaukhamba Orientalia—Varanasi p. 344	(1979)
3. Bell, E.T.	I.	'Development of Mathematics' Macgraw hill—New York	1940
	II.	'Mahavira's Diophantine System B.C.M.S. (Calcutta) 28 pp. 121-122	(1946)
4. Boyer, C.B.	I.	'A History of Mathematics' John Wiley & Sons—New York	1968
5. Cajori, F.	I.	'History of Mathematics' (IInd revised and enlarged) Macmillan New York—P.	1958
6.Chakravarti, Guru Govind	I.	'Growth and Development of combination & Permutation in India' B.C.M S. (Calcutta)—24 pp. 7 -88	(1932)
	II.	'Surds in Hindu Mathematics' Jou. of Department of Letters—Calcutta Univ. 24 pp. 9-58	(1934)
7. Das, S.R.	I.	'Origin and Development of Hindu Numerals' I.H.O. (Poona)-3, pp. 97-120, 365-75	(1927)
8. Dikshit, S.B.	I	"भारतीय ज्योतिष" मूल मराठी कृति का हिन्दी अनुवाद, अनु०—शिवनाथ झारखंडी, हिन्दी साहित्य ग्रन्थमाला, प्रकाशन ब्यूरो—उ० प्र० शासन लखनऊ, पृ० 713	1957
9. Dutt, B.B.	I.	'On the Mahavira's Solution of Rational Traingles and Quadrilaterals' B.C.M.S. (Calcutta) 20-pp. 267-294	(1928)
	II.	'The Jaina School of Mathematics' B.C.M.S. (Calcutta) 21—pp. 115-143	(1929)
	III.	'Geometry in Jain Cosmography' Quellin and Studien Zur Geschichte der Mathematic-Abtolung B Sec-1 pp. 245-254	(1930)
	IV.	'Mathematics of Nemichandra' The Jain Antiquary 1-II pp. 25-44 हिन्दी अनुवाद-"नेमिचन्द्राचार्य का गणित" अनु०-अज्ञात, जैन दर्शन पृ० 1-7,एवं 50-54	(1935)
	V.	'A Lost Jaina Treatise on Arthematics' The Jain Antiquary (Arrah) 2-II pp. 38-41	(1936)
	VI.	'Sabda Sankhya Pranali' (Bengali) B.S.P.P.—(Bangiya Sahitya Parisad Patrika) B.S. pp. 8-30	(1930)
	VII.	'Aksara Samkhya Pranali (Bengali) B.S.P.P. B.S. pp. 22-50	(1936)
	VIII.	'Jain Sahitya Nama-Samkhya' (Bengali) Bangiya Sahitya Parishada Patrika (B.S.P.P.) B.S. pp. 28-39	(1937)
	IX.	'Nama-Samkhya' (Bengali) B.S.-P.P.-B.S. pp. 7-27	(1937)
	X.	Ankānām Vamto Gatih (Bengali) B.S.-PP.-B.S. pp. 7-30	(1937)
Dutt B.B. & Singh, A.N.	XI.	'History of Hindu Mathematics' (2 Vols) Motilal Bonarsidas-Lahore 1935-1937 IInd ed. (Combined) Asia Publishing House New Delhi-1962 प्रथम भाग का हिन्दी अनुवाद, अनु०-डा० कृपाशंकर शुक्ला, प्रकाशन ब्यूरो—उ० प्र० शासन-लखनऊ	1967
	XII.	'Hindu Geometry' (ed. by K.S. Shukla) 1. J.H.S.-15 2 pp. 121-199	1980
10. Divedi, Sudhakar	I.	"गणित का इतिहास" वाराणसी	1910
	II.	"गणक तरंगिणी" 1889,पं० पद्माकर द्विवेदी द्वारा संशोधित संस्करण-वाराणसी	1933
11. Eves, Harward		'An Introduction to History of Mathematics' Holt, Rienholt andWinston—New York.	1964
12. Gupta, R.C.	I.	Mahaviracharya on the Premeter and Area of an Ellipse' M.E. (Shiwan)VIII-1 pp. 17-19	(1974)
	II.	'Circumference of the Jambuduipa in Jaina Cosmography' I.J.H,S.(Calcutta)-10 1 pp. 38-44	(1975)
	III.	Mahāvirācārya's Bule for the Surface Area of a Spherical Segment—A new Interpretation' Tulsi Prajna (Ladnu)-I-2 pp. 63-64	(1975)

[IV. 'Jaina Formula for the Area of a Circular Segment, Jain Journal (Calcutta)-XIII-3 pp. 89-94 (1979)

