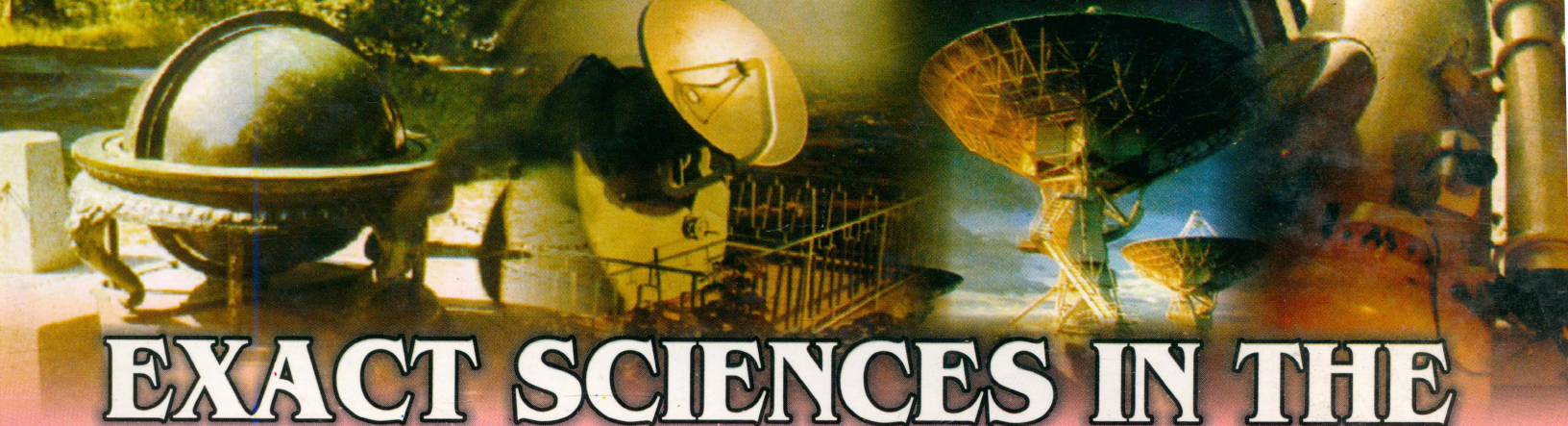


EXACT SCIENCES IN THE KARMA ANTIQUITY

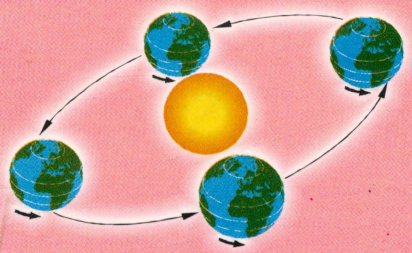
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LAXMI CHANDRA JAIN

With The Collaboration Of

PRABHA JAIN

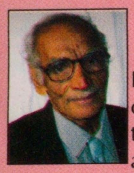
VOLUME - IV



APPENDICES ON THE KARANĀNUYOGA TEXTS AND MISCELLANY

SHRI BRAHMI SUNDARI PRASTHASHRAM

21, Kanchan Vihar, Vijay Nagar, JABALPUR



About the Author

He was born at Saugar (M.P.) on 1st July, 1926. He passed the M.Sc. examination in applied mathematics from the university of Saugar in 1949. Interestingly, he also holds a Diploma in Homoeopathy and Biochemistry (1971).

He joined the Madhya Pradesh State Educational Service in 1951, and served various Government Colleges in various capacities till his retirement in 1984 as Principal of the Govt. P.G. College, Chhindwara. Since then he is the Honorary Director of the Acharya Shri Vidyasagara Research Institute, Vijay Nagar, Jabalpur.

Prof. Jain is a well-known scholar, especially, in the field of Jaina mathematics. He has carried out deep studies of Sanskrit and Prakrit texts of the Jaina School. He is very proficient in mathematical systems theory.

He is proliferous writer both in Hindi and English. His writings are full of variety, covering publications in unified field theory, history of Indian mathematics, and popular articles which are related to general topics as well as to history of science. Special mention may be made of his recently completed huge INSA project on the Labdhisara about 1000 A.D. which is on advanced theory of Karma System. He has also completed an INSA project on the "Prastara Ratnavali", as well as third project from INSA on the Mathematical Contents of the Digambara Jaina Texts on Karananuyoga Group.

The work of Professor L.C. Jain, Dr. R.C. Gupta (Unesco representative in India) and Professor J. Needham shall go a long way in filling up the gaps in the history of science in India.

For more than three decades, Prof. L.C.Jain has been dedicated to ancient mathematics. His vast knowledge of Jaina sources and long experience has made him a great authority of Jaina exact sciences. He has a good knowledge not only of ancient languages (including Sanskrit and Prakrit) and of ancient exact sciences but also of several modern languages and modern mathematical sciences.

Recently, he has been awarded the Prakrit Jnana Bharti Education Trust, Bangalore Award for his meritorious services in scientific studies of Prakrit Literature. His work, The Tao of Jain Sciences, has also been awarded by the Kundkund Gyan Pith, Indore.

EXACT SCIENCES IN THE KARMA ANTIQUITY

BY

LAXMI CHANDRA JAIN, M.Sc., D.H.B.
RETIRED PRINCIPAL GOVT. P.G. COLLEGE, CHHINDWARA
Visiting Fellow, Ex- INSA Research Associate,
Secretary, G.R.Karma Science Museum, Jabalpur (M.P.)

WITH THE COLLABORATION OF

PRABHA JAIN, M. A., M.PHIL., PH.D.
DIRECTOR, ŚRĪ BRAHMĪ SUNDARĪ PRASTHĀŚRAMA
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EXACT SCIENCES IN THE KARMA ANTIQUITY

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करणानुयोग ग्रंथों की विषयानुक्रमणिका

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2. नारक लोक स्वरूप निरूपण प्रज्ञप्ति
3. भवनवासी लोक स्वरूप निरूपण प्रज्ञप्ति
4. मनुष्यलोक स्वरूप निरूपण प्रज्ञप्ति
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THE FORMER AUTHOR WOULD LIKE TO EXPRESS HIS SOLEMN AND CHERISHED GRATITUDE TO HIS BELOVED LATE WIFE *Shreemati Gulab Rani* WHO COOPERATED WITH HIM FOR MORE THAN HALF A CENTURY IN HIS RESEARCH, TEACHING AND ADMINISTRATIVE WORKS.

INDEBTEDNESS IS DUE TO THE FOLLOWING ACADEMICIANS FOR THEIR TIMELY HELP :

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Professor V.V. Narlikar (Poona, India)
Professor K.S. Shukla (Lucknow, India)
Professor R.C. Gupta (Jhansi, India)
Professor G. Sahasrabudhe (Nagpur, India)
Professor Lakhmi C. Jain (Adelaide, Australia)

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SOME REMARKS ON THE WORKS OF PROF. L. C. JAIN

I have been able only briefly to glance over pages of your remarkable book, 'The Tao of Jaina Sciences' you kindly sent me. I was impressed by the profound back ground of your presentation. I have to confess that I had to be stuck at every term I met technical terms in languages of Indian origin.....

Your way of attributing the differentiation of bio-creature classes to different kinds of karmas restricting them reminds me of the fundamental groups in defining different kinds of geometry according to the Erlangen Programme.

Kazuo Kondo
Prof. Emeritus, Tikyo University

I'm very happy to hear of your progress in your most important historical research..... please do replace the book and keep me informed (Via abstracts of summaries) of your progress so that I may give further work and thought to this area.

R.E.Kalman
Research Professor, University of Florida

The Tao of Jaina Sciences is a veritable mine of information on the history and philosophy of the Jaina sciences. It is indeed a mile-stone in the history of world on Indian Philosophy as it discusses at length the Jaina sciences in the context of the complex of old and new philosophies spread across the globe.

C.K. Jain
Secretary-General, Loka Sabha, New Delhi

During recent times a vast number of research and investigation work has been carried out in lokottara mathematics of the Jaina School. The foremost credit of this goes to Professor Laxmi Chandra Jain, who has greatly contributed in bringing to light these achievements of the Jainas and also in correlating them with corresponding results of modern mathematics. Indeed, it is important and immeasurable.

R. C. GUPTA
M.Sc.(Goldmedalist), Ph.D.(Hist. of Math.)

रानी दुर्गावती विश्वविद्यालय
RANI DURGAWATI UNIVERSITY
(Formerly University of Jabalpur)

जस्टिस गुलाब गुप्ता
कुलपति

Justice Gulab Gupta
Vice-Chancellor
Formerly
Chief Justice, High Court of H.P
Judge, High Court of M.P. and
Chairman, M.P. State Human Rights Commission

Saraswati Vihar, Pachpedi,
Jabalpur (M.P.) - 482001, INDIA.

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FOREWORD

"The Exact Sciences in the Karma Antiquity" constituted a series of the Indian National Science Academy Projects (1984-1995), operated at this University by Professor L.C. Jain, with the assistance of Dr. Prabha Jain. The series of publications also included several other research works pursued by the authors for the History of Science in India.

This series of works forms the foundation for research into the mysterious, symbolic and mathematical theory of Karma, in the ancient Prakrit Texts. During the last century, there has been an increasing interest in the ancient Indian scientific awakening and achievements. This publication, I am confident, will be welcomed into the world of historical learning where problems about the scripts, place value notation, comparability of transfinite sets, as well as the biological phenomena still persist.

I appreciate the hard labour of the authors and hope that this would go a long way to serve the cause of the humanity.

My best wishes,

(Justice Gulab Gupta)

LIST OF ABBREVIATIONS

WORK

ABT	Āryabhaṭīya of Āryabhaṭācārya
AGS	Āṅgasuttāṇi
APN	Ādipurāṇa of Ācārya Jinasena
ASG	Artha Saṁdṛṣṭi of Ṭoḍaramala
BBS	Bhadrabāhu Saṁhitā of Ācārya Bhadrabāhu
BJK	Bṛhajjātakaṁ of Varāhamihira Ācārya
BKS	Bṛhatkṣetrasamāsa of Ācārya Jinabhadra
BSG	Bṛhatsaṅgrahaṇī sūtra of Ācārya Candrasūri
BTS	Bhāṣikā Ṭīkā of Ṭoḍaramala
CPJ	Candraprajñapti Sūtram
DVL	Dhavalā Commentary of Vīrasenācārya
DVS	Dravyasaṁgraha of Muni Nemicandra
GJK	Gommaṭasāra Jīvakāṇḍa of Ācārya Nemicandra Siddhānta Cakravartī
GKK	Gommaṭasāra Karmakāṇḍa of Ācārya Nemicandra Siddhānta Cakravartī
GNG	Gaṇitānuyoga (Collection) by Muni K.L. 'Kamal'
GSS	Gaṇitasārasaṅgraha of Mahāvīrācārya
GTK	GaṇitaTilaka of Ācārya Śrīpati
JDL	Jayadhavalā Commentary of Vīrasenācārya and Jinasenācārya
JGD	Jaina Gem Dictionary. by J. L. Jaini
JKP	Jyotiṣa Karaṇḍakam Prakīrṇakam
JLV	Jaina Lakṣaṇāvalī by B. C.Siddhānta śāstrī
JPS	Jaṁbūdīvapaṇṇattī Saṁgaho of Ācārya Paumnandi (Sholapur)
JPT	Jaṁbūdīva-paṇṇattī Saṁgaho (Bombay)
KJP	Kevala Jñāna Praśna Cūḍāmaṇi of Ācārya Samantabhadra
KPS	Kasāya Pāhuḍa Sutta of Ācārya Guṇadhara
LKS	Laghukṣetrasamāsa of Ācārya Ratnaśekhara

LVG	Loka Vibhāga of Ācārya Siṁhasūri
LVV	LaghuVidyānuvāda by Ācārya Kunthusāgara
LVY	Loka Vijaya Yantra (of Ācārya Bhadrabāhu ?)
MBD	Mahābandha of Bhagavanta Ācārya Bhūtabali
MBK	Mahābhāskarīya of Bhāskarācārya
MHP	Mahāpurāṇa of Puṣpadanta
PGT	Pāṭīgaṇita of Śrīdharācārya
PJP	Praśna Jñāna Pradīpikā
PSD	Pañca-Siddhāntikā of Varāhamihira Ācārya
PSK	Pañcāstikāya of Ācārya Kundakunda
SKG	Ṣaṭkhaṇḍāgama of Bhagavanta Ācārya Puṣpadanta and Bhagavanta Ācārya Bhūtabali
SPJ	Sūrya-Prajñapti Sūtram
SSD	Sūrya-Siddhānta
SVS	Sarvārthasiddhi of PūjyaPāda
TLS	Trilokasāra of Ācārya Nemicandra Siddhāntacakravartī
TPT	Tiloyapaṇṇattī of Ācārya Yativṛṣabha
TVT	Tattvārthavārtika of Bhaṭṭācārya Akalaṅkadeva
UPN	Uttarapurāṇa of Ācārya Guṇabhadra
VDJ	Vedāṇga Jyotiṣa of Lagadha Ācārya
VTN	Vrata Tithi Nirṇaya (by N.C. Śastrī)
YTR	Yantrarāja of Mahendra Guru
YTS	Yantraśiromaṇi of Śrīviśrāma

JOURNALS

AHEI	Archives of History of Exact Sciences
AORS	Annals of Bhaṇḍārkara Oriental and Research Society
ARAS	Archaeo-Astronomy
ARVC	Arhat Vacana (Indore)
ASCN	Āsthā Aura Cintana (Felicitation Volume)

ASRE	Asiatic Research
BAMT	Bibliothica Mathematica
BCMS	Bulletin of Calcutta Mathematical Society
CNTR	Centaurus
EPGI	Epigraphica Indica
GNBT	Gaṇita Bhāratī
HRST	Historia Scientiarum
IDIR	Indo-Iranian Journal
IDST	Indological Studies
IJHS	Indian Journal of History of Science
HRMT	Historia Mathematica
ISJM	Proc. International Seminar on Jaina Maths and Cosmology (DJICR, Hastināpura)
JAOS	Journal of American Oriental Society
JASC	Journal of Asiatic Society, Calcutta
JASI	Journal of Astronomical Society of India
JBRS	Journal of Bihar-Orissa Research Society
JGKV	Journal of Gaṅgānātha Jhā Kendrīya Sanskrit Vidyapīṭth (Allahabad)
JNAQ	Jaina Antiquary (Arrah)
JNSB	Jaina Siddhānta Bhāskara (Arrah)
JRAS	Journal of Royal Asiatic Society of Great Britain and Ireland
JRHA	Journal of History of Astronomy
MASI	Memoirs of Archaeological Survey of India
MTED	Mathematics Education
NISI	National Institute of Science in India
SCMT	Scripta Mathematica
TSPJ	Tulsī Prajñā (J.V.B.I. - Ladnun)

ROMAN TRANSLITERATION OF DEVANĀGARĪ

VOWELS

Short:	अ	इ	उ	ऋ	ऌ		
	a	i	u	ṛ	ḷ		
Long:	आ	ई	ऊ	ए	ओ	ऐ	औ
	ā	ī	ū	e	o	ai	au

Anusvāra: . = ṁ

Visarga: : = ḥ

Non-aspirant अ = ऽ

CONSONANTS

Classified:	क्	ख्	ग्	घ्	ङ्			
	k	kh	g	gh	ṅ			
	च्	छ्	ज्	झ्	ञ्			
	c	ch	j	Jh	ñ			
	ट्	ठ्	ड्	ढ्	ण्			
	ṭ	ṭh	ḍ	ḍh	ṇ			
	त्	थ्	द्	ध्	न्			
	t	th	d	dh	n			
	प्	फ्	ब्	भ्	म्			
	p	ph	b	bh	m			
Unclassified:	य्	र्	ल्	व्	श्	ष्	स्	ह्
	y	r	l	v	ś	ṣ	s	h
Compound:	क्ष्	त्र्	ज्ञ्					
	kṣ	tr	jñ					

मंगलाचरण

अलंघ्यं त्रिगत्सारं यस्यानन्त चतुष्टयम् । नमस्तस्मै जिनेन्द्राय महावीराय तायिने ।।1।।
संख्याज्ञान प्रदीपेन जैनेन्द्रेण महत्विषा । प्रकाशितं जगत्सर्वं येन तं प्रणमाम्यहम् ।।2।।

-गणितसार संग्रहः

Adoration to Mahāvīra, the Lord of the Jinas, the protector (of the faithful), whose four infinite attributes, worthy to be esteemed in the three worlds, are unsurpassable (in excellence).

- Gaṇita Sāra Saṅgraha

DEDICATED
TO

ALL THE FIVE BELOVED-SUPREME OF ALL REGIONS AND ALL TIMES,

THE ARIHANTAS, THE SIDDHAS, THE ĀCĀRYAS, THE UPĀDHYĀYAS

AND THE SĀDHUS

WITH ADORATION TO

THEIR HOLINESS

THE GREAT AND VERSATILE DIGAMBARA JAINA ASCETICS

WHO ARE NINE CRORE AS REDUCED BY THREE

EXISTENT IN THE TWO AND A HALF ISLANDS

ALL OF WHOSE BLESSINGS ARE WITH US

INTRODUCTION
(IMPORTANCE OF MATHEMATICAL RESEARCH)

Mathematics is usually separated into its pure and applied aspects. A line can not be drawn between them, and they traditionally fructify each other. The role of mathematics in the modern world can be visualized in the proliferation of the mathematicians since 1900. These 100 years have seen many branches of medieval and modern pure mathematics brought into application in the artificial intelligence used in expertize, robotics and space research. Activities of a more or less mathematical character now employ tens of thousands of workers at all levels of competence. Mathematics is now no longer the preoccupation and an academic elite, it is a broad profession attracting talented men and women in ever increasing numbers. Mathematical research and teaching have extended to enormous limits and its techniques have penetrated deep into such fields which are outside the mathematical sciences such as physics, into new realms of technology, as also in biological sciences, into economics as well as other social sciences. Computers have shown the importance of mathematical research.

About three centuries ago the main fabric of mathematical thought was supplied by geometry, inherited from the ancients and augmented meagerly during the last two thousand years. Then a rapid and radical transformation arose in the structure and foundation of mathematics due to revolution in the concepts of transfinite numbers and sets introduced by Georg Cantor (c.1864 A.D.) and the subsequent emergence of the rigorous, axiomatic, deductive style of geometry which yielded to inductive, intuitive insights, and formalistic attitudes. This had the consequence that purely geometric notions gave way to concepts of number and algebraic operations embodied in analytic geometry, the calculus and mechanics. The new mathematics spearheaded the forward thrust of science and technology. The medieval accumulated wealth of results and the demonstrated power of mathematical science and technology brought a widening of the narrow human basis of scientific activity, and opening up of new careers in the expansion of human knowledge and revelation of the herefore secrets of nature.

The 16th century started with the "classical" mathematics, retaining its form, power and position still today. It may be seen that some of its most fruitful work has come down through clarification and generalization of the its two basic concepts in calculus. One is that of a function or functional which is concerned with the interdependence of two or more variables. The second is that of the limit, which brings the intuitive notion of continuity within rigorous scrutiny. Similarly, the concepts of mathematical analysis, including the theory of differential equations, which is an essential tool for dealing with rates of change, covers a vast expanse of modern mathematics. When geometry became free from the dependence of the conceptual function and the numbers of various types its first and foremost offsprings had been the evolution of the topology, differential geometry, differential topology, algebraic topology and so on. Then there was the origination of the field of probability on which rests the global applications in science, technology and philosophy of science. The foundation of mathematics aims at the structure of mathematics as well as the meaning of "existential" and "constructional" sets as the objects of mathematical thoughts for getting solution to deeper problems in every day life of conflicting nations and the struggle for the very existence of the human beings.

Due to various creations in the branches of specialization in mathematics, it has become difficult to get a particular research which is required to be applied to a certain problematic field in scientific and technological research. For coping up this problem of unification and coherence, many packages , like the mathematica, mathcad, mathematical equations have been put at the disposal of the programmers and research workers, alongwith other facilities of spell check etc., styles and so on, with the result that the humanity is being benefited with most updated research in mathematics.

Whereas the Euclid's works have been attractive for their deductive inferences, those of the Socratic methods proceeding from the particular to general eschews dogmatic compulsion leading the way to independent productive thinking and reasoning. Thus we are following both the ways, that of the intuitionism and the logistics with a formalism in mathematical manoeuvre. The present day mathematics has thus become an interplay between generality and individuality, deduction and construction, logic and imagination. Whatever achievements are seen at present in the feats of scientific world, they are the consequence of the mathematical modelling flight into abstract generality starting from the concrete and specific and returning back again to the same concrete and specific character.

MATHEMATICS IN ANCIENT CIVILIZATIONS

These methodical surveillance may be seen from the ancient times, with the awakening of science in the civilizations of the world since the era of Pythagoras, Mahavira, Buddha, Laotse and Cofucius. They created a generalized mathematics and applied it to the Tao of Freedom from the cycles of births and rebirths. Pythagoras applies his compendium of knowledge of mathematical treasures in measures of worldly objects for propagation of his doctrines among the neighbours as follows:

"Then, too, there was all this talk about what he ate , or rather about what he would not eat. What could the man possibly have against beans ? They were a staple of everyone's diet; and here was Pythagoras refusing to touch them because they might harbour the souls of his dead friends.....He had even deterred a cow from trampling a patch of beans by whispering some magic word in its ear.....He also tells that the Pythagoreans did not bury their dead in woollen clothing.[2] This looks more like religious ritual than like mathematics. The Pythagoreans, who were held up to ridicule on the stage, were presented as superstitious, as filthy vegetarians,[3] but not as mathematicians.... .The thought of all the souls they might have left shivering in the void by devouring their own goats and swines made the good Samians extremely unhappy. A few weeks more of these upsetting suggestions, and they would all be strict vegetarians- except for beans. Equally upsetting was the ghastly thought that some of their own children might be malicious little monsters with no souls to restrain their bestial instincts. For Pythagoras had assured them that the total number of souls in the universe is constant".(Vide, E.T. Bell, The Magic of Numbers, Oxford, 1946).

In India, the theory of Karma was given in mathematical details by Mahāvīra (c. 6th century B.C.) and his traditional disciples, specially in the Digambara Jaina School, the mathematical symbolism seems to have created a profound effect on the society, so much so that the Indian culture became deeply soaked with the nonviolence and truth for centuries to come. Even this also influenced the Indian kings and armies to adopt kindly war-disciplines which were not present in the foreign barbarian tribes who went on attacking this part of the world civilization and getting always the upperhand due to their limitless cruelty as could be seen in the second world war. It was not a superficial story, but the Karma theory could explain the very process of Karmic fruition through mathematically scientific manoeuvre, available in the INSA projects (1984-1995) on the Jaina School of Mathematical Sciences.

MATHEMATICS IN THE MEDIEVAL PERIOD

We may see how Mahāvīrācārya gave the appreciation of mathematics in the Gaṇitasāra Saṁgraha," In all transactions which relate to worldly, Vedic or other similar religious affairs calculation is of use. In the science of love, in the science of wealth, in music and in drama, in the art of cooking, in medicine, in architecture, in poetics and poetry, in logic and grammar and such other things, and in relation to all that constitutes the peculiar value of the arts, the science of calculation (*gaṇita*) is held in high esteem. In relation to the movements of the sun and other heavenly bodies, in connection with eclipses and conjunction of planets, and in connection with the *tripraśna* (direction, position and time) and the course of the moon indeed in all these it is utilized. The number, the diameter and the perimeter of islands, oceans and mountains; the extensive dimensions of the rows of habitations and halls belonging to the inhabitants of the world, of the interspace between the worlds, of the world of light, of the world of gods and of the

dwellers in hell, and other miscellaneous measurements of all sorts. All these are made out by the help of *gaṇita.* The configuration of living beings therein, the length of their lives, their eight attributes , and their similar things; their progress and other things, their staying together, etc.- all these are dependent upon *gaṇita* (for their due comprehension). What is the good of saying much? Whatever there is in all the three worlds, which are possessed of moving and non-moving beings, cannot exist as apart from *gaṇita* (measurement and calculation)."It was due to the credit of this mathematician that for the first time the imaginary numbers came to be recognized in the ninth century and played the vital role in the modern physics, science and arts.

According to Bell, there has been a tremendous surge of general interest in science, and its bearing on our rapidly changing philosophical outlook on the universe. The great mathematicians, as Gauss, Cayley, Riemann, and Hermite have played a great part in the evolution of scientific and philosophical thought. It must not be imagined that the sole function of mathematics - "the handmaiden of the sciences"- is to serve science. Mathematics has also been called "the Queen of Sciences". It has a light of its own wisdom, above any possible application to science. This is not the old doctrine of art for art's sake; it is art for humanity's sake. Plato is said to have inscribed, "Let no man ignorant of geometry enter here" above the entrance to his Academy." The basic ideas of modern mathematics, from which the whole vast and intricate complexity has been woven by thousands of workers are simple, of boundless scope, and well within the understanding of any human being with normal intelligence. It is not only a handful of symbols, formulas or diagrams in a text. They are the expressions of how the actual process of life goes on through infinite varieties of events. Langrange believed that a mathematician has not thoroughly understood his own work till he has made it so clear that he can go out and explain it effectively to the first man he meets on the street. According to Bacon, pure mathematics do remedy and cure many defects in the wit and faculty of individuals; for if the wit be dull, they sharpen it; if too wandering they fix it; if too inherent in the sense, they abstract it.

In the opinion of Tryon Edwards, the study of mathematics is like climbing up a steep and craggy mountain; when once you reach the top, it fully recompenses your trouble, by opening a fine, clear, and extensive prospect. The study of mathematics cultivates the reason; that of the languages, at the same time, the reason and the taste. The former gives grasp and power to the mind; the latter both power and flexibility. The former, by itself, would prepare us for a state of certainties which nowhere exists; the latter, for a state of probabilities which is that of common life. Each, by itself, does but an imperfect work: in the union of both is the best discipline for the mind, and the best mental training for the world as it is. Johnson maintained that if a man's wits be wandering, let him study the mathematics; for in demonstrations, if his wit be called away ever so little, he must begin again.

Of great interest are the mathematical subjects which may be as follows: the modern doctrine of the infinite which was already pursued in India in the Jaina School of Mathematics, the origin of mathematical probability, the concept and importance of a group, the meanings of mathematical invariance, the non-Euclidean geometry, the Riemannian and non-Riemannian geometry, the origin of the mathematics of general relativity, the properties of whole numbers and their modern generalization, the meaning and usefulness of the so-called imaginary numbers, like $\sqrt{-1}$, symbolic reasoning in mathematical logic, the mathematics of quantum mechanics, the mathematics of topology, differential topology, differential geometry, polyhedral topology and algebraic topology with its modern developments.

Modern mathematics began with two great advances , analytical geometry and the calculus. The former took definite shape in 1637, and the latter about 1666, although it did not become public till a decade later. Descartes was responsible for the creation of the analytical geometry, shared with that of Fermat, which could be evolved from the description of motion in the Akalaṅka's work .Similarly, it was Minkowski who led the Einstein's theory of special relativity through his fourfold space-time and the

imaginary numbers upto the invention of the mass energy relation responsible for the creation and releasing of atomic energy.

Galileo said ,"Nature's great book is written in mathematical symbols" which was the same as the statement of Plato, "God ever geometrizes". Jacobi also stated ,"God ever arithmetizes". The scientific mystics has the creed that every thing is mathematics. Pythagoras asserted ,"Number rules the universe" and we are ruling the number through artificial intelligence of the updated super computers. The most extensive history of mathematics is that of Moritz Cantor, *Geschichte der Mathematik* in three large volumes, whereas the mathematical Karma theory occupies the space of forty large volumes at present in published form.

It may also be noted that the beginningless period before 1900 breaks quite sharply into two branches. The break occurs about the year 1700, and is mainly due to Issac Newton (1642-1727). For some of the most important ideas discussed in connection with their originators-groups, space of many dimensions, non-Euclidean geometry, and symbolic logic, for example- are needed to study the new sciences, today. Archemedes had the fundamental notion of limiting sums from which the integral calculus originates. He also made use of the differential calculus. As we approach Newton and Leibnitz in the 17th century, the calculus was being tried to be a tool of the astronomical science.

However, these concepts of these indivisibles and their manipulation in the Karma theory were in crude and naive stage in India for want of the interest in a scientific spirit due to predominance of a religious trial and error pursuits in the society raided off and on by the foreign invaders. Their religious beliefs had included everything from the narrowest orthodoxy- sometimes shading into the blackest bigotry- to complete scepticism. Actually the mathematical truths are immortal, imperishable for ever, the very stuff of which eternal varieties are fashioned and the one glimpse of changelessness behind all the recurrent cycles of births and deaths and decay.

From the earliest times two opposite tendencies , sometimes helping each other, have governed the whole involvement of mathematics. They have been those of the discrete and the continuum. Just as the time fluent in the Tiloyapaṇṇattī has a discrete structure and the soul or space fluent has a continuum structure, the discrete struggles to describe all nature and all mathematics atomistically, in terms of distinct, recognizable individual elements, as 1, 2, 3, instants or points in space, samaya and pradeśa.

The continuous seeks to apprehend natural phenomena- the course of a planet in its orbit, the flow of a current of electricity, the rise and fall of the tides. We feel intuitively that the motion is smooth, is without jerks, is unbroken. There is no next point on a continuous segment. When the conception of continuity was developed in the manner of Newton or Leibnitz into various types of calculi, its innumerable applications to science and technology, and to all that is called today as mathematical analysis. The discrete pattern based on the natural numbers, is the domain of algebra, the theory of numbers, and symbolic logic. Thus geometry partakes of both the continuous and the discrete.

It was a question of abstractness and generality when the society passed on from the existential one to the various which involved two and so on. This is found in the various generalization discussed by Vīrasenācārya in his Dhavalā commentary. Bertrand Russell was the foremost in discovering this type of mathematical philosophy in the Greek works and which also appears in the theory of Karma. Not only the concepts of the instant and point or an ultimate particle but the measure units for the abstract volition and affections were provided as indivisible-corresponding-sections, called the avibhāgī-praticcheda of various types.

The concept of a point may have been defined in the ancient manner as that which is having no magnitude, without a midpoint and end or beginning. Now it is defined through the Cartesian geometry through ordered numbers. The place value in Jaina texts may be found for writing of big numbers as well as for manipulation of factor multiplication shown in the Arthasaṁdṛṣṭi of Ṭoḍaramala. This is pure

logic. Such dealing through abstract generalities were adopted by mathematicians whose quotes may be realized. Descartes told, "Give me space and motion and I will give you a world". Einstein may have retorted, "Altogether too much is being asked, in fact, without a world-matter, there is neither space nor motion". Leibnitz spoke about the $\sqrt{-1}$, "The Divine Spirit found a sublime outlet in that wonder of analysis, the potent of the ideal, that mean being and non-being, which we call imaginary (square) root of negative unity."

Hamilton gave in 140, the calculus of variations and the number couples. Hertz discovered wireless waves, telling, "One cannot escape the feeling that these mathematical formulas have an independent existence and an intelligence of their own, that they are wiser than we are, when even than their discoverers, that we get more out of them than was originally put into them." Charles Darwin asserted, "Mathematics seems to endow one with something like a new sense". Mati, in Jainology represents all the knowledge that could be sought and achieved through senses and mind and there seems little doubt that the Greek word matimatiki for mathematics might have its origin as in jīvāmiti and arthamiti called the geometry and arithmetic today. Bertrand Russell spoke, "Mathematics, rightly viewed, possesses not only truth but supreme beauty- a beauty cold and austere, like that of sculpture, without appeal to any part of our weaker nature, without the gorgeous trappings of painting or music, yet sublimely pure, and capable of a stern perfection such as only the greatest art can show."

The nineteenth century is said by Bell, to have contributed to mathematical knowledge about five times as much as was done in the whole of preceding history. Mathematics has had four great ages: the Babylonian, the Greek, the Newtonian (around 1700), and the recent, beginning about 1800 and continuing till today. Competent judges have called the last as the Golden Age of Mathematics.

MATHEMATICS IN THE MODERN WORLD

Babylonians discovered many such mathematical rules both in algebra and geometry without proof. The Greeks began to invent proof-deductive reasoning from about 600 B.C. Then intuition and insight were also used freely in mathematics as in the Dhavalā commentary. Gauss, Abel, Riemann and Galois studied and invented many secrets through algebraic equations. Upto the nineteenth century the mathematicians tried to get firm foundations for differential and integral calculus while facing the Zeno paradoxes as well.

The new era ushered then and the mathematicians like Georg Cantor, Dedekind, Weirstrass opened the door to such pursuits. Russell calls mathematics as symbolic logic. It is based on deductive reasoning applied to sets of outright assumptions called axioms or postulates. Mathematical logic goes far beyond the common rules of logic which describe the deductive reasoning. Russell, Brower, Hilbert Goedel entered into this field of study and contributed much to remove the blasphemies of transfinite sets and numbers in a logistic, intuitionalistic and formalistic manner, respectively. The Aristotelian logic began to take new shapes when the variables and functions in symbolic form began to replace its terms in the ancient logic. These , then began to find place in the development of the generations of computers, the super giant brains, limited in their own capacity of artificial intelligence, robotics and expertize. The cyber space has thus been a creation of new mathematical tools.

Lobatchewsky, the inventor of non-Euclidean geometry, was a strong believer in the philosophy that in order to get a thing done to your liking you must either do it yourself or understand enough about its execution to be able to criticize the work of another intelligently and constructively. He, thus, overthrew the Euclidean geometry which had dominated the 2200 years of mathematical world and opened the doors to enter into generalized geometries for delving deep into the hidden facts of nature. The concepts of geodesics or extrema got new interpretations as straight lines challenging the axioms of Euclid and offering more to the mathematicians and scientists to expand the vision through more assumptions and postulates for building up several new structures in mathematics and technology.

We may now bring in Einstein to say some thing about geometry and experience. He says, "One reason why mathematics enjoys special esteem, above all other sciences, is that its propositions are absolutely certain and indisputable, while those of all other sciences are to some extent debatable and in constant danger of being overthrown by newly discovered facts. In spite of this, the investigation another department of science would not need to envy the mathematician if the propositions of mathematics referred to objects of our mere imagination, and not to objects of reality. For it cannot occasion surprise that different persons should arrive at the same logical conclusions when they have already agreed upon the fundamental propositions (axioms), as well as the methods by which other propositions are to be deduced therefrom. But there is another reason for the high repute of mathematics, in that it is mathematics which affords the exact natural sciences a certain measure of certainty, to which without mathematics they could not attain."

He goes on to appreciate mathematics, "At this point an enigma presents itself which in all ages has agitated inquiring minds. How can it be that mathematics, being after all a product of human thought which is independent of experience, is so admirably appropriate to the objects of reality? Is human reason, then, without experience, merely by taking thought, able to fathom the properties of real things?" He answers himself, "In my opinion the answer to this question is, briefly, this: as far as the propositions of mathematics refer to reality, they are not certain; and as far as they are certain, they do not refer to reality. It seems to me that complete clarity as to this state of things became common property only through that trend in mathematics which is known by the name of 'axiomatics'. The progress achieved by axiomatics consists in its having neatly separated the logical-formal from its objective or intuitive content; according to axiomatics the logical-formal alone forms the subject matter of mathematics, which is not concerned with the intuitive or other content associated with the logical-formal." (Einstein, A., Ideas and Opinions, 1979, New Delhi).

Einstein gave the following answer regarding a mathematician's mind:

1. The words or the language, as they are written or spoken, do not seem to play any role in my mechanism of thought. The psychical entities which seem to serve as elements in thought are certain signs and more or less clear images which can be "voluntarily" reproduced and combined.

There is, of course, a certain connection between those elements and relevant logical concepts. It is also clear that the desire to arrive finally at logically connected concepts is the emotional basis of this rather vague play with the above mentioned elements. But taken from a psychological viewpoint, this combinatory play seems to be the essential feature in productive thought - before there is any connection with logical construction in words or other kinds of signs which can be communicated to others.

2. The above mentioned elements are, in my case, of visual and some of muscular type. Conventional words or other signs have to be sought for laborious only in a secondary stage, when the mentioned associative play is sufficiently established and can be reproduced at will.

3. According to what has been said, the play with the mentioned elements is aimed to be analogous to certain logical connections one is searching for.

4. Visual and motor. In a stage when word intervene at all, they are, in my case, purely auditive, but they interfere only in a secondary stage, as already mentioned.

5. It seems to me that what you call full consciousness is a limit case which can never be fully accomplished. This seems to me connected with the fact called the narrowness of consciousness.

Now, we pass on to the concepts introduced in modern mathematics. As we have seen there has been the move from the practicality to abstractness and from speciality to generality. Then intuitionism and formalism have been investigated the foundations of mathematics. Pictures have been considered essential as an aid to thought. Mathematics has been regarded beautiful, intellectually stimulating, useful

resembling fine arts. Pure mathematics was used to discover waves. Maxwell laid down a number of equations to describe a unified picture of electrical phenomena. Tensor calculus was useful for developing the theory of relativity resulting in the release of atomic energy. Matrices were found useful for quantum theory and economics. Theory of functionals and the integral equations were applied in social sciences.

The application of mathematical researches has been found to be delayed and taken decades to be fruitful and subject to utilization. About 150 years of the invention of the wave equation, Marconi applied it to radio mechanism. After 100 years of development of the differential geometry, it was applied to the atomic bomb technology. Similarly, after 100 years of Cayley's invention of matrices, they were used in solving the problems in economics. About 30 years after the invention of the integral equations and modification by Courant and Hilbert, they were applied to the theory of quantum fields. All these inventions in pure mathematics alongwith with various branches of topology have revolutionized the technology of computers and our everyday life after some years of their origination.

NEW MATHEMATICS

The more interesting things that one could imagine in mathematics may be recalled as: Galois theory of groups, motion without movement, the world built on probability, Short cuts in the higher mathematics, the theory of sets, the theory of functions and functionals, operators, operands and transforms, abstract algebra, symmetry as a group concept, axiomatics, theory of transfinite numbers, topological dreams of experts, artificial intelligence, the power of indirect thinking (the four colour problem), topological invariants, algebraic topology, homology, homotopy, hyperspaces, linear algebra, real and complex variables and their analysis, theory of differential equations and integral equations, uses of computers and the internet mathematical programming, foundations of mathematics, mathematical logic, and so on.

NEW APPLICATIONS OF MATHEMATICS

For 2000 years geometry meant Euclidean geometry. Then it was found not only that other geometries described physical space equally well but also that geometry was properly the study of all possible spaces or universes.