13. Jaggi, O.P. I. 'Science and Technology in Medieval India Atma Ram & Sons—Delhi pp. 136-209 1977

14. Jain, Anupam
I. "गणित के विकास में जैनाचार्यों का योगदान" (एम० फिल्० योजना विवरण का सारांश—मेरठ वि० वि०, मेरठ) गणित भारती (दिल्ली)-3 (112) पृ० 43-44 (1981)
II. "प्राचीन भारतीय गणितज्ञ" अभिव्यक्ति (सलावा)-2 पृ०47-51 (1981)
III. "महावीराचार्य व्यक्तित्व एवं कृतित्व"-जैन सन्देश (मथुरा) शोधांक-47 दिस० पृ० 258-260 (1981)
IV. "षट्त्रिंशिका या षट्त्रिंशातिका" जैन सिद्धान्त भास्कर (आय)-34 (2) दिस० पृ० 31-40 (1981)
V. "कतिपय अज्ञात जैन गणित ग्रंथ"-गणित भारती (दिल्ली)-4 (1, 2) पृ० 61-71 (1982)
VI. "कन्नड साहित्य एवं गणित" सन्मति वाणी (इन्दौर)-11 (10) जून पृ० 8-12 (1982)
VII. "जैन गणित के अध्ययन की आवश्यकता एवं उपयोगिता" सेठ सुनहरी लाल जैन अभि० ग्रंथ-पृ० 356-361 (1983)
VIII. "जैन गणितीय साहित्य ' तुलसी प्रज्ञा (लाडनूं) में प्रकाशनार्थ प्रेषित
IX. 'Mahāvirāchārya the men & the Mathematician' Accepted for Publication in Acta Ciencia India (Meerut)

15. Jain, B.C. I. "गणित"—अन्तर्गत भारतीय संस्कृति के विकास में जैन तीर्थों का योगदान" अखिल विश्व जैन मिशन—अलीगंज (एटा) (1961)

16. Jain, B.S. 1. 'On the Ganita-Sar-Sangrah of Mahavira (850 A.D.) 1 J.H.S. (Calcutta)-12-1 pp 17-32 1977

17. Jain, G.R. I. 'Cosmology Old and New' (2nd Revised) Bhartiya Jnanpith, New Delhi 1974

18. Jain, H.L I. "भारतीय संस्कृति में जैन धर्म का योगदान" मध्य प्रदेश शासन, साहित्य परिषद्—भोपाल 1962

19. Jain, L.C
I. "तिलोयपण्णत्ति का गणित" जम्बुद्वीपपण्णत्ति संग्रहो के साथ प्रकाशित, जीवराज ग्रंथमाला-शोलापुर-पृ० 1-109 (1958)
II. "लोकोत्तर गणित विज्ञान के शोध पथ"-भिक्षु स्मृति ग्रंथ—कलकत्ता पृ० 222-231 (1961)
III. "गणितसारसंग्रह (महावीराचार्य कृत) विस्तृत प्रस्तावना, पाठ टिप्पणियों, परिशिष्टों सहित [श्री एम० रंगाचार्य के अंग्रेजी संस्करण (1912) के आधार पर] संपादित एवं अनूदित हिन्दी संस्करण-जैन संस्कृति संरक्षक संघ, शोलापुर (1963)
IV. 'On the Jaina School of Mathematics' छोटे लाल स्मृति ग्रंथ—कलकत्ता अंग्रेजी विभाग पृ० 266-292 (1967)
V. 'Researches on Jain Mathematics' Jnanpith Patrika—Sodha Visheshank (N. Delhi) Oct. Nov.—pp. 33-41 (1969)
VI. "भारतीय गणित शास्त्र एवं जैन लोकोत्तर गणित" अनुसंधान पत्रिका—जैन विश्वभारती (लाडनूं) अप्रैल-जून, पृ० सं० 20-37 (1973)
VII. 'Mathematical Foundation of Karma : Quantum System Theory' I Anusandhan Patrika, J.V.B. (Ladnu) Oct-Dec pp. 1-12 (1973)
VIII. 'Set Theory in Jaina School of Mathematics' 1 J.H.S. (Calcutta) 8-I pp. 1-27 (1973)
IX. 'Role of Mathematics in Jainology' Jou. of Birla Inst. of Arts & Music-Prachya Pratibha (Bhopal) 2-1 pp. 5-52 (1975)
X. 'Norms of Truth and non-violence for Karma Optimality'Tirthankar (Indore)-1-6 pp. 11-15 (1975)

XI. 'Jaina School of Mathematics (A study in Chinese Influence and Tronsmission)' Contribution of Jainism to Indian Culture-Motilal Bonarsidas-Varanasi pp. 206-220 (1975)

XII. 'Scientific Socio Political Control and Karma System Theory' Tirthankar (Indore)-1-4 pp. 12-15 (1975)

XIII. 'Zero's and Infinities of Ancient India' Tirthankar (Indore)-1-7-12 pp. 93-97, 106 (1975)

XIV. 'On analytic Treatment of Transfinite Numbers in Dhavali' Chainsukh Das Nyaytirth Smriti Granth—Jaipur, pp. 173-188 (1976)

XV. 'On certain Mathematical Topics of Texts' I.J.H.S. (Calcutta)-11-2 pp. 85-111 (1976)

XVI. 'Principle of Relativity in Jaina School of Mathematics' Tulsi Prajna (Ladnu)-5 pp. 20-28 (1976)

Tirthakar (Indore)-2-1 pp. 13-20, 21 (1976)

XVII. 'The Jaina Theory of Ultimate Particles'
"जैन दर्शन एवं संस्कृति आधुनिक संदर्भ में" इन्दौर वि०वि०, इन्दौर द्वारा प्रकाशित पत्रिका में pp. 53-55 (1976)