Elementary algebra deals exclusively with the general properties of numbers. Higher algebra and abstract algebras can deal effectively with anything or any subject or object and on occasion they could be pursued without reference to anything in particular.

Probability has been given an equal importance. The real world confronts the mathematician with events that are not strictly predictable. The methods he has developed to deal with events for chances and risks and help have opened new domains of pure mathematics.

Regarding a thought on the foundations, now, be given. When a new mathematical idea is born or is found to be useful, a superstructure of mathematics rises from it. Later the original idea may prove to be shaky, but it must be repaired or modified without destroying the structure as in the construction theoretic approach in physics. However, in the principle theoretic approach , this does not seem possible according to Einstein.

How does the mathematics works and helps in the development of the physical sciences? The outstanding examples of the power of mathematics to relate the facts of nature can be found in physics. The latest example is the use of group theory to relate the fundamental particles in nature as well as in the computer technology supporting the profound space research.

MATHEMATICS IN BIOLOGICAL AND SOCIAL SCIENCES

Does mathematics play its predominant role in the biological sciences? There are many problems in biology related to genetics and evolution theory . These problems show the fundamentality of probabilistic laws and the fundamental role of chance. The problems may be on the origin of life on the earth, the change in the sizes of population of species, the simulation of the nervous system, and the creation of a model of the human brain, apart from the origin and evolution of species, the random combination of

genes in crossbreeding, hereditary variability, unpredictability of new species as well as the phenomenon of mutations.

Biologists use and utilize mathematics, but the complex systems they study, specifically the brain, resist mathematical description. The kind of description that might someday be helpful is suggested by the abstract analysis of self production and artificial intelligence in computers.

Mathematics also finds topmost place in the social sciences. Certain social sciences such as economics deal with facts that are usually represented by numbers. New techniques for relating these numbers point towards the mathematical analysis of entire societies. The behaviour of the society or the administrative systems of a state could also be brought under the mathematical economics for restrictions, sanctions and controls over them.

For introducing control or cybernetical controls in various types of systems, mathematics is called upon for suggestions, decisions and advice. Specifically, in technology, the most advanced applications of mathematics are in the design of machines that control themselves or reproduce themselves. The same methods are relevant to the control mechanisms of the living organisms as well as societies, states, nations and the world as a whole system.

Now we shall consider about the computers and their developing generations in the microfields. These machines that not only do arithmetic at high speed but also act as super brains for memory and other functions have evolved in response to the need to apply mathematics. Now they also promise to play a vital role in the progress of mathematics itself through updated mathematical package-programming. Artificial intelligence in the computers is now coming as an encyclopaedic work with several application of mathematics. The knowledge based systems are also under the application of mathematics through several types of functions in various types of spaces.

Mathematical games, puns, palindromes, and other games with automation and animation partake of the mathematical spirit. There has been controversy about the Human Genome Project which is aimed at sequencing all the 100,000 genes of the human genome by this century. The international HGP is about guaranteeing that the sequence of the human genome will not be a trade secret and will be freely available in everyone's hands, with no restrictions on its distribution or on its analysis. According to Span, May-June, 2001, the HGP is as good as done, says MIT's Eric Lander. Now it is time to start thinking about how the data will be used. For insiders in genome research, this mathematician has evoked a palpable image of the trends sweeping biology-automation, computers, entrepreneurialism, big science and big ideas. It has also been marked whether genetic modification for fun and profit become a home-grown industry. Preparations have been made to run a polymerise chain reaction making millions of copies of a DNA template.

FOUNDATIONS OF MATHEMATICS

Henri Poincare made certain remarks about mathematical sciences which are worthy of attention. "It is impossible to study the works of the great mathematicians, or even those of the lesser, without noticing and distinguishing two opposite tendencies, or rather two different kinds of mind. The one sort are above all preoccupied with logic; to read their works, one is tempted to believe they have advanced only step by step, after the manner of a Vauban who pushes on his trenches against the place besieged, leaving nothing to chance. The other sort are guided by intuition and at the first stroke make quick but sometimes precarious conquests, like bold cavalrymen of the advance guard. The method is not imposed by the matter treated. Though one often says of the first that they are *analysts* and calls the others *geometers*, that does not prevent the one sort from remaining analysts even when they work at geometry, while the others are still geometers even when they occupy themselves with pure analysis....."

The mathematician is born, not made, and it seems he is born a geometer or an analyst." In this way Poincare finds Weirstrass as an analyst and Riemann as an intuitionist; Lie as an intuitionist and Madame

Kovalevski as a logician. According to him, intuition can not give us rigor, nor even certainty. In mathematics, according to him, logic is called *analysis* and analysis means *division, dissection.* Each is indispensable. Logic, which alone can give certainty, is the instrument of demonstration; intuition is the instrument of invention.

The methods of demonstration dear to analysts is that founded on the employment of dominant functions. It is the intuition of pure number, that of pure logical forms, which illumines and directs those we have called analysts. This it is which enables them not alone to demonstrate, but also to invent. By it they perceive at a glance the general plan of a logical edifice, and that too without the senses appearing to intervene. "In rejecting the aid of imagination, which, as we have seen, is not always infallible, they can advance without fear of deceiving themselves. Happy, therefore, are those who can do without this aid ! We must admire them; but how rare they are! Among the analysts there will then be inventors, but they will be few". (Vide, Value of Science, Dover)

METHODS IN MATHEMATICS

Paul Halmos in his ,"A Hilbert Space Problem Book", tells that the only way to learn mathematics is to do mathematics. That tenet is the foundation of the do-it-yourself, Socratic, or Texas method, the method in which the teacher plays the role of an omniscient but largely uncommunicative referee between the learner and the facts. The right way to read mathematics is first to read the definitions of the concepts and statements of the theorems, and then, putting the book aside, to try to discover the appropriate proofs. To the passive reader a routine computation and a miracle of ingenuity come with equal ease, and later, when he must depend upon himself, he will find that they went as easily as they came. The active reader, who has found out what does not work, is in a much better position to understand the reason for the success of the author's method, and, later, to find answers that are not in the books. The problems are intended to be challenges to thought, not legal technicalities.

According to Weyl, there has been a plainly discernible parallelism between the more recent development of mathematics and physics. Occidental mathematics has in past centuries broken away from the Greek view and followed a course which seems to have originated in India and which has been transmitted, with additions, to us by the Arabs; in it the concept of number appears as logically prior to the concepts of geometry. The result of this has been that we have applied this systematically developed number concept to all branches, irrespective of whether it is most appropriate for these particular applications. But the present trend in mathematics is clearly in the direction of a return to the Greek standpoint; we now look upon each branch of mathematics as determining its own characteristic domain of quantities.

The algebraist of the present day considers the continuum of real or complex numbers as merely "one field" among many; the recent axiomatic foundation of projective geometry may be considered as the geometric counterpart of this view. This newer mathematics, including the modern theory of groups and "abstract algebra, " is clearly motivated by a spirit different from that of "classical mathematics," which found its highest expression in the theory of functions of a complex variable. The continuum of real numbers has retained its ancient prerogative in physics for the expression of physical measurements, but it can justly be maintained that its essence of the new Heisenberg-Schroedinger-Dirac quantum mechanics is to be found in the fact that there is associated with each physical system a set of quantities, constituting a non-commutative algebra in the technical mathematical sense, the elements of which are the physical quantities themselves (vide preface to "Theory of Groups and Quantum Mechanics", Dover, 1928).

He, then, introduces the same as follows," Our generation is witness to a development of physical knowledge such as has not been since the days of Kepler, Galileo and Newton, and mathematics has scarcely ever experienced such a stormy epoch. Mathematical thought removes the spirit from its worldly haunts to solitude and renounces the unveilings of the secrets of Nature. But as recompense, mathematics is less bound to the course of worldly events than physics.

SYMMETRY AS A MATHEMATICAL TOOL

While the quantum theory can be traced back only as far as 1900, the origin of the theory of groups is lost in a past scarcely accessible to history; the earliest works of art show that the symmetry groups of plane figures were even then already known, although the theory of these was only given definite form in the latter part of the eighteenth and in the nineteenth centuries. F. Klein considered the group concept as most characteristic of the nineteenth century mathematics. Until the present, its most important application to natural science lay in the description of the symmetry of crystals, but it has recently been recognized that group theory is of fundamental importance for quantum physics; it here reveals the essential features which are not contingent on a special form of the dynamical laws nor on special assumptions concerning the forces involved." (Vide ibid., introduction).

Tarasov adds to this concept of symmetry as follows, " Symmetry is encountered everywhere - in nature, engineering, arts, and science. Note, for example, the symmetry of a butterfly and maple leaf, the symmetry of a car and plane, the symmetry of a verse and tune, the symmetry of patterns and borders, the symmetry of the atomic structure of molecules and crystals. The notion of symmetry can be traced down through the entire history of human creative endeavours. It has its beginnings in the wellsprings of human knowledge and it has widely been used by all the modern sciences. Thus, principles of symmetry dominate in physics and mathematics, chemistry and biology, engineering and architecture, painting and sculpture, poetry and music." (Vide Preface to "This Amazingly Symmetrical World", Moscow, 1986).

The symmetry of positions, forms, and structures can be thought of as geometric symmetry. For the naturalistic picture of the world we have to the physical symmetry as well as anti-symmetry, both of which giving a total picture of the natural phenomena. Mathematics of this sort was applied by Einstein to create his non-symmetric field theory, as a last attempt for unification of all the natural interactive fields. He could hardly get a part of the unification of the gravitational and the electromagnetic fields. The nuclear fields, then asked for some revolutionary quantum theoretic approach as revealed by Weyl in his book already mentioned above and in his another work, "Space, Time, Matter."

CHAOS AND FRACTALS

With the fall of classical mechanics in which determinism was predominant, and a partial failure in unification of gravity with the rest interacting fields, the scientists began to be in search of still subtler geometries, even beyond the fibre-bundle geometry. That is called the jagged geometry or the geometry of the fractals about which Hausdorff gave a hint in his, "Set Theory". It depicts the ugly and the beautiful, seeds of self similarity; designs in snowflakes and tiles, holed carpets and spongy boxes, strange attractors and devil's staircase. Then also in the theory of kinks and solitons as well as the chaos. This type of geometry also plays its important role in the subjects on the thermodynamic arrow of time, the creative arrow of time, the descriptive structures, the cellular automata and the enigma of life.

NON-LINEARITY AND THE ROLE OF MATHEMATICS

The hint given by Einstein, while solving his tensorial non-linear field equations of the general theory of relativity with his colleagues, Infeld and Hoffman, has been found to be of utmost importance, that such forms of non-linear equations in algebraic, differential or integral structural forms can relate mathematically such complex phenomena as have been considered to be complex.

Simple phenomena in nature may be explained through linear forms but when the structures and functionals are in nature, interconnected, interlinked, interlocked and intermingled with their unfolding attitudes, the non-linearity in mathematics is the only way to reveal the hidden secrets of the complexity of nature. Examples of non-linearity abound in nature and has a constructive role: to keep the situation from exploding and sometimes it can make things worse. It all depends on the kind of feedback that non-linearity in a situation gives rise to.

The discovery of chaos offers the insight that simple systems (with a few degrees of freedom) governed by deterministic laws, with no element of chance in them, can show exquisitely complex behaviour. A necessary condition for this to happen is that the basic laws are non-linear in character. Chaos is an evidence of non-linearity in the system. To a weatherman, chaos is unpredictability of deterministic laws arising from hypersenstivity to initial conditions. To an ecologist, chaos is irregular fluctuation in population arising from deterministic laws, and yet containing a deep structure governed by a self-similar regularity. A non-linear clock can go haywire. It can tick irregularly, unpredictably. According to Newtonian classical laws, as the clock ticks regularly, the universe unfolds according to its deterministic laws. But it may also be that the clock itself may not be periodic. The conception of 'Chaos' put up by Poincare was ahead of his time and it became a reality only in the early 1960's when that powerful human artifact arrived on the scene as the digital computer.

Abstruse and pure inventions in mathematics, conceived initially for mere intellectual pleasure and advancement of a subject, turned out to have immense applications in practical, down to the worldly life contexts. Mathematical numbers seemed like a dusty, uninteresting number even to Hardy, the great English mathematician, until his research scholar and collaborator, the genius Ramanujan cleared the dust. Similarly, Cantor introduced several types of proper infinities. Cantor's set is a basic fractal set which when combined with other sets can generate interesting new shapes. There is relation between chaos and fractals. Both, chaos and fractals give a common message: underlying apparent irregularity of motion (chaos) or of spatial shapes (fractals) may lie some striking simple laws and regularity. There is a more subtle connection between chaos and fractals, which takes us to one of the most remarkable ideas in the new frontier of science - that of a 'strange attractor'.

One of the most cited example of a fractal curve is the snowflake-like shape invented by von Koch early this century. It is a self-similar geometrical object obtained by iterations of a simple transformation on an equilateral triangle. The transformation consists in replacing a line segment by removing its middle third and erecting an equilateral triangle. In one way the Koch curve is a mathematical pathos. Any smooth curve like an ellipse or a parabola or a circle is continuous and has a well defined slope at every point. The Koch curve is continuous everywhere but does not have a well defined shape at any point.

Iteration of a suitable transformation is the key to generating self- similarity and fractals. One of the resulting self-similar object created through the process of iteration in transformation of a specific type is a Sierpinski carpet. The destructive game of making holes can create a Sierpinski gasket. The three dimensional version of a Sierpinski carpet is a construction called as the Menger sponge. Here we start with a cube. The Menger sponge has infinite surface area enclosing zero volume. The famous Eiffel tower of Paris is based on the idea of providing structural strength through branching rather than through solid supporting base. Menger sponge has also been used as a mathematical model for flow in a highly porous medium.

STRANGE ATTRACTORS AND CYCLES OF PROPER INFINITIES

Now we pass on to the concept of a strange attractor. Non-linearity in nature appears in very many configurations or *prakṛtis*. Sometimes it arrests the growth of an explosive situation creating an equilibrium. Often it may be accelerating growth towards catastrophe or collapse. Or it may be generating a cyclic behaviour in a system. Some way it may also lead to chaos. This may be seen in the hyposerpentine and hyperserpentine periods in the Karma bhūmis of Jaina cosmology.

The non-linear systems may be complex or of variety, they generally settle into certain steady behavioural patterns. A steady behaviour may be distinguished from mere equilibrium. Steady behaviour implies it has a fixed trajectory in phase space (*bhāva rāśi or pariṇāma rāśi*). Equilibrium means the system remains at a fixed point in a phase space. Different initial conditions or restraints of the system may take it along different paths (*mārgaṇās*), but after a while the transient behaviour dies out and the

system converges to a steady state. Note that it is, as if, in the phase space of the system, the steady state is pulling towards it the phase space trajectories around. That is the reason the these states are called "attractors" of the system.

Cantor who died in a lunatic asylum, worked on transfinite sets and numbers and his work was extraordinary, and one of his infinite construct was a fractal. He invented a countable and an uncountable infinities. This was just a replica of the Jaina system of the *saṁkhyā and upamā pramāṇas* needed for the Karma theory in which several types of comparable infinite sets were depicting the pictures of fractals , chaos and the attractors.

If the system has more than one attractor, its phase space gets divided into "basins of attraction" for different attractors. Each attractor pulls towards it the states or *prakrtis* lying within its basin. An attractor may be just a fixed point in phase space - an equilibrium which the system attains as *bhava* or *gati*, whatever its initial state. Or an attractor may be a definite phase space trajectory or *bhava gati* - a steady state to which a system evolves and settles into after the initial transient behaviour.

A driven linear pendulum takes up a steady periodic motion; its phase space trajectory then is a closed loop (yoni), that has no "memory" of the initial conditions (perhaps from one sensed to four sensed bios). This is the case with all phase trajectories of the pendulum, no matter where they start from, they eventually converge to the closed loop. The closed loop is a *"periodic attractor"* of the pendulum. The periodic attractor is also called the "limit cycle". The periodic attractor is one of the pervasive features of non-linearity not only in all sciences but also in the theory of Karma (action). The non-linear models, whether in physics, physiology or sociology, display attractors - the states which systems converge to, independent of their previous history.

Before the advent of chaos concept, the point attractor and the periodic attractor were well known things in non-linear mathematical models and sciences. It was found by David Ruelle and Floris Taken (1971) that chaotic motion was also associated with attractors in phase space, and that these were complex, strange, difficult to explain and visualize objects in phase space. These "strange attractors" had strange shapes in the phase space. The fundamental attributes are depicted by the strange shapes as follows:

1. Chaotic motion is hypersensitive to initial conditions. Correspondingly, neighbouring points in phase space charts divergent paths.
2. Chaotic motion can never be strictly periodic. It can be quasi-periodic.
3. Chaotic motion is not unbounded, remaining confined in a finite volume of phase space.
4. In the full phase space of dynamical variables (say, yoga and moha) required to describe a system (say, Karmic picture), no two trajectories should ever cross each other. Otherwise, the same initial conditions would give rise to two paths, which is inconsistent with the deterministic nature of the laws of the system.

The above are the requirements for a shape in phase space- a shape confined in a finite region, non-cyclic or quasi-cyclic with the trajectory never crossing itself, and yet having neighbouring points go along divergent paths. Such shapes have been found to have been visualized by Stephen Smale, generated by transformations as stretching, squeezing and folding in phase spaee These are the shapes of the strange attractor towards a point of which the system converges to. It is an infinitely layered web of interconnected loops confined in a finite volume. This reminds us of the fractals. Many fractal attractors have been discovered with whose notion, chaotic dynamics is united with fractal geometry. Strange attractors represent a subtle synthesis of two apparently dichotomous features of chaotic motion which is a fractal in the phase space of the system. All trajectories converge eventually to some point or other on the chaotic attractor. For the non-linear systems of nature such as weather, physiological cycles, driven oscillators and so on, dissipation has a positive role, helping in neutralization of fluctuations threatening a system's stability so that the system remains saddled to its steady state. Strange attractors in chaotic

motion of systems owe their stability to the ubiquitous dissipating processes in nature. Hence, paradoxically, dissipation is an agent of order.

MATHEMATICS IN BIOLOGICAL STRUCTURES AND FUNCTIONS

Most processes of nature, causing the ubiquity of chaos and fractals have, strong non-linearities built in them. Fractals are "economic" for nature since they fill up space more efficiently than ordinary smooth curves and surfaces, and this economy is needed in many biological contexts. For biological structures, the recursive transformations could be encoded genetically, which tells why living matter (Karma) generates fractal structures so pervasively. Chaos and anatomical fractals are present in a human body, the former may well be a symptom of good health for it offers the system variability and robustness, being intermediate between strict periodicity and unstructured disorder. Rigorous periodicity of cardiac and neurophysiological systems may be a symptom of aging or disease.

Self-similarity and fractals appear also in social sciences and humanities in which scale invàriance have been sought for. Percolation phenomena gives new insight when they are modelled and run on a computer. They are found to have a fractal character near he critical threshold. When mathematical fractal shapes are combined with artistic choice of colour, shades and composition, the result is a new fractal art of aesthetic beauty. This is possible through combination of mathematical research and artistic imagination.

ENTROPY AND NEGENTROPY

The thermodynamic arrow of time, the direction of an irreversible process in nature is defined by the direction of entropy change. The whole universe is an isolated system and its entropy must increase as it evolves from past to present to future. It must turn more and more disorderly. It is inexorably proceeding to its destiny: heat death - a featureless, completely disordered state. Quite opposite to this is the presence of many natural processes which generate order and evolve towards increasing complexity, regulation and organization.

This experience is common with living matter, say, the human neonate into which a featureless embryo grows in nine months into an intricately structured and organised system. This seems to contradict the second law of thermodynamics. An embryo growing into a foetus is not an isolated system, continually exchanging energy and matter with its environment. There are several such systems, called open systems in which there is the state, inputs and outputs. Such a creativity means building up structures of increasingly greater order and complexity, open systems of nature, containing a creative arrow of time.

It was Ilya Pigogine who suspected that science enslaved by mechanistic and thermodynamic paradigms had learnt to ignore the truly creative process of nature. Since past and future are all determined by the present in Newtonian mechanics, time was neutral and impotent in his theory, a mere parameter for labelling events. Thermodynamics did assign a role to time, but it was a passive degenerative role, bidding the universe to decay in time. Instead, nature also assigns time a creative role, that manifests itself in so many of its open systems which not only display complexity- they seem to have a propensity to grow in complexity. The scientists' 'accidental initial conditions' view seemed to give no clues to the extraordinary robustness and stability of complex structures in nature and the answer given by the physicist through the creative arrow of time was an evasion. Prigogine tried to bridge this gap by synthesising physics and biology. He overthrew the notion of disputative structures and was awarded Nobel Prize in chemistry in 1977.

MATHEMATICS OF SELF ORGANIZATION

Effects of fluctuations of the environment on the system are dissipated away; keeping the self-organisation within the system intact. He termed self organising far from equilibrium thermodynamic systems as 'dissipating structures'. These were not confined to biology and it was found that structures as self organising non-equilibrium systems existed in physics, astronomy, chemistry and so on. Their common feature was their non-linearity which usually arise from feedback mechanisms (*āsrava*). Non-linearity is thus the seed which, in far from equilibrium systems, flowers into self-organisation that symbolizes nature's

creativity whose pathways are by no means fully deterministic and predictable.

There is the mathematical counterpart of this phenomenon, which lies in the multiplicity of solutions of the basic non-linear differential equations governing the phenomenon. The solutions of an equation depend upon the nature of the equation, the values of the various parameters it contains as well as the boundary conditions satisfied by it. The latter represent the nature of interaction and constraints the environment imposes on the open system. Here, the biology and physics has not been unified so far.

'Life' has structures (organisms) whose behaviour and evolution of real life characteristics; cooperation, combat, reproduction, growth, decline, etc. The highest degree of self-organisation is contained in the cognitive processes of the human mind. A human brain consists of trillions and trillions of cells called neurons through which learning, thinking, knowing, memorising or other mental processes are conducted through designed neural networks which are vastly complex versions of cellular automata. Out of a few hundred of neurons, some are either in state of fired or in state of unfired. The state of each neuron after every tick of time is determined in terms of states of its large number of neighbours (*visrasopacaya*). The various parameters of the network such as strengths of inter-neuron connections can be continually varied alongwith insertion of noise through allowing of random elements in the rules of neuron firing. Computer simulation of such systems shows up many self-organising features. Ingenious neural networks have been designed whose behaviour mimics such mental functions as learning, recognition and memory.

The state of a cell in an automaton does not change in a fixed manner. It affects and is affected by the states of its neighbours. This kind of interlocking feedback introduces an inherent non-linearity in the rules governing the evolution of the automaton. The fact that it displays self-organising features confirms what was already seen in the dissipating structures in physics and chemistry. Non-linearity in suitable regimes breeds self-organisation. Many automata evolve by rules asymmetric in time, which readily generate spontaneous self-organising structures automaton hinting that asymmetry is to be introduced in physics if self-organisation is to be breaded therein. A global law is not needed to create a global order. Hence, the self organisation , the harmonious coherence and coordination of different parts of a biological structure need no complicated global master plan- they are rooted in the recursive application of suitable local laws or rules.

KARMA AND CHANCE IN MATHEMATICAL FOLD

Non-linear local laws, recursion, boundary constraints and fluctuations are the creative agents in the universe for all bio and physico- and all other phenomena as Karma, indeed. For organisation takes place in a hierarchy of interlocking levels of coordination in our emotional behaviour (*kaṣāya*) and the yoga as a substratum of physical behaviour through mind, body and speech, which in turn derives Karma from a complex organisation of Karmic or biochemical processes, which again in turn are based on the cooperative behaviour of a large number of molecules, and so on (rise etc. states of Karma).

The apparent complexity has been made transparent in the eightfold Karmic configurations (*prakṛtis*) classified further as 148 ones, exchanging energy and matter in fixed and well defined rules of the Karma phenomena. However the scientists say at present that the behaviour of a biological system cannot be predicted instant to instant; yet it has a certain stable and predictable patterns of overall behaviour. This is just the *mati jñāna* whose measures bring about the mathematics of arithmetic, algebra and geometry, developed to most updated modern levels through computer techniques. This feature of local unpredictability and global stability of a living organism may be enigmatic for a *mati jñānī* but it may be non-enigmatic for an omniscient or to a lower levelled clairvoyance or telepathy, having direct source of knowledge as a faculty, postulated by the *mati* and *śruta jñānī* (say an omniscript).

The problem remains with the scientist, as the dichotomy of necessity and chance in life. Chance is not luck, but a self earned attainment (*labdhi*), which comes through efforts of anti-karma activities of phases of an organism as mentioned in the *Labdhisāra*. There is a detailed genetic programme (*sattva,*

bandha, āsrava, saṁvara and nirjarā phenomena) embedded in the organism system which takes it along its predestined route.

Thus all science is founded on the assumption that the physical world is ordered. The ordered dependability of nature is not, however, ubiquitous. Various events in nature are random also. It was commonly believed that chance events were always the result of our ignoring, or effectively averaging over, vast numbers of hidden variables or degrees of freedom.

Two major developments of the 20th century have out paid to the idea of a clockwise universe. First was that of quantum mechanics wherein lies the Heisenberg's uncertainty principle, which states that everything we can measure is subject to truly random fluctuations, inherent in the workings of nature on an atomic scale. However, as a statistical theory, quantum mechanics remains deterministic Quantum physics thus builds chance into the very fabric of reality, but a vestige of the Newtonian-Laplacian universe view exists.

The concept of chance was present in the work of Poincare a century back, The key feature of chaotic processes show that the predictive errors evolve with time. In a chaotic system, a small difference between two identical systems grows rapidly or rather exponentially such that the prediction of their behaviour's difference is not possible. The universe is thus incapable of digitally computing the future behaviour of even a small part of itself. This also means that even if we accept a strictly account of nature, the future states of the Universe are in some sense "open". The future of non-linear chaotic systems is unknowable, as they depended on complexity and chaos. In the real world, things are more than the sum of their parts; equilibrium is death; increasing, not diminishing, returns are the rule; causes are effects and effects are causes; disorder and paradox are everywhere. In such a new universe new rules are necessary due to complexity and chaos. For all such explanation, the Digambara Jaina Theory of Karma still stands the test of modern times.

A new technique uses the self similarity property of fractals to compress the image memory requirement to a thousandth of its actual volume. Self similarity is often seen in natural form. Fractals are also applied in the field of high definition television. A special attachment to a conventional TV set can create detail using fractal logic.

Through the application of various types of modern logic theories in developing artificial intelligence in computer systems, the following problems of heuristic programming are solved through computers : Search, Pattern-recognition, Learning, Planning, and Induction.

THE REVOLUTION IN GEOMETRY FROM THE PAST TO THE PRESENT

Geometry was certainly vitally important to the ancient and medieval natural philosophers; it was in geometrical terms that Ptolemy, the schools in oriental civilizations, Copernicus, Kepler, and Galileo all expressed their thinking. But when Descartes, like the Jaina School, introduced coordinates into Euclidean geometry, he showed that the study of geometry could be regarded as an application of algebra.

However, the relatively simple geometry of three- dimensional Euclidean world, in which the nineteenth century physicist lived, can be mastered quickly, while learning the great diversity of analytic techniques that must be used to solve the differential equations of physics makes very heavy demands on the student's time. Another reason is that these analytically technical methods were developed in response to the realization by the physicists that the laws of nature could be expressed as differential equations and hence geometry was neglected till the advent of relativity and its development.

According to relativity, Euclidean three dimensional space is only an approximation to correct description of the physical world. The second development in this twentieth century has been led by mathematicians, led by Cartan, that the relation between geometry and analysis is a two-way street:

1. Analysis may be the foundation of study of geometry.
2. The study of geometry leads naturally to the development of certain analytic tools (as the Lie derivative

and the exterior calculus) and certain concepts (as the manifold, the fibre bundle, and the identification of vectors with derivatives) which have great power in application of analysis.

Thus geometry remains subsidiary to analysis. For example, the basic concept of differential geometry, the differential manifold etc. are defined in terms of real numbers and differentiable functions. In this way, concepts of analysis can be expressed geometrically gaining considerable heuristic power. The special and general relativity have contents of differential geometry, whereas other fields of research in electromagnetism, thermodynamics, Hamiltonian theory, fluid dynamics as well as elementary particle physics, geometry involves a more abstract space of variables, as the, Hilbert space.

ECONOMICS IN A MATHEMATICAL FRAME

There has been a great role of mathematics in the development of economics. Cournot was the first to treat the theory of the firm in a mathematical form. Walras constructed a mathematical model of general equilibrium in terms of a set of simultaneous equations for determining prices and quantities uniquely. He also propounded the theory of marginal utility set in mathematical terms.

Jevons founded econometrics. Mathematical background was provided by the microeconomic theory by Marshall. Pareto developed analytical economics and contributed to the field of indifference curves. Edgeworth introduced contract curves and contributed to the field of statistics.

Hicks developed mathematical models about the behaviour of consumer on the basis of utility. Keynes developed mathematical economics for some macro-problems in employment, trade cycle and rate of interest. Harrod contributed to the mathematical framework to the growth theory. Allen developed economics in a new dimension through mathematics and statistics. Slutsky contributed to the field of probability, time series and serial correlation. Leontief introduced matrix algebra in his input-output model.

Thus various successors went on making use of mathematical methods in economics due to its suitability to explain and analyse the abstract reasoning and concentrating on special problematic fields. Economics began to be studied as a system theory in which inventions in pure mathematics went on occupying place of importance in theories as the flow of productive services and consumer goods and its reverse flow in various aspects.

In this system theoretic approach, mathematics was found to be useful in the following respect: precision; explicit expression; explanation of equilibrium, price, output, static and dynamic conditions, net revenue, minimum cost, optimality; facilitation of presentation and clarification of abstract concepts; display through graphs, charts, pictograms, bar and schematic diagrams, equations and identities; behaviour; functionality. Similarly, uncertainty and randomness began to be treated through statistical methods.

CYBERNETICS THROUGH MATHEMATICS

Our twentieth century may also be termed as the century of cybernetics. Today, with the basic tools of mathematics, science, technology, industry can hardly be imagined without electronic computers, without automata, without new methods which science of control and regulation places at the disposal of man. Electronic computers control automatic plants, pilot space vehicles, control road traffic, carry out mathematical computations, make diagnosis, draw up plans, teach, account, calculate. Similar is the case of electronic robots serving like creatures. They can do the job of a guide to exhibitions, sell lottery tickets and books, advertise products and polish floors. They are being further developed to work in distant planetary worlds and to fight the enemies.

Regarding controlling a system, a Russian scientist, M. Bongard, an expert in cybernetics, reported regarding collective behaviour. He spoke about the great harm that may be caused to a living organism by excessive centralization. Increasing centralization will make an organism waste a growing amount of resources to process information leaving less and less time for search and adaptation activity.

For example, advanced yogis whose practice, among other things, includes "raising the level of conscience" to control physiological processes which generally occur in humans at the level of autonomous or semi

autonomous control systems. Thus they can speed up or slow down their cardiac rhythms, cause their stomachs to contract or relax, and change their body temperatures. What effect do these abilities produce? If they were to neutralize all the automatic systems, a yogi would be compelled to use all his time and brain resources to avoid a malfunction which may threaten his life. He would then have no time left for meditation or contemplation.

It is certain that Hindu yogis never find themselves in such a dangerous position. They don't neutralize the automatic reflexes entirely and only occasionally interfere in their operation. The point is that they have their another goal. By trying to control over the autonomous processes occurring at a subconscious level, they seek to comprehend the laws which govern their human bodies. Decentralization, in which subsystems operate practically independently of any control centre, has a significant drawback explicit in the models working in rapidly changing environments. A longer period of adaptation is a penalty for decentralization. A decentralized system reacts more slowly to any change in the environment than does a system in which commands are generated by a centre having advanced information about the coming changes in the properties of the environment. It is probably for this reason that living organisms and, particularly, man has two levels of control, centralized and decentralized which do not overlap. Decentralized control completely dominates the situation when the environment is favourable and is not subject to significant change. Our separate subsystems function on their own and have almost no interaction with each other. Then comes a rapid change in the environment (upasarga) which is fought with dangerous consequences. It is vital that all the subsystems be put in a "state of alert" as soon as possible. This is the time for a centralized control to function and put a human body into a state of stress or a reaction. Whatever the danger an organism is facing, this reaction causes all the subsystems of the body to interact with each other. Blood starts receiving hormones which improve adaptability, the body is warned of the coming loss of energy, muscles are better fed, etc. After that, either we adapt or the stress situation comes to an end. In the worst case, a human body remains in a state of "immediate stand-by" for so long that it becomes exhausted or even collapses. This is the intriguing distribution of functions between the decentralized and centralized parts of a control system.

Thus in slowly changing or constant environments, a decentralized control system can cope with the task of adaptation and achieving the body's global goals, while a central controller is turned on whenever there is a need to handle a dangerous contingency. Such a mathematical manoeuvre works similarly in generation and function in of a robot. They are also called the puppets without strings or automata. In mathematics, a variable is said to be random if the values it takes and the frequency at which it takes them are known, but what particular value the variable will assume in each particular case is unknown (and can not be known in the framework of the given mathematical problem).

In the *Labdhisāra*, the development of a soul in the ladder of control stations (*guṇasthānas*) has been treated mathematically through symbols. Here we find that karma has been the subject of study by being made a mathematical object. The *yoga* and *kaṣāya* are controlled through certain operators which are usually the phases of the bios. Through the controls the bios gradually destroyes karma configurations (*prakṛtis*) and ultimately attains freedom from transmigration after destroying the whole of its own karma.

DECISION THROUGH MATHEMATICAL "MAY BE"

When there is an invitation and the answer is to be given it may either in yes or no or else maybe , that is, in an infinite variety of motives for selecting one or other of such answers. The decision can be put off in the last case by saying "may be". The foundations on which the decision is to be given rests on statistical hypothesis testing and sequential analysis, about the theory of risk and modelling, about identification and prediction, about the theory of passive and active experiment. These are esoteric issues.

Actually, sometimes we tackle our problems, make observations or experiments in a difficult situation, in a fog of uncertainty. Hence statistical methods are helpful here. Yet conscious design necessitates clear

understanding of the entire procedure that involves the conception of the experiment, analysis of a priori information, modelling, before randomization, sequential strategy, optimal selection of a point in a factor space, reasonable interpretation of results of statistical processing, represented in a compact, convenient form.

The art of research is the art of modelling. And if the situation calls for randomization, the investigator must be able to employ an effective statistcal method. To this end, one must not only have some grounding in statistics, but must also feel the problem and snags involved. Both arts can not be achieved easily, hence a skilled statistician on a team of experimentalists can be helpful.

NON-SYMMETRY IN MATHEMATICAL WORLD

In physics, the 'group theoretical' methods are used in nuclear structure. It may be noted that here the bilinear products of creation and annihilation operators lead to Lie algebras and they are classified. These are then combined with a discussion of 'quasispin' operators acting like fictitious angular momenta which arise in various areas. At the appearance of the unitary symmetry, there was the physicist's demand for understanding and using the unitary symmetry without learning characters and cosets. Unitary symmetry was applied to the theory of elementary particles and they were not interested in nuclear structure and many-body problems. The techniques of angular momentum algebra can be extended to treat other Lie groups and to give several examples illustrating the application of the method. In the theory of Karma, creation and annihilation, the study of such classification of Lie algebras of bilinear products of creation and annihilation operators, symplectic groups and study of applications to pairing correlations and seniority in many-particle systems may be found useful as the SU_3 group deals with eight types of formation found also in eight types of basic Karmas. Here permutation symmetry and Young diagrams may also be found useful in Karma theory.

MATHEMATICS IN MYSTICISM

The great mystic, Swami Ramtirth was a professor of mathematics. One of his publications is a booklet of two lectures for the Indian students on 'Ganita aura Vedanta'. The lectures were:

1. Why study mathematics ? And
2. How to excel in mathematics?

He wrote that there is similarity in mathematics and Vedanta in that both are non-dual, there is no duality in both and there cannot be so. The answer is one , that which is unchangeable, is unambiguous, definite, eternal and ever existent. The original bases of our material progress are the various dimensions of science; and the basic secret of all science dimensions is the mathematics.

What is science? It is actually the ordered knowledge; and mathematics shows and displays what is order. And, Vedanta is the ultimate transformation of knowledge and science; is knowledge itself. The original mystery of knowledge is ;know and build up'. Mathematics is an ocean where gems could not be obtained without diving deep. Mathematics is the companion of advenience, patience, and concentration, through which not only a single but several treasures of gems can be captured. During his times mathematics was compulsory in collegiate education.

He gives three analogies:

1. Mathematics is like an ocean, which is dreadful and roaring on its surface due to perturbation created by strong waves. But in whose bottom and low layers there are present the costless best of all, pure gems, jewels etc. scattered here and there.
2. Mathematics can be compared with the ancient sculptures of Greek gods Satyrs and Sileni, which though may seem to be bad in form, yet they have been carved and cast as attractive, inspirational artistic forms.
3. Mathematics is like the light of the sun which is completely colourless in view of an ignorant person. But actually in that light are present all the seven colours of a rainbow which when intermingled make the light of the sun.

MATHEMATICS GOVERNING THOUGHTS

George Boole called his work "Laws of Thought". The matter is that the algebra of propositions is closely related to the rules of the process of thinking. Because the sum and the product of propositions reduce to nothing but the logical (propositional) connectives "or" and "and" respectively, the "bar" operation has the sense of the negation and the laws of the propositional algebra describe the basic rules for the logical operations which all the people follow in the process of thinking. In every day life few people think of these rules as mathematical laws of thought but even children freely use them. Nowadays Boole's approach to the mathematical interpretation of the laws of logic as certain :algebraic rules" has become an object of intense interest. As long as logical operations were performed by people who used them in the process of thinking quite intuitively, there was no need to formulate the logical rules rigorously. In recent decades the situation has changed and nowadays we want to make electronic computers perform the functions which in the past could only be performed by people, for instance, such functions as production process control, traffic scheduling, solving mathematical problems, translating books , economic planning and finding necessary data in scientific literature; as is known, modern electronic computers can even play chess. Thus, the "Laws of Thought" must be followed by the "thinking" machines. For a computer, these rules of the game must be stated in a clear manner using the only "language" which a mathematical machine can "understand", that is the language of mathematics. Similarly, the theory of games is in fact a mathematical theory of conflict situations. The aim of the theory is to elaborate recommendations for each of the opponents to act rationally in the course of a conflict situation. For a mathematical analysis of a situation to be possible, it is necessary to disengage oneself from these secondary factors and construct a simplified formalized model of the situation. Such a model is called a "game".

CONCLUSION

The discoveries of today's biology not only revolutionize our view of the living matter but also make a profound impact on medicine, agriculture, and a number of manufacturing industries. Had the ideas of cybernetics not been taken over by the biological theory and its applications, these discoveries would be inconceivable. Control science, theory of large-scale systems, information theory, study of data transformation systems and communication channels in the living matter coupled with the ideas and techniques coming from chemistry, physics, and mathematics shape the biological science of today.

Extensive utilization of experimental methods, simulation study, and systems analysis promoted biology to the rank of exact science. Genetic engineering makes it possible to change in a purposeful way the machinery of inheritance, to design the living matter. Biotechnological processes are utilized in the manufacture of medical drugs, foodstuffs, and fodder. Today's biology is humanitarian and it is essential for genetics and psycophysiology and fro research on the structure and functioning of the brain.

Man's life is longer when he uses his biological reserves sparingly and effectively and minimizes the negative and undesirable factors which reduce the life of man as a social being. The growth hormone has been found to have no significant effect on the ageing process. Noticeable changes are known to occur in both the feed-forward and the feed back loops of neurohormonal regulation.

In particular, "hypothalamic misinformation" occurs. Hypothalamus, essential in regulation of the organism's homeostasis, becomes less sensitive to the incoming signals and this results in inadequate perception of the signals. For this reason for hormonal preparations which would normalize the data perception in the hypothalamus is an important line of research.

Until very recently attempts to extend life by modifying functional characteristics of the genome were scarce. This modification is made possible by inhibitors of transcription (olivomicin) and translation. Biochemical and morphological analyses revealed that the preparation significantly slowed the RNA and

protein synthesis in the cerebral cortex, hypothalamus, liver and in the muscles whereas in the pituitary and the myocardium the rate of biosynthetic processes increased.

The search for ways which would directly influences the temperature regulating centres in the hypothalamus or other elements of the thermal control system so as to obtain extensive temperature reduction seems to be a most promising way to increase the longevity of warm-blooded animals. If the scientists succeed in determining how the cells are differentiated and how they connect into tissues, these processes will be carried out in the tissue culture.

We live in a world more vulnerable to the vicissitudes of chance which abounds in an endless variety of forms. Some darken our existence, confound our plans and prevent us from realizing our most cherished ambitions. Others do not effect us, while others still illuminate our lives with all colours of the rainbow and bring happiness and success. The only reliable defence against the chaos resulting from chance is control; and cybernetics, the science which investigates the laws of control, is the science that deals with the struggle against chaos.

which in the past could only be performed by people, for instance, such functions as production process control, traffic scheduling, solving mathematical problems, translating books, economic planning and finding necessary data in scientific literature; as is known, modern electronic computers can even play chess. Thus, the "Laws of Thought" must be followed by the "thinking" machines. For a computer, to act rationally in the course of a conflict situation.

✦✦✦✦

ON ZERO AND DECIMAL PLACE VALUE SYSTEM

(FROM JAINA SOURCES)

ABSTRACT

In view of the knowledge derived from Babylonian mathematical cuneiform texts by Neugebauer, Sachs and others, and the claims of Needham and Ling in the Science and Civilization in China, various opinions have been set forth regarding the use of Zero and its adoption in the place value system, In India, however, some volumes as the Dhavalā, Jayadhavalā, the Jīvatattva pradīpikā in Kannaḍa and other commentaries, as well as the Tiloyapaṇṇattī have brought forth rich mathematico-symbolic material on Karma theory which points towards necessity of a decimal place value system in *Pūrvagata* (Earlier Heritage), the parts of the Agrāyaṇī and the Jñāna pravāda, still living with the Digambara Jaina School. They are required to be studied for further opinions and investigation regarding the origination of the Zero and its use in place value system. The model for astronomy in India had to do with geometry of a circle and a straight line and their extension to cosmological details by the Jain school to algebra and arithmetic was the outcome of the Karma theory studied as systems analysis and Cybernetics in an abstract form as a unified theory of bios and matter interactions. It was far beyond any astronomical theory, even beyond the unified model of the Vedāṅga Jyotiṣa or Jaina Jyotirlokavijñāna. That really needed a decimal placevalue notation for its various set theoretic numerical measures as will appear from this paper.

INTRODUCTION

The study of the mathematical cuneiform texts of the Old-Babylonian period (1600 B.C.) has shown their system of numeration to be based on place-value notation, based on a sexagesimal scale. Neugebauer opines that it was transmitted to the Greeks and then to the Hindus who contributed the final step by using the place-value notation for the smaller decimal units.[1] He also finds that the Arabic form for the zero symbol (a little circle with a bar over it and related forms) is simply taken from Greek astronomical manuscripts as recognized by F. Woepcke in 1863 [2]. However, he felt that no definite answer could be given to the question when the zero sign was introduced in Babylonian mathematics, which did not exist before 1500 B.C., but which was in full use from 300 B.C. on.[3]

Towards the far east, Needham and Ling[4] find that the shang aracle bone numeral forms (1400 - 1100 B.C.) and the method of writing numbers with them are based on the decimal place-value idea continued in the rod numerals, and suggests the possibility of the discovery of Zero in South-East Asia where Hindu culture " met the southern zone of the culture of the Chinese ". He also opines that while the ancient systems pointed to a date well before +500 for the development of place value and the zero concept, it was never entirely convincing because of the uncertain chronology of Indian History and the difficulty of dating documents in literary and epigraphy evidence for antiquity of place-value in India.[5]

Apart from the above information, these has been an emphasis on " emptiness " of Taoist mysticism which is no less than the "void" of Indian philosophy, which are said to have contributed to the invention of a symbol for sunya, i.e. zero.[6] To this may be added the Jaina annihilation of a karma existential matrix, perpetuating transmigrations, leading to a zero or nil existence of the world culminating in an eternal life of bliss and unending power[7]. Hence as this turning point, it may be worth while to present the role of zero and decimal place value system from the recently published Digambara Jaina texts, the Tiloyapaṇṇattī,[7] the Chakkhaṇḍāgama,[8] the Kasāyapāhuḍa, [9] the Mahābandha [10] of Bhagavant Bhūtabali, their summary texts by Nemicandrācārya [11] the Trilokasāra, the Gommaṭasāra, the Labdhisāra and the Kṣapaṇāsāra along with their commentaries by Mādhavacandra Traividya, Keśavarṇī and Ṭoḍaramala also

will be referred wherever needed. These texts give an elaborate exposition of a systematic development of mathematical models for geography, astronomy, cosmogony, cosmology and Karma theory, displaying the need for a system expressing large numbers and other systems for set-theoretic manoeuvre.

2. DECIMAL PLACES

The DVL, books 3 and 4 contain quite a rich material on decimal notational places. The source book CKG contain the following words which signify the decimal places : (C. 2nd century A.D.)

Word	Meaning	Verse	Book (Volume)	Remarks
coddasa	fourteen	2	GKG	cadu for four, dasa for ten
dasa	ten	P.236	2	P ≡ projected in DVL from earlier source.
suṇṇa	zero	DVL p.36 (c. 9th century	3	
sahassa	one thousand	DVL p.37		
terasa	thirteen	DVL p.40		te for three, dasa or vasa for ten
aṭṭhattīsa	thirty eight	p.37		attha for eight, tisa for thirty.
saya	hundred	p.36		
tehattari	seventy three	p.37		te for three, hattari for seventy
ekkavīsa	twenty one	DVL p.67		ekka for one and visa for twenty
naudī	ninety	DVL p.67		
solasa	sixteen	p.37		so for six, lasa for ten
aḍayāsaṁ	forty eight	p.37		ad for eight, yāsaṁ for forty
vārasa	twelve	p.40		va for two, rasa for ten
koḍi	crore	7		
lakkha	lac	DVL p.89		

[Note : Here 59398204 is written in words as pañcakoḍīo, tenaudīlakkha aṭṭhanaudi sahassa chauttaraṁ vīsadanica. This is from left to right in decimals and numerals.]

cauvaṇṇa	fifty four	9	3	cau for four vaṇṇa for fifty
saṭṭhi	sixty	DVL p. 92		
sada	hundred	9		
culasii	eighty-four	p.43		cul for four, asii for eighty

[Note : 1. In p.52, the number 46666664 is described beginning with sixty four, then towards left six hundred, then sixty six thousand, then sixty six lac then four crore: Causaṭṭhī chacca saya chasaṭṭhīsahassa ceva parirnaṇāṁ/ chasaṭṭhisayasahassa koḍi caukkaṁ pamattaṇām //52//]

[Note : 2. In p. 53, the order is reciprocal and from left to right, for writing 22799498.]

[Note : 3. In p. 56 the style is quite different for writing 69999996 which is spoken as six in the beginning, six in the end, nine six times in the middle :

" Chakkādi chakkamta chaṇṇavamajjha ya saṁjāda savve / "]

Sattakoḍisaya seven hundred crore p.68

$7 \times (10)^{9}$

[Note : In verse 45 of CKG, the number of developed illusion visioned human beings is given as above koḍākoḍākoḍīe and below koḍākoḍākoḍākoḍīe i.e. above $(10)^{21}$ and below $(10)^{28}$:

"manusapajjāyesu micchaitthe davva pamaṇeṇa kevaḍiyā, koḍākoḍākoḍīe uvari koḍākoḍākoḍākoḍīe heṭṭhādo//]

From the above it appears that the decimal places had to do with the vertical line or horizontal line and zero. It also appears as if *dasa*, a word for ten, got abbreviated from *daṁḍa* and *suṇṇa*, where *daṇḍa* stands for a rod and *suṇṇa* for a zero. Similarly *'sada'* appears for one hundred, abbreviated from *sadasa* or a *suṇṇa* added to dasa. Similarly *sahassa*, a word for one thousand, appears from sa*hatta ha* for a rod and three " sss " for three zeros. Further *sada sahassa*, *dasa sahassa* could be interpreted for the choice of their denominations for 1 lac and 10000. One koḍi, (a crore) also comes under *dasa sada sahassa*. This could possibly be thought of their entry into the realms of decimals place value system.

3. NOTATIONAL PLACES

The TPT describes the two fundamental instant-sets, the *palya* and the *sāgara*, needed to give measures of various existential sets, as simile construction sets, In the process of evaluating the *palya*[12], the number of palya-hair (palya-roma), is a number given by

$(4134526303082031777495121192)(10)^{18}$

expressed as a product of $\frac{19}{24}$ and the following 3 rows :

So | 96 | 500 | 8 | 8 | 8 | 8 | 8 | 8 | 8 |

So | 96 | 500 | 8 | 8 | 8 | 8 | 8 | 8 | 8 |

So | 96 | 500 | 8 | 8 | 8 | 8 | 8 | 8 | 8 |

where So stands for 3 zeros, to be placed on the right after the product. The above number is expressed in the decimal place value style as follows :

aṭṭhārasa ṭhāṇ esuṁ suṇṇāṇim do ṇavekka do ekko/ paṇa-ṇava-caukka-satta saga-satta ekka-tiya-suṇṇa//123// V. do aṭṭha suṇṇa-tia-ṇaha-tiyachakka doṇṇi-paṇa caukkāṇi/ tiya ekka caukkāṇim aṅka kameṇa palla romassa// 124// V.

Translation- Eighteen zeros in the last places, two, nine, one, two, one, five, nine, four, seven, sven, seven, one, three, zero, two, eight, zero, three, zero, three, six, two, five, four, three, one and four, these are the digits of palya-hair inorder.

In this, circa 4th 5th century text, the symbols also occur, following the verse. The decimals with words appear as follows :

Word	Meaning	Symbol	Verse	Chapter	Remarks
sada	hundred	100	125	1	TPT (V)
lakkha	lac	100000	158		
uṇavaṇṇa	forty nine	49	168		
coddasa	fourteen	14	171		
dasa	ten	10	179		
vādāla	forty two	42	152		
terasa	thirteen	13	186		
tettīsa	thirty three	33	191		
saya	hundred	100	191		
paṇṇattari	seventy five	75	198		
uṇadāla	thirty nine	39	198		
chappaṇa	fifty six	56	201		
ekkoṇavaṇṇa	forty nine	49	214		
causīdi	eighty four	84	229		
saṭṭhi	sixty	60	285		

[Note : The number 31980000 is expressed as twenty less one lac eighty thousand, tiṇhaṁ koḍīṇāṁ: ch. 1, p.123 (TPT (V))

" eguṇavīsa - lakkha - asīdī - sahassa - tiṇhaṁ koḍīṇāṁ "]

Thus the only change in decimal place for denomination of sada sahassa has been to lac in TPT and DVL from the CKG. In other denominations only declension count.

The notations in decimals may be seen at peak in the denominations of time in years in chapter IV of TPT (V) :

This is described in vv. 294 et seq. They are as follows:

Denomination of Notation	Meaning	Remarks
dasa	ten	Two yugas of five years each on multiplication by 10 from the preceding
sada	hundred	

sahassa	thousand	Two yugas of five years each on multiplication by 10 from the preceding
dasa sahassa	ten thousand	Two yugas of five years each on multiplication by 10 from the preceding
lakkha	lac	On multiplication by 10 from the preceding
puvvaṅga (pūrvāṅga)	$(10)^5 \times 84$	On multiplying the preceding by 84
puvva (pūrva)	$\left[(10)^5 \times 84\right]^2$	On squaring the preceding [or $7056\ (10)^{10}$]
pavvāṅga (parvāṅga)	$\left[(10)^5 \times 84\right]^2 \times 84$	On multiplying the preceding by 84
pavva (parva)	$\left[(10)^5 \times 84\right]^2 \times 84 \times 84 \times (10)^5$	On multiplying the preceding-ceding by $84 \times (10)^5$
nayutāṅga	$\left[(10)^5 \times 84\right]^2 \times 84 \times 84 \times (10)^5 \times 84$	On multiplying the preceding by 84
nayuta	$\left[(10)^{20}\right][84]^6$	On multiplying the preceding by $84 \times (10)^5$
kumudāṅga	$\left[(10)^{20}\right][84]^7$	On multiplying the preceding by 84.
kumuda	$\left[(10)^{25}\right][84]^6$	On multiplying the preceding by $84 \times (10)^5$

The above process of multiplication with 84 and $84 \times (10)^5$ goes on till mahālatā is obtained. Then the process of multiplication by 84 lac or $84 \times (10)^5$ continually gives śrīkalpa, hastaprahelikā and ultimately acalātma whose value is $10^{80} \cdot 84^{31}$ years. This is to be carried over to maximal numerate (utkṛṣṭa saṁkhyāta), of which the process of construction has been very elaborately described by R.C. Gupta, as maximum numerate plus one, or as the first minimal innumerate.[13]

It may be noted that for setting the measures of various types of sets in Karma theory, there have been various types of constructed numbers as numerate, innumerate and infinite which have not been expressed to dazzling heights without any purpose. Hence it appears that the school needed a system of this decimal type in their theory.[14]

WORDS FOR ZERO

First typical words for zero be examined from CKG, DVL and KPS, JDL :

Word	Meaning	Value	Remarks
avahirijjanti[15]	a set making by reduction or exhaustion exhaustion one by one and one to one correspondence	zero	DVL 1,2,3, concept of (exhaustion one by one) p.28, Book 3, vide p.220 also
aṭṭa suṇṇa	eight zeros	zero	
viṇasa ṇaṭṭhaṁ (tattha)	for removal of (at the end)		
avahiranti	making a set zero o exhausted	zero	CKG,1,2,3, p. 68 vide also p.230, in vv.1, 2, 3, 4,1, 2, 35.
antarmuhūrta	tending towards muhurta in the limit of difference tending to zero	approximate-	DVL, 1, 2, 6, p.69
avaharattha saṁditthiṇā	seen symbols for values of denominators of time	division	DVL, P.37; 1, 2, 6, p.87
khavaga	destroyer or annihilator		DVL, P. 44, 12,12, p.94
aṇantabhāgassa	infinitesimal	limit to	DVL, P.121, 1, 2,15
aṇantiṁbhāga	part of infinite's major part	infinitesimal	
asaṁkha bhāga	innumerable part	limit to innumerably smallpart	DVL, P.63, 1,2,16, p.130
asaṁkhejjadibhāga	innumerable part	limit to innumerably smallpart	CKG, 1, 2, 17
abhāva	absence	nil	DVL, 1, 2, 18 , pp.160,161
suṇṇaṭṭhāṇa	zero place		DVL, 1, 2, 19 , pp.181,188
gayaṇa	sky	zero	DVL, p.71; 1, 2, 45
ṇabha	sky	zero	p.255, in place value

[Note : The verse depicting place-value, from right to left is

gayaṇaṭṭha - ṇaya - kasāya causaṭṭhī - miyaṅka - vasu - khara - davva/

chāyāla - vasu - ṇabhacala - payattha - caṁdo ridū kamaso // 71 //]

Translation : The number is given by taking in order, eight zeros, ṇaya (two), kasāya (sixteen), sixty four, mṛgāṅka (one), eight, khara (six), dravya (six), forty six, eight, zero, acala (seven), padārtha (nine), moon (one), and ṛtu (6).

This number is 61970846668164162 $(10)^8$. The verse projected is ancient and earlier to DVL, collected as such.

There is one more verse next, projected in DVL, showing the area of Jambū island, in place value system, but left to right, in which word suṇṇa (zero) occurs explicitly two times :

satta ṇava suṇṇa pañca-chaṭṭha ṇava caducakkaṁ capañca suṇṇaṁ ca/

jambūdīvassedaṁ gaṇitaphalaṁ hodi ṇādavvā // 72 //

Translation : The area of the Jambū island should be known (given by writing numbers as) seven, nine, zero, five, six, nine, four, one, five, zero, (in square yojanas).

This number is 7905694150.

It may be noted that zero has not only been used in place - value notation, but also defined set theoretically to give the concept of a set having no element or member, by exhausting a set with elements, one by one. This is not only for instant sets (samaya - rāśis) but also for point -sets (pradeśa-rāśi). For example, " khetteṇa veindiya - vendiya - caurindiya tasseva pajjatta - apajjattehi padara ṇavahiradi aṅgulassa asaṁkhejjadi bhāga vaggapaḍibhaeṇa."

Translation : Relative to region, two sensed, three sensed four - sensed bios set - cardinals exhaust the universe - square (jaga pratara) as divided by the square of innumerate part of linear finger - width (in terms of point - sets)[16]

Word	Meaning	Value	Remarks
suṇṇa	zero	zero	JDL, 1, P-33, p.81, vol.1

[Note : The verse carries zero here in a place value, while giving the number of letters in scriptural (śruta) knowledge (right to left) [17]

"pañcekka chakka ekka ya du-pañca ṇava suṇṇa satta tiya satta/

suṇṇa du-caukka sataccha cadu cadu aṭṭhekka suda veṇṇa // 33 //

Translation : Five, one, six, one, two times five, nine, zero, seven, three, seven, zero, two times four, seven, six, four, four, eight, and one (when placed in left - ward sequence), give the letters of the scripture. The number is 18446744073709551615.

suṇṇa	absence	zero	JDL, vol.4, v.22, p.11
ṇaṭṭha[18]	abolish	zero	JDL, vol.6, v.22 p.127

[Note : The sentence is,

" kammapadesaṇamuvasamana-ṇikācaṇa-ṇidhatti karaṇa-ṇaṁ visohie viṇasapaduppaya ṇattharh."

Translation : In order to abolish (annihilate) the karma particles, the operations of subsidence, preservation and reservation have been mentioned.

Now the TPT and TLS are sought for zero word :

Word	Meaning	Value	Remarks
suṇṇa	zero	0	TPT (V), 123, ch.1
ritta	vacant	0	v.127. The concept of exhaustion of a set
cauthaṇesuṁ suṇṇa	zero in four places	0000	chapter 3, v.54, 86, 88,
padaṭṭhāṇe suṇṇaṁ	zero in place of foot	pa 0	ch. 4, c. 33
ṇaṭṭhi tuḍareṇu	zero in place of tudarenu (scale)	0	ch. 4. v. 55
ambara	sky	0	ch. 4, v, 59
ṇaudi suṇṇaṁgaṁ	On placing ninety zeros	$(10)^{90}$	ch. 4, v. 312

[Thousand is also given as ten hundred, v.1199]

[**Note** : dasa ghaṇa meant $(10)^{90}$ for 1000, v. 1170]

ṇabha	sky	0 in units place	ch. 4, v.1173
gayaṇaṁbara	sky - sky	00 in two Also places	ch. 4, v.1174 ch. 4, v.1174
āyāsa - ṇabha	sky - sky	00.....,,.....	ch. 4, v.1175
ṇabha - ṇabha	sky - sky	00.....,,.....	ch. 4, v.1176
ṇabha - aṁbara - gayaṇa	sky - sky - sky	000 in three last places	ch. 4, v.1176 from right to left

[**Note** : The verse, for example is as follows :

ṇabha - ṇabha - ti - cha - ekkekkaṁ aṁda - kame hoṇti savva vadigaṇa/

sattagaṇa ṇabha - aṁbara - gayaṇaṭṭha - caukka - aḍa doṇṇi // 1176 //

Translation - All debators were (given by) sky, sky, three, six, one and one (116300), in ordered digets. The total number of these seven classes is given by sky, sky, sky, eight, four, eight, and two (2848000) in sequence of digits.

gayaṇa ṇabha	sky - sky	00 for $(10)^2$ product	ch. 4, v. 1228
suṇṇa	indirectness	placing in some of the boxes showing directness and indirectness between ford founders and cakravartīs.	ch. 4, v. 1298 -1302

[Note : Here presence of a cakravartī in the period of a Tīrthaṅkara is shown by 1 and his absence by 0. Total boxes are 34.]

tha	zero	place second	ch. 4, v. 2407, v. 2807 sc.

[Note : The area of Videha region as 2969349902 $\left|\begin{matrix}300\\361\end{matrix}\right.$ is shown in the following verse where kha occurs- (4 century to 5th century AD.)-

du - kha - ṇava- vau - tiya- ṇava - chaṇṇava - duga joyaṇekka - pattīe/

bhāga tiṇṇi saya igi - chattiya - harida videha khetta phalaṁ//

Translation : The area in square yojanas of Videha is given by the number (written right to left) as two, sky (kha), nine, nine, four, three, nine, nine, six, two, yojanas (square) in a line. (To this is added) three hundred divided by one, six, three (or 361).]

khaṁ - ṇabha	sky - sky	00 or $(10)^2$	ch. 4, v.2682

Now we come to 10th - 11th century word TLS.

suṇṇa	zero	31 zero or $(10)^{31}$	TLS, v.21, p.28.

Note : Here the number 19791209299968 $(10)^{31}$ is given in place value in words as vidhu, ṇidhi, ṇaga, ṇava, ravi, ṇabha etc., from left to right.

ṇabha - nṇbha		sky - sky	place value (left to right)	TLS, v.24, p.31
ṇa	alphabet na for zero	place value (left to right)	kaṭapayādi system denoting zero Cf. ASG, p.2.	
gayaṇa	sky	zero		TLS, v.309, p.254
suṇṇa	zero	place value		TLS, v.313, p.261

[**Note** : Here the number of hair in a palya is given]

gayaṇa	sky	zero	TLS, v.309, p.254
suṇṇa	zero	place value	TLS, v.313, p.261

Note : The number is in place value from right to left. It is one krosa more than 7905694150 yojanas (square).

Example : Chādāla suṇṇa sattaya vāvaṇṇaṁ honti meru pahuḍiṇaṁ/

paṁ ca ṇṇaṁ paridhayaḥ krameṇa aṅkakrameṇaiva // 386 // TLS // p. 335.

Translation : In order of digits (527046), the circumference of the Meru happens to be given in digits from right to left as forty - six, zero, seven, fifty - two out of the five circumferences.

ṇabha	sky	zero in	TLs, v.770, p.610.
		place - value	(right to left)
suṇṇa	zero	zero in place	JPS, 11.41, p. 189.
		value	(left to right). JPS, 1.135,
			p. 45 (right to left) JPS,
			10.94. p. 183, (left to right)

Note : In JPS, The number 66 486 88 780504 has been the combined area of Kāloda ocean, but related as- (v.11.47)

chāvaṭṭhiṁ aḍadālaṁ aṭṭhaṭṭhiṁ sattasīdimasīdiṁ ca/

paṇṇasaṁ ca caukkaṁ havadi ya kālodadhisaṁkhā // 47 //

Translation : The area of kaloda ocean (added with area of Jambū island etc.) is sixty six, forty eight, sixty eight, eighty sseven, eighty, fifty and four (square yojanas).

This is an example of stating the number in decimals, place value, pairing and from left to right. The pairing is also seen in V. 10. 96, p.183 of the same JPS, where each digit is stated and the 10 in the end is stated as " dasa ", and not as 10, from left to right. Thus combinations of two, three, etc. digits were followed for specific purpose of expressing numerical measures in different units of time and space in astronomy. In karma theory, however required several types of units apart from the space and time units, even beyond the theory of matter requirements, as the bios phases were required to be related with particles phases of matter (pudgala).

KEY NOTATIONAL DECIMAL WORDS IN THE EARLIEST WORK

The kasāyapāhuḍa sutta of Guṇadharācārya has been regarded as the earliest monumental work on the theory of karma (C. 1st century B. C. later)[19], about two hundred years earlier than the Chakkhaṇḍāgama of Dharasenācārya's disciples, Puṣpadanta and Bhūtabali. (C. 2nd A. D.). This text is in Śaursenī Prakrit and was produced from the third Pāhuḍa, ' Pejjadosa ' (Love and Malice) of the tenth Vastu of the fifth Pūrva, " Jñāna Pravāda " of the fourth class Pūrvagata from the Dṛṣṭi Vāda, the twelfth aṅga of Jaina scripture. It describes a profound and unified system - theoretic technique, founded on set theoretic approach, gradually developed through symbolic, operational details of relations between phases of karma material particles in form of āsrava (input), sattva (state), bandha (bond), nirjarā (out put etc.) over quantitative maps, through matrices (vide ĻDS). The tradition goes back to the south Indian Śramaṇa Belgoḷa Candragiri where Ācārya Bhadra Bāhu (C. 4th century B. C.) along with his initiated Maurya

Emperor Candragupta, (respectively, knower of 14 and 10 Purvas) spent twelve years earlier than Aśoka's inscriptions began to appear in Brāhmī.[20]

Words	Meaning	Remarks
Dasame (Dasa)	tenth	KPS, v.1, p.1; v.86, p.611
Sadeaside	One hundred and eighty	v.2, p.4
paṇṇārasa	fifteen	v.2, p.4
ekkārasa	eleven	v.7, p,8
aṭṭhāvīsaṁ	twenty-eight	v.8, p.9
sattarasa	seventeen	v.27, p.260
solasa	sixteen	v.28, p.261
bārasa	twelve	.....,,.....
vīsa	twenty	.....,,.....
uṇavīsa	nineteen	v.29, p.263
terasa	thirteen	v.35, p.267
aṭṭhārasa	eighteen	v.45, p.274
suṇṇaṭṭhāṇa	zero places (absence)	v.49, p.277 and the following
saṁkhejja sahassa	numerable thousand	v. 114, p.641

Note : The versse gives a rare type of place value in terms of a variable, " numerable (saṁkhejja) as follows :

Saṁkhejja ca maṇussesu khīṇamoha sahassaso ṇiyamā/

sesesu khīṇamoha gadisu ṇiyama asaṁkhejja // 114 //

Transalation : Among the human (male) beings the annihilator serene visioned are numerable - thousand as per rule. In the remaining life courses they are innumerable as per rule.

vassa saka	The Saka Era- hundred	v. 131, p.760
sahassa	thousand numerable years	
sadasahassesu	innumerable	
asaṁkhejjesu	hundred thousand	.....,,.....

Note1 : The verse gives the life-time of bonds here :

vassa sada sahassa imaṭṭhidisaṁkhāe du mohanīyaṁ tu/

bandhādi ca sadasahassesu asaṁkhejjesu sesāṇi // 131 //

Translation : In the inter - state of two - instant - effect, (the bios) binds the charm - karma as present transition - proestablisher, for life - time of numerable - hundred - thousand years, and the remaining karmas are bound for life - times of innumerable - hundred - thousand years.

Note 2 : The calculation is further carried on to infinity - a proper infinite, as if of G. Cantor, detailed further in LDS. bārasa ṇava cha tiṇṇi ya kiṭṭio homti adha vā aṇamtāo/ eddeddamhi kasāye tiga tiga adhavā aṇamtao // V. 163, p.806 //

Translation : The tracts of fluorescent anger etc. affections are twelve, nine, six and three or infinite. In every one of the affections there are three krstis (tracts) respectively or there happen to be infinite tracts.

There is one more word, gaṇanādiyamte ṇa, meaning beyond numeration, or meaning innumerable, (v. 224, p.885). Upto this time of Guṇadharācarya, the verses were pronunciated and then their meanings were lectured (K p^{s}, p.4). Professor A Cakravarty has placed Kundakundāeārya, the alleged author of " Parikarma ", a commentary on the first three sections of the Chakkaṇḍāgama, and it appears, according to the veneration he attained just after Gautama Gaṇadhara, as early as 1st century B. C. By the time of Ācārya Bhūtabali, we find in literature, Mahābandha, the symbol for zero has been used for filling up gaps in writing of detailed Karma bond theory (prior to Kundakundācārya). through out the word. (vide MBD, pp. 41 et seq.)

For example : "ṇavari ṇiḍḍu - pacalā ogham / theṇagiddhi 0 3 micchā 0 aṇamta ṇu 0 4 jahā o amto o /

Translation : Specifically, that of sleep, deep sleep is as the Ogha, (i.e. minimal, maximal inter- muhūrta). The somnambulism (three) 3, illusion, infinite - pro - bonding (four) 4, is minimal inter - muhūrta. (V.115, p. 91, MBD)

This treatment shows that by this time zero had not been used as a decimal place value. The commentator, Kundakundācārya, author of Parikarma commentary of CKG and MBD, must have before him CKG, MBD and KPS. This style of abbreviating the full words and sentences, in which 7 volumes of MBD have been written might have inspired him to start with a line and zero (a danda and sunna) to go ahead of nine digits as 10. This is just a conjecture, for the author has been placed as the 3rd rank in benediction, prevalent as an ancient tradition in the Digambara Jaina School. [21]

maṅgalaṁ bhagavāna vīro maṅgalaṁ gautamogaṇī /

maṅgalaṁ kundakundādyo jaina dharmostu maṅgalam //

Translation : Lord Mahāvīra is auspicious, Gaṇadhara Gautama is auspicious, Kundakundācārya is auspicious and the Jainism is auspicious.

However, although Parikarma has been quoted by the traditional authors like Vīrasenācārya, it is not available now in the Bhaṇḍāras of Jaina temples.

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1. Neugabauer, O., The exact Sciences in Antiquity, Providence, 1957, p.20.

2. Ibid. p.26

3. Ibid. p.27

4. Needham, J, and Ling, W., Science and Civilization in China, vol. III, Cambridge, 1959. p.11. Needham also finds that from the time of King Aśoka (- 3rd century) these was a steady development of forms akin to the ' Hindu - Arabic numerals ', the first three integers being written in just the same way as the Chinese, the first epigraphic evidence for zero in India being of the late + 9th century. 9 bid., p.10.

5. CF. ibid., p.10. 6. cf. ibid., p.12.

6. *Trilokasāra* of Nemicandra Siddhāntacakravartī, with Sanskrit commentary of Mādhavacandra Traividya. Ed. R. C. Mukhtar and C. P. Patni, and Hindi commentary by Aryika Visuddhamati, 1976, Shri Mahaviraji.

7. The Tiloyapaṇṇattī of Yativṛṣabhācārya (c.5th century A.D.), vol.1, 1943 ; vol. 2, 1952 , edited by H. L. Jain and A. N. Upadhye, Sholapur, (abbr. TPt).

8. The Chakkhaṇḍāgama of Puṣpadanta and Bhūtabali Ācāryas, (c. 2nd century A. D.), with Dhavalā commentary of Vīrasenācārya (c. 9th century A. D.), (abbr. DVL), vols. 1 - 16, Amaraoti etc., 1939 - 1959.

9. The Kasāyapāhuḍa of Guṇadharācārya, (c.1 century A. D.), (abbr, KSP), with Jayadhavalā commentary of Vīrasenācārya, and Jinasenācārya, vols. 1 - 14, edited by Pt. Phoolcandra and Pt. Kailashcandra, Mathura, 1972-

10. The Mahābandha (abbr. MBD) of c. 2nd century A. D., cols. 1 - 7, Kashi, 1947 - 1948.

11. He belongs to the end of 10th century A. D.

a] The Trilokasara with commentary of Mādhavacandra Traividya and Viśuddhamatī Āryikā, (abbr. TLS). Shri Mahavirji, 1976.

b] The Gommaṭasāra, vols. 1 - 4, (abbr. GJK and GKK) with Karṇāṭaka vṛtti of Keśavavarṇī - (c.13th century A. D.) and translation Samyakjñāna Candrikā commentary of Ṭoḍaramala in Hindi (c. 15th century A. D.), New Delhi, (1978 - 81). ASG will denote its Artha Saṁdṛṣṭi.

c] The Labdhisāra including the Kṣapaṇāsāra, along with Ḍhūṁḍhārī commentary of Ṭoḍaramala, (Abbr. LDS, KPN), Agas, 1980, edited by Pt. Phool Candra Siddhantashastri. ASL with denote its Artha Saṁdṛṣṭi (Symbolism for Norms).

12. Cf. TPT, ch. 1, vv. 1.93 - 1.132.

13. Gupta, R. C., The first Unenumerable Number in Jaina Mathematics, Gaṇita Bhāratī, 14 (1 - 4), 1992, 11 - 24

This number is analysed by him to have been constructed through pits in units, tens, hundreds places. Cf. also TPG, pp. 102 - 103, for an easier analysis by L. C. Jain.

14. Jain, L. C., The Tao of Jaina Sciences, Delhi, 1992, vol. 1. pp. 1 - 46. Vide also Kapadia, H. R., Introduction to Gaṇita Tilaka of Śrīpati, Baroda, 1937. pp. V - LXIX, for information on Notational

places in GSS, Sthānāṅga, Jambūdvīpa prajñapti, Sūrya prajñapti, Anuyogadvāra, and Jīvasamāsa etc., as also the Jyotiṣa karaṇḍaka. The Tattvārtharājavārtika and the svopajña bhāṣya of the Tattvārthādhigamasūtra, wherein the names differ some where along with the process of constructions. But in all of them 10 has been used along with 84 for this purpose. It may also be noted that for finding out the value of π, the number 10 has been used for finding the finer values of π through difficult processes as may be seen in, Gupta, R. C., ' Circumference of the Jambudvipa in Jaina Cosmography ', IJHS , 10.1, 1975, 38 - 4. The originality of manipulation is evident there in. The number 84 is also connected with the generative places called yoni or jati which are 84 lac in number of various types of bios classified in several ways.

15. For example, the verse 1, 2, 34 is in CKG as-

asaṁkhejjahi osappiṇi - ussappiṇihi avahiraṁti kāleṇa // 34 //

Translation : Relative to time (the five sensed subhuman bios set) is exhausted by innumerable - innumerate hypo-serpentine and hyper - serpentine (periods of time or instant - sets). Method of one-to-one correspondence is described here in DVL, p.233, Book 3; 1, 2, 35.

16. CKG, V. 1, 2, 79, p. 313, Book - 3 (DVL).

17. This is the combinatorial work from 64 alphabets. Vide Bhūvalaya of Kumudendu.

18. The details of these operations is given in details in GKK, II, p.675. and LDS. The Nikācita operation means that the karma particles could neither be brought into rise trail (udayāvali), nor could be brought into other configuration (prakṛti) form, nor could be uptracted or downtracted. The Nidhatti operation means that the karma particles could neither be brought to the rise - trail (udayāvali), nor could be transited into other configuration form.

19. Edited by H. L. Jain Siddhantashastri, along with Cūrṇisūtras of Yativṛṣabhācārya (C. 5th century A. D.), Calcutta, 1955, (abbr, KPS), p.58

20. Vide, Jinasena, Harivaṁśa purāṇa, 9/24, and Mahāpurāṇa, 16/103-104-109. The Sundarī may be taken to be Hinākṣarī and Brāhmī as Ghanākṣarī, which were required to be perfected for learning of Karma Theory.

Vide, Jain, L. C., Secret of Hinākṣarī and Ghanākṣarī (in the Moon cave of Girinagara), Arhat Vacana, 1 (2), 1988, 11-16.

Vide also Goyal, S. R., Brāhmī - An Invention of Early Mauryan Period, in 'The Origin of Brāhmi Script', ed. by S. P. Gupta and K. S. Ramchandran, Delhi, 1979, 1-53.

For more details, Cf. Jain L. C, Arhat Vacana, 2(2), 17-26, 1920; 2(3), 1-2, 1990, and pp. 82, 92, ibid; 4(1) 1992, 13-20; 5(3), 1993, 155-171.

21. Vide Jain, L. C., Arhat Vacana, 3(3), Inl. 1991, 33-41, ibid., 2(1), 1989, 7-12, ibid., 2(4), 1990, 82-92.

These are on Kundakundācārya relevant to decimal place value. Even the use of 10 in finding value of π as $\sqrt{10}$ and its vasana by Mādhavacandra Traividya is in support of this conjecture.

Cf. Gupta, R. C., IJHS, 21(2), 1986, 131-139

For use of place value in subtraction from factors, vide Jain, L. C., IJHS, 24(3), 1989, 163-180.

AUTOBIOGRAPHICAL REFLECTIONS

BENEDICTION

O ! UNIVERSAL LORDS AMONG THE LORDS GREATEST,
THE BRAVEST, THE OMNISCIENT AND THE KINDEST,
THE ANNIHILATOR OF THE KARAMA GRAVEST,
THE PROPOUNDER, THE FOUNDER OF THE DHARAMA HOLIEST!
I ADORE YOU ALL WITH MY HEART CLEANEST,
FOR ACHIEVING THE FREEDOM SUPREME PUREST.

I was born at Saugor in Madhya Pradesh, India on the 1st July, 1926. My wife Sau. Smt Basanti Devi was also born at Saugor nearby, on the Basant Panchami, the 14th february, 1935. My father, shri Damru Lal Jain, born on 20th october, 1895, was a middle school teacher at the Govt. High School, Saugor. He was born at Narsinghpur, M.P., and was the only son of his father, shri Paramasukh Lal. My grandmother was handicapped and after the death of my grandfather came to Jubblepore, for the education of my father who had two sisters, one at Bargi and the other married to shri Jugrao Sao Diwakar at Seoni. My mother Smt. Chameli Bai (Ghasita Bai), was born at Bilahari (Katni), M.P., the old capital Pushpavati of the Kalchuri Dynasty, under King Karṇa. My grandmother served at the Jaina Boarding, Jabalpur, as a cook, and died in harness.

I had two brothers, the eldest Pooranchand, dying at age of two years and the elder Komal chand dying on the 10th december, 1944, at 1.00 p.m., on sunday as a patient number 10, at the Victoria hospital, Jabalpur, during his operation of hernia. He was a Yogi, practising all yogic activities, āsanas, prāṇāyāma , excercises, visiting yogis at Āryasamāja temple, gymnasiums and so on. He would never allow any friend or relations to smoke, use tooth brush and artificial things which might be harmful for health. He went on writing health and yogic notes till his last breath. He was weak in mathematics and lost a year in matric with a sad heart due to it being the compulsory subject.

My father was one of the most sincere teachers, always giving cent per cent like results of his class but while in his last breath, before 6th november, 1945, he instructed me never to become a teacher in life, as he had very bitter experiences as the most loyal government servant. He never allowed us to have any sort of bad company, visiting of cinemas or even standing near panwala shops or taking tea at any stall. We could not see even any street singer or dancer and drive a cycle for all these would make us weak. He did study religion also for becoming a Pandit but left it as he thought the society did not regard a teacher in good terms. There was less harmony between my father and mother for he was too economic which my mother would not like at least for the kitchen. Sometimes we had to feel tortured due to all this, yet we realized the value of economy when my father was transferred to Hoshangabad in 1943, as a precautionary measure of the British rule, after the QUIT INDIA movement launched by the congress leader, Mahatma Gandhi in 1942. My mother remained at Saugor and we two brothers were at the Robertson College Hostel, at Jabalpur. My father could send only Rs. 60/- a month for us and we had to remain on one time meals alone. However, we also realized that we enjoyed good health and our father could purchase a house and about eighty tolas of

gold, due to his very hard austeric type of life. I could neither purchase nor build a house, nor I could have a conveyance or dresses befitting a professor. I could not balance the family nor its upkeep and my sons began to give importance to earning of money about which I had never cared.

My father used certain proverbs and my mother used some ahānes which were very instructive in the practical life. From his unpleasant experiences my father used to say, ' Veśyā kisakī jorū aura baniyā kisakā yāra ?' This meant that neither the prostitute nor a trader is friendly to anybody. He also said, ' Na nau mana tela hogā , na Rādhā nācegī.' This was an expression for the impossibility for any work : neither there will be an accumulation of nine maunds of oil, nor will Rādhā dance. One more proverb he used to relate was, ' Rāṇḍa sāṇḍa nakaṭā bhainsā, jaba jūjhai taba hove kaisā'. This meant that it is a perplexing event when a prostitute, a bull, the shameless and a buffalo begin to fight. He used to call me , 'Lolā', meaning that I was not at all befitting for worldly success. Once he punished me for I had returned one day at about nine p.m. Whenever there was a quarrel between me and my elder brother, Komal bhaiyā, he used to scold only Komal and he loved me more. However, his fury was also on me, and he used to rush at me and I could dodge him by climbing and running from roofs to roofs and ceilings to ceilings. But when I quarrelled with my younger sister Sitara, he scolded me not to be militant. Komal bhaiyā was often teased by me when I took his cleaned clothes or else at other such occasions he was angry and used to strike and break his pen nib on the table. Sitara was always free to play and mix with her friends and Komal bhaiyā had friends who were of yogi types. His friend, Vinayak Kher, was practising telepathy with him and used to instruct him to come in dreams etc. We used to learn swimming together and visited yogis who showed feats to us and also to the public. Milk and ghee were very cheap, milk eight seers a rupee and ghee two seers a rupee, wheat sixteen seers a rupee and sugar ten seers a rupee. Komal was a gymnast also and had a friend, Keshav. We played kho kho and kabaḍḍiī at parakota, Saugar. We also visited Digambara ascetics whenever they came and my mother was a great devotee of them. She never liked any fan or comforts in the temples or at home and wore the simple dress. She became widow at the age of forty one only. Her sister, Pyari Bai, who was married to Kodu lal at Damoh also became widow at eighteen years of age due to tuberculosis of her husband. My younger māmī also had become widow at about sixteen years of age and according to our customs they all remained so throughout their lives.

My mother was a very good singer having a very sweet voice and she sang religious songs and she used to tell various stories, proverbs and idioms which I have stored separately. She was very inspiring, bold and never submitting to the circumstances. After she became widow, she was writing letters to the prime minister, Indira Gandhi, making complaints against officers who neglected her petitions for financial help. She was very much careful about my handicapped sister and spent most of her resources and money for her treatment, education and upkeep. She was most religious and gave āhāra to munīs several times by taking severe vows that the ascetics called for. She never allowed me night meals at all costs. She gave me food only after I showed sandal wood ṭīkā on my forehead showing that I had been to the devadarśana (temple). As I could not get my transfer back to Jabalpur, she remained all alone with my handicapped sister for fourteen years from 1964 to 1978 till her death. All her love and frustration for her son, Komal, had been completely concentrated and directed towards Savita, my handicapped sister. She had great affection towards my maternal uncle and she always got him financially helped by my father. She loved her native place and the birth village and we often visited them. Bilahri had many Jaina monuments and relics of the ancient periods and she was proud of them. Her father's house was attached with the temple construction and she used to say

that deities came to sing and dance at the dead of nights. There was a small garden in which chhītāphala (custard apple) and guavas were the sweetest during the winters. There was a neighbour, a shepherd near our home, called Fuddīṁ, who had a very simple blanket, called hazāratagī, and a wretched carpet in his house. There was a great poverty among ninety five percent of the population and even a Jaina family used to trade with the hair of pigs, for the purpose of money earning. They also indulged in lending money on interest and a very rich one was murdered owing to his atrocities upon the poor, while on his way to ugāhī and takājā. Before her marriage at the age of only fourteen years my mother had lost her brother, called Veera, the most talented and a good earner in the family, who died of red fever or lāla bukhāra, the dreadful influenza just after the first world war. My mother had topped the list at her primary final examination and the educational authorities advised to get her admitted for higher studies which the villagers never would like in those days. The family was poor and my father also was poor, just matric from the Hitkarini School, Jabalpur. He was twenty-four years of age when married to my mother. Among his classmates were Ganesh Bhatt and Sunderlal Golchha. The former retired as the Chief Judge of the M.P. high court and the latter, having lost his business in Balaghat mines, remained a defunct advocate. One day, Ganesh Bhatt told me that time never runs against government law and the crime once committed can ever be challenged in the court of law. The same is the case with every bound karma paramāṇu which one creates. It never leaves without fruition, though the way it terminates may be altered to a calculated value on accounts of the new inputs, called the āsrava in Jainism.

To such parents I was born. My mother related that she read the Pradyumna caritra several times before my birth and she was blessed by the Diagambara ascetics.

At the last month of her conception she fell into a ditch and a very big stone fell on her. Every one thought that the womb's child had crushed but I remained all safe into the womb. She also related that when I was born I carried a garland like structure round my neck and whosoever saw me told that I have come from the paradise in this world of mortals. I was so much healthy that even the sūpā was insufficient to hold me. She related that I was sucking her milk upto the age of six years as my next sister, Sushila died, at the age of two years due to liver cirrhosis. Then was born my sister, Sitara, on the 29th august, 1933. At the death of my father she was 12 and also suffered from liver weakness. She was in the seventh class at the Radha Kanya primary school where she had a friend, Gyanvati, who remained her closest till marriage. She was Brahmin and studied under me for English. She and Sitara were talented and won every prize in dramas and debates at many competitions throughout the state till they were graduates.

So begins my story into the light from the darkness of the past life, the life in the previous birth about which one could only guess and speculate at a very long distance in time. "Pūta ke lakṣaṇa pālane meṁ dikhate haiṁ." "Honahāra biravāna ke hota cīkane pāta." So goes the saying. I have remembrance of a very few events of my childhood. My father took pains to take tutions of a few students who used to come at night. They had a torch with them and it was a great curiosity for me. He also had tutions of son of a judge and other officers. Our house was at the Śanīcarī ṭauriyā, leading to a climb up hill at the top of which was a big mosque. Below the hill was our small house on rent from one Tilī wāle whose brother, Bhaiyalal, had become an M.L.A. who married again a widow nurse. The rooms were dark and made up of soil. Sometimes I could see some pathānas roaming about our house, and my mother used to be afraid of them.

One day I remember very well, we were playing a drama of Rāma and Rāvaṇa, and I stood by the side of a door in the drainage lane when suddenly I was bitten by some poisonous creature. Father was out at school and my mother took me to bath room on my cries and poured over a lot of water thinking that this would remove the poison. Some persons tried to see the creature in the hole but could not detect. My mother wore a torn saree of kitchen and she in that very dress without any loss of time, went rushing towards some doctor. After a distance of two hundred yards, we got a tāṅgā and mother led it to various dispensaries but they all were closed. It was about two o'clock and as luck would have it, Dr. Bhagwat was present. He operated the right hand middle finger and a lot of poisonous blood was taken out. Then I was taken to the temple by my mother where I was given Neem and chilies to taste. My hand was tightly bound at three places and I was to remain awake for three nights. My father was handling with very great difficulty on the first night which was so callacious for me. I also remember to have a very serious attack of vomitting when I took badas of Urada pulse. I also suffered from chinang, some burning sensation when urinating, and when this was increased some medicine was brought for me from Bilahri, as herbal roots which cured me once for all. I had suffered from the tertial malarial fever continuously for three years and that counted upon my liver weakness and I could not run very fast and take part in athletics and gymnastics in which Komal excelled.

I was admitted to primary school soon after I was five. I did not like the school's disciplines and wished to be ever free. I also never wanted a tutor, and whenever the same was arranged by my father I used to run away. I remember to have received an award from my teacher, shri Panda Janabji, as we called him. He always carried a thick, strong stick, with him, and as a Śaiva devotee had sandal signs on his forehead. He gave about ten problems to solve for the students. I was the first to solve them in a lot of about a hundred students. He was very much pleased with me and called my father. In father's presence he awarded me a Victoria one-rupee-coin and gave his stick to me to supervise the students. God alone knows how I could solve them all at a time. Nevertheless, I knew well that the problems were all those which I could solve very well. I could not see him after that and when I became aware of his recognition, quite late in life, I tried to find him in Saugar but he had already paid the debt of nature. Our headmaster was a jolly fellow. He used to ask me, what Jaina I was, Golālāre, Golasiṅghāre, or Golāpūraba. My father used to say, "Golā pūraba bāniyā, baṅśa gayā kī jāta; Jaise lakaḍi bānsa kī, uṭhe phānsa meṁ phānsa".

Our school was at the place where there were graves and good tombs erected with decorative shades above. We did not know whether they were, Muslims or Hindus. We played and sometimes were afraid of the spirits residing therein. There was a well and our friend told that "cuḍellinas" reside in that and whosoever looks into them is drawn in by them. They have reversed feet and if some one could snatch away their chuṭiyā he could have command over them. They are out in the midnight and they catch away any one who went there. We had a vast expanse and playgrounds in our school and our teachers, Sri Purushottam, Mr. Rahaman Ali and various others were very sincere in imparting education to us. We were taught reading of mahājanī letters and we read maps apart from the mother language and geography. Our examination of the fourth primary final was in 1934 and I got very bad marks in writing an essay on the Daśehara, understanding it to be something else. Thus my father could get my admission to the Govt. High School with a great difficulty by pursuing a malagujāra to get his son admitted to the municipal school.

At the age of 13 years I had felt some sort of supersensitivity in myself. I wanted to be all aloof from the rustles and bustles of life. My father had given me some books in English on life in England,

Outlines of Jainism and so on, as to be aware of the environment we had around us and to be prepared for the struggles ahead. One day I felt that I should not remove my eyes from an idol of Gommaṭeśvara at the temple while on the street. It was significant, as later on I was destined to work, on the Gommaṭasāra and the relevant works throughout my life for tracing the truth through history, exposition, modelling, and deeper study through mathematics. This was founded on the geographical and astronomical models as well as the cosmological models in the Trilokasāra and relevant texts. I was only interested in mathematics for it required the least taxing on memory as is required for learning Sanskrit or history and geography. Where algebra was said to be *akalaghabarā* and geometry as *jāna meṭane vālī*, there was also the fact, *"History Geography baḍī bevafā, Rāta ko ghonṭī sabere safā."* There was a very good set of teachers who prepared us with their utmost devotion, more so because of their sons being our classmates. I preferred algebra to arithmetic and geometry. As soon as I joined the Robertson College, I had again a very good team of teachers, Dr. S. C. Dhar, the Principal, from the Allahabad university, to teach us applied mathematics. Professors Raghavacarya (mathematics), G. S. Ganeshan (physics), so also in chemistry. I had topped in securing highest marks in mathematics and Dr. Dhar had very good hopes about me, but I had to leave college due to death of my father in november, 1945. It was really fortunate for me to do M.Sc. in applied mathematics which had been introduced by Dr. Dhar, under affiliation to the University of Saugar (now the Sir Hari Singh Gour University). There was astronomy as well as the mathematical theory of electricity and magnetism which proved to be most supporting in my researches ahead. In the second college year itself, I had appeared at the *Dravya Saṁgraha* and then *the Tattvārtha Sūtra* examination in which I topped the list. Thus my study, deep into the cosmology and astronomy, went on side by side with the ancient works. I tried to know the truth of the ancient works and also wished to remain in touch with the contemporary knowledge covering very vast fields. While preparing myself for the M.Sc. in applied mathematics as a non-collegiate student, I was serving, doing selected tutions, and getting books on loan, asking for notes from the regular students, and asking for guidance from my seniors like Radhikacharan Khare. I became interested in the nuclear physics also and I was assured by Khare that I could get every thing from books. I passed and was able to join the College of Science as a lecturer in mathematics in 1951, where I soon came in contact with a great scholar of Jainological studies, Dr. H. L. Jain, who was at the Morris College. So my parallel studies began in the ancient and the modern. The former started with the translation of the *Gaṇitasārasaṁgraha* of Mahāvīrācārya, and then the mathematical contents of the *Tiloyapaṇṇatī*. Dr. H. L. Jain was very serious about the most unprejudiced and impartial attitude towards the research. I found that with exception of a few methods like the *Kapāṭa Sandhi*, the remaining topics were all covered by the intermediate mathematics. In the Tiloyapaṇṇattī, however I found complicated phenomena in the series and sequences, some of the problems were taken up later by Dr. R. C. Gupta, the unesco representative for history and philosophy of science in India. These covered the calculation of the circumference of the Jambūdvīpa wherein came the term *"kha kha padssaṁ sassa puḍhaṁ"*. The complicated sequences and series were covered in the *topics on the dwellings in hells and the* innumerate rings of lands and the oceans, doubling at every step, starting with the Jambū island at the very centre of the cosmos or the three universes, the upper, the middle and the lower, signifying respectively, the lives in the paradise, the earth and the hell. It was actually the mathematical universe through which the modellers gave various types of measures in numbers or similes best known in the ancient minds. The measures were for the population sets of various species, their sets of dwellings, then for their environments. The measure

through the *rajju* (rope) signifies the relation with the Harpedonopties of Egypt. Then there were some ancient symbols, some of which could be directly related with the ancient Brāhmī script.

The above works were published in 1958 (TPT) and 1963 (GSS). I was given also the third, fourth and the tenth volumes of the *Dhavalā* text on which a professor at Amaraoti and Dr. A. N. Singh had written a few articles. It was easy to deal with the mathematics of the third and the fourth volumes but not so easy with the the tenth volume in which the deeper philosophy was involved. Moreover, some symbols in the Tiloyapaṇṇattī were puzzling and I needed some more anciant books. In the mean time due to reorganization of the states, Nagpur was to go with the Maharashtra and I was obliged to get myself transferred to Jabalpur Robertson College. Soon after I joined at Jabalpur, I came in contact with professor Potdar who was interested in the Einstein's works. We decided to go to Varansi (Benaras), where Dr. V. V. Narlikar was the Head of Department of Mathematics, at the Hindu Univesity (1956). The proofs of the Tiloyapaṇṇttī were also to be seen at the Maidagin Dharamshala where Pandit Balchandra Shastri was working on the Jambūdīvapaṇṇattī saṁgaho. While at Nagpur I had also come in contact with the Abstract Set Theory and various other books which I had needed for the study of set theory of the Jaina texts. At Benaras we attended lectures of some research scholars on Einstein's field equations, equations of motion and perhaps Cosmoloy in which Dr. Narlikar was interested. He was taking mathematical physics. He suggested some books, the Cosmology by Bondi, Space Time Structure by Schroedinger, A History of the Theories of Aether and Electricity, Theory of Relativity by Pauli, and the Jubilee of Relativity Theory (1956), from time to time. Soon after a year I sent to him four research papers for perusal but he could find very short time to go through them as he was to join Ajmer public service commission as a chairman. He wrote to me later on that my interest in relativity was still unabated and further that it was a strange Indian phenomenon that one had to do reasearch outside the university.

Meanwhile in 1959, I was promoted as assistant professor and joined Devas degree college. I joined there all alone and left my family at Jabalpur. On every saturday, I used to go to Indore, a distance of eight anna piece those days, about 20 miles from Devas. I used to stay at the Udāsīna Ashram there and in contact with some wise tyāgīs I could have a look at the vast commentaries of the Gommaṭasāra, known as the *Jīvatattvapradīpikā* of Muni Nemicandra and the *Samyakjñānacandrikā* of Ṭoḍaramala. The former was said to be that by Keśava Varṇī but that was in Kannada and was published later, but without Ṭodarmala's Artha Saṁdṛṣṭi chapters, by the Bharatiya Jnanapith very late in Devanagari script through the efforts of Pandit Kailashchandra and Dr. A. N. Upadhye. I had seen the *artha saṁdṛṣṭi* chapters of Ṭoḍaramala in Dhūṁḍhārī in the vast commentaries which were the great source for my future research in the field of Jainology, neglected so far at every centre of Jaina learning. I prepared a paper, "On the Jaina School of Mathematics" and it was published in the Chhotelal Smriti Granth from Calcutta in 1967. The future researches were to be history of science in India.

Thus, by this time I felt that I had before me such text which could enable one to contribute to the unified field theory and to think of giving to the world a theory of every thing (TOE). There was the historical aspect of study in the discovery of the origination of the Brāhmī Sundarī scripts, the origination of the place value in which the zero has been used specifically and the other techniques of place value in subtracting of factors etc. Then there were the models of Jaina geography, astronomy and cosmology, apart from the Karma System Theory with Cybernetics. Moreover, There was the whole ocean of modern physics introduced by Einstein through his revolutionary concepts of invariance, relativity, freedom from inertial frames, the absolutes of the classical physics, the theory of

quanta introduced by Max Planck, the theory of sets originated in a new aspect by Georg Cantor. There were also the Quantum Field Theories and the String Field Theory was still awaited. The Elementary particle physics with its four forces of nature, the gravitation, the electromagnetism, the strong nuclear and the weak nuclear forces were under grand unification theories and the supergravity theories alongwith the group theoretic approaches. Perhaps the dilemma before the world was more formidable than that might have been before Einstein. Kazuo Kondo had been approaching the problem through his geometrical approach of epistemological principle and the modified Kawaguchi Spaces and Zermelo conditions. Thus I was to proceed ahead slowly with both of these aspects and play a definite role in the perspectives of the chaos theory and the theory of fractals. The tensors and vectors were left far behind as the Einstein's theory proved a failure in the field of unification of the gravitation with electromagnetism, the particles being defined as the singularities of the fields. Then the unification of four forces was to be carried to the biotic phenomema wherein stood the Karma theory. I was all the time encouraging my students to work upto this but the spirit of dedication could not be seen, nor any media could be available for publicity. With this target, I had to proceed ahead of the times, no matter whatever be the consequences. There were also domestic and other obligations which had to be disposed, yet I never cared for the consensus or rebuke or negligence on the part of my very near and dear ones.

At Sehore, in 1969, I came in contact with R. M. Jaiswal and we sent the first paper, "On the Non-Symmetric Field Theory" in Gaṇita (Lucknow). It was published showing that there were two terms neglected by Einstein, which could be interpreted as the presence of the Lorentz force responsible for the motion of an electron, which the Einstein's field equations could not. In 1979, I was at Bareli degree college as Principal and Dr. Kondo had been invited by the Einstein Foundation International, founded by professor T. M. Karade at Nagpur. I presented the paper on the " Foundations of the Unified Field Theory", which Narlikar had asked for being thrashed out more carefully. For the first paper, his remark was the question about the conditions in which the two terms as mentioned above could not vanish. I was to tell about the discontinuities which could not be thought of in the continuum structure. However, the second paper was published in the proceedings of the Einstein's centenary symposium under the editorship of Kondo and Karade. Kondo accompanied me to the Bareli small town where there was neither a riksha nor a tanga. Mrs. Kondo (Reico) was also in the company and Kondo delivered his interesting lecture on his theory of music, the Japanese hikoos, and so on. From these days awakened my fortune to get several papers published in the Post-RAAG reports and so on, continuously. I had then two students working under my guidance, Professors Soni and miss Keller. Soni worked on the Tachyons and Keller was working on the quantization of gravity.

First I shall like to discuss about the line of approach of my research in the Jaina astronomy. So far as the shape of the earth was concerned it was the concept of a flat earth. The maps were in the same TO shape as in Babylon quite long back. China was moving towards building up of good maps of certain portions of the earth with which they were acquainted. I worked with only one sun and one moon to find out the calculations concerned with the motion of the sun, the moon, the stars and constellations. It was quite evident that the second sun, or the moon, or the stars or constellations could well be avoided in calendrical calculations. They were to be regarded as simply counter bodies to assist in locating positions of the hidden astral bodies during the day time or under some such circumstances. To bring the knowledge of the Jaina kinematics of the astral bodies in the Jambū island

and the Lavaṇa sea, I published a paper in the Tulsi Prajna in 1975, on the kinematics of the sun and the moon in the Tiloyapaṇṇattī. Then it was a bit more elaborated and published in the IJHS in 1975 as, the kinematic motion of astral real and counter bodies in Trilokasāra. This was further elaborated for the concept of actual motion of the sun or any other astral body round about the Sumeru mountain serving the purpose of the celestial axis, and published in the IJHS in 1978 as,"On probable spiro-elliptic motion of the sun implied in the Tiloyapaṇṇattī. In this paper I calculated the forces operating on the sun due to the geometry of such an spiro-elliptic orbit. Only the proportions could be traced from the equation of the spiro-elliptic polar equation of motion of the sun round about the Sumeru. David Pingree did not agree at my finding. While operating the third INSA project on these works of the Karaṇānuyoga group I published three more papers recently in the IJHS for further elaboration of the calendrical details and certain tough calculations about the family of the moon. These were as follows:

a. Constant-set (dhruva rāśi) technique in Jains school of astronomy.(1993)
b. The method of finding out the number of moons and their families in the Tiloyapaṇṇattī.(1995)
c. Certain special features of the ancient Jaina calendar.(1995)

Lishk could also follow the trend of my ideas and got published his thesis as Jaina Astronomy in 1987. I tried to give all these special features in my work, The Tao of Jaina Sciences, in 1992. I had tried to get the value for a yojana from the measure of a hand and Lishk tried to get it from the shadow reckoning method. This made possible to correlate the 510 yojanas of the range of the distance between the tropic of cancer and that of capricorn as 47 degrees approximately. As one degree at the centre could be taken to measure a distance of about 69.09 miles, the yojana could be calculated as equal to 6.37 miles, approximately. I had calculated it to be about 9 miles as shown in the Tiloyapaṇṇattī kā Gaṇita (1958). Similarly, the indivisible instant could be calculated from the fact that an āvalikā contains instants as jaghanya parīta asṁkhyāta raised to the same quantity. However, the calculation of the jaghanya parīta asṁkhyāta is quite difficult as shown by Gupta in his Gaṇita Bhāratī (1992) paper, The first unenumerable number in Jaina Mathematics.

In the field of the calculations we came across in the case of length of mountains, their width and the areas related with them and the divided lands on the flat circular earth. I had already worked them out through the formulas given in the ancient texts. However there were some data in them which I could not calculate for Visuddhamati's commentary of the Tiloyapaṇṇattī's new version. Gupta could find some formulas which are given in its introduction. Again, this was possible through a binomial theorem approximation. The calculations for the areas and volumes of the three universes and its divisions into the hells and the heavens were not so difficult as those of the atmospheric levels of air and moisture. This was a rectangular wedge shaped universe whose volume was coincident with the value given in the *Parikarma.* For proving that this was a correct shape of the Universe, Vīrasenācārya resorted to find the value of the volume of the conical universe prevalent in his times, through the method of exhaustion as shown by Dr. Singh in his paper, Mathematics of *Dhavalā,* in the Jaina Antiquary, (1950). This showed that the Jaina ascetics did not hesitate to refute whatever was not admissible in mathematics.

Till this century, the study of the *Gommaṭasāra* was almost limited to a few first chapters of the *Jīvakāṇḍa* in which there was kept correspondence between the control stations (*guṇasthānas*) and the various attributes as well as the wayward stations (*mārgaṇā sthānas* and *jīvasamāsa*). All types of mathematics was avoided except some combinatorial situations. The *Gommaṭasāra* and *the Labdhisāra* were the summary texts from the *Dhavalā* and the *Jaidhavalā* and the *Mahābandha* texts.

Yet their commentaries were rich in symbolism and mathematics. I concentrared on their set theoretic approach by first tracing out various types of sets of units, sets of fluents, sets of attributes and so on. This gave the idea of the domains and ranges of the theory of sets applied to the Karma theory. There was the use of comparability, the topology in sequences of various types of sets including those which could be denominated as *asaṁkhyāta* and *anan ta.* In this topology, there was the use of the dyadic sequences of various types. This description was made in my two research papers in the IJHS, as Set Theory in Jain School of Mathematics (1973), and Divergent Sequences locating Transfinite Sets in Trilokasāra (1976). This made very many solution-study possible so far as the domains and ranges of them were concerned. When I started the study of the Karma theory, the concepts of the *palya, sāgara, muhūrta, antarmuhūrta, sūcyaṅgula, jagaśreṇī* came to be the simile sets of instants and points or *samayas* and *pradeśas*. As may be noted in the *Tiloyapaṇṇattī kā Gaṇita* (1958) the values depended on that of the palya which could be evaluated in term of multiples of years, which again baffles investigation when they are to be converted into the sets of instants or *samayas*, wherein there may be a term like the *asaṁkhyāta* interrupting to go into the exact understanding through numbers for an *āvalikā* is again to be calculated on the basis of the first unenumerable number. Thus one has to be very attentive in maniplulating these quantities to be able to go deeper into the spirit of the ancient theorists who were well versed in dealing with these innumerates and the infinities which were proper in the sense of Cantor. The two fundamental equations given in the Tiloyapaṇṇattī show how they correlated the instant sets and the point sets for giving an idea of the existential sets:

$$AṄGULA = [PALYA]^{[LOG_2 PALYA]}$$

$$JAGAŚREṆĪ = [(AṄGULA)^3]^{[LOG_2 PALYA]+A}$$

The *vyavahāra palya* may be calculated to be about (4.13) $(10)^{44}$ years which ought to be converted into the number of instants (*samayas*), leading to the same problem with the *jaghanya parīta asaṁkhyāta.* Again, the *uddhāra palya* may be calulated to be (4.13)$(10)^{44}$ (*jaghanya yukta asaṁkhyāta*) $(10)^7$ years, which are again to be converted into instants. The *addhā palya* and the *sāgaras* also involve the quantities which are to face the same difficult steps. Actually, these numbers are also not actually innumerate but as they go beyond the capability of the *Śrutakevalī* they are formally, called the innumerate. They reach the domain of the *avadhijñānī* and hence they are to be called the actual innumerate when the existential innumerative sets are inserted into them. These may be called the proper innumerates in the spirit of Georg Cantor. Similar is the case with the formal and the proper infinities.

Now we shall pass into the formulation of a new field theory which I called the Functional Non-Symmetric Field Theory (FNFT) which started with the paper on the foundations of the unified field theory (1980). After having contacted Dr. V. V. Narlikar, I had felt seriously to modify the field equations of Einstein's NFT. I had already found that the assumption of the vanishing of the two terms as noted above was to be left out and a condition was required to be emerged out so that various other such terms could be revived through certain new postulates extending the postulates of Einstein without effecting his spirit of avoidance of inertial frames and keeping the principle of equivalence intact. This could only be possible if there could be evolved a more generalized principle of equivalence and for its manifestation, the principle of covariance should also be required to be

generalized by introducing functional in place of functions as the tensors and vectors and so on. I tried to change the postulates on the basis of the knowledge of the Dhavalā, vol.4, in which I found that an indivisible instant (*samaya*) could be taken to correspond with a natural existence of a minimal and a maximal velocity of propagation of fields and so on. If light was regarded as having the maximal velocity of propagation of the electromagnetic field, for instance, and could remain constant in all inertial frames of reference, then why should this not be the case with the minimal possible velocity of propagation of fields in all the inertial types of frames of reference. Later on, it was a suggestion from Dr. Kondo that it could be possible with the gravitational waves (1992), which have not been detected so far and this could also be correlated with the radioactive beta-decay, in both of which very long periods are involved. However, more solid experimental proofs are to be shown before one could confirm this idea.

In the mean time I had come across with the Theory of Functionals by Veto Volterra and his work convinced me that the principle of generalized covariance could manifest the principle of generalized equivalence through the theory of functionals. I then adhered to the two postulates a year after the meeting with Narlikar in 1956. They were as follows:

1. There exist the extremals : the minimal and the maximal velocities corresponding to a minimal time-interval or instant, both of these bearing a constant value in inertial frame of reference (Principle of Functional Covariance).
2. The equations of the theory shall be derived from stationary and variational action principles, subject to the first principle, alongwith the postulate of the Principle of Generalized Equivalence in view of avoiding inertial systems.

I surprised also the direct consequences of the above postulated as follows:

A.The instant interval, measured in inertial frame, corresponding to V_{ma} or V_{ml} is to be treated as indivisible or irreducible, as the divisibility will be inconsistent with the first principle, mathematically. This leads to the quantized and generalized Einstein's space-time.

B. In an instant, say tau, a moving particle does not occupy a single point or event (alone), but some integral multiples of or step functional multiples of V_{ml} along a single direction in 3-space (or in a fractal type of curve or a curvilinear displacement as the case may be). Consequently, exact position of a single moving particle could be located everywhere instantaneously in the entire (displacement) interval. Similarly, the phenomena in two or three dimensions may be noted as a cloud of the particle.

C. For the states of rest, least motion (movement), and intermediate propagation, the correspondence between time and space will not only be one-one alone, but also it may be many-one, many-few, one-many or few-many.

D. The principle of action or field interactions will be coordinated consistently, with new deterministic quantum theoretic relations, (where the amounts of distances less than V_{ml} or less than the indivisible instant will not be considered valid in the physical nature of things as the energy amount less than the Planck's constant is made inadmissible, leading to the uncertainty relations. The same uncertainty relations will appear in this new theory FNFT).

E. The inertial frames could be distinguished either for their motion or state of rest, due to the correspondence between space and time coordinates, which might be either many to one, one to many or one to one. This will depend upon the functional form of the field in the frame which may be either in motion or at rest.

This work was published after 24 years in 1980 with the joint authorship. This attempt was made on the following observations:

1. The principle of the universal limiting velocity plays a fundamental role in the definition of concepts concerning space and time.
2. The coordinates have no direct physical significance in the general theory of relativity.
3. Riemanniam and Non-Riemannian geometry, in general, tells us nothing of space as a whole.
4. Matter may share the dual characteristics of radiation and that the position of a moving electron or that of any sub-atomic particles is known to within a certain accuracy.
5. Various notions of time and temporal relations within physics require unification.
6. Nuclear forces and the phenomena of high energy particle physics (alongwith the unification of gravitation and electomagnetism) is inexplicable as a unified field theory. There was one more point which attracted my attention at the following oservation of Einstein in his autobiographical notes," One more general remark concerning field-structure and the group. It is clear that in general one will judge a theory to be the more nearly perfect the simpler a "structure" it postulates and the broader the group is concerning which the field-equations are invariant. One sees now that these two demands get in each other's way. For example: according to the special theory of relativity (Lorentz-Group) one can set up a covariant law for simplest structure imaginable (a scalar field), whereas in the general theory of relativity (wider group of the continuous transformation of coordinates) there is an invariant field-law only for the more complicated structure of the symmetric tensor. We have already given *physical* reasons for the fact that in physics invariance under the wider group has to be demanded: from a purely mathematical standpoint I can see no necessity for sacrificing the simple structure to the generality of the group." "The group of the general relativity is the first one which demands that the simplest invariant law be no longer linear or homogeneous in the field variable and in their differential quotients. This is of fundamental importance for the following reason. If the field-law is linear (and homogeneous), then the sum of two solutions is again a solution; as, for example: in Mawxwell's field-equations for the vacuum. In such a theory it is impossible to deduce from the field-equations alone an interaction between bodies, which can be described separately by means of solutions of the system. For this reason all theories up to now required, in addition to the field-equations, special equations for the motion of material bodies under the influence of the fields. In the relativistic theory of gravitation, it is true, the law of motion (geodetic line) was originally postulated independently in addition to the field-law equations. Afterwards, however, it became apparent that the law of motion need not (and must not) be assumed independently, but that it is already implicitly contained within the law of the gravitational field." (pp.78-79, 1949)

This made it clear that the postulates set up by me extended the group of point-transformations in the general theory of relativity to the group of all functional transformations adjoint to the metric in the quadratic differential form. This was due to the extension of the coordinates x, y, z, t to the form $x(p_1)$, $y(p_2)$, $z(p_3)$, $t(p_4)$, where p_1, p_2, p_3, p_4 are the parameters reducible to be a single one parameter p, the time may be taken to be a natural number. This also showed that the anti-symmetric $g_{[ik]}$ could be considered as non-vanishing in the interval expression for ds^2. As such we could get many more terms for manipulation of various types of the electromagnetic and the nuclear fields including the gravitational as the base field to start with in the spirit of Einstein. This was possible because of the two-way traffic insertion in the terms like $x(p_1)$. One could be left handed and the other could be right handed, and this introduced the discontinuities as well as jumps like situations from point to point. Thus the continuum of space could be treated as a disdrete one for the purpose of the field-equations. Further, there was one of the greatest achievements. The principle of equivalence which was lost in

the attempt of Einstein to unify the gravitation field with the electromagnetic field, (NFT), was automatically revived in our attempt to unify all the four fields, (FNFT). The 16 metric fields, g_{ik} and the 64 displacement fields $\Gamma^{\lambda}_{\mu\nu}$ were extended to work as 32 and 128 fields. The directions of the curves in which lay the particles could be made to create curvatures in the more generalized space-time and the tensors, vectors, scalars all took a new form, called respectively as the tensorals, vectorals and the scalarals. The cone which divided the Minkowskian space into the time like and the space like regions, now became a double cone. This double cone divided the space-time into three regions. One region alone was the time like, whereas the remaining two regions in its neighbourhoods became space like. There was one more achievement. One also got the new Lorentz transformations with respect to which the field-equations in the special theory of relativity were invariant. One was also able to get more such results due to this generalization. This was shown in the paper, Conceptual Foundation of a new Metric, (1991).

The continuous group of linear functional transformations were studied by Kowalewski, Vessiot and Michel (1924). The reversible transformations studied were those of Volterra type (Michel, 1925): $\int_0^z y_1(x) = y(x) + K(x,s;a)\, y(s)\, ds$. For variation of the parameter a for its all values the transformation from y(x) to $y_1(x)$ are found to be similar to those of Lie's continuous transformation groups, defined in n-dimensional space. Here, according to Volterra, there is a generalization, as the transformation could be obtained from a Lie group by increasing the number of dimensions from n to infinity for function spaces with a finite number n of dimensions. Michel found the extended group of infinitesimal transformations for the functionals. His treatment suggests that the functionals g_{ik} and F_{ik} are required to be treated for their invariance and their transformations will be required to be treated as those of Lie's continuous transformation groups defined in infinite dimensional spaces which are also functionals. The transformation Kernels will also be of the form $\psi(s)\, e^{x/c}$, indicating that the propagator functions as unitary operators whose bilinear products in the form of creation and annihilation operators will generate a Lie algebra each for various combinations of states considered for quantized time (indivisible instant) scale, through Kondo's approach to tristimulous principle in Jain and Keller (1984). Moreover, the metric ds could have two forms, the real metric serving the purpose of Lorentz invariance and point-transformation invariance, whereas the imaginary metric serving the purpose of the internal symmetry in form of the unitary and special unitary transformation groups, U_1, SU_2, and SU_3 resulting due to the introduction of c_0, c, and t_0. In FNFT we further have the time t_0 appearing as an operator in the form $\phi_0 x_0$, where x_0 is time coordinate, and ϕ_0 is the step operator in the sense that if it appears in instants one by one without any break, making a discrete structure of a sequential space of integers. In the integrodifferential form the shifts of origin are included which are absent in the differential form of the Lorentz group. Hence the group of all functional transformations in FNFT includes the Poincare group.

The study of the FNFT was then done for the analysis of symmetries. The first could be the geometrical symmetry in static aspect which appears in the symmetries of invariant states (vacuum or equilibrium states) or physical systems. This also leads to the concept of the entropical aspect in which the biophysical phenomena could be involved. This had been a root in the development of the group

theory. The next is the dynamical aspect of symmetries which may be of two types: The global symmetries and the local symmetries. There is very little in common between local and global symmetries. In particle physics the present trend is to eliminate the global symmetries from the fundamental dynamical laws. The idea of local symmetries has led to the development of the gauge theories in (Weyl, Klein, Pauli, Yang-Mills) specifically, this is also the case with the FNFT which has the gauge group as the group of all functional transformations or path transformations at every instant of t_0. In mathematics this has given rise to the theory of fibre and principal bundles. The physicists have a trend to find dynamical laws which admit the usually non-Abelian "local symmetry group". However the spatial symmetries (Poincare Covariance) are still global symmetries, if the gravity is not included. Such dynamical laws are expressed in the form of gauge theories. In turn this trend has posed the problem of deriving the global, internal symmetries of phenomelogical models or macroscopic descriptions as dynamically generated, a symptotic symmetries.The FNFT may be found to have the following symmetries: Space-time symmetries, exact dynamical symmetry of unknown origin, almost exact dynamical symmetry of unknown origin, approximate dynamical symmetries, dynamical symmetries in vector spaces and the unitary group U(N) symmetry.The sequence of the various groups may be noted in the homotopy for the FNFT. There may also be noted the following cases of breaking of global symmetries in FNFT as follows:

1. Explicit breaking is the case in which the dynamics of the physical system contains a small term which is not invariant under a symmetry group. It saves invariant other terms of dynamics. This could be a small mass. When in the classical limit (tree approximation), there is a symmetry which does not survive on quantum level, it is due to anomalies. This is the case with Chiral symmetry, dilation or conformal invariance, the case of the eight fold way.

2. Spontaneous breaking is a global symmetry group also, H of a physical system X, which is said to be broken spontaneously, or dynamically if H is an invariance group.

3. Dynamical breaking does not manifest itself on the tree level, and is not perturbative. Spontaneous symmetry breaking appears on tree level and may be discussed perturbatively. Regarding the breaking of local symmetries the concept of a broken, local symmetry is a general covariance under changes of internal coordinates. The symmtry enhancement of the FNFT is the group of all functional (path) transformations passing from the invariance under the Lorentz and the Poincare groups to the group of all (coordinate) transformations.

4. Breaking of Lorentz invariance in a system at zero temperature and density.

5. The breaking of continuous internal symmetries and translation invariance accompanied by the appearance of zero mass excitation (the Goldstone bosons, the phonons), The breaking of rotation invariance also implies a similar decay but not the existence of Goldsyone excitations. The quantum field models in the space-time dimensions exhibiy spontaneous breaking of internal O(N) symmetries at suitably chosen values of thermodynamic parameters, the coupling constant and the bare mass.

The following is the comparative table of basic interactions in the FNFT:

It may also be noted that we come across two types of groups in the FNFT:

1. The first is the Lie group, the group of all $n \times n$ real matrices with non-vanishing determinant. This group is called GL(n, R) or the general linear group in n real dimensions. It is a Lie group of two reasons: (i) it is a group with the operation of matrix multiplication, the unit matrix being the identity element. The deteminant does not vanish.

(ii) It is a manifold. Any matrix in GL(n, R) with specified entries provide non-vanishing determinant. Any tangent vector can be represented as a matrix. The one-parameter subgroup generated by any matrix A is the integral curve through e of the left-invariant vector-field whose tangent at e is A which is called the infinitesimal generator of the subgroup. The rotation group is the Lie group.

2. As soon as we extend the domain to the complex one, we get the GL(n, C), the group of all complex n x n matrices of non-vanishing determinant. In general it is a linear group in n complex dimensions, which has the subgroup SU(n), the special unitary group in n dimensions. Since each entry may be complex and each complex number is defined by two real ones, GL(n, C) has $2n^2$ (real) dimensions. Its subgroup U(n) is the unitary group whence the Hemitian congugacy exists. If we have analogy with O(n), its Lie algebra consists of all non anti-Hermitian matrices. SU(n) is the set of all matrices in U(n) with unit determinant and having $n^2 - 1$ dimensions. The representations of SU(2) are particles, whereas they are not representations of SO(3) although the former universally covers the latter, and has the simple global topology whereas the latter has not.

Now something about the string field theory, having a group E(8) x E(8) large enough to accommodate the minimal SU(3) x SU(2) x U(1) of particle physics. The theory could not posssibly be brought from 26 or 10 dimensions to 4 dimensions. There have been two approaches to build up this theory as in the quantum theory:

1. Geometry $\longrightarrow$ Action $\longrightarrow$ Classical Theory $\longrightarrow$ Quantum Theory

2. Quantum Theory $\longrightarrow$ Classical Theory $\longrightarrow$ Action $\longrightarrow$ Geometry.

The first approach is called the top-down whereas the latter is the bottom-up. The string field theory is derived from two simple principles based on an underlying geometry (Green and Schwartz, 1985) and Michio Kaku, (1987).

1. The principle of global symmetry: The theory must propagate helicities (i.e. the photon and the graviton) with pure spin 1 and spin 2 fields which transform as irredicible representations of SU(n) and the Lorentz group (both of which are contained in the symmetry groups of the FNFT). The formulation is either through the light cone or through BRST. The FNFT is fundamental as the geometric approach.

2. The principle of local symmetry: In this case the action must be locally SU(n) and generally covariant. The first principle of global symmetry is sufficient to derive the free action. This eliminates higher derivative actions. Similarly, the second principle allows us to write down the entire action. Similar basic strategy is followed in point particle gauge theory, in general relativity and FNFT to originate the action of the field theory:

Local Gauge Group $\longrightarrow$ Covariant Derivatives $\longrightarrow$ Curvature Tensors or Tensorals $\longrightarrow$ Action. The local gauge group of the string field and FNFT is actually 2 in 1 or two local gauge groups to be combined in one. The string field theory and the FNFT can be formulated geometrically through two principles. First of all a physical string C or in case of FNFT a physical path P, is defined in space-time which should be independent of the way we parametrize the string or the path. Mathematically, the theory must be invariant under all possible diffeomorphisms of the string C or those of the paths P in case of FNFT. This assures not the fictitious parametrization length but the physical invariance length. The string theory is built on tensors but the FNFT is built on tensorals, allowing us to change the parametrization length at any instant. In the same way, the gauge theory or general relativity must be globally Lorentz invariant, hence it is demanded that all fields transform as irreducible representations of

global Diff (S), where S = [0, π] or S_1 and diff (π), where Q [θ, π] invariance under Diff (S) or diff (Q) guarantees that the theory remains unchanged when we map a physical space-time space-time string C or path P into itself, C $\longrightarrow$ C as a string and P $\longrightarrow$ P as a path. It is to be noted that this mapping is a global one upto now. We can also make Diff (S) or Diff (Q) into a local gauge invariance, i.e., we can make not only some representations of all strings and paths but also can make a functional of the string variable itself or the path into a functional form. This means that there is a different parametrization for each string C or each path P. We could call this local gauge invariance as universal covariance because of its resemblance to general covariance. This universal covariance in string theory or in FNFT establishes an inter-relationship between all the states of the string or the path (in FNFT) which in turn will induce a universal coupling between all the particles in the string theory or FNFT. We could now, for the combination of the universal and string covariance or path covariance into one, define as follows:
The universal string group (USG) or the universal path group (UPG) as the group which maps a string C or a path P into itself and all the conjugates. Two strings or paths are conjugate to each other if they appear in the same triplet which is a set of three strings or paths (as in Volterra's theory of functionals), of arbitrary invariant and parametrization length C_1 , C_2, C_3 or P_1,P_2,P_3. In general, the product of C_1 and C_2 or P_1 and P_2 is equal to c_3 or P_3. Hence they close in string or path and form a syring or payh group. The product of three strings or three paths is invariant under USG or UPG. The key reason why the product of three strings or paths as functionals is invariant under the group is that we are integrating over strings or paths of arbitrary physical length. In case of paths, the length works as a phase. Thus the string theory or the FNFT should

1. Propagate fields transforming as pure irreducible representations of Diff (S) or Diff (Q) and super Diff (S) or super Diff (Q) with zero central term. This is global invariance.
2. Be locally invariant under the USG or UPG. This is a local invariance.

These are the two geometric principles of the string field theory or the FNFT. The string field theory is the gauge theory of the USG and the FNFT is the gauge theory of the group UPG in the same way as the Yang-Mills theory is the gauge theory of local SU(N). The similarity between ordinary gauge theory and the string field theory or the FNFT is as follows:

Global Lorentz $\longrightarrow$ Global Diff (S) or Global Diff (Q),
Local SU(N) $\longrightarrow$ String or Path covariance,
General Covariance $\longrightarrow$ Universal Covariance

Tangent Space: Lorentz Symmetry $\rightarrow$ Tangent Space: Diff (S) Symmetry, or Tangent Space: Diff (Q) Symmetry. Thus, the group Diff (S) or the group Diff (Q) has a much richer set of irreducible representations and tensor or tensoral products than the Lorentz group, for the string field theory or the FNFT.

The postulates of c_0, t_0, and c introduce the concept of a new metric combined with a phase which being invariant in view of the transformaion groups so introduced. The Minkowski space is fused with a new type of Minkowski's phase space evolve through the postulates, bringing unitarity in the resultanat space. The functional forms of g_{ik} are introduced and spinors as well as the general Lorentz transformation group is introduced in the FNFT. For introducing unitary transformations in Minkowski space, it is built up from x_1, x_2, x_3, and $x_0 = ict$, and it is fused with a new type of Minkowski space built up from $ds_0^2 = x^2 + y^2 + z^2 - c_0^2 t_0^2$. From this one gets additional or a dual Lorentz and Poincare transformations. The minimal t_0 and the c_0 introduce a norm just like that in Hilbert space, which is also introduced due to the adven t of the Planck's constant h/or a quantum of action. Kondo (1997) also proposed that every microscopically

significant object must be given as an invariantof the conformal transformation: $h \longrightarrow \rho\, h^2 = \rho^2 g_{ik}\, dx^i\, dx^k$, where ρ is an arbitrary scalar independent of the specific local direction indicated by dx. Similar may be the case with c_0, t_0 and c which may be related with h as follows: $c_0 = \sqrt{(hGc)} \approx 10^{-33}$ cms/sec. Further $A_1\, A \approx 10^{-66}$ cm/t_0, where G = 6.67 x 10^{-11} Newton m^2/kg^2 a or $\approx 10^{15}$ Gev. Similarly $t_0 = 10^{-23}$ sec.These conjectures may further be amended through actual experimental verification. These basic quantities are to be postulated as constant in any inertial frame. Formerly the ds^2 was a metric, but now it is a norm, including a phase invariance also apart from the scalar due to functionality introduced through c_0 and t_0. The question is to fix the gauge of the norm? This has been discussed in detail by Samiuddin and Jain (1991). When this new metric is further generalized for the unitary transformations, there is introduced the complex mtric $ds^2 = g_{ik}\, dx^i dx^k$ as an adjoint to the group of all functional transformations. This group, therefore, covers not only the group of all point-transformations but also all the normal coordinates or the group of unitary transformations. In this case we should have all types of field interactions, the weak, the strong nuclear, the electromagnetic and the gravitational.

The strings unify QM and Gravitation into a single theory, as also the FNFT. In string theory it is not always possible to demonstrate them as a model owing to their infinitesimal dimension. The strings would be apparent only at collision energies of the order of the "Planck mass" or above, i.e., at energies 10^{28} times greater than those released in the most powerful of accelerators. The same is the case with the FNFT where the c_0 plays the same part as the Planck's constant. Strings are now called superstrings, existing in ten dimensions (nine of space and one of time), similarly, as in the FNFT moving particles exist in four-dimensional space-time with parameters making up the paths independently as in any kinemetical or dynamical phenomena. The instantaneous paths have thus definite lengths as the strings, representing the particles themselves in the case of SFT the strings are elastic infinitely, as they have a constant tension. A superstring can also break, when two superstrings cut each other during an interaction, and the ends of a super string can also rejoin, which could also be the case in FNFT. Thus analogies work out the same as in QED and QFT. The ends of the strings could be either closed, in the case of gravitational interactions or open to describe the remaining interactions. Similarity holds with the FNFT. The distinction between the constituents of matter and fields of force is based on the difference in the behaviour and properties of these particles called fermions and bosons. The fermions are individualistic and the latter are associative. Two fermions can in no way exist in the same quantum state and the bosons like to congregate together in the same state. In the model of the SFT or FNFT the behavioral difference is accounted for through recently introduced supersymmetry of the universal string group or the group of all functional transformations in the case of FNFT which is embedded in a compact, complex and homogeneous geometry of fibre-bundles. The fermions and bosons are the two different aspects of the strings and the instantaneous-path-particles; the fermionic path-particles can not be in the same state, whereas the bosonic ones can. The difference in the intensities between the two types of interactions is proportional to the tension of the superstrings. This is also the case with the path-particles. Moreover, the high tension in string or in the instantaneous-pathparticlescan explain the relative weakness of gravity. One has to choose a single parameter as the tension of the superstrings, which is also the case with the path-particles. In FNFT, the particle could occupy a point at rest, but it becomes an instantaneous-path-particle at t_0 by virtue of its motion, velocity or acceleration; it can be at more than one point, making a path, coming to a string form, contrctible according to motion, velocity or acceleration ranges at evey t_0 . Schwartz and Green, during 1980-84, started to construct the superstring theory with

space-time supersymmetry. They incorporated the supersymmetry by use of a light-cone formalism (Goddard, P. et al, 1973). In FNFT we have two light-dark-cone formalism as in the following figure, one cone being for the light limiting velocity and the other being for the dark limiting velocity. Here follows the manifestation of the FNFT through double cones for c_0 and c. The group of the FNFT has been further studied by Meena Jain (Thesis,1998). She has also studied the irreducible representations for FNFT group.

The development in differential geometry has been through the introduction of the Riemannian and Finslerian geometries and their modifications with various kinds of parallelisms and transcendental edifices of abstract algebras and topologies. Kazuo Kondo, in his deeper and extended studies into various phases of epistemological penetration to nature, applied the theory of Kawaguchi spaces based on the fundamental constitution of epistemological recognition in terms of expoint coordinates. They are systematic means of comparison of information built up in the domain of real numbers. He introduces his first step in laying new foundations for the physical views needed for unification of microscopic quantum concepts with the macroscopic picture of gravitation (1958). For his fudamental principle of postulational observability of real numbers, the first ayyempt has been to base the theory on the geometry of connection, the theory of holonomic groups and the theory of fibre bundles. Equipped with the physical objects and a measuring apparatus, the theory of observation is based on three assumptions:

1. The errors are attributed, a priori, to measurements,
2. The measuring apparatus is a real frame or space,
3. The measuring apparatus is a real frame or space.

Such a concept of observation leads to an "observation bundle". Here the set of states is the object of observation, called the base space. The state is operated on by physical observation as input and there is afforded some recognition as an output which may not be the same for each operation as well as for states. The generalization by Kondo may be summarized as follows:

1. The holonomy group of observations is isomorphic for every point of the (connected) base space, and observation bundles of the same base space are all equivalent in the structural group of measuring space.
2. A Riemannian metric is associated with every differential manifold and it is connected with statistical observation.
3. Postulating the maximum possible dimension number of the measuring space associated with an irreducible observation to be four and the decomposition of the observation fibre into four-dimensional parts, the study of the observation on simple spinors could be summarized into the wave equation of Dirac type, and it may be regarded as a microscopic representation of the metric leading to a gravity criterion.
4. On the basis of primary observation of correlated submeasuring the problem of many-particle system, second quantization and quantum statistics could be treated. Covariance was also treated. Further, in order to fit the observation theory for modification of the micro- and macro-world phenomena into a geometrical formalism Kondo made another attempt and started with primary elements akin to Leibnitz monads. By multiple observations, the initially neutral monads were classified and the set showed the structure of a Kawaguchi space which covered in its geometry the Finsler and Riemannian spaces as special cases, offering to describe the system of elementary particle structurology. The important proposition regarding geometrical criterion may be noted: If the primary physical observation is restricted to picking one-dimensional varieties or curves in the manifold of expectation value coordinates, the observational manifold can be treated as Riemannian and the curves are always its geodesics. But, when the observation is

extended to higher orders (above countability and classification into a number of mutually independent subsets giving a multidimensional Gaussian distribution in statistical observation) it acquires the structure of four-dimensional Kawaguchi space with one time dimension (1962). It is clear that Kondo's work has been, at the outset, in the very spirit of Heisenberg. He has tried to bring the relativity theory close to the theory of quanta, as the FNFT has been working for the fusion of the both. This has been possible through the principle of construction of an observational manifold (a relativistic and quantum theoretic joint approach manifold built up) which is postulationally approached and set on an empirical basis and not hypothetical. Kondo (1985) summarizes that the space-time metric, ds^2 is statistically constructed for a large number of constructions. It stands as the argument in the Gaussian distribution where the variance is proportional to the mean squared time deviation, forming a foundation for the FNFT. Kondo's tristimulus principle sets a many to one correspondence between space and time instant, in case of moving objects or frames of reference in motion. What we had postulated as a ~~minimal~~ velocity corresponding to a minimal time interval, is now remarkably recognized by Kondo to be the possibility of the smallest velocity of propagation of the gravitational field represented by the Planck's constant $h/2 = O\ (10^{-27})$ cm/sec. This suggests the difficulty in discovering the gravitational waves experimentally. There is also revealed the indication of the helicity with coefficient emerging into spin in the intrinsicality description of the higher order dimensions.

The dimensional analysis procedure is adopted to explain the elementary particle system covered under the symmetry gauged by conformal invariance, when conformality is regarded as equivalent to physical notion of causality. Historically, conformal has usually been a concept for group theoretic approach concerned with causality and symmetry in cosmology and a conformal invariance restricted to the light-cone equation. The conformal invariance was first apllied in physics when it was found that Maxwell's equations are not only covariant under the Poincare group, but also under a larger 15-parameter Lie group inclusion, besides inhomogeneous Lorentz transformations, dilatations and inversions. The Lorentz transformation is connected with a maximal velocity of light, Hence its scope takes on to the range of observable cosmology, towards comparison of red shift theory or the chronometric hypothesis. Then question naturally arises as regaeds the dual phase whether in the ultramicroscopic range one can do with conformal invariance associated with the velocity of light and the light-cone equation. Kondo remarked that an apparent common feature could be pointed out between the Minkowskian electromagnetic-field limit and the hyper-microscopic world, the former, as the limit of the indefinite metric, trivially conformally invariant, $d\tau^2 = \sigma^2 = 0$, and the latter's conformally invariant standpoint has been argued for in Kondo's Post-RAAG report no. 201. From this point of view , $d\tau^2$ is a summary of the higher order features so that $d\tau^2$ is postulated for the lower order electromagnetic field to assume apparently a trivial space-time conformal invariance : $d\tau^2 = 0$. If an absence of fuzziness : $d\tau^2 = 0$ implies a deterministic causality, then Segel's proposition may be brought about (1997). Here the FNFT suggests that for dealing with the domain of elementary particles a dual to the Lorentz transformations be sought restricting the Minkowski's space upto the existence of a minimal velocity corresponding to a minimal time interval. There is another restriction to the causality. The group of all local causality-preserving transformations in the vicinity of a point of Minkowski space is, as a local Lie group, identical with the conformal group, (Segal, 1977). This makes significance when the observations are towards the zero axis of the Minkowski cone. Hence for application to elementary particle theory, the conformal invariance is associated with a dual to the Lorentz transformation acquiring in nuclear dimensions, as may be thought, a shape of invariance with respect to unitary transformation.

Further the set of all vector fields on Minkowski space which generates smooth local causality preserving transformations, is identical with the set of conformal vector fields.The 11-dimensional sub-algebra of infinitesimal Lorentz transformations, augmented by the infinitesimal transformation, of 15-dimensional Lie algebra of all infinitesimal conformal transformations, consists of such vector fields, This makes an appeal to resort to the c_0 and t_0 for modification with regard to the microscopic coformal invariance, by applying the dual to the Lorentz transformations (Samiuddin and Jain, 1991). As soon as we approach the dual we reach a compact group through c_0 and t_0, and naturally to many to one correspondence between space and time coordinates, and the Kondo's theory gets a support, a fortiori. Here appears the secret of macroscopic and microscopic observability together alonwith subtraction, cut off, and renormalization needed, for a group of transformations (Kondo, 1986).

It is convenient to introduce the concept of irreducible representations through matrix representations. When there is given a space of n-dimension invariant under a set of operators {A}, that corresponding to any chosen basis $\{e_r\}$ in S, there exists an n x n matrix representation of {A}, denoted by the relations $Ae_s = \Sigma_r e_r U_{rs}(A)$, where the set {U(A)} of n x n matrices is called the matrix representatin of {A}. An irreducible matrix representation denotes a matrix representation afforded by a representation space irreducible under a given set of operators {A}. The irreducible matrix representations of a group are properties of the underlying abstract group. These are required to be studied in analogy with those of the string theory group for the group of FNFT. The gauge theory may be compred with the FNFT as follows:

Recently, Kondo (1997) has published a monograph on "Three Phases of Epistemological Penetration to Nature" in four parts dealing with the geometry of higher order spaces, regime of elementary particles, mystery of high energy edifice, chemistry dealing with atoms and molecules, and the world of bio-creatures through entropy-theoretic approach as well. The investigation by Kondo into the micro-world has been developed into a unified theory in terms of the geometry of higher order spaces, spaces being themselves particles and particles being themselves spaces. There are as many particles as are spaces defined by higher order geometry. This work has therefrom gone to the feasibility to construct a unified picture of the bio-world in terms of a similar geometrical language. There could be as many bio-creatures as are spaces of various kinds although the correspondency could be more obscure owing to the quantitative inaccuracy that may be inevitabily involved because not only the most elementary or fundamental elements of information but also more compound ambiguous units have to be handled to start with.

According to Kondo (1993, 1994), the term space could be replaced by cosmos (since living units) beginning with human creatures used to be called micro-cosmos. The formal correspondence asserted by him is:

space vers particle = cosmos vers bio-units

with the mapping higher ordered into micro-cosmical may summarize the entire perspective.

First of all, Kondo gives the apparent correspondency between elementary particles and bio-creatures. He gives a table for the bio-world in size ratio, mass ratio, mass quantum, interaction, alongwith that of the perfectly inorganic H-atom.Then he gives geometrical construction for biological equivocation. He draws our attention to the concept of Kawaguchi tree described as a graphical representation of $K^{(M)}_N$ of the Zermelo conditions. Every plant is a metamorphosis of the Urpflanze, all sorts of vascular plants are embodiments of the Kawaguchi tree. The passages of the time-like parameter draw an Urpflanzenbild of the vascular system. The standpoint of the animal is based on a modification of the Zermelo conditions in which two

Gauge Theory	FNFT
1. Two types of gauge transformations and the third being local type (coordinate)	1. Lorentz, point transformations and functional transformations
2. Gauge groups	2. Groups of Lorentz, point and functional transformations
3. Gauge potential A_μ	3. Coefficients of connection
4. Gauge Higg's field	4. Metric field g_{ik}
5. Bianchi identities	5. Bianchi identities
6. Field strength G_{ik}	6. Curvature tensor R_{ik}

Kawaguchi-trees lie paralleled close to each other.

If the plant is compared to the lepton (for being simple-parametrically defined), the animal could be compared to the meson consisting of two quarks, although a restriction to the parallel actually close-arrangement is imposed so that the governing equations are modified. It is a reflexion of its habit or instinct to move. In the biological world, individuality being emphasized, the thermodynamical laws do not dominate. An entropy, if any, measured similarly, should not increase, or a negative entropy is favoured. The Zermelo conditions have the structure of partial differential equations in regard to fundamental function F or in terms of f = log F . They are put as a system of non-homogeneous equations: $\Delta_k f = \delta_K{}^I F, \Gamma^{\lambda}_{\mu\nu}$ (K = 1, ..., M), where the operator Δ_K is put in terms of expoint coordinates and partial differentiations with respect to them. The general solution of the first of these equations $\Delta_1 f = 1$ consists of a particular solution, for instance, $f = f_0 = \log x^{(1)i}$ and a general solution of the homogeneous equation $\Delta_1 f = 0$, which is $f = f_0 + \phi(\omega)$, where ϕ is an arbitrary function of the argument, $\omega = \Sigma \mu_{\alpha,I} \log x^{(\alpha,I)}$, where $\Sigma_{\alpha,I} \mu_{\alpha,I} = 0$. $\mu_{\alpha,I}$ Involving the arbitrary function, the homogeneous solution is a representation of a more abstract aspect, tracing a regime which could be psychological or physiological. The relation, f = log F has the structure of Weber-Fechner law. The difference is given by $f_1 = f - \phi$, which pertains the non-psychological regime. The quantitative discreteness is also suggested by the Stiring's formula, P! = P log P - P which is approximately the same as the logarithmic function $\chi = \log S$, experimentally approached by H. E. Weber (1705-1877) between the psychological quantities S (stimulus) and χ (response). In a discrete range, an informational-theoretical entropy, $S = \{ P! \} / \{ P_1, ..., P_s \}$, where the set of P discrete elements is given as sum of subsets: $P = P_1 + P_2 ....+P_s$.

Kondo found that the constructions of the bodies of bio-creatures and their intrinsic behaviour are all restricted by the following conditions set over the space $K^{(M)}{}_{L,N}$ in terms of

1. The expoint coordinates $X^{(r)i}$ defined as $d^r X^i / dt^r$ and the $\delta^{(\rho)}$ defined as $\delta / \delta X^{(\rho)i}$ where x^i (i = 1, ..., N) are N-dimensional coordinates.
2. Any fundamental informational quantity, if any, that will be indicated by F in the following, as in the foregoing, is a fuction of $x^{(r)i}$. But it is first of all, subject to the conditions $\delta F / \delta t = 0$, $\delta F / \delta x^i = 0$, owing to epistemologically fundamental requirements.
3. The concept of an arc length, $S = \int F dt$, summarizing information features along the parameter t, has to have intrinsic significance, independent of how the parameter is chosen.
4. The above leads to a set of further conditions, called Zermelo conditions, $\Delta_k f = \delta_K{}^I F$, (K = 1, ..., M), where $\Delta_k = \Sigma^M_{r=K} \{ {}_K{}^r \} x^{(r-K+1)I} \delta_{(r)I}$. From the Kawaguchi-Hombu theorem or Zermelo

conditions, Kondo found that M = 3 provides a lower bound for all sorts of sufficiently well developed bio-creatures. It is then important to know that Kondo has extended the Kawaguchi-Hombu theorem to the Kawaguchi-Hombu-Kondo theorem placing restrictions on the M, L, and N, preferably on N and M culminating in a dimensional lemma. Then he derives that the bio-creatures or particles, as the elementary objects, are three-dimensional where they are included in a macroscopic observation. One can argue that the three dimensional construction of the space bio-creatures like plants and animals live in is fundamentally due to the requirement based on the theorem.Thus elementary particles stand as microscopical versions of the bio-creatures essentially under the Zermelo conditions and so on.

We proceed towards an important derivation by Kondo. It is an introduction of a cascade of mass quanta beginning with the one working in the regime of the electron, followed by a larger one having the size multiplied by the inverse fine structure constant. More and more masssive mass quanta come to work in more compound regimes, as approaching the bio-world. In the table,given by Kondo, it is suggested that mass quanta, far more massive than those working in the regime of elementary particles, are dominant in the bio-feasible regime of animals and plants. Such a massive units must be considerably various in size according to the scales ranging from whales to mice, from oak tree to microbes. There should be thus quantitative or qualitative uncertainty and multifold compound construction leading one to envision some internal variations within the bio-creature himself, which Kondo calls individuality, (parallel ?) due to the thermodynamical picture of the inorganic world, where entropy needs to increase or at least not to decrease, Thus Kondo finds that the costitution opposite to thermodynamics characterizes the organic bilogical world, where significant creatures that may be regarded as living support themselves by reducing the thermodynamical entropy, or by creating negative entropy if any.

The general features of infomation regarding individuality is summarized into the information-theoretical entropy, expressed as the logarithm of a certain probability (compatible with the *S* of the foregoing). Kondo has found that psychological stimuli and sensations have also been associated with entropy, although as a lower approximate feature of the higher order geometry, He is able to find the stabilization interference criterion. By the macro-stabilization $\delta \int \varphi \, ds = 0$ of the creature of order M, the atmosphere is simplified; but the kernel creature is raised to the sphere reaching the order 2M -1 and by the micro-stabilization $\delta \int \varphi \, ds = 0$, it is reduced to a lower sphere of the order M-1. He further observes that the amplification by such an absorption of the atmosphere by micro-stabilization could be compared to an excretion ecdysis of the bio-creature, with rejuvenation, if need be. Kondo further discusses mathematically the metabolism, procreation and death. He also finds the feasibility of bifurcation into plants and animals. He works in this regard with the modification of the Zermelo conditions suggested by A.Kawaguchi finding it instrumental for accounting for the bilateralism of animals. The theory of vascular plants and so on are included. Discussions went over the symmetries in the bodies of living beings leading to group theoretical approach in lives, and not only in particles.

Now we come to the relativistic compromise with the Kondo's theory as he puts it. I had contributed to the non-symmetric field theory through the functional approach and extension of Einstein's postulates, it is desirable to find a contact between FNFT and Kondo's theory through the generalization of the metric to its functional form in the spirit of Veto Volterra. The work with the metric of space-time structure starts with the special theory of relativity, when for the first time Eistein recognized its importance as a physical law governing the invariance of the velocity of light in moving frames of reference. This also led to the extension of the group of

transformation s which could keep this metric in an invariant form chosen according to the fields treated with the principle of equivalence. But Einstein had to lead the idea of further generalization of the metric and he took resort to the non-symmetry without paying attention to the principle of equivalence, the very heart and blood of the theory of gravitation. He could not extend the group of point transformations in spite of his wish which he expressed in his autobiographical notes (1949), as he could not further generalize the metric still further to a functional form which could serve as adjoint to the general formulation. I had been able to find such a group and its adjoint metric which is under a deeper study of the homotopy theory and the fibre bundle theory and most of the papers with my colleagues have been contributed in the publication of the Post-RAAG, Japan. I have also tried to correlate my theory generalizing the metric of Kawaguchi spaces of the higher order. Kondo, along the line propounded by Kawaguchi, related it with the quadratic differential form $ds^2 = g_{ij}\, dx^i dx^j$, where the g_{ij} is called the metric tensor. The ds^2 can be compared to the square of $ds = Fdt$ which is fundamental in the foregoing formulation, If not higher order features of order ≥ 2 are involved, the tensor g_{ij} is derived from F^2 by $g_{ij} = 1/2 \{ \partial^2 F^2 / \partial x^{(1)i} \partial x^{(1)j} \}$. The standpoint of this restricted geometry was studied by P. Finsler (1918). Then in its extension an extensive study followed refering to inscrutable concepts such as external forces, discipation, etc., that permeates pragmatical extensions of classical mechanics. In respect of the implication of these unclarified aspects beyond the Hamiltonian formalism prevalent without being excluded, Kondo noted that they are but reflections of the beyond Finsler geometry, apparently disguised by osculation of higher oreder aspects. Thus the square of the arc length in the Finsler space $ds = F^2 dt^2$ has to be mapped into the form $ds^2 = h_{ij}\, dx^i dx^j$. However h_{ij} does not satisfy the restriction apparently the same as the Finslerian g_{ij} and a metric tensor can be defined by
$h_{ij} = E_{li1}\, E_{lj1} + \Sigma_{r\neq 1} \Sigma_s \eta^{rs} E_{lir} E_{ljs} + \eta\, aF^{2M-1} F_{(M)i(M)j}$ where E_{ljr} 's are Synge's vectors satisfying $dx^i E_{lis} = ds$, $dx^i E_{lir\neq 1} = 0$, $dx^i F_{(M)i(M)j} = 0$, and η^{rs} and η are arbitrary multipliers. The general formula for the metric tensor is the one modified by Kondo along lines started by Kawaguchi. The Finsler metric is a particular one missing most of esoteric aspects associated with the higher order space within which the bio-world are constructed. The connection of the bio-world to the physics is traced more evidently than otherwise through the dimensional and order lower bounds; for the construction of plants is 3-dimensional and that of animals 4-dimensional. The metric tensor can be expressed with reference to its principal directions, with which the metric ds^2 assumes the forms $ds_p^2 = dx^2 + dy^2 + dz^2$, and $ds_a^2 = dx^2 + dy^2 + dz^2 + d\tau^2$ for the plant-metric and the animal metric respectively. This expression of the plant-metric is not concerned with the fourth square. Hence it is an invariant from the plant's point of view. On writing dt^2 for ds_a^2 we have $d\tau^2 = dt^2 - dx^2 - dy^2 - dz^2$, which is fundamental invariant characterizing the restless animal world from the standpoint of the rest system of the plant world. This is indeed the Minkowski space-time metric on which the special theory of relativity stands. It may be noted that the difference of the definitions regarding dt^2 and $d\tau^2$. This is the most crucial point of our reinterpretation of the Principle of Relativity. For treating $d\tau^2$ as an invariant it is necessary to fix all the redundancies coming from the higher orders or from the fourth dimension etc. It is in this sense that the relativistic formalism is a compromise.

Now we get permeation to FNFT. I contributed three research papers to connect the *functional non-symmetric metric* exploring it with that of the Kawaguchi and Finsler spaces. I have been extending the consideration to the tristimulus principle emphasized by Kondo. The tristimulus principle is a consequence of KHK theorem as already mentioned. In FNFT, this consideration is for the sake of pragmatic utility. I considered monads as having minimal

velocity c_0 and a maximal velocity c corresponding to a minimal time interval t_0 .This paved the way to a quasi-quantized *functional non-symmetric field theory.* It is evident that such displacements, with the minimal possible indivisibles, the velocity and the time interval, in the physical nature of things, to the maximum possible velocity of light, require to be exposed as elements of displacements, velocities, accelerations and so on upto an order of derivation feasible separately for different types of constructed particles or bio-creatures, under observation through stationary and moving fields and particles and their interactions. I realized that the classical relativity theory having been constructed not in the FNFT, for accounting for more empirical facts related to the extension to a functional form, more general viewpoints would be required, not to mention the Einstein-Cartan space formalism, dealing with the non-symmetric field theory extended to a functional form, in compliance with the thoughts of the Kawaguchi spaces, (which includes eventually a restriction to the tristimulus principle). We have eventually got rid of the restriction to the one to one correspondence principle of the classical mechanics which has been serving as a prejudice for the deterministic lay out.

Our functional observation leads to the extended concept of an event which we now call an evental in the FNFT, that may be defined as f_0x_0, f_1x_1, f_2x_2, f_3x_3 where f_0, f_1, f_2, f_3 are operators and f_0 may be taken as a shift discrete time operator working in arbitrary 2 space-steps, continuous at every instant t_0. Further, f_1, f_2, f_3 may be regarded as translational or rotational or vibrational etc. shift operators. Thus the above eventals may denote arbitrary arcs of lengths or the generalized paths of Feynman types, in time and space built up as a generalized functional homotopic structure. These may be denoted by $s^0(t)$, $s^1(t)$, $s^2(t)$, $s^3(t)$ as functions of an arbitrary parameter t. When we consider them as functionals of one or more separate parameters making the representation of space-time multiprametric, they become the subject of further study, comparable with the geometry of $K^{(M)}{}_{L,N}$, as also perhaps to materialize a repercussion with generalized unified field theories.

Now arc lengths or the instantaneous paths in Kawaguchi space embeded in a quasi-Riemannian space could be used to make a metric of general relativity in the extended form as $d\tau^2 = g_{ij}ds^ids^j$, where $g_{ij} = g_{ij}\{ s^0(t), s^1(t), s^2(t), s^3(t) \}$, where $i = 1, 2, 3$; $j = 0, 1, 2, 3$ and the arc length or spin or path etc., is given by $s^i = F^i (x^i, x^{(1)i}, ..., x^{(M)i})$, where s will now be an evental.It may also be noted that the eigentime $d\tau n$ is not the original line element ds itself (which is reinterpreted into dt) but a summary of the renundancies carried by the fourth dimension etc. or higher expoint features beyond the KH and KHK lower bound. For further study into the application of the extended groups and their application to the unification of fields in elementary particle physics and biophysics, the published material may be referred. For dealing with the conscious beings they could be associated with an automaton in which there is input, output, state existence, controls, feedback, functions and functionals and interactions due to defined operators.

It has been found that when the thermodynamic irreversibility is introduced through a nonunitary transformation theory, it leads to a deep alteration in the structure of dynamics They require the lead from the groups to semigroups, and from trajectories to processes. So far in celestial mechanics aspects of Einstein we can not talk of the problems of space and time independently of the postulate regarding the constancy of velocity of light in inertial frames. Similarly, the elemination of the "unobservables" has had its own importance in QM and QFT. But the attempt to bring in the unified field theory of both the theories may allow us to construct a perpetuum mobile forbidden by the second law of thermodynamics. Thus the quantities or sets that are defined from the point of vies of continuums in mechanics shall not be the observables

of the system can satisfy the second law of thermodynamics in FNFT. Now the trajectory of a system as a whole will be an observable at an instant along space-points. This will help in distinguishing two trajectories and the concept of thermal equilibrium will not lose meaning. In this way the dynamics and thermodynamics will not limit each other.

The expression $\overrightarrow{\Gamma}^{\lambda}_{\mu\nu}$ is a very important one signifying the functional as a function of paths which may have the clockwise or anticlockwise directions. Similarly one finds the same for the

$\overrightarrow{g}_{\alpha\beta}$ as having the same property.

The supermetric of FNFT is thus playing a role which is in a hyperspace alongwith the super displacement fields as shown in the objects in the above note. Kondo has supported this view that there exist circumstances in the nature of the physical world where such supermetric exists when the antisymmetric objects do not cancel out each other owing to the orientations of the chosen paths. Similar is the case with the superdisplacement fields as well as the objects we couild chose to be the functionals or the functions of paths. This treatment may be made less general by reducing the quantities or objects to be the functions of coordinates alone. In this way we could deal with the various situations through homotopical manoeuvre as well as the non-Riemmannian geometry. This further leads us to the treatment of the theory through the fibre bundle theory, the gravitation theory has already been studied for fibre bundles by Trautman (1978). There are the following advantages in studying the FNFT through fibre bundle aspect.

1. There may be important global information as the topological charge in Yang-Mills theories.
2. There are geometrical structures related to curvature that can be defined directly on a fibre bundle, (being automatically invariant) when expressed in terms of a mapping. This guarantees gauge-independence.
3. Geometrically, curvature allows one to take over all the machinery of classical differential geometry to prove results obviously when expressed in terms of a particular gauge. In general relativity and supergravity , we are not dealing with dynamics of a field in a bundle, but with dynamics of a bundle with fields when bundle is employed it tends to hide the geometrical structures due to imposition of necessary constraints. This is not the case with the FNFT as the bundle is not soldered to the base.

Let us pass on again to the mathematical modelling of equations in nature where there is not only reversibility but also irreversibility. In physics and chemistry dissipative structures have been accepted and the science is now seeking for differential and integral equations for finding out the solutions to the problems of the origin, growth and evolution of life.The bios, displays a level of organisation and internal regulation compared to physical and chemical phenomenal organised structures. The organization in a bios takes place in a hierarchy of interlocking levels. The emotional behaviour has a sub-stratum of organised physical behaviour, which is derived from an organisation of biochemical processes in which there is a role of a large number of molecules. The genetic codes depend upon the structure of proteins and nucleic acids, seeming to advance through molecular biology and genetics. The system theoretic approach for including exchanges through inputs and outputs of various kinds of energy and matter with the environment, with open systems, away from equilibrium coditions may be able to generate self organisation. The bios's behaviour is required to be predicted every instant through its overall behaviour. Thus there could flourish the concept of a strange attractor and solve the problem of chaotic situations through the non-linear system theoretic approach. I came in contact with the

works of Professor Kalman, specifically his, 'Mathematical Topics in System Theory'. In order to extend his theory two more processes required to be included. The first is the morphogenesis, the process by which an embryo develops into the highly differentiated and integrated structure. It is known, however, that the Prigoginian allows global structure to be built up through local interactions. For a bios, an open system, the biochemical reactions involve autocatalysis and cross-catalysis. These provide non-linearity for chemical dissipative structures. It is important to note that the development has several critical thesholds of bifurcation points, of controlling parameters allowing to adopt a self organised state in which the symmetries go on breaking abruptly and the embryo gets progressively differentiated and integrated spatially and functionally. This is one model given for the generation of self organization.

Regarding the origination of life, about three billion years ago, again the probability for sequence of events is considered, turning certain groups of molecules into bigger chains in an unending process. Then is the problem of evolution. The scintist apply the theory of Darwin in its fundamentals and say that characteristics change from one generation to another because of random mutations of genes and the adaptive advantage of some of these mutants carries on the gradual evolution of species. Yet the enormous time scales of millions and billions of years available could justifiably compensate for their rarity, in case the adaptive mutations may be rare, and moreover, there is no arrow of time in it. Further the problem of reduction of the complexity arises and science has to pursue for a simple model. This is illustrated in the mathematical theory of Karma in the Digambara Jaina Agama texts. There is the system theoretic approach and the cybernetics described in details through tetrads of the bonding of karmic matter: in terms or parameters of the configurations, number of particles, life-time, and energy of impartation. There are the operations which bind the bios through these tetrads, the operations of yoga and kaṣāya, which are defined through the units of indivisible corresponding sections. Then there is the sequence of transforms depicted through the matrices of various forms. This I found to be a path leading to the Heisenberg's type of original matrices which he formulated in quantum mechanics before Schroedinger. One such is the life-time strucutre matrix (foe mass and energy) shown in its simplest form. This is trangular in form and shows in the figure which is very common to be places in the commentaries of the Gommaṭasāra. The output is the same s input in it. It is assumed that every instant only one cell (nisus) decay every instant from the instant-effective bond samayaprabaddha), bound in the past sequence of instants, only one IEF at a time alone. But in actual life this is not possible as every instant the input may differ from the output in every member of the tetrad. Thus the matrix so constructed could work in a complicated way. I then formed a general expression for the state at any instant derived its equation of motion in differential form and it took a dissipative or diffusional form expressing the second law of thermodynamics, as is the Boltzman introduced the statistical concept of entropy related with probability through the equation: $S = k \log P$, order to disorder, defining the thermodynamic arrow of time, which may be true for isolated systems alone. An embryo is not an isolate system. It is an open non-equilibrium thermodynamic system exchanging matter and energy with its environment. Here is a creative arrow of time shown through the increase of complexity and self organization with increase in time. Entropy increases from a low value to higher. The dynamical description is transformed to the probablistic description. In the probablistic process it is a new distribution function (not the density function as in dynamics) satisfying a Markov type of equation. The dynamical process may lead to order , while the probablistic process leads to increased disorder. However if we proceed with the FNFT, for the description of evolution of a system in terms of dynamical correlations of new types, we can

give a simple meaning to the symmetry breaking introduced by the second law of thermodynamics and to the choice of the relevant semigroup as is found in the modern system theory. Boltzman work on kinetic theory, Planck's discovery of quantum theory and Einstein's theory of spontaneous were all based on the second law of thermodynamics. Thus FNFT could work well with the following conditions of life's basic properties:

1. Life is spontaneously created from non-living matter. **2.** Life has highly ordered structure.

3. Life has a constant influx and outflux of ordered energy from external sources.

4. Life has a very effective internal control and regulation system which responds to external situations. **5.** Life has the ability to multiply (self reproduction).

Then we have at our disposal, the four types of fundamental fields in nature defined through the metric and displacement fields in the FNFT, the strong and weak nuclear, the electromagnetic and the gravitational fieldwhich could play the roles of carrier of matter and energy for the living systems. The live elementary particles could thus also play the role of carriers of life, having several types of life-span depending upon the bonds created due to the life itself at the various types of response given at the provocation through stimuli. Usually lighten elements may be carriers of life in this type of world but the worlds may be different also, where the live-elements may be from heavier elements. Further, the planetary chemical evolution and the spontaneous creation of life has a low probability and may be quite rare in the universe. The probability of finding extra terrestral life is small. The evolution of the biosphere is heavily dependent on the sources of free energy and this gives a basis for prediction of the subsequent evolution of life well over the next billion years as suggested by M. Taub.

Now, we come back again to the Karma theory of the Digambara Jaina Agamas. The state matrix at any instant represents a life structure which is subject to change or transformations. The Abhavya bios belongs to the species of a closed system as is the that of the accomplished souls. The difference being that the Abhavyas can not rise above the first control station ever. The bios who could have a capacity, or to be able to cross this phase and pass on to the fourteenth control station, are the the accomplished souls. Now the Bhavya bios form an open system, jumping over beyond the first control station, through various types of depuration. The depuration being responsible for the ultimate destruction of the state matrix of *Karma*. The whole process is described in detail in the *Labdhisāra*, the *Gommaṭasāra* setting all types of sets for further elaboration of this phenomenon. Just as the Heisenberg matrix mechanics was easily dealt with the Schroedinger wave mechanics and ultimately through the quantum field theory evolved in various forms, so also we could start with the *Karma* mechanics in the form available in the *Labdhisāra*, depicting the gradual annihilation of the state matrix through the process of depuration in which the phases of a bios play the role in just a different way from the worldly way before. It has to break the bondage-fluence known as the illusive fluent through the *karaṇa labdhi* or the fifth operational attainment known as *karaṇa*. This fluent is for the first time divided into three types of fluent with divided mass numbers of karma particles carrying their separate tetrads, yet totalling to the same amounts as was in the original fluent of delusion type. With all such concepts of mass and energy, could we pass on to the FNFT wherein we shall be required to find similarities with the Karmic mechanics or the Karmic display where the bios and matter are in bondage to create living matter again and again. The state matrix would take the form of a density function, ever dissipating or diffusing till the whole curvature, representing the state through the space-time discrete structure, reduces to a flat space-time. The remaining description will not be so difficult through manipulation of the differential and integral equations in tensorial or more generalized forms with the help of super computers. I have tried to approach

this problem by resorting to the group theoretic approach ultimately. If the groups which I have envisaged and created are studied deeply for their irreducible representations, this problem will be reduced to the study of live-matter (karma) and the non-living matter (pudgala). The interactions could be studied through the non-linear differential and integral equations and their non-singular solutions as we have already defined the limits of the measures of the minimal velocity and time, as well as taken the maximal velocity to be the prsent value of the velocity of light. The Nobel prize (physics-1998) winner, H. L. Stoermer, and his team associates, have discovered that electrons acting together in strong magnetic fields can form new types of particles, with charges that are fractions of electron charges, breaks the way again to approach an ultimate particle structure theory.

Now, we go beyond this description to discuss the fusing of the biological phenomenon with the material or physical one. We consider the $R_{\mu\eta}$ as the state denoting the possession of energy of action contained in the live matter of a bios. Let it be denoted as a collection of column matrices corresponding to a finite number of configurations with which a bios is endowed with. Let this be computed for a period which may move to the past or negative time dimension, till the collection fairly works for the present state of action capacity of the corresponding bios. Every instant there is an input of a matrix column of action corresponding to the input functions set to input by the bios. We could well define such functions through the functional relationship between the functions and their effects in terms of energy of action every instant. Then we could calculate the newly evolved state $R'_{\mu\eta}$ and further calculate the change in the output as a result of various types of derivatives. This will be a principle theoretic method as to be disnguished from those evolved through construction theoretic approach. The former method. The former method was adopted by Albert Einstein in his theory of relativity. At present, Kazuo Kondo (2001) who has been working in the unification of all interactions in physics and chemistry through higher space order geometry, (cf. all his publications in the Post-RAAG Reports, published in Japan, all along,) has suggested that this could be unified with biology through further generalization of the KH and KHK theorems in the selection of further higher order coordinate elements as well as other elements in his theory of higher order space geometry unifying microphysics, chemistry and biology.

At present, there has also been coming up works on the knowledge-based intelligent systems, lead by L. C. Jain, Australia, who has found that so far no single technique is capable to solve all the problems of engineering, science and business discipline. According to him, the recent research on hybrid systems suggest that by complementing each other's weakness, one can create an efficient and intelligent system for practical application and that the hybrid intelligent systems will dominate the 21st century. The predominant mode has been the use of two of the technologies in a given hybrid system; however, a large application may use many modules of each type. Most of the hybrid systems work to date has combined expert systems and neural networks, fuzzy logic and expert systems, or fuzzy logic and neural networks. Further, much interest has been recently taken towards systems integrating genetic algorithms with neural networks or with fuzzy systems.

Could we pass on to a hybrid system through a principle theoretic approach through our functional non-symmetric field theory? For developing such a neuro set up for evolving various computing software consisting of fuzzy logic, neural network theory, and probablisistic reasoning (which includes areas such as genetic algorithms, belief networks, parts of learning theory, and chaotic systems as well as fractal theory) we may proceed ahead through the input program for a well defined

bio-system as proposed by us, where the state has been defined through the $R'_{\mu\eta}$ changing every instant at each input and output through the well defined input functions and operators as well as well defined output functions and operators.

Now we shall attempt to extend our theory, Functional Non-Symmetric Field Theory (FNFT) to make it applicable to the biological phenomena. We have seen how the correspondence of the minimal time interval t_0 with the minimal velocity c_0 as well as with the maximal velocity c, the velocity of light, led us to the application of the theory of functionals originated by Vito Volterra. This was all meant for unification of the four fields, those of the gravitation, electromagnetism, nuclear weak and strong. The published papers on this account have mostly appeared in the Post-RAAG. This theory is to be made applicable to the biological phenomena apart from to the physical phenomena.

The most important concept that requires introduced in this case is that of heredity. It requires the consideration of the present state of the system which is a biological one. Every instant the bios adds to its state whatever it acquires as its action, in the generalized sense of the action concept introduced by Einstein, workable for the biological case also. This could be achieved if in the field equations of the Einstein's Non-Symmetric Field Theory (NFT) or in those of the FNFT, we introduce the heredity consideration. The hypothesis of heredity appears in terms of the type of functionals,

$$Z = F [f (\overset{t}{\underset{-\infty}{\tau}})],$$

which depend upon the values taken by one or more functions of the time, $f (\tau)$, in the interval $- \alpha$ and the moment or instant in this case t. This takes the form, in case of the linear heredity, as

$$Z = \int_{-\infty}^{t} \phi (t, \tau) f (\tau) d\tau.$$

Now, through some simple hypotheses, the nature of these functionals can be particularized. Volterra suggests an extremely natural postulate, which is to suppose that the influence of the heredity corresponding to states a long time before the given instant gradually fades out, as in the case of dissipation phenomenon of waves. Precisely, that the $f (\tau)$ being always limited in absolute value ($< M$), the modulus of the variation of the quantity

$$Z = F [f (\overset{t}{\underset{-\infty}{\tau}})],$$

when $f (\tau)$ varies in any way (its modulus being always $< M$) in the interval $(-\infty, t_1)$ (with $t_1 < t$), can be made as small as we please by taking the interval $(t_1 < t)$ sufficiently large.

Such a postulate represents the principle of dissipation of hereditary action, which can be applied in the theory of karma where the bondage-fluent is required to be calculated ab aeterno.

Putting

$$Z' = F [f (\overset{t+h}{\underset{-\infty}{\tau - h}})],$$

it may happen that always $Z = Z'$, whatever f and h may be. This occurs in hereditary case, the phenomenon always follows the same course if it passes successively through the same conditions, whatever may be the relative position of these onditions in time. If we accept the law as a postulate, at least for isolated biological systems, we shall say that heredity is invariable (as in case of the sthiti

racanā yantra, or the life-time structural matrix, prevalent in the Karma theory of the Digambara Jaina School of Mathematics). If the function $y = f(\tau)$ is periodic with period T, then the function

$$Z(t) = F[f(\overset{t}{\underset{-\infty}{\tau}})],$$

is periodic with the same period T. The relation representing the phenomenon by $y = f(t)$, $t = Z(t)$ gives a locus, a closed curve in every period T. Viceversa, when f (t) is periodic, Z (t) is also periodic, and in the same period T for both, then heredity is invariable. This principle is called the principle of the closed cycle. In the theory of karma we also come across with the state in form of life-time structure which remains invariable with a value equal to slightly less than one and a half geometric regression as multiplied by instant- effective-bond.

In this case of the invariable heredity, all the kernels of the integral equations obtained are simply functions of the difference $t - \tau$ of the two variables, that is, are permutable of the first kind with unity and with one another. This gives the group of the closed cycle.

In case of linear heredity, let ρ be a parameter whose value at time t depends on the parameter q by the relation

$$\rho(t) = aq(t) + \int_{-\infty}^{t} q(\tau)\, \Phi(t-\tau)\, d\tau .$$

The function $q(\tau)$ determines the history of the parameter q (the primary history), and the function $\rho(t)$ determines the history of the parameter ρ (the hereditary history). Similarly, in the theory of karma we also have the primary history and the heriditary history. In this case heredity is complete. Further, just as the primary history subsequent to t_0 determines the hereditary history, so the hereditary history subsequent to t_0 determines the primary history.

These concepts are to be applied to modify the field equations of the FNFT so that they may be applicable to the biological phenomena which are to be subjected to the same consideration as in any recent system theory in which there is state, input and output consideration in limited conditions.

Now we are required to go still deeper to penetrate the entropy concepts which are to be considered for the biological phenomena. It has been experimentally verified that the bios is cocerned with the laws in physical nature of events going the other way off the second law of thermodynamics. This may be brought into the biological fold if we take the negentropy concepts into consideration. For consideration of the order or management effected by a bios, we are led to the consideration of the extension of the Minkowski's space time which dealt with the cone in which only the velocity of light restricted the events. In FNFT we restricted it to the minimal velocity c_0, creating another cone. Still ahead was the speculation of Professor Kazuo Kondo to go beyond the velocity of light in dealing with the events connected with the neurons in a bios. This meant that we are to consider the velocity which could be that of the neurons as the tachyons. Recami has been working on the tachyons and it will be helpful in deriving results for the field equations in biological studies.These will include the hereditary corrections to be made in the field equations of the FNFT.

The principle of teleology has already been applied in the variational principles where the nature's laws of cause and effect, just following in sequence of time are defined. This also happens in case of the postulates about the minimal time interval and minimal velocity which may remain constant in all frames of reference in empty space-time. What happens in accelerated frames may be further investigated.

Let us now come to the theory of Karma in the Prakrit and Sanskrit texts in the Digambara Jaina School of Mathematics. Here we find that the Karma has been made a mathematical object, just as Einstein and other physicists had made the action as the mathematical object. The scientists put the action to be treated with varaiational principles for gettng the field equations or equations of motion.

Here, in the Jaina School we find that they were already equipped with the minimal and maximal values in several places of treatment and they felt no difficulty in giving the results what the present scientists could get only through the application of variational principles. But how the ancients could get the same analogous results is a subject of research in Karma Field theory. They stipulated a karmaless structure of life, karma being a matter transformed into some mass which had energy to perform some functions, beyond the realities that existed in their imaginary karma free structure, the soul in the purest form as was the notion in ancient civilizations. The worldly life, as it appears, is a dual compromise between the soul and the karmic matter. They postulated that it was the yogic and kāṣāyic activity of the worldly bios that was the cause of converting the suitable matter into eight basic types of karmic configurations, endowed with the life-time, mass number of matter particles, and energy for being capable of impartation of fruition in various ways, some of which were directly involved in rendering material happiness or unhappiness to the bios who had been responsible for the specific yogic and kāṣāyic activities.

Thus the bios was considered to be playing the role of negentropic phenomena and the karma so created was playing the role of entropic phenomena in nature. This type of assimilated karma by the bios as well as the phases of bios which were out of the range of the yogic and kāṣāyic activities, were very deeply studied and a mathematical theory of karma as a mathematical object was developed, through the passage which was representing the transmigration. They might have thought that the life of a yogi who could have restraint over the yogic and kāṣāyic actions, was happy not only in the present but also in his future life. This empirical evidence might have been the cause of their research into the discovery of the phases of the bios which could help annihilate the existing state of the karma associated with the bios as heredity or other forms, created in the past. If there were operators which created a certain state of matter in form of the karma, there could be such operators in the bios which could annihilate the past hereditary state and check the creation of new karmas which with their so association with the bios as merits and demerits were the cause of the transmigration, the cycle of births and rebirths.

It was then natural to discover the correspondence between the bios and matter through a system theoretic approach in which the whole theory was to have an empirical data base which is available in the mentioned texts. Karaṇas (operators) in various forms were discovered, alongwith the minima and maxima of results of both the mathematical objects , the bios and the karma, as well as their associated states, conditions and so on. All these were rendered the various types of measures through numbers as well as sets which were existential and constructive types, the latter evolved to give the clear exposition of the existential sets in the actual world of bios and matter interactions.

From the texts on the karma theory with mathematical symbols, it appears that their methods of generalization from the finite to the transfinite might have been the efforts of several centuries and their very step into the proper infinities of Georg Cantor and the laws governing their mathematics, the display of the logarithms for an easy way to deal the products and powers as summation and multiplication, as well as various other methodical procedures carried them a long way towards their approach for the impedance and annihilation of karmas created and bound due to various phases of the bios consequent upon the interactions between bios and the present state of karma as a heredity. They tried to represent the present state of the karma of a bios through a hereditary matrix, the simplest one, in which the same arguments appear to have been taken as in the naive approach of Vito Volterra.

For analysing a karma particle, considered for its attributes and situations, and its comparison with another type of karma particle, one may take help of the logic of fuzzy sets introduced by Zadeh. Objects may be clusters of karma particles in form of a variate, a variform, a super variform, a geometric regression and an instant-effective-bond. The types could be basically of eight kinds and of one hundred and forty-eight kinds, called configurations. The attributes may have four parameters, the

first two being configuration (prakṛti) and particle number (pradeśa-saṁkhyā) as a consequence of yoga and the next two being life time (sthiti) and energy (anubhāga) as a consequence of kaṣāya. The situations may be dealt with space and time. That is how the fuzzy set theory may be applied to the karma phenomena. The yoga through mind speech and body may be experimentally dealt with the combination of encephalogram, oscillograph and body clock regulated by modulation. The kaṣāya may also be experimentally dealt with electrocardiogram. Thus for differentiation of each type of karme particle, it shall be required to build up a software consisting of operative signal circuits. Professor L.C. Jain (Australia), who is working on knowledge based systems may be helpful in future.

Before his death, Professor Kazuo Kondo, in 2001, had expressed,"Attention is especially centered on how traditionally developed apparently different fields of science-microphysics, chemistry biology etc., - can be described from the same root based on the *a priori* indispensability comparable with Kant's "Ding an sich" on Platonic ideas to show how the traditional fields are grasped as its approximations with emphasis on different aspects respectively. Geometry of higher order spaces provides the fundamental thesis..... These works on epistemological restriction to finiteness of human recognition capacity. The dominance of unitarity as in quantum mechanics is pointed out to be indispensable since it is equivalent to finiteness.....Most important roles are accorded to the KH and KHK theorems and their generalisation to the multiparametric picture. The construction of the world of elementary particles is shown to be framed under them. So is the constitution of the world of bio-creatures differentiating into the Plants, the Animal Kingdom, and further with many phyla, classes, orders etc. ....The concept of metric tensor needs to be scrutinized from this standpoint (atmosphere of the line element of higher order space) to clarify quite a number of puzzles. Mostly, so far the work of atmospheric effects have been considered in association with the main body of the particle or creature. If there can be possibility for them to be detatched, some abstract phenomena might take place to be observed in the outside of concrete particles or creatures. They can be carriers of information rather than of matter. Here could be an opening of a need recognition of information propagation whether as artificial communication techniques or as natural phenomena in animal and human physiology or psychology." (Vide, Kazuo Kondo, Three Phases of Epistemological Penetration to Nature, Academia Pontaniana, 1997, p.105).

For the International Conference at Nagpur, India, 1999, he sent his message," ....We proceeded to demonstrate, the more general thesis, that a particle itself is a space and a space itself is a particle....From this kind, a fundamentally different regime of observation or recognition needs to come about if the observed items have individuality.....This is the standpoint of the mathematical constitution of the classical analysis of the bio-world" (Yotsukaido, Nov. 1998)."

About Professor Kazuo Kondo's contribution, we find the post-RAAG Reports, of January 2001, February, 2001, March 2001, as numbers 354-356, giving Epistemological Recognition of the Unified Mathematical World Picture, describing :

1. Introduction and Mathematical Foundation
2. Classical Physical World (Classical Space Construction)
3. Micro-Mechanical Catastrophe.

These were his last papers received by us at Jabalpur, India. Had he been in this transitory world for a few years more, we could have got more of his insights into the secrets of nature.

So far, I have remained silent about my blessed wife, Gulab Rani, who came into my life in July 1949 and served, cooperating with me till 25th December, 2002, in all of my teaching, research as well as administrative works. Without her active devotion, all this work could never have come to being. I have no words to express my birth to birth gratitude to her for all the care she had been taking during my intensive study, without even the least opposition throughout my life, as an ideal life partner.

L. C. JAIN

APPENDIX 1

UNITS OF LENGTH OF POST UNIVERSAL MEASURE

TILOYAPAṆṆATTI UNITS:

Infinite-infinite ultimate particles	= 1 avasannāsanna particle (skandha) (anntānanta paramāṇu)
8 avasannāsanna units	= 1 sannāsanna particle
8 sannāsanna units	= 1 truṭareṇu particle
8 truṭareṇu unite	= 1 trasareṇu particle
8 trasareṇu units	= 1 rathareṇu particle
8 rathareṇu units	= 1 uttama bhaoga bhūmi bālāgra particle
8 uttamabhoga bhūmi bālāgra units	= 1 madhyama bhogabhūmi bālāgra particle
8 madhyama bhūmi bālāgra units	= 1 jaghanya bhogabhūmi bālāgra particle
8 jaghanya bhūmi bālāgra units	= 1 Karma-bhūmi bālāgra particle
8 Karma-bhūmi bālāgra units	= 1 likṣā (kīkha) particle
8 likṣā units	= 1jūṁ yūka particle
8 jūṁ units	= 1 jau yava barley corn particle
8 jau units	= 1 aṅgula finger width particle
8 aṅgula units	= 1 pāda particle
2 pāda units	= 1 vitasti span
2 vitasti units	= 1 hasta (fore arm or cubit)
2 hasta units	= 1 rikkū or kiṣku
2 rikkū units	= 1 daṇḍa staff or dhanuṣa bow
2000 daṇḍa units	= 1 kosa (krośa)
4 kosa units	= 1 yojana

Note :

Aṅgula is of 3 types:

1. **Utsedha aṅgual-** The aṅgula produced in order of the above definition
2. **Pramāṇa aṅgula-** This is equal to 500 utsedha aṅgula units. This is the aṅgula of first Bharata emperor (cakravarti) of avasarpiṇī period. Through This aṅgula, the measure of islands, seas, mountains, altars, rivers, wells, lakes, boundary, Bharata region etc. is effected.
3. **Ātma aṅgula-** This is a variable measure depending upon the measure of self aṅgula of persons of various periods in the Bharata and Airāvata regions. Through this aṅgula the measures of the jhārī, Kalaśa pitcher, darpaṇa (mirror), veṇu, bherī, yuga, (śaiyyā) bed, śakaṭa (vehicle), hala (plough), śakti (energy), tomara, siṁhāsana (throne), bāṇa (arrow), nālī (channel), akṣa (axis), cāmara (fan), duṁdubhi, pīṭha (stand), Chatra (umbrella), residental place, city, parks etc. are effected in numbers.

TLS UNITS OF LENGTH-

No explicit unit of length has been defined in the Trilokasāra which is an abstract text compiled from the source, the Tiloyapaṇṇattī of Yativṛṣabhācārya, (c.5th century A.D.) It seems that is has been taken for granted that the reader is acquainted with the fundamental units of length or distances. In verse 1.3, it has been stated that in the very central portion of the all-space (sarvākāśa) which contains infinite points (space-points) there is the universe which contains innumerate points. The point has not been defined. Thus the measure of the spatial volumes of the whole space and that of the universe space is given through two sets of points, one of which is infinite and the other is innumerate.

Then is the verse 1.6, the vertical height of the universe has been said to be 14 rājus, but the cosmological distance, rāju has not been defined here, which is a great unit of cosmic distance, the volume of the universe-space being $(7)^3$ or 343 cubic rāju.

Further in verse 1.7, the 7 rāju distance has been called a universe-line or jagaśreṇī. The jagaśreṇī or L is related with cubic finger set of points as follows:

$$L = (F^3)^{(\log_2 P) \div A} \quad \text{.....(a)}$$

Here the units of lengths have been again given through an equation between two sets of points. the L, the set of all points in the universe line or jagaśreṇī and the F, the set of all points in the linear finger (sūcyaṅgula). Then these have been equated through the $\log_2 P$, where P is the set of instants (samaya). This is divided by an innumerate quantity called A. Thus the two points sets have been connected with the set of instants and an ordinal type of number A which is innumerate. This is a set theoretic approach which is at present regarded as of fundamental importance in all sciences,

In verse 1.8, the set of points in F and the set of instants P are related as follows-

$$F = [P]^{\log_2 P} \quad \text{.....(b)}$$

Then in verse 1.95, the yojana has been used akin to li in China, but it has not defined here. It has been used to define the set of instants, P or palya.

Further in verse 1.126, the unit kośa has been used, and the dhanuṣa has also been used, but their measure in terms of either aṅgula etc. is not given. In this way, it seems that the author has taken it for granted that the reader is already having the knowledge of the units of length, which the later commentators have elaborated.

JPS: units of length (ch.13, vv.19 et seq.)

infinite infinite paramāṇus (ultimate particles)	=	1 avasaṇṇāsanna (particle) skandha
8 avasannāsanna skandha	=	1 sannāsanna skandha
8 sannāsanna dravyas (fluents)	=	1 practical paramāṇu or truṭireṇu
8 practical paramāṇu or truṭireṇu	=	1 trasareṇu
8 trasareṇu	=	1 rathareṇu
8 rathareṇu	=	1 uttama bhogabhūmija bālāgra
8 uttam bhogabhūmija bālāgra	=	1 madhyama bhogabhūmija bālāgra
8 madhyama bhogabhūmija bālāgra	=	1 jaghanya bhogabhūmija bālāgra
8 jaghanya bhogabhūmija bālāgra	=	1 karmabhūmija bālāgra
8 karma bhūmija bālāgra	=	1 likṣā
8 likṣā	=	1 yūka
8 yūka	=	1 yava
8 yava	=	1 aṅgula sūcyaṅgula or utsedha aṅgula
6 aṅgula	=	1 pāda
2 pāda	=	1 vitasti
2 vitasti	=	1 hasta
2 hasta	=	1 kiṣku rikku
2 kiṣku	=	1 daṇḍa

[1 daṇḍa = 1 dhanuṣa = 1 yuga = 1 nālī = 1 akṣa = 1 mūsala] each measuring 4 ratni or hasta.

2000 daṇḍa	=	1 gavyūti kośa
4 gavyūti kośa	=	1 yojana

Note 1. Aṅgula is of 3 types :

1. utsedha aṅgula
2. pramāṇa aṅgula
3. ātmāṅgula

Utsedha aṅgula - In is the same as sūcyaṅgula produced as per definition shown above. Through this the heights of the hellish, subhuman, human and superhuman (deva) are measured.

Pramāṇa aṅgula - Five hundred utsedha aṅgula make 1 pramāṇa aṅgula. The regions like islands, seas, mountains, Jina temples, rivers, wells etc. are measured throught this aṅgula measure.

ātma-aṅgula - The human beings born in Bharata and Airāvata regions, in different periods, have their aṅgula measures known as the self-finger or ātma aṅgula measure. All pitchers, bhṛngāra, daṇḍa, dhanuṣa, phalaka, power, tomara, hala (plough), mūsala, ratha (chariot), śakaṭa, yuga, throne, cāmara (fan), ātapatra, home, beds etc. are measures through this ātma aṅgula.

Note 2 :- The LVG loka Vibhāga does not mention these definitions.

Anuyogadvāra sūtra (ADS) units of length (149.12, 124.13.1, 149.93)

infinite paramāṇu-pudgala	=	1 ussaṇhasaṇihaya
8 ussa units	=	1 saṇhasaṇihaya
8 saṇha units	=	1 ūrdhvareṇu
8 ūrdh units	=	1 trasareṇu
8 trasa units	=	1 rathareṇu
8 ratha units	=	1 devakuru bālāgra (hair's head)
8 devakuru bālāgra units	=	1 harivarṣa bālāgra
8 harivarsa bālāgra units	=	1 hemavat bālāgra
8 hemavat bālāgra units	=	1 videhakṣetra bālāgra
8 videha bālāgra units	=	1 bharata kṣetra bālāgra
8 bharata bālāgra units	=	1 likṣā (mini louse)
8 likṣā unit	=	1 yūka (louse)
8 yūka unit	=	1 yavamadhya
8 yavamadhya unit	=	1 utsedha aṅgula

Note :- This has one unit in excess of TPT and JPS

6 aṅgula units	=	1 pāda
2 pāda units	=	1 vitasti span
2 vitasti units	=	1 ratni
2 ratni units	=	1 kukṣi
3 kukṣi (2?) units	=	1 dhanuṣa
2000 dhanuṣa units	=	1 gavyūti
4 gavyūti units	=	1 yojana.

Note1: There is again a difference in kukṣi as compared with kiṣku of TPT and JPS.

Note2: Sūcyaṅgula, ātmāṅgula and utsedhāṅgula (sūcyaṅgula) as well as pramāṇāṅgula have been the three kinds of aṅgula defined in ADS as follows:-

A linear measurement of an aṅgula is called sūcyaṅgula execpt in case of pramāṇāṅgula where it is termed as śreṇyāṅgula. Here pratarāṅgula and ghanāṅgula [also in TPT and JPS] denote square and cube of an aṅgula width, respectively.

The following definition of three of aṅgula are given in ADS.

1. Utsedha aṅgula: ADS, 149.23, states, "Every great emperor possesses a kākaṇīratna of 8 souvarṇka (weight measures) of the size of a cube having six surfaces, twelve edges and eitht diagonals. Every side of it is one utsedhāṅgula long. It is equal to half of that of Lord Mahāvīra. One thousand times of it is one pramāṇāṅgula."

2. Pramāṇāṅgula: The length of one pramāṇa aṅgula is one thousand times the length of an utsedhāṅgula.

3. ātmāṅgula: ADS, 149.13, 1, defines, "Twelve aṅgula of a person make one's face-length, nine times

the face length equals the lengh of puruṣa (the person)".

So the finger breadth of a person is called an ātmāṅgula.

	Thus 1 utsedhāṅgula	=	1/2 ātmāṅgula		
	1 pramāṇāṅgula	=	1000 utsedhāṅgula		
	1 pramāṇāṅgula	=	500 ātmāṅgula	=	100 utsedha aṅgula.
Thus ,	1 pramāṇa yojana	=	500 ātma yojana	=	1000 utsedha yojana (ADS)

1 aṅgula $= 8^{10}$ trasareṇu (ADS)
$= 8^{9}$ trasareṇu (TPT, JPS)
$= 8^{6}$ trasareṇu (Siddhāntic units Śripati, The āryana system)

1 Buddhistic yojana =7/8 Jaina yojana (ADS units)
= 7 yojanas (TPT units)*

APPENDIX 2

SAMAYA CONCEPT OF INSTANT

In the verse 4.285 et seq., the indivisible instant has been difined as a unit or irreducible unit of time in physical nature of things. Referring to the DVL, vol.4, 1.5.1, p. 318, one finds the definition in more details: Samayādīṇamattho vuccade -

aṇoraṇvaṁtara vyatikramakālaḥ samayaḥ/
coddasa rjju āgāsa padesa kamaṇamettakāleṇa jo
Samae ghettūṇa eyā āvaliyā hodi /.....

Translation - The norm (gauge) of instant etc. is stated. Whatever time is required by an ultimate particle in transgressing other ultimate particle is called an instant (samaya). This means that the ultimate particle which is capable of trespassing the fourteen rājus through the trespassing time of fourteen rājus of space-points (ākāśa-pradeśas), its trespassing of one ultimate particle is in the period known as an instant (samaya). Innumerate such instants (samayas) form an āvalī.

Just as there is the concept of an ultimate particle, this definition introduces the concept of an ultimate time particle or time period, called instant. At the same time it is suggestive of a minimal and a maximal velocity corresponding to an indivisible instant. Both are the events and similar other events may take place in this indivisible instant as a constant of nature, remaining invariable in all the inertial frames of reference as the maximal velocity of light.*

It can be proved logically,that the above paradoxical postulate stays and remains valid and becomes invalid if the process of the units of velocity and time are not limited and subdivided indefinitely. The paradoxes of Zeno may also be discussed in view of the above postulates. This also reminds us of teleology.

The principle of relativity is involved here as the correspondence between the indivisible instant with minimal and maximal velocity introduced a profound space-time structure set into space-time continum through functionals.

* For details, vide Jain, L.C., et al., On the foundations of Unified Field Theory, Proc. Of Einstein Centenary Symposium, vol. II, Ed. K. Kondo and T.M.Karade, Nagpur, 1980, pp. 475-487.

cf. Gaṇita Sāra saṁgraha of Mahāvīrācārya, loc. cit., Hindi indroduction, pp. 26-29.

cf. Jain, L.C., The principle of Relativity in Jaina School of Mathematics, Tīrthaṅkara vol.2 , no.1, march 1976, pp. 13-20 and 26.

* cf. Lishk et al., length units in Jaina Astronomy. Jain Journal, April 1997. pp. 143-154

APPENDIX - 3

CARTOGRAPHY IN THE JAINA GEOGRAPHY (TPT AND OTHER TEXTS)

Geography is concerned with the features of the mundane world. It is a subject which draws a common line between the natural sciences and the humanities.

Geographical knowledge in Jaina texts is available in the books on the Prathamānuyoga and the Karaṇānuyoga. Both the groups of works abound in the description of the Jambū island, for its earth, geology, topography, physiography, geomorphology, rocks, soils, climatology, meteorology, astronomical and mathematical geography. The adjoining Lavaṇa ocean geography consists of oceanography, waves, tides. Their flora and founa, agriculture and irrigation, mineral exploration, town planning, political and urban geography. There is also description of ethnology and anthropology. There have been application of skill of mapping, through cartography, with and without scales in yojanas etc.

So far as the present day map of the world is concerned, the experimental observations are also of the view that the earth is more or less a sphere as other planets are and have two motions: the motion of revoluton and that of the rotation. Moreover, the earth has a finite radius ranging to about four thousand miles. The rotation is completed in about twenty-four hours less four minutes, and the revolution is completed in slightly more than 365 days, called a solar year. This system is obviously quite different and description, manipulation and philosophy as compared with the Jaina system.

The Jambūdvipa and other islands and oceans are not only perfectly symmetric but also difficult to scale cartography. For example, if one wishes to make the map of the Bharata khaṇḍa through a scale in yojana to centimater. one will see and find it extremely difficult to trace the map and place the knowledge of the scripture as it is, howsoever big the map be or the radius of the Jambūdvīpa be taken. The geographical details for human beings alone, alongwith other beings extend from the centre of the Jambū island upto the Puṣkarārdha island (that is, upto $2\frac{1}{2}$ islands). The range, covers two and a half islands and two oceans, each having its width twice of the preceding, in a wonderful symmetry, in alternate details.

Now, coming to the question of existence of such islands and oceans on the surface of the middle universe, (the concept of the surface of a flat but limited earth), the measures given in yojanas of the islands and the exact measures of the mountains and rivers therein, along with other objects with the same symmetrical details, perhaps do not seem to justify the point to point scientific cartography. Even if one adjusts the yojana with a measure of six to nine miles, through device like shadow reckoning and finds that the circumference of the Jambūdvīpa is about 24000 miles*, still the problem remains about the Lavaṇa sea and other seas and islands, each of which are of double the width of that of the preceding. It is therefore not possible to imagine such a structive with concrete geometrical means on the present concepts and ideas and discoveries. Hence one must understand the infringement of the astronomical and cosmological measures and structures for specific plans and programme (yojanā) in view of psychic means which are abstract, complex as well as transcendental, some examples may be seen, how the concept of the numerable is extended to the innumerable and the various types of infinites having comparability, even at present, due to the development of the theory of sets and its application in several spheres of studies. Similarly, the measures of geographical knowledge is required to be accommodated in the various spheres of the living and non living beings.

One could also explain the length of day and night, specially in the symmetrical regions of the Jambū island, and satisfy this perfect symmetry of the two suns and two moons phenomena of the island, and then extend the theory of real and counter bodies* of the Jambū island to the other islands and seas having the geometrical structure of rings, with known width, at specific distance from the centre of the earth's surface. This symmetry is the lateral inversion or reflection symmetry.

All such structures in the middle universe, are concerned again with the complex and transcendental planes of the psyche for exposition of the theory of karma system in which the number system and simile system of measures in space and time units, (aṅgula, jagaśreṇī, palya and sāgara), are based on the extension in space and time in the middle and other universes.

DISCUSSIONS

Here we whall be concerned with the geography of the Jambū island, and due to its own measure system in the Jaina school, the setting seems to be problematic. For solving the problems of the geographical model which is connected with the astronomical model of this school, there have been serious attempts by Jain, lishk, Gupta and some others, *Only some relevance appears in the description of the purāṇas in various sects, and in that given in the TPT. It appears that the names of cities, spesifically, have changed to a great extents, comparatively, as are given in the TPT, yielding them to the new denomination in course of time. It may be clearly observed on comparision of the above list with tat given for the Purāṇās in various books on the geography of ancient India, and the world's ancients civilizatios.

The other parts of knowledge of geography in the Jaina school reqarding climate, days and niths, soil, minerals etc. are not so important as is the recognition and identification of the objects like rivers, mountains, seas, towns and cities. The words which could give some significance may be Andhavana, Añjanagiri, Ayodhyā, Ariṭṭhapura, Aśoka, Aśmaka, Uttara kuru, Utpalāvatī, Airāvatta, Kanaka, Kailāsa, Kauśāmbī, Gandhāra, Gandha mādana, Candragiri, Candrapura, Jambūdvīpa, Niṣadha, Naimiṣa, Padmāvatī, Maṇi mountain, Mithilā, Raivataka, Lohita, Satruñjaya, Hastināgapura, and Hemavat alone, as found in the TPT. It therefore appears that the TPT is a work compiled long before the writing of the Purāṇas.

If Shadow-reckoning in the ancient times, for time and space both, was the only basis for cartography, some programme might have been fixed in those times to settle a measure of yojana which has a value rauping from 6 to 7 miles or else 9 miles *

The work TPT mentions the following works in its compilation which should have been compiled long before - (The exact date could not be fixed at present) : the Agrāyaṇīya, the Diṭṭhivāda, the Parīkamma, the Mūlīyāra, the loya-viṇicchiya, the loya vibhāga, the logāiṇi and perhaps some other ancient texts. The texts of the Karaṇānuyoga group, mostly of the Śvetāmbara sect, were studied by the German Scholars and the Digambara Jaina texts have come to light in recent years. (TPT, TLS, etc.)*

Almost every text as mentioned, describe the Jambū island structure, form, details, in the same way. In this connection the folowing verses of its TPT are important.

1. In the very central portion of the mobile bios channel (trasa nālī), in the upper part of the citrā earth, there is the human universe which is extremely spherical, with a diameter of forty five lac yojanas (4.6).
2. Over the central portion of the universe, the width of that human universe is one lac yojanas and the cirumference is given by the digits, nine, four, two, zero, three, two, four and one respectively. (4.7)
3. In the very central portion of the human rigion, there is the first island, well known as the Jambū island, like a sphere (ring?) with a with a diameter of 100,000 yojanas. (4.11)
4. At the centre of this jambū island there are peoples regimes (jana padas) of seven kinds, and in the joint intervals of these peoples-regines there are the beautiful six family mountains (kulācalas). (4.10)
5. Starting from the southern direction there are the seven regions, Bharata, Haimavata, Hari, Videha, Ramyaka, Hairaṇyavata and Airāvata, Which have been diveided by some mountains. (4.91)
6. At the foundation there are the six family mountains, the Himavān, the Mahāhimavān, the Niṣadha, the Nīla, the Rukmi, the Śikharī, and over they have the same width, and are touching the former and latter seas. (4.94)*

* Vide. Jain, L.C., On the Probable Spiro-elliptic Motion of the Sun implied in the Tiloyapaṇṇattī, IJHS, 13.1, 1978, 42-49.

The fourth chapter of TPT describes the human universe, in which there are the Jambū island, Lavaṇa sea, Dhātakīkhaṇḍa island, the Kāloda sea, the half of Puṣkara island, and there are sixteen sections in this chapter. The sections are on the types of human being, number, comparability, transition in various types of control stations etc., phases leading to longevity, wombs measures, pleasures and pains, causes for accepting paths.

The Jambū island has been described for its sixteen topics (TPT 4.12-14), for its boundary, area, Bharata region, the cycles of periodic change in it, the mountains and regions as divisions, the lakes, the cities, the palace like buildings with measures in dhanuṣas etc. (4.75 et seq.) In the very centre of the human universe, this Jambū island is one lac yojana in diameter and circular area approximating to 7905694150 sequare yojanas, and a circumference approximating to 316227 yojanas. If we take the utsedha yojana, toget which, 500 divides the diameter, getting 200 yojanas, Similarly, for the Lavaṇa sea if we take the widths of both sides, it is 400 + 400 = 800 yojanas. Thus the total comes to be 200 + 800 = 1000 yojanas. If one yojana is approximately taken to be 6 to 8 miles, the diameter as the pole and at the equator may coincide with the modern measures forth earth.

This secret gives a cline to reduce all other measurements into utsedha yojanas and not the pramāṇa yojanas which must be preserved intact for astronomical and cosmological measuras. This measure in utsedha yojanas of the Jambū and Lavaṇa sea combined also coincids with that given by Āryabhaṭa I, 1050 yojanas, (Vide Āryabhaṭīya, 7th verse, Gitikā section, op. cit).

According to Āryabhaṭa (I) 8000 nṛ make a yojana. This again leads to the fact that nṛ may be taken tobe a miles distance approximately.

Hence the dimeusions given in the TPT and allied later texts of the Karaṇānuyoga group in the Digambara Jains school of Geography, describing the same measures may be programmed to divede each measure by 500, in order to reduce them to the utsedha yojana for the purposes of geographical setting of its objects lying in the human universe, specifically the Jambū island and the Lavaṇa sea. It further seems that the remaining human universe of the Dhātakī khaṇḍa island, the Kāloda sea, and half of the Puṣkara island may be projected as concemed with lives on other planets or gallaxy, concerned with astronomy. In astronomy, the chapter V of the TPT, we shall deal with many problems and fix the correct model setting for its descriptions, most of which have been solved by Dr.S.S. Lishk in his Jaina Astronomy. There the problem of the two suns, two moons, etc. will be settled. Here the length of the day and all the details of a Pañcāṅga may also be taken as a subject topic of as tronomy and we shall deal it there. Similarly, the shadow reckoning on the surface of the earth and the theory of eclipses will also absorb our attention there.

So far as the atmosphere of the earth is concerned, the three envelops air and vapours of water, going on thinner at various heights. Similarly, description is that of earths surface as lithosphere, hydrosphere, biosphere, and technosphere in the TPT.

Regarding the inner structure of the earth on the surface and in its deeper layers, the TPT, chap II tries to probe into the mysteries of the lithosphere, pyrosphere, and barysphere. The depth of the earth is divided into the seven regions, the Ratnaprabhā, the Śarkarā prabhā, the Bālukā prabhā, the Paṅkaprabhā, the Dhūmaprabhā, the tamaḥprabhā, and the tmastamaḥprabhā. These earths are respectively containing the sugar, sand, mud, smoke, darkness and total darkness. The quantity of their measures are respectively thirty two thousand, twenty eitht thousand, twenty four thousand, twenty thousand, sixteen thousand and eitht thousand yojanas, totaling to 308000 yojanas roughly. But we are concerned with the earth which may extend to the diameter of 1 lac yojanas and that is given by the hard part of 16000 yojanas, mud part of 84000 yojanas of the Ratnaprabhā. The portion where there is more or execss of water is 80000 yojanas. (TPT, 3.9 et seq.)

The hard part (khara bhāga) consists of 16 types of earths with different constituents, the top of it being the Citrā earth, every one of the earth is 1000 yojanas thick, each in the geometrical shape of a trapezoid, and all consisting of various types of gem stones, metals and nonmetals etc. Upto the fifth hellish earth, the residences of the hellish as holes have extremely hot temperature. That is what the modernfinding is.

The length of the rivers and mountains are to be proportionately reduced, as we did for the diameter of the jambū island and Lavaṇa sea. We divide these big dimensions by 500 to reduce the pramāṇa yojanas into the utsedha yojanas. (TPT. 4. 94 et seq.)

The heights of the mountains are accordingly to be taken to be as follows, so also the lengths (width) of them and regions

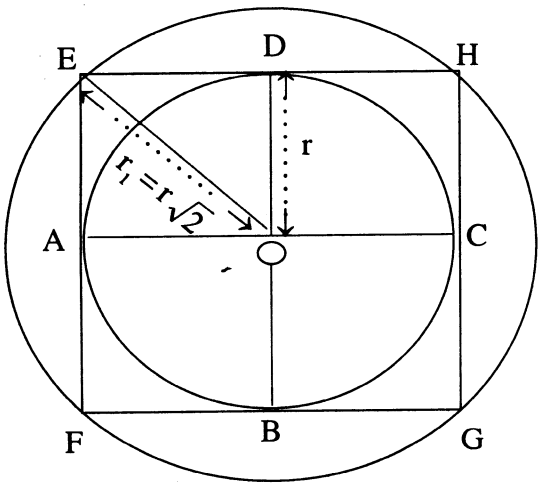
	LENGTH (WDTH) YOJANAS	HEIGHI OF MOUNTAIN
Bharat	$526\frac{6}{19} \div 500$	
Himavān	$1052\frac{12}{19} \div 500$	$100 \div 500$
Haimavat	$2105\frac{5}{19} \div 500$	
Mahāhimavān	$4210\frac{10}{19} \div 500$	$200 \div 500$
Hari	$8421\frac{1}{19} \div 500$	
Niṣadha	$16842\frac{2}{19} \div 500$	$400 \div 500$
Videha	$33684\frac{4}{19} \div 500$	
Nīla	$16842\frac{2}{19} \div 500$	$400 \div 500$
Ramyaka	$8421\frac{1}{19} \div 500$	
Rukmi	$4210\frac{10}{19} \div 500$	$200 \div 500$
Hairaṇyavata	$2105\frac{5}{19} \div 500$	
Shīkharī	$1052\frac{12}{19} \div 500$	$100 \div 500$
Airāvata	$526\frac{6}{19} \div 500$	

The above measurements are reasonable. Similarly, the stretch of the mountains from one end to another, the regions from one end to another can be found and located along with the proper situations of the Vijayārdha etc., and the divisions of the Bharata region etc. It is evident that the proportionte measures can go a long way to recognize the mountains, regions and rivers. The most important rivers, The Ganges and the Sindhu may be traced under the same proportionate scale, getting a correct estimate as desired in a rough approximation. However, the proportionate scale scheme for rivers does not appear to fit in this and the following alternative scale scheme is proposed.

*Needham and ling, op. cit., p, 526.

Cf- ibid-, pp. 528 at seq.

scale scheme alternative



In this programme, O is the pole of the earth or the Jambū island and half of its upper part has been projected on a plane sheet of paper, resulting in the circle A, B, C, D. The lower hemisphese containing the Lavaṇa sea may be assumed to be projected as E F G H round about the upper hemisphare A B C D, in another ring with the follwing measures of the radii,

$\pi r_1^2 = 2 \pi r^2$ where $r = 50000$ yojanas

$\because r_1 = \sqrt{2}\, r$ $\quad\quad$ $\because r_1 - r = (\sqrt{2} - 1) r = (1.414 - 1) r = 20700$ yojanas

The remarks of Needham* are worthy of mention here, "The development of Greek cartography has so aften been expounded that it is only necessary here to remind ourselves of its essential features in very few words[d]. It began with Eratosthenes (-276 to -196,)[e] the contemparary of Lü Pu- Wei, whose application of a coordinate system to the earths surface originated from his determination of the earth's curvature. The famous abservations of the gnomon shadows at summer solstice at syene and Alexandria led to the approximately correct figure of 25,000 geographical miles for the earth's circumference.[f] It is to be noted that the spherical earth was as much at the basis of Greck cartography as the flat earth was at the basis of chinese. But in practice it made less difference than would seem at first sight, for the Greeks never developed satisfactory projections for describing the spherieal surface on a flat sheet of paper."

His further remarks on the religious cosmography seems to give support for this alternative scale. scheme of the Jaina school;* "After the time of Ptolemy, the Great Interruption sets in. European map-making suffers a degeveration so extreme that it would hardly be believable if we were not so familiar with it. Scientific cartography is drastically replaced by a tradition of religious cosmography.[d] All attempt at coordingates is abandoned, and the world is represented as a dise[e] divided by a few partitions into continents, acroses which rivers and mountain ranges stray in wild disorder, There is no lack of these 'maps' or 'Mappaemundi', to use the medieval term[a], which may be found in numerous collections Their classification has been the subject of an interesting paper by M.C. Andrews.[c] The usual name for them is 'wheel-maps' or 'T-O maps'- the significance of the latter we shall see in a moment."

phei Hsiu (+267). the minister of works, gives particulars of map making in 35 thapter of chin shu preserves, and relates the following six principles observable.*

1. The graduated divisions (fĕn lü[2)], which are the means of determining the scale to which the map is to be drawn (so i pien kuang lun chih tu yeh[6]).[c]
2. The rectangular grid (chun wang[3)] (of parallel lines in two dimensions), which is the way of depicting the corret relations between the various parts of the map (so i chĕng pi tzhu chih thi yeh[7])[d].
3. Pacing out the sides of right angled triangles (tao li[8]), which is the way of fixing the lenghts of derived distances (i.e. the third side of the triangle which cannot be walked over) (so i ting so yu chih thu yeh[1]).[a]
4. (Measuring) the high and the low (kao hsia[2)].
5. Measuring right angles and acute angles (fang hsieh[3]).
6. (Measuring) curves and straight lines (yü chih[4]). These three principles are used according to the nature of the terrain, and are the means by which one reduces what are really plains and hills (lit. cliffs) to distances on a plane surface (so i chiao i hsien chih i yeh[5])

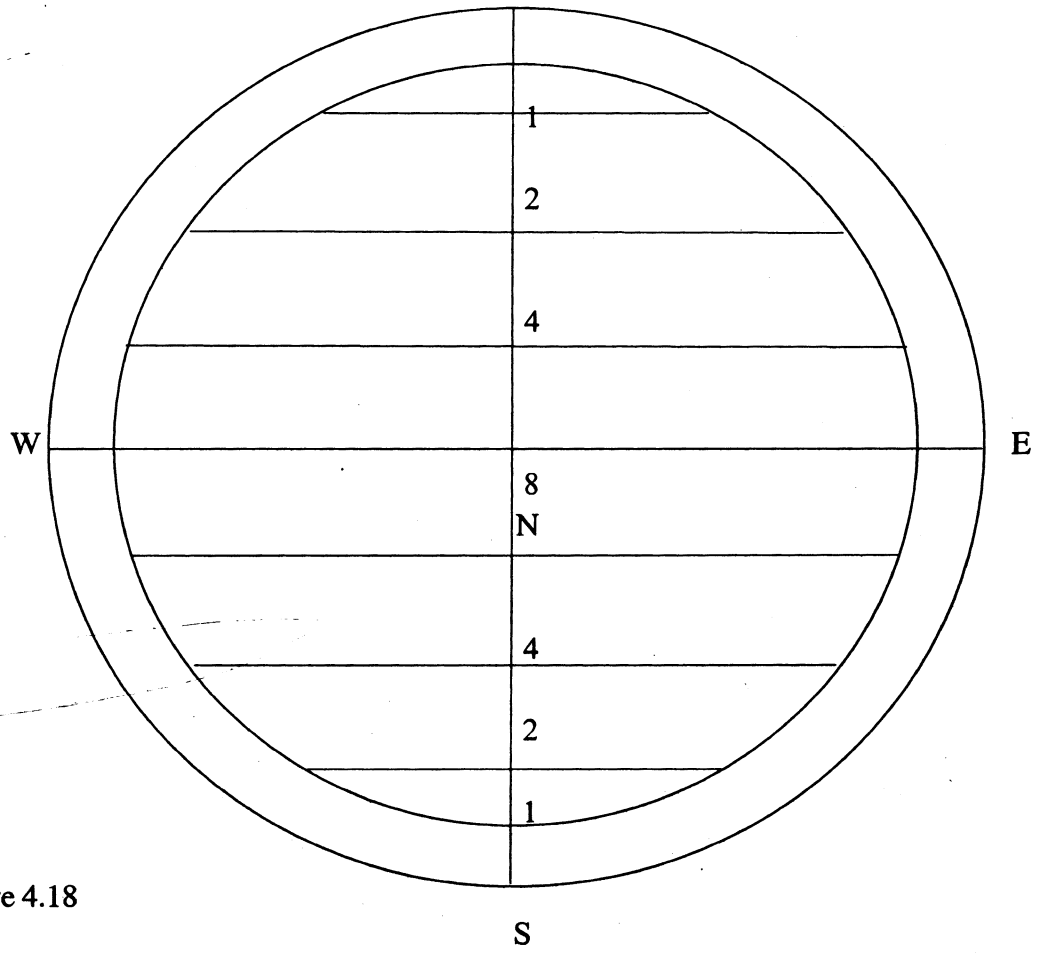


figure 4.18

The scheme of division is like this, as illustrated in the figure. Actually they are 1,2,4,8,16,32,64,32,16,8,4,2,1, totalling to 190 elements. Through such parallel regions, land and mountaneous, the earth or the Jambū island alongwith the upper and lower projections in the form of the circle for upper himisphere and the surrounding ring for the lower portion of the Jambū island.

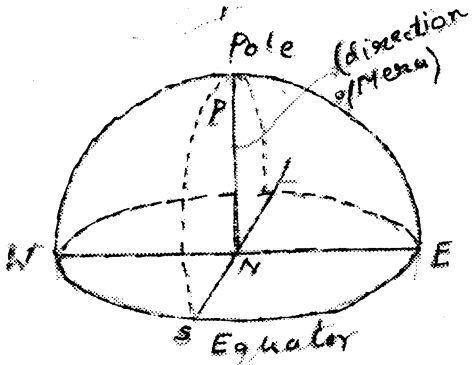


Figure - 4.19

Thus the dome projects as equator as circle, and semi circles, parallel to WPE great circle, 190 in number, define the regions as constituted through 1,2,4,8,16,32,64,32,16,8,4,2,1, as plane land and mountainous regions, the slices by vertical planes on surface being projected on the equatorial plane through parallel chords, keeping an exact symmetry in the WSE and WLE portions, as shown in figure 4.18.

It is evident that SL gives the diameter 8000 miles of the earth, or 12800 kilometers. The semi circle SPL measures $8000 \times \pi$ miles or $12800 \times \pi$ kilometers. The divisions give 190 elements as 180^0 in modern use of angles, from S to P and P to L. Perhaps use of 190 is connected with $\frac{19}{6}$ as the value of π. Thus the LWSE is the discoidal map of the projected Jambū island. The roots for π are deeper.

As will be noted, the tropic of cancer and tropic of capricorn could also be traced in this diagram, parallel to horizontal planes.These horizontal planes may range from Nto P, an earth's distance approximating to 4000 miles. The distance between the innermost and outermost orbit is given as 510 yojanas for the sun, between the topics as 48°, When 1° is taken as 69.9 miles, 510 yojanas is eual to 48 $\times$ 69.9 miles, giving 1 yojana such as this, as 6.6 miles roughly.

Note:- This was the quantitative mapping scheme. Everywhere the lakes are spotted for making the places of origin and sources of rivers, on mountains. An example may be cited about the source of the gangas in the lake at Himavan mountain, its length in different directions and ultimate entry into the sea, are all given in yojanas. On the scale as found above, their lengths the may be compared with the actual modern length.

from the scheme, and idea of India and other region may also be studied. The divisions, 6 mountains and 7 lands, appear to form a grid of zones.

One more finding of Needham and ling[#] may be noted as under, " The T-O map tradition did not die out till as late as the +11th century, as may be seen from a book such as the Variae Orbis Universi, by Petrus Bertius (+1628).[c] Before leaving it, however, a word may be said about certain aberrant representations in the accident. There was, for instance, the Christian Topography[d] written by Cosmas Indicopleustes between + 535 and +547. This was essentially a controversial work, intended to expose 'the wicked folly of the Greeks in Geography.[e] It therefore has importance in connection with the exact reasons why christian Europe, under the influence of the Fathers, threw away all the Hellenistic achievements in quantitative cartography.[a] The principal picture which cosmas gives of the universe has often been reproduced, but as we are here comparing accidental with oriental levels of attainment, we may not omit it (fig.218). There is Heaven with its walls and barrel vault. White below is the flat surface of Earth, with some schematic sea and land hard to interpret.[b] We are particularly to note, however, the high mountain in the north (or in the centre?) round which the sun is pictured both rising and setting, for

this was an idea well known and widespread in Asian thought and cosmas himself, as his cognomen indicated, had made the voyage to India, and perhaps to Ceylon.[c,,]

The Arabs also patrticipated in the tradition of religious cosmography, making their wheel maps centre on mecca ratter than on the Jerusalem, Mt meru or Mt khun-lun of other civilizations. This type of map is centred on the legendary mountain in central Asia or the north of Tibet, Mt khun-lun; west of which are unknown regions, while to the east, korea, chine, Indo-china and india form a series of promonatory continents extending into the eastern oceans. Around these outer seas there is a ring continent itself surrounded by further ocean. In Jaina cosmography, these lead to astronomical picture as well as the geographical quantitative maps. In Jambūdvīpa (oikoumene), centoring upon Mt meru, there are Uttarakuru in the north, Pūrvavideha in the east, Jambūdvīpa in the south and Aparagoyāna in the west, was the idea with the Buddhists Brahmaṇic tradition also has the ring-continent, modified by what were perhaps the echos of Greck climates * it is abvious that such maps point to an Indian origin of wheel maps, and may be that all wheel maps might have had a babylonian origin.

In Jaiṇa cosmography, however. such a Jambū island has two suns and two moons, out of which only one set is workable for the calender coustruction.

In our scheme of the map, the lower portion of the Jambū island has been shown as the projected portion of the Lavaṇa sea which we have seen to be a concentric ring of radius $\sqrt{2}$ 50000 yojanas, surrounding the radius of 50000 yojanas, the lower southern globe of the earth. If this was the true scheme with the school, the case of real and counter suns as well as real and counter moons will require further research over the research paper by Jain.* These points as well as the illuminated areas of the Jambū and Lavaṇa areas will be examined is the chaper on astronomy.

The dèscreption of the various regions is indetails of their contents, minerals, residents, structures artificial and natural, gardens, lakes, trees, altars, characteristics as Āryana and Barbarians regions, pleasure lands and so on. The rivers in main, alongwith their tributories have been shown flowing towards the lavaṇa sea.

The Lavaṇa sea is deseribed as having a shape produced due to placing of an inverted boat over another (TPT, V. 4.2399), and thus that sea is situated all around the sky in the shape of a circular arb (maṇḍala), The width of the sea in the upper layer is ten thousand yojanas and at the direction of Citrā earth, its width is two lac yojanas. The depth is 1000 yojanas. The increast-decrease is 190 yojanas.

Now in its very central portion, all around, there are one thousand eight under regions (pātālas), being the maximal, intermediate and minimal. (vide TPT, 4.2408 et seq.) In these under regions, there is only water in one third part of upper portion, there is only water and air in the middle portion, and there is only air in the one third lower portion. The water air middle portion movers or remains still due to the air in the lower one thired portion. (T.P.T, 4.2430). Their drape is also combination of two cones as follows:

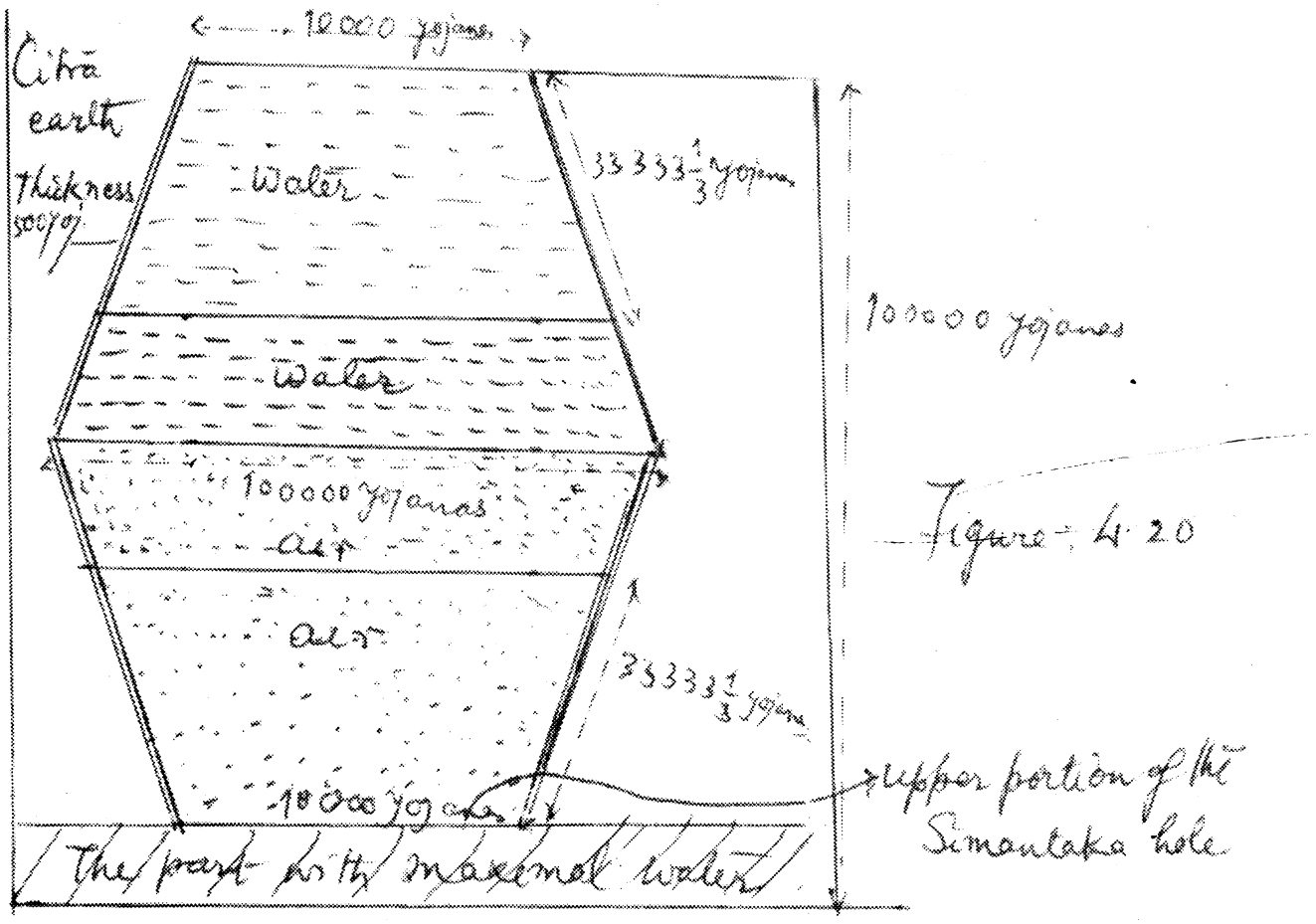


Figure - 4.20

The above is the diagram of a maximal under region. For figures in details, vide the mathematical. notes of the 4th chapter of TPT, earlier. The difference of intervals, their placing round about, in the Lavaṇa sea, has been given in symmetrical arrangements as has been the style throughout with quantitative description. Just like hot gases in the inteior of the earth's surface, move to produce earth quakes and volcanoes inthe weaker crust of the earth, so also here the air in the lower portion, first moves the middle portion of the underregion. This ultimately causes the increase-decrease in the level of waters of the Lavaṇa sea in the white and dark halves (pakṣa). The quantity of the increase in air on the fifteenth (full moon) of white half, everyday is given as two thousand two hundred twenty two yojanas and even greater. Thus due to this, in the under regions, on the full moon day, there is air in two third portion and water in the upper one third part.

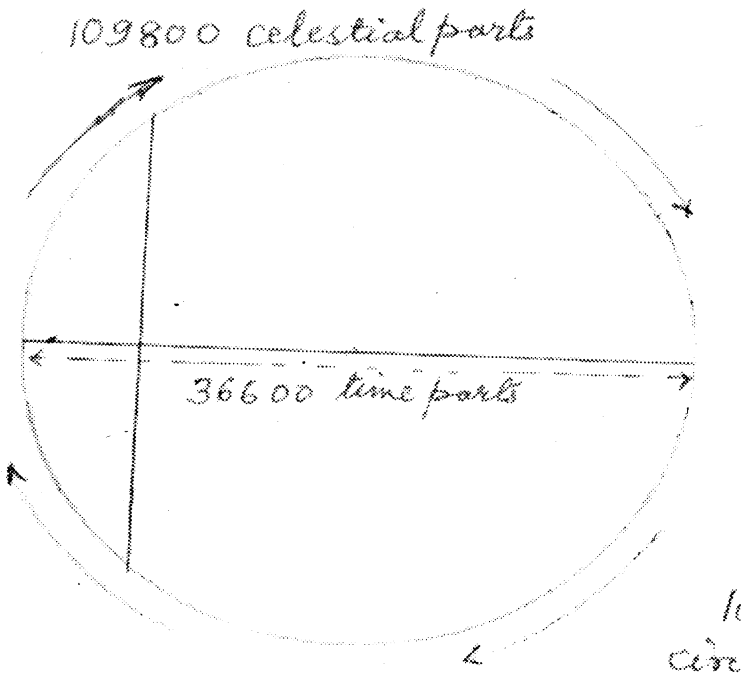
Thus the gravitational effects of the moon has been described in the manner of the under regions, consequent upon the air disturbances, mainly, due to the gradual changes in the phases of the moon.

The description and the setting of astronomical bodies, the mountains and rivers etc. have complicated types of symmetry in futher islands. The limit to the human reach upto half of the Puṣkara island has been put throught the Mānuṣottara mountain. The remaining descriptions about its regions, etc. is as usual.

APPENDIX 4

CHARTS BASED ON JAINA CALENDAR

INTRODUCTION



Like ptolemy who took 360:120 ratio for the table of chords, so also the Jaina calendar is constructed on the basis of 109800 celestial parts (for two suns, two moons, ie, the real sun and its counter etc.) and 366 days, and this is actually seen of we have a circle of 109800 celestial parts as circumference and is one third as diameter of 36600 time parts. A year of a yuga roughly consists of 366 days. Āryabhat took 3438 as parts of a radius, whereas we find here $\frac{109800}{32} = 3431.125$ or the diameter was taken to be 6876, whereas here $\frac{109800}{16} = 6862.25$. The convenience sought by the jain school may be examined by the ~~follo~~wing.

We have already shown that the calendar culd be prepared with one sun and is movement over the circle of half the parts or 54900 celestial parts. It seems that for correspondance of location of a constallation in day and night, the upper constellation and lower constellation were shown through the counter semi-circle, complating the double path in 109800 celestial parts (gaganakhaṇḍa).

CONJUCTION OF THE MOON WITH CONSTELLATIONS:

In a yuga, the moon conjuncts with a constellation 67 times, whereas the sun conjuncts with it 5 times. Hence, the constellation which conjuncts with a constellation for I muhūrtas and $\frac{27}{67}$ part of a

muhūrta is multiplied by 67, getting $9\frac{27}{67} \times 67 = 630$ muhūrtas. As the Ahorātri consists of 30 muhūrtas, getting $\frac{630}{30} = 21$ ahorātris, the period of total conjunction in a yuga the same constellation conjuncts 5 times with the sun, hence in a yuga the conjunction of the sun is $\frac{21}{5}$ ahorātras or 4 ahorātras and 6 muhūrtas. The constellations which conjunct with the moon for 15 muhūrtas, they conjunct for 15×67 = 1005 muhūrtas in a yuga. This period is equal to $\frac{1005}{30}$ or $33\frac{1}{2}$ ahorātris. They conjunct with the sun for the period $\frac{1005}{30 \times 5}$ or 6 ahorātras and 21 muhūrtas. The constellations which conjunct with the moon for 30 muhūrtas, they conjunct for $30 \times 67 = 2010$ muhūrtas in a yuga or $\frac{2010}{30}$ or 67 ahorātras. Similarly the sun will conjuct with constellations in a yuga for $\frac{67}{5}$ or 13 ahorātras and 12 muhūrtas. Furthēr the constellations which conjunct the moon for 45 muhūrtas, they conjunct with it for $45 \times 67 = 3015$ muhūrtas in a yuga, or $\frac{3015}{30}$ or $100\frac{1}{2}$ ahorātras. Whereas for the sun this period is $\frac{100\frac{1}{2}}{5}$ or 20 ahorātras and 3 muhūrtas. See thē chart ahead for details as below as well as above.

The region of the Abhijit and later aposterior portion of the Śravaṇa conjuncts with the moon in slightly more than 39 muhūrtas in the evening of the first day. this shows that the yuga begins with the morning. From this instant and point, the conjunction with the Abhijit constellation starts. It conjuncts with the moon for $9 + \frac{24}{61} + \frac{39}{61 \times 67}$ muhūrtas. It is equiregional (sama-kṣetrī) with śravaṇa constellation for $\frac{21}{61 \times 67}$ portion. After the Abhijit constellation, the conjunction with the śravaṇa of the moon is for 30 muhūrtas. The conjunction of both is with the moon in the region from south to west. Although Abhijit conjunction starts in the morning, but being equiregional with $\frac{21}{61 \times 67}$ portion of śravaṇa, it has been taken in the posterior part. Both the constellation remain with the moon for a night in excess of a day, or the yuga ends at $9 + \frac{24}{61} + \frac{39}{61 \times 67}$ portion of the next, śravaṇa, on the next day.

From there, the moon (disconjuncts) disjuncts from that constellation, and on the second day of the yuga there is its conjunction with the Dhaniṣṭhā at the evening after $9 + \frac{24}{61} + \frac{39}{61 \times 67}$ muhūrtas. Thus

in the next day, the remaining muhūrtas are $8+\frac{32}{61}+\frac{28}{61\times 67}$ muhūrtas. At its first instant, from the evening, the Dhaniṣṭhā constellation conjuncts for 30 muhūrtas. After conjunction, it completes the conjunction on the third day of yuga during the $9+\frac{24}{61}+\frac{39}{61\times 67}$ muhūrtas, and then there remain $8+\frac{30}{61}+\frac{28}{61\times 67}$ muhūrtas of the day. At is 1st instant from the evening, the moon gets into the śatbhiṣā. This constellation conjuncts for 15 muhūrtas at night, ending its conjunction with the moon for $6+\frac{30}{61}+\frac{39}{61\times 67}$ muhūrtas in the night of the 3rd day. The remaining portion of the night is $5+\frac{36}{61}+\frac{39}{61\times 67}$ muhūrtas. From that point at the first instant, the pūrvābhādrapada constellation conjuncts with the moon for 30 muhūrtas in the direction of the East-South. Here the constellation remains in conjunction during the remaining night of the 3rd day. The fourth day and upto $6+\frac{32}{61}+\frac{39}{61\times 67}$ muhūrtas for the night of the 4th day. For the remaining period $5+\frac{36}{61}+\frac{39}{61\times 67}$ muhūrtas of the night, at whose first without the moon conjuncts with the uttarābhādrapada constellation which is of 45 muhūrtas. This conjunction is for the period from the remaining night, fifth day and night, and for $9+\frac{24}{61}+\frac{39}{61\times 67}$ muhūrtas of the 6th day of the yuga. Then the moon conjuncts with Revatī constellation which is a posterior portion of 30 muhūrtas. At the lapse of $9+\frac{24}{61}+\frac{39}{61\times 67}$ muhūrtas of the sixth day of the yuga, at the next instant is the conjunction which lasts for 1 night, 1day, and $9+\frac{24}{61}+\frac{39}{61\times 67}$ muhūrtas of the 7th day of the yuga. Then the conjunction of the moon starts with Aśvinī constellation, and similar phenoment may be calculated for the remaining constellations.

The method of finding out the constellation corresponding to a Parva a Tithi has been discussed in the research paper.

DURATION OF THE MONTHS

Constellation- Month: In a yuga there are 67 constellation-months. A yuga consists of 1830 days which is divided by 67 or moon's month, getting 1 month of 27 days $9\frac{27}{67}$ muhūrtas. On multiplying this by 30 muhūrtas, one gets $819\frac{27}{67}$ muhūrtas as the duration of constellation-months.

*Cf.KKD, appendix VI, pp. 176-221.

Solar-Month: In a yuga therē are 60 solar months and 1830 days. On dividing this by 60, a month is found to be of $30\frac{1}{2}$ days. On multiplying this by 30 muhūrtas, the duration of the solar month is of $30 \times 30\frac{1}{2}$ or of 915 muhūrtas.

Lunar Month: There are 62 lunar months in a lunar-year, having 1830 days. On dividing this by 62, therē are $29\frac{1}{2}$ day-nights in a month as well as $\frac{1}{62}$ part. On multiplying this by 30 muhūrtas, one gets $885\frac{30}{62}$ muhūrtas in a lunar month.

Season-Month: There are 30 season-months in a yuga, and 1830 days. On dividing 1830 by 30, a season contains 60 day-nights. On multplying this by 30 muhūrtas one gets 1800 muhūrtas in a season-month.

Thus the Jaina calendar could be constructed for various astral events, where the diameter represents the gadual movement in muhūrtas, days, years etc. and the circumference locates the constellations, sun and moon through celestial parts. This correspondance is 1:3, as taken up by Ptōlemy, with various types of intervals in celestial parts as well as the time taken in muhūrtas by the moving astral bodies. These give the correspondence between the arcs and the parts of the diameter, or chords, or jyā etc. We have taken here 3 as a rough approximation for π, which could be takeñ much finer, as $\sqrt{10}$ or $\frac{355}{116}$. Āryabhaṭa adopts 360° for the circumference, and takes the radius as 3438. It is evident than this type of relation, both in ptolemy and Āryabhaṭa, is between angular coordinats and chords, which have the significane of time in the Jaina works..*

TABLE FOR FIVE YEAR YUGA FOR PARVA, TITHI, IN TERMS OF CONSTELLATION

INTRODUCTION-

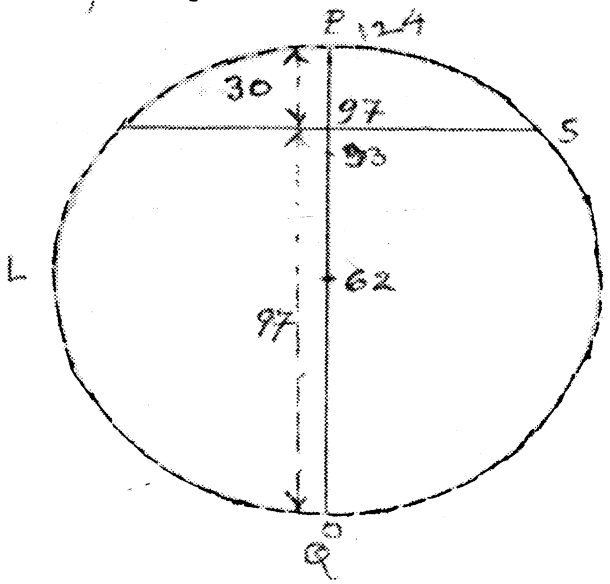
This topic has been detailed in the research paper

It is meant for locating the moon when it conjuncts on first moon and other phenomena. It complete the 44th amāvasyā (conjunction day of the sun and the moon) in two Abhijit constellatio yugas. This is so when 6 muhūrtas and $\frac{37}{62} + \frac{47}{62 \times 67}$ muhūrta have lapsed of the Abhijit. In a yuga there are 62 full moon or pūrṇimas and 62 amāvasyās.

We note the portion of a particular orbit (maṇḍla) at which the moon completes the 62nd full moon of the yuga. From the location of that full moon, the moon completes the first full moon of lunar-yuga, while traversing 32 parts out of 124 parts of an orbit, in order. There alone, the moon completes second full-moon (pūrṇimā) at the 64th part. In the portion, where the moon conjuncts the second full moon, from that place. one orbit may be divided as 32 out of 124 parts, in order, and there itself the moon completes the third full-moon. from this location of their pūrṇimā, again the orbit may be divided into 124 parts, and take 288 parts in order, there the 12th pūrṇimā completes. The 12th pūrṇimā is 9th in order from the 3rd pūrṇimās. Thus ther are $32 \times 9 = 288$ parts. For 30 pūrṇimā, adding 96 parts, this becomes 324 parts, and on dividing in by 124, there are the quotient and remainder as 3 orbits and 12 parts. Here the moon conjuncts with completion of 12th pūrṇimā, The process is similar for all the orbits at is 32nd part.

Thus the moon complete the 62nd pūrṇimā as follows: The east-west length of the Jambū island and the north-south tongue are used to divide it into 124 parts. The southern orbital's one fourth part is

taken, where 27 parts are completed and the 28th part is taken. This is divided into 20 parts and 18 parts out of these are taken. Then the 19th portion is divided into 3 parts and 2 parts are taken. In the west, at the lapse of 3 parts of the 124th part, and 20 or one part and 3rd part of the one part remaining, at the mid of this location, the moon completes the 62nd pūrṇimā. In a yuga the moon traverses 1768 half-orbits and 2 moons complete 884 full-orbits.



The adjoining figure is meant to explain that 366 was a rough approximation for the langth of a year in the Jaina school. It is mentioned in the Gaṇitānuyoga, "The land in which the sun is in yoga on the last 62nd amāvasyā, from that location, on reaching the 94th part of 124 parts of the orbit, the sun is in yoga on the first amāvasyā". Similarly, in the five year yuga is in yoga on the first pūrṇimā, "The land in which the sun is in yoga on the last 62nd pūrṇimā, from that pūrṇimā station, on reaching the 94th part of 124 parts of the total orbit. In the above orbit, OLP is 54900 parts as celstial parts.

Thus Q and P, actually denote the same position of the sun. Hence the position of S from P being 30 parts, the hours passed after the 365th day of the year is $\frac{30\times24}{124}$ = 5.81 hours or 5 hours 48 minuts and 23 seconds.

The modern value for the year is 365 days, 48 minutēs and 45.98 seconds (tropical). The Jainas thus had a good approximation to the length of the tropical year.

The location at which the sun conjuncts the pūrṇimā of the last 62nd number, from that point, 94 parts out of 124 parts are taken in sequence. The second pūrṇimā then starts and from the letter point, again the orbit is divided into 124 parts and 94 parts are taken in sequence. Here the sun completes the 2nd pūrṇimā conjunction. Similarly, for getting the location on the orbit for the 12th pūrṇimā, at the location of the completion of the 3rd pūrṇimā, one orbit of that point is divided into 124 parts, and the 846th part point be taken in sequence. This is obtained as $94 \times 9 = 846$. This process is thus continued for every point of the completion of the pūrṇimā. Now in order to get the 62nd pūrṇimā location, the east-west length of Jambū island or north-south tongue divides the orbit into 124 parts. In thē eastern trend, from the 4th part of the orbit, 31 parts are taken, out of which 27th part is taken. Then the 28th part is divided into 20 out of which 18 parts and two subparts are taken, and the 3rd part remains. The 124th and 1 part out of 20, and one subpart remains. At this point the sun completes the last 62nd pūrṇimā. One sun completes 1830 half-orbits and 2 suns complete 915 full orbits.

Similar description may be given for the amāvasyās of the sun and the moon. Division into 124 parts is important to note for the history of astronomy. The remaining description may be seen in to research paper, for parva and tithi calculations.

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FOR THE SUNS SOLSTICES (AYANAS)

Solstice	Parva	Tithi
1	0	1
2	12	7
3	24	13
4	37	4
5	49	10
6	62	1
7	74	7
8	76	73
9	98	43
10	111	10

MOVEMENT OF THE ASTRAL SUN MOON AND CONSTELLATION

ASTRAL BODY	MOVEMENT OUT OF 100800 IN A MUHŪRTA	HOW MANY ORBITS COMPILED IN A YUGA	HOW MANY MAṆḌ. COMPILED IN A YUGA	HOW MUCH TIME NEEDED FOR TWO HALF OR ONE FULL ORBIT		
				DAYS	MU	PART OF MUHŪRTA
MOON	1768	884	1768	2	2	23/221
SUN	1830	915	1830	2	0	0
CONSTELLATION	1835	$917\frac{1}{2}$	1835	1	29	307/367

FREQUENCY OF SOLSTICES

FREQUENCY	TITHI	LUNAR CONSTELLATION	REMAINDER			SOLAR CONSTELLATION	REMAINDER WITH MOON			REMAINDER WITH SUN MUHURTA
			Muhūrta	62nd part	67th part		Muhūrta	62nd part	67th part	
1	Śrāvaṇa D-1	Abhijit	9	24	66	Puṣya	19	43	33	264
2	Māgha D-7	Hasta	5	50	60	Abhijit	9	24	66	126
3	Śrāvaṇa D-13	Mṛgaśira	11	39	53	Puṣya	19	43	33	264
4	Māgha W-4	Śatbhiṣā	2	28	46	Abhijit	9	24	66	126
5	Śrāvaṇa W-10	Viśākhā	13	50	40	Puṣya	19	43	33	264
6	Māgha D-1	Puṣya	19	43	33	Abhijit	9	24	66	126
7	Śrāvaṇa D-7	Revatī	25	32	26	Puṣya	19	43	33	264
8	Māgha D-13	Mūla	6	58	20	Abhijit	9	24	66	126
9	Śrāvaṇa W-4	Pūrvāphālgunī	12	47	13	Puṣya	19	43	33	264
10	Māgha W-10	Kṛtikā	18	36	6	Abhijit	9	24	66	126

NOTE.1. D for dark half , W for white half .

2. Fivefrequencies are of Southern solstice with Puṣya constellation and five are of Northern solstice with Abhijit.

Cf. CPJ, pp. 536-556 sūtra 12.5

MAURYA EMPEROR CANDRAGUPTA

[ON THE DATE OF RENUNCIATION (JINA INITIATION) AND HIS CONTRIBUTION TO THE INVENTION (ORIGINATION) OF THE *BRĀHMĪ* AND *SUNDARĪ* SCRIPTS IN INDIA]

ABSTRACT

This paper discusses various opinions of various historians about the possibility of the origination of the *Brāhmī* and *Kharoṣṭhī* (*Sundarī*?) scripts in India. The authors, however, base this opinion on the facts found in the use of mathematical symbolism in the so called, Digambara Jaina *Āgama* texts, the *Chakkhaṇḍāgama* and the *Kasāya Pāhuḍa* Prakrit texts as well as their relevant commentaries and summary texts with mathematico-symbolic commentaries. All this is related to the period of renunciation of Mauryana Emperor, Candragupta and his preceptor, Ācārya Bhadrabāhu, residing at Śravaṇabelagola for twelve years in isolation away from the Muni Saṁgha.

INTRODUCTION

The chronology and the invention of the *Brāhmī* and *Sundarī* scripts has relevance in so far as the following verse 4.1481 of the *Tiloyapaṇṇattī* (TPT) is concerned,

" mauḍadharesuṁ carimo jiṇadikkhaṁ dharadi Candogutto ya /
tatto mauḍadharā du ppavvajjaṁ ṇeva geṇhaṁli //4.1481// "

Translation: Candragupta, the last among the crowned, took Jina initiation. After this, the crowned do not take to renunciation. //4.1481//

Candragupta was contemporary of the fifth "*Caudaha Pūrvī*, Ācārya Bhadrabāhu, who was also called the last heard-knowledge-omniscient (*śrutakevalī*). Candragupta was called Prabhācandrācārya or *"Dasa Pūrvī"*. The approximate date of his Jina initiation event may be taken to be (100-12) years or 88 years over 62 years after *Vīra nirvāṇa*.[1] Thus, if *Vīra nirvāṇa* is taken to be 470 B.C., the date of *Jina* initiation of Candragupta is found to be (470-150) 320 B.C. This, however, approximates to the date of crowning of Candragupta: 321 B.C. and his reign continued upto 297 B.C., he remained king emperor for 24 years. This difference of 24 years is important to note. However, R. Singh places in his work[1] that Candragupa migrated to Mysore in 299 B.C.

We begin with certain remarks of P. B. Desai, regarding Candragupta Maurya[3] :

1. "Śrī Śaila on the bank of the Krishna in the Kurnool District has been claimed as a Jaina resort in the story. This probably furnishes one more indication for this early chronological limit. The Mauryan king Chandragupta whose later affiliation with the Jain creed is well known and has been connected with this place by a tradition which averses to the existence of a town named Chandraguptapatnam in the vicinity across the river. (An. Rep. on S.I. Epigraphy, 1915, p. 91; Madras Archaeological Report, 1917-18, p. 22)"
2. "Āgupatāyika Era, I think, has something to do with the Sātavāhanas whose early partiality for the Jaina creed has been celebrated in the Jaina legend and literature. But the foundation of the Sātavāhana power is still an unsettled problem of Indian History. According to the old view it was somewhere between 220 and 211 B.C., Dr. K. Gopalachari, who has discussed the starting point of the Sātavāhana rule in his early History of Andhra Country (pp. 28 ff), shifts its date to 234 B.C. This date would probably suit the calculation of the years specified in the present record. If so, we shall have to refer the name Gupta in the expression to Candragupta Maurya and the expression Āguptāyika kings to the Sātavāhanas who were the successors of the Maurya in the political sense."
3. "Jainism too, alongwith Buddhism, must have wended its way to this attractive place (Kopbal or Konkinapulo) from the early centuries before the Christian era, though no direct evidence is available on the point. Still, the early penetration of the Jaina creed in the 3rd century B.C. further south as far as Śravaṇa Belagola in the Kannaḍa country as attested by Bhadrabāhu-Candragupta tradition, the early

age attributed to Konḍakunda and other teachers who championed the cause of the faith in the South, and the patronage and support conferred upon it by the early rulers of the Gaṅga and Kadamba families of Karnāṭaka, are the pointers that squarely justify the above assumption. The earliest epigraphical record that testifies to the eminence of Śravaṇa Belgola as a Jaina holy place is approximately assigned to the 7th century A.D."

We now have a reference to Epigraphica Carnatica, Mysore, 1973.

The identification of Bhadrabāhu, *śrutakevalī* and Prabhācandra, his, disciple, the Maurya emperor, Candragupta, at Śravaṇabelgola, has been discussed by many scholars, but the following scholars seem to have reached the justifiable results based on the epigraphic records and *Digambara* Jaina tradition which the earliest records of a mathematical karma theory in symbolic details:

1. The earliest record at Chikka Betta is the inscription of the 6th-7th century characters. It records the death by *Samādhi* of Prabhācandra, a Jaina saint. It also mentions that seven hundred *rishis*, in course of time, followed the example of Prabhācandra. The earlier part of the record refers to the migration of the Jainas from the North to the South when Bhadrabāhu swāmī, an ascetic belonging to a lineage of illustrious men like Gautama *gaṇadhara* and others named, foretold at Ujjayani of calamity of 12 years befalling on the country.[4]

We have reference to *Brāhmī* and *Sundarī* scripts[5], which revolutionized the trends and tendencies in India. Who were their inventors, the genius communion in isolation, for twelve years at Chikka Betta? The inscription[1(1)*] at Chikka Betta needs reproduced here, which is on rock to the right of Pārśvanātha basadi: "Success! Be it well. Victory has been achieved by the venerable Vardhamāna, the establisher of the glorious holy faith and the embodiment of the nector of happiness resulting from the perfection attained; the singular power of whose *range of knowledge* pervades things movable or immovable, having their support in both the universe and the non-universe; who has acquired supreme honour in the world by his inconceivable greatness and has attained the great position of an *Arhat* by the abundance of his religious merit which procured for him the name *Tīrthakṛt* (or, *Tīrthaṅkara*). And after him, victorious today in holy Viśāla is his doctrine, beneficial to the world, guideless and refuting hostile creeds."

"Now indeed, the sun Mahāvīra- who had risen to elevate the whole world, his virtues which caused the blooming of his lotuses, the blessed people, nourished in the lake of supreme Jaina doctrine which was an abode of pre-eminent virtues and who has shown with a thousand brilliant rays- had completely set, Bhadrabāhu svāmī, of a lineage rendered illustrious by a succession of great men who came in regular descent from the venerable supreme ṛṣi Gautama Gaṇadhara, his immediate disciple, Lohārya, Jambū, Viṣṇudeva, Aparājita, Govardhana, Bhadrabāhu, Viśākha, Proṣṭhila, Kṛttikārya, Jayanāma, Siddhārtha, Dhṛtiṣeṇa, Buddhila and other teachers, who was acquainted with the true nature of the eight-fold great omens and was a seer of the past, the present and the future, having learnt from an omen and foretold in Ujjayini a calamity lasting for a period of twelve years, the entire *saṁgha* (or, community) set out from the North to the South and reached by degrees a country consisting of many hundreds of *villages and filled with happy people, wealth, gold, grain and herd of cows, buffaloes, goats and sheep."*

"Then, separating himself from the *saṁgha*, an *Ācārya* Prabhācandra[6] by name, perceiving that but little time remained for him to live and desiring to accomplish *samādhi*, the goal of penance associated with right conduct, on this high peaked mountain which forms an ornament to the earth and bears the name Kaṭavapra, with rocks dark as a mass of great water-laden crowds and variegated with the embellishment of masses of flowers and fruits of very choice trees, and with extensive lowlands, valleys, ravines, great caverns and inaccessible places, filled with herds of boars, panthers, tigers, bears, hyenas, snakes and deer, bade farewell to, and dismissed the *saṁgha* in its entirety, and, in company with a single disciple, mortifying his body on the wide expanse of the cold rocks, accomplished (samādhi)."

"And in course of time, seven hundred *ṛṣi* or saints (similarly) accomplished (*samādhi*)." "Victorious be the doctrine of the Jina!" It is widely current the Jaina traditional accounts and literature that both Bhadrabāhu and Candragupta migrated to the South, No. 251 inscription, belonging to the 11th century,

states that Jinabhadra bowed to the feet of Bhadrabāhusvāmī. This is engraved on a rock in the Bhadrabāhu cave. On a pillar in the Siddhārā basadi in the Doḍḍa beṭṭa is found a record dated 1432 A.D. (No. 364) wherein śrutakevalī Bhadrabāhu and his disciple Candragupta are mentioned. Bhadrabāhu and Candragupta are also referred to in Nos. 77 and 71 dated 1129 and 1163 A.D. In number 71, Bhadrabāhu is described as śrutakevalī. Both of them refer to Candragupta as his disciple.

In the two records (c. 900 A.D.) found in the Śrīraṅgapaṭṭana Taluk it is stated that Kalbappu is blessed with the imprints of the feet of Bhadrabāhu and Candragupta. (Vide E.C., vol. iii, Sr. 147, 148). In the inscription no. 24 (c.7th century) at Śravaṇa Belagola, in Chikka Beṭṭa, both Bhadrabāhu and Candragupta have been named, saying that the *dharma* that had been consolidated by them, viz., the Jaina *dharma, was* later strengthened by Śāntisena-muni when it showed signs of weakness.

All the above show that Bhadrabāhu and Candragupta had lived in the cave on the Chikka Beṭṭa at Śravaṇa Belgola and gave up their lives there itself, had taken deep roots even as early as the 7th century A.D. Prabhāchandra, the disciple was the name taken by Chandragupta at the time of initiation[7]. Although inscription No. 1 is not clear on this point, the others from Śriraṅgapaṭṭana and Śravaṇa Belgola do indicate that this Bhadrabāhu was the *śrutakevalī* and this is more acceptable. Candragupta that came to the South may as well be his namesake, the Mauryan emperor.[8]

THE POSSIBILITY OF INVENTION OF *BRĀHMĪ* AND *SUNDARĪ*

On this topic we shall discuss the possibility of the invention of the well known *Brāhmī* and the *Sundarī* (written in the style of *Kharoṣṭhī*) scripts by the attempts of the Mauryana emperor Candragupta initiated as Prabhācandrācārya under his initiator *Ācārya* Bhadrabāhu.

A publication[9], "The Origin of *Brāhmī* Script" has appeared in which the fiercely controversial topic on the origin of Brāhmī script has been again discussed by S. R. Goyal and K. V. Saundara Rajan. These are two key papers. Goyal is regarded as one of the most ebullient young historians and the latter is an eminent field-archeologist and culture-scholar. The articles give a deeper insight and thought towards the origination of *Brāhmī* script. One gets a trace of the invention at the Śravaṇabelagola, Candragiri, where the mysterious stay of Bhadrabāhu, (*caudahapūrvī, śrutakevalī*) and Candragupta (Prabhācandra, *dasapūrvī*) for twelve years in isolation from his *saṁgha* is recorded, where he had asked his *saṁgha* to migrate to still deeper into the South India.

With the discovery of the script of the Indus civilization. The question posed at present is whether the Aryans who composed the vast literature were utterly illiterate or they knew some sort of writing and if the answer to this query is in the affirmative, what that script was, whether it was an earlier form of *Brāhmī* or something else? For this problem, S. R. Goyal adopts a new method and approach based on the following important key-points:

1. Absence of Written Documents in the pre-Aśokan Times
2. Testimony of Megasthenese

Goyal then surveys the current theories and also proves the absence of regional variations in the Aśokan script and its implication. He also finds that the Aśokan *Brāhmī* is an invention of the Grammarians, he also proves that *Brāhmī* was not derived from the Indus script. He does not agree with the assertion that *Brāhmī* was the result of an invention usually ascribed to Brahma.

On the basis of assertions of Goyal it appears that the invention must have been made by the team of ascetics who were in dire necessity of finding written expressions to their new philosophy which they had accomplished not only in words but also in the *artha* or mathematical measures (norms or gauges). Actually, the mathematical Jaina theory of *Karma* was in the South India which found its expression in the *Ṣaṭkhaṇḍāgama* and the *Kasāya Pāhuḍa Sutta* (*Kaṣāya Prābhṛta*) which were commented upon in thousands of pages (the *Dhavalā*, the *Jayadhavalā* etc.) by the later *Digambara* Jaina ascetics, condensed in the form of the *Gommaṭasāra* and the *Labdhisāra*[10], and again commented upon with extensive

mathematical symbolism in the Karnāṭaka *Vṛtti*, a Sanskrit commentary and the *Samyakjñānacandrikā* commentary. Herein we find not only the evolved *Brāhmī* but also the evolved *Sundarī* in form of *artha saṁdṛṣṭi* (norm symbolism), *aṅka saṁdṛṣṭi* (numeral symbolism) and *ākāra saṁdṛṣṭi* (geometric symbolism).[11]

The work started with Bhadrabāhu and Candragupta team, thus continued upto Ṭoḍaramala[12], (from the 4th century B. C. to the 18th century A.D.). In his 53-page article, in the monograph, Goyal has given a proper clue into the origin of the invention of the *Brāhmī* script in the South India. He finds that the entire evidence at our disposal leads us to two inescapable conclusions. Firstly, the *Brāhmī* script was invented sometime in the first half of the third century B.C., likely in the reign of Aśoka, the grand son of Candragupta, already referred to as the disciple of Ācārya Bhadrabāhu (of the *Digambara* Jaina school). Secondly, the Indians, barring the people of the North-West, did not have any written letters. before the time of Aśoka.

The *Sundarī* has not been mentioned in the following names of scripts in Śvetāmbara's, "*Samavāyāṅga Sūtra*":

1. Brāhmī, 2. Javaṇāliyā, 3. Dosāūriyā, 4. Kharoṣṭhikā, 5. Kharasāviyā, 6. Pahārāiyā, 7. Uccattariyā, 8. Akkharamuṭṭhiyā, 9. Bhogavaiyā, 10. Veṇatiyā, 11. Ninhaiyā, 12. Aṅka lipi, 13. Gaṇita lipi. 14. Gandharva lipi. 15. Bhūta lipi, 16. Ādarśa lipi, 17. Māheśvarī lipi, 18. Dāminī lipi. 19. Belindi (Polidi) lipi.

These are later developments, showing the date of writing of the *Samavāyāṅga Sūtra*. Experiments and application of have been in the 3rd century B.C. in the inscriptions of Aśoka, and later upto second-third centuries A.D. in the Punjab and North-West frontiers, upto Chinese Turkistan. It was usually written from right to left as against *Brāhmī* which was written from left to right.

Remarks of H. L. Jain about the above scripts may be summarised as follows:[13]

1. Regarding the *Brāhmī* script origination, it has been stated in the Jaina *Āgamas* and *Purāṇas* that its invention was made by the ford founder Ṛṣabhanātha who taught his daughter a language script being written from left to right, who was called *Brāhmī*, hence the script came to be known as *Brāhmī*, similarly about the *Sundarī* daughter who was taught gaṇita to be written from right to left.
2. In the *Samavāyāṅga sūtra* 46 generator (*mātṛkā*) alphabets (vowels and consonants) of the *Brāhmī* script have been mentioned.
3. In the *Bhagavatiī* (*Viyāhapaṇṇattī*) sūtra, at the beginning ,"*Namo Bambhīe livie | Namo "Śuyassa"* has appeared alongwith the *Pañca Namaskāra Mantra.*
4. Possibly, *Javaṇāliyā* meant Greek script.
5. *Muṣṭikā* script is of *Sābhāsā* and *Nirābhāsā* types, whose implication might be to indicate word through an alphabet and to indicate word through finger etc.
6. *Aṅka lipi* may denote the number 1, 2, 3, etc.
7. *Gaṇita lipi* may signify calculation operators +, -, ÷ and ×.
8. *Gandharva lipi* may indicate the notes symbols for music.
9. *Ādarśa* may denote as reflected in a mirror with lateral inversion.
10. *Bhūta lipi* may denote that of Tibet (*Bhota*), *Māheśvarī* that of Maheśvara, *Dāminī* that of Dravida, *Bhogavaiyā* that of Bhogavati (Nāgās).

One more list is from the *Āvaśyaka sūtra* commentary:

1. Haṁsa lipi, 2. Bhūta lipi, 3. Yakṣa lipi, 4. Rākṣasa lipi, 5. Ode (Orissa) lipi, 6. Yavanī, 7. Turuṣkī, 8. Kīrī, 9. Drāviḍī, 10. Saindhvī, 11. Mālavinī, 12. Naḍī, 13. Nāgarī, 14. Lāṭī, 15. Pārasī, 16. Animitti, 17. Cāṇakyī and 18. Mūla devī.

The remarks of H. L. Jain about the above list are:

1. The *Bhūta lipi*, *Yavanī* and the *Drāviḍī* are the same as in the *Samavāyāṅga*. The remaining may be belonging to various communities and country.
2. First four scripts seem to be those of various Non-Āryans.

3. From *Oḍa* to *Pārasī*, 11 scripts belong to the lands.
4. *Cāṇakyī* and *Mūla devī* tradition continued for a long time, Gūḍa lekhya, Animithi, might be Aṅka lipi,
5. *Kauṭilīya* and *Mūla devī* may be generated through mutual *vyatyaya* of their classes.

However, far earlier than the above lists, we find that Puṣpadanta and Bhūtabali (the compiler of the *Ṣaṭkhaṇḍāgama*) were given certain words to enchant as a test of their scholarship. When they experimented, two deities, the *Hīnākṣarī* (with less letters) and the *Ghanākṣarī* (with more letters), appeared, showing two types of scripts, or learnings in two types of scripts.[14]

The preceptor who tested them was Dharasenācārya (c. 1st century A.D. or even earlier) who is said to have obtained this enchant-learning from the Kūṣmāṇḍinī great deity, the patron deity at Candragiri, Sravaṇabelagola, the place of 12 years of austerities of Bhadrabāhu and Prabhacandra (initiated Mauryana emperor Candragupta). Kūṣmāṇḍinī is the *Yakṣiṇī* of the ford-founder, Lord Neminātha, and she gives a connecting link between the Candragiri Śravaṇabelagola story of Bhadrabāhu and Candragupta with the Girinagara story of Puṣpadanta and Bhūtabali at the Moon cave of Girinagara (the accomplishment abode of Lord Neminātha) in Gujarat. The tradition continues till the time of Nemicandra Siddhāntacakravartī (the author of The *Gommaṭasāra* and the *Labdhisāra* at Śravaṇabelgola again, alongwith Cāmuṇḍarāi, the prime minister and commander in chief of the Gaṅga dynasty, erecting the 58 feet high statue of Bāhubali, the younger son of Ṛṣabhanātha, the brother of *Sundarī*. These texts were commented upon by Cāmuṇḍarāi, Mādhavacandra Traividya and two centuries later by Keśava varṇī in Kannaḍa, round about the same land. That is why, these facts lead on to the truth of invention and origination of *Brāhmī* and *Sundarī* by *Bhadrabāhu* and *Prabhacandra* in the 4th century B.C.

Looking into the vast expanse of symbolic mathematics of the *Karma* theory and beyond, the scripts as *Hīnākṣarī* and *Ghanākṣarī* appear to be *Sundarī* and *Brāhmī* scripts. These works are further commented in brief by Muni Nemicandra (c. 16th century A.D.) in Sanskrit and then by Ṭoḍaramala of Jaipur (c. 18th century A.D.) in *Ḍhūṇḍhārī*. Ṭoḍaramala separated the whole symbolic portion in the earlier commentaries into the language commentary on the one hand and *Artha saṁdṛṣṭi* chapter on the other. The untraceable earlier commentaries are said to be written as "*Uccārṇāvṛtti* by Bappadeva", Śāmakuṇḍa's *Paddhati* commentary, and *Cūḍamaṇi vyākhyā* by Tumbulūrācārya.

A. H. Dani has proved that the invention of *Brāhmī* is earlier than that of the *Kharoṣṭhī*[15] "The first important issue is about the origin of the Indian alphabet. *Brāhmī* certainly has the precedence. My new study on Taxila has convinced me that *Brāhmī* was not a stranger in this part. Right from the time it appeared on the local coins in the second century B.C., it continued to be used though occasionally. *Kharoṣṭhī* was evolved for foreigner's on Indian phonetic system, the roots of which lay in *Brāhmī*."

Dani regards the writing concept as a part of culture! Was it the culture evolved by Bhadrabāhu and Prabhācandra (Candragupta)? He further opines that the system is different from that of semitic. Hence the origin of *Brāhmī* should look elsewhere. Traditions and techniques are necessary for finding out the development of the script signs in India. Various styles of writing define those specific cultures and their periods. The symbols may not be given importance for formal comparison. The symbol's total number may be reckoned for comparison. Unity is to be searched out through outer forms and technical analysis as well as base of phonology for the relations and mutual connection between alphabets. It is also not possible to find the date of the inscriptions through ancient script.

In the *Gommaṭasāra*[16] there are 33 consonants given by k, kh, g, gh, ṅ; c, ch, j, jh, ñ; ṭ, ṭh, ḍ, ḍh, ṇ; t, th, d, dh, n, p, ph, b, bh, m; y. r, l, v, ś, ṣ, s, h. The vowels have one, two and three metres: a, i, u, ṛ, ḷ, e, ai o, au are the 9 which are further subdivided as short (*hṛsva*), long (*dīrgha*) and lengthened 9 (*pluta*), getting 27 varieties follow: a, ā, ā3; i, ī, ī3; u, ū, ū3; ṛ, ṝ, ṝ3; ḷ, ḷ, ḷ3; e, ē, ē3; ai, aī, aī3; o, ŏ, ŏ3; au, aū, aū3. Further, aṁ, aḥ, 𑀓 ka, 𑀧 pa are the four *yoga vāhas*. Thus the stem of basic (*mūla*) alphabets are 64. Their combinations are 2^{64} - 1. Note that I is not long in language (*bhāṣā*), but in other

national language a, ai, and o are not short in Sanskrit but they are in Prakrit and national language.

Similarly, the writing of numerals and variables through arithmetic and algebraic symbols are abundant in the ASG and ASL. Of course, they have been transformed in the course of time, yet some of the symbols seem to be quite ancient. The writing of world line as a dash ' - ' may be said to be of the period of Nānāghāṭa inscriptions.[17].

Whatever might have been the later developments, the Bhadrabāhu cave at Candragiri of Śravaṇabelagola and the presence of their foot-prints there, as well as other relevant inscriptions testify to their company alongwith mysterious and secret methods adopted by adepts, for the cause of approach to liberation in theory and practice[18]. The inscriptions are as follows:

Inscription No. 34 (31): "When the faith (the Jaina Religion), which had greatly prospered at the time when the pair of the great sages Bhadrabāhu and Chandragupta shed lustre on it, became afterwards a little weak, the coral-lipped Śāntisena-muni renovated it; and, on the mountain at Velagola, having given up food and other things, became the lord of the cessation of birth. (E.C., p. 369)

Inscription No. 71 (64): South Face....."May the great ocean of nectar consisting of the group of the illustrious Nābheya-nātha (i.e., Ṛṣabha) and other great holy Jinas continue as long as the moon and stars endure, an ocean which has the highest knowledge regarding the group of faultless objects for its great altar (or, seal-ring)..... In that ocean (arose) the group of excellent jewels the mighty and illustrious *munis*, Gautama and others endowed with the seven great supernatural powers. In their line was born a storehouse of knowledge, a great *muni*, who by reason of being auspicious on all sides, was famed as Bhadrabāhu, the best and last of the Śrutakevalī. His disciple, with fame brilliant like moonlight, was Candragupta, by whose glory the *munis* of his group (*gaṇa*) were worshipped by forest deities. In his world-renowned line arose Koṇḍakunda-munīśvara, who had at first the name Padmanandi and who through proper self-control, acquired the power of moving in the air. He was also known as Umāsvāti-munīśvara and Gṛidhrapicchācārya; in his line there is none equal to him in the knowledge of all the predicaments of the time....."[19] (EC, pp. 377 et seq.).

Inscription No. 73: ".....In that ocean (arose) the groups of excellent jewels, the mighty and illustrious *munis*, Gautama and others, endowed with the seven great supernatural powers. In their line was born, in the Nandi-gaṇa, Padmanandi, also known as Kundakundācārya, who, by his lofty character, acquired the power of moving in the air. He was like wise known as Umāsvāti-munīśvara and Gṛidhrapicchācārya; in his line there is none equal to him in the knowledge of all the predicaments of the time...." (EC, pp. 360-361).

Here Koṇḍakunḍa again arrests attention due to his mathematical manoeuvre, if he had written, now untraceable *Parikarma* (commentary on the first three parts of the *Ṣaṭkhaṇḍāgama*). Nemicandra Siddhāntacakravartī recommends to study the divergent sequences in *Bṛhaddhārā Parikarma* which is not available now. (Vide Jain, L.C., IJHS, 12.1, 1977, pp. 57-75.)

Inscription No. 77 (67) North face: "..... Say, how can the greatness be described of Bhadrabāhu whose arms have grown stout by subduing the pride of the great wrestler, delusion, and through the merit of being, whose disciple the renowned Chandragupta was, served for a long time by the forest deities. By whom, on this earth, is he not worthy to be honoured, the lord Kauṇḍakunda, a bee to the beautiful lotus hands of the *chāraṇas*, who adorned the regions by his fame brilliant like white jasmine and who firmly established sacred knowledge in Bhārata ? Worthy of honour is the teacher Samantabhadra, the head of a *gana* (or, school), skilful in reducing to ashes the disease *bhasmaka* (morbid appetite), receiver of an exalted position from the goddess Padmāvatī, who summoned Chandraprabha by the words of his spells and through whom in this Kali age the auspicious Jaina path became again and again auspicious on all sides.....". (EC, pp. 384-385).

Further connecting link is Cāmuṇḍarāi who was responsible for installation of the 58' high colossus on the Dodda Betta. Prof. T. N. Srikanthya surmised that Cāmuṇḍarāi came to be known as *Gommaṭa*

through the favour of Kūṣamāṇḍi, the *Yakṣī* of Nemi-tīrthaṇkara. *"Gommadi"* is the Prakrit form of this and *Gommaṭa* is derived from *Gummadi*.[20] *Gommata* means beautiful, good or excellent as agreed by all. Bāhubali is described as Manmatha in the literary works of the Pūrvapurāṇa of Jinasenācārya and Ādipurāṇa of Pompa. Even in the Chavuṇḍarāyapurāṇa, it is stated that Bāhubalikumāra was in those days called Kāmadeva. Recently discovered Gudnapur inscription of Ravivarma, the Kadamba king (c. 485-519 A.D.) refers to the construction of a Kāma-Jinālaya by him. It is also described as an abode for Manmatha. This may be a temple for Bāhubali. Another temple for Bāhubali is the one at Sravanabelgola built by Camundaraya. The *Artha saṁdṛṣṭi* or *Artha saṁdṛṣṭa* or the measure or norm which is beautiful to look at, might be thus connected with *Sundarī*, the sister of the only brother, Gommata or Bāhubali, predating the worship of Bāhubali to the 6th century.

In these inscriptions, the most prominent of the teachers is Koṇḍakundācārya who played a dominant role in the promulgation of Jainism in South India. In the inscription No. 364 dated 1433 A.D., Koṇḍakunda is differentiated from Umāsvāti in the same lineage.[21] Padmanandi is the original name of Koṇḍakunda.

Camundārāya was a minister of Mārasinha II and Rāchamalla IV. Many details about him are known from the Cāmuṇḍarāyapurāṇa. That he belonged to the *Brahmakṣatra* family (Inscr. No. 388). He fought many battles and was ever victorious.

Thus three personalities, Bhadrabāhu, Candragupta and Kundakunda seem to have carried over the mathematical manoeuvre of the *Karma* theory through symbolism. As in the *Ṣaṭkhaṇḍāgama*, so in the *Mahābandha*, zero appears to fill up the gaps. Kundakunda who might have written Parikarma (operational mathematics) on the *Ṣaṭkhaṇḍāgama*, might have started the writing of numerals in place value notation, as also seen in the subtraction technique of writing, the value changing according to the place where the bar or tail enters into the factors. (Vide ASG and ASL). Thus, as *Brāhmī* and *Sundari* got originated in the South India through the efforts of Bhadrabahu and Candragupta, it also seems probable that Kundakunda, in the South, evolved the place-value over the symbolic mathematics of his two predecessors and got the direct significance from Gautama gaṇadhara and Bhadrabāhu whom he regarded as *gamaka guru*.

The recent remarks of Needham and Ling[22] are really worth investigating in this regard:

"From the tables in which ancient Indian numerals have been assembled[e] it can be seen that from the time of Aśoka onwards (-3rd century) there was a steady development of forms akin to the 'Hindu-Arabic' numerals of today.[23] It is worth noting that in all these systems the first three integers are written in just the same way as the Chinese; some of the ancient systems[f] also have a X for 4 (cf. Table 22, cols. I,J).[g] But in nearly all of them[h] there were separate symbols (containing no 'place-value-component') for 10 and multiples of 10, 20, 30, 40, 100, etc., and so long any such practice prevailed place-value arithmetic could not exist."

"While the first epigraphic evidence for the zero in India is, as has just been mentioned, of the late +9th century,[j] it has been discovered about two hundred years earlier in Indo-China and other parts of south-east Asia. This fact may be of much significance. The literary and epigraphic evidence for the antiquity of place-value in India has been conflicting. While the former pointed to a date well before +500 for the development of place-value and zero concept,[k] it was never entirely convincing because of the uncertain chronology of Indian history and the difficulty of dating documents. Kaye (1), in his critical examination of the dated inscriptions, could not take place-value back before the +8th century at the earliest. But Coede's (2) has shown that Indo-Chinese inscriptions use place-values much earlier (Cambodia +604, Campa +609, Java +732). They employed a system of 'symbolic words', i.e., names of things which were universally known to be associated with a given numerical value.[a] Thus in an inscription at Phnom Bayan in Cambodia for +604, the 526th year of the Saka era was expressed as 'the

year (designated by) the (five) arrows, the (two) Asvins, and the (six) tastes'.[b] Now it is soon after this period that the first inscriptions appear showing the zero (simultaneously in Cambodia and Sumatra, + 683; and on Baka Island, +686). The 605th year of the Śaka era is represented as ꣑꣒꣓ using a dot (bindu), and the 608th as ꣑꣐꣙ showing the modern zero itself.[c] The Indian numerals without the zero, and encumbered with separate signs for the multiples of ten, were no improvement at all on the Greek and Hebrew alphabetical scripts. Yet Indo-China would seem at first sight a rather unlikely place for such a revolutionary discovery as that of the essential liberating element".

"Coede's does not believe that the southeast Asian inscriptions indicate an east-Asian origin for the symbolic word system (as Kaye has hinted might be possible), but rather that the Hinduising settlers of south-east Asia already had symbolic words and the old numerals when they first went there, or at any rate were soon followed by them.[d] So far so good, but we are free to consider the possibility (or even probability) that the written zero symbol, and the more reliable calculations which it permitted, really originated in the eastern zone of Hindu culture where it met the southern zone of the culture of the Chinese.[e] What ideographic stimulus could it have received at that interface?"

The above remarks, most naturally, hint towards the Śravaṇabelagola and around the area where Koṇḍakunda or Padmanandi worked for this revolution in the writing of big numbers needed for their Karma theory (the theory of every thing). This also hints for correction of present chronology with a difference of about 135 years, and placing the date of Padmanandi so earlier in date as well as that of the writing of the *Ṣaṭkhaṇḍāgama*.[24]

The commentaries JTP, SJC as well as the TPT form very important sources for the development of evolution of symbolism in the Karma theory of the Digamabara Jaina sect. The most convincing fact is the use of strokes and zero in the lengthening of accents. The initial of an artha (norm or gauge) for a measure of fluent (*dravya*), quarter (*kṣetra*), time (*kāla*), phase (*bhāva*), is taken