XVIII. 'Distinct Features of Indian Astronomy upto Aryabhatta I' Prachya Pratibha (Bhopal)-IV-2 PP. 118-222 (1976)

XIX. 'Mathematical Foundation of Karma System' Bhagwan Mahavir and his Relevence in Modern Times – Bikaner pp. 132-150 (1976)

XX. "आधुनिक शोध के सन्दर्भ में जैन गणित"-सन्मति वाणी (1976)

XXI. Divergent Sequences Locating Transfinite sets in Triloksar' I. J.H.S. (Calcutta)-12-1 pp. 59-75 (1977)

XXII. "जैन गणित विज्ञान की शोध दिशायें"-महावीर जयन्ती स्मारिका—ग्वालियर-पृ० 281-290 (1977)

XXIII. 'On the Contributions Transmissions and Influences of the Jaina School of Mathematical Sciences' Tulsi Prajna (Ladnu)-3-4 pp. 121-134 (1977)

XXIV. 'Mathematical Contributions of Todarmala of Jaipur' The Jain Antiquary (Arrah) 30-1 pp. 10-122 (1977)

XXV. "जैन ज्योतिष एवं ज्योतिष शास्त्री"-मुनि द्वय अभि० ग्रंथ—जोधपुर पृ० 392-399 (1977)

XXVI. 'Crisis in Mathematics Tirthakar (Indore)-3-1 pp. 16-18 (1977)

XXVII. "पंडित परम्परा और जैन गणित विज्ञान" तीर्थंकर (इन्दौर)-6-3 पृ० 73-78 (1978)

XXVIII. "समयसार सप्तदशांगी टीका में गणितीय न्याय एवं दर्शन" श्रमण (वाराणसी) 29-9 पृ० 6-11 (1978)

XXIX. 'Perspective of System Theoretic Technique in Jaina School of Mathematics between 1400-1800 A.D.' I. Jain Journal (Calcutta)-13-2 pp. 49-66 (1978)

XXX. 'System Theory in Jaina School of Mathematics-I I. J.H.S. (Calcutta) 14-1 p. 29-63 (1979)

XXXI. "आगमों में गणितीय सामग्री तथा उसका मूल्यांकन-तुलसी प्रज्ञा (लाडनूं) खंड-6, अंक-9 पृ० 35-69 (1980)

XXXII. "विज्ञान के परिप्रेक्ष्य में जैन सिद्धान्त"-पं० बाबूलाल जैन जमादार अभि० ग्रन्थ, बड़ौत पृ० 165-169 (1981)

XXXIII. "सिद्धान्त चक्रवर्ती नेमिचंद्राचार्य का गणितीय उपक्रम"-भ० बाहुबली प्रतिष्ठापना सहस्राब्दि महोत्सव, महाभिषेक स्मारिका, नई दिल्ली पृ०सं० 209-212 (1981)

XXXIV. System Theory in Jainism and Science Paper Readin Jain Vidya Sangosthi Bombay 7-8 Sep. (1982)

XXXV. 'The Jaina School of Exact Science' (Five Volume) Due for Publication

XXXVI. 'The Jaina School of Exact Science' (Five volume) Due for Publication

Jain, L.C & Ved. Prakash XXXVII. 'आधुनिक गणितीय शोध के सन्दर्भ में जैन गणित का पूर्वेक्षण'-तुलसी प्रज्ञा (लाडनूं) 6 पृ० 67-78 (1976)

Jain, L.C. & Jain C.K.	XXXVIII.	'Contribution of Jainology to Indian Karma Structure Theory' Tulsi Prajna (Ladnu) 7-5, 6, pp. 1-10	(1982)
	XXXIX.	"जैनाचार्यों द्वारा कर्म सिद्धान्त के गणित का विकास" आ० श्री धर्मसागरजी अभिनन्दन ग्रंथ, कलकत्ता पृ० 663-672	(1982)
20. Jain, N.C. (Shashtri)	I.	"आचार्य नेमिचन्द्र एवं ज्योतिष शास्त्र" जैन सि० भा० (आरा) पृ० 6-11	(1940)
	II.	"जैन गणित की महत्ता"-नाथूराम प्रेमी अभि० ग्रंथ—इन्दौर पृ० 713-723	(1945)
	III.	"श्रीधराचार्य" जैन सि० भा० (आरा)14-1 पृ० 31-42	(1948)
	IV	"भारतीय ज्योतिष का पोषक जैन ज्योतिष"-वर्णी अभि० ग्रंथ-सागर-पृ० 478-484	(1950)
	V.	"ग्रीक पूर्व जैन ज्योतिष विचारधारा"-ब्र० चन्दाबाई अभि० ग्रंथ—आरा पृ० 462-466	(1954)
	VI,	"भारतीय ज्योतिष"-भारतीय ज्ञानपीठ—काशी प्रथम संस्करण	1958
	VII.	"जैन ज्योतिष साहित्य"-आचार्य भिक्षु स्मृति ग्रंथ—कलकत्ता पृ० 210-221	(1961)
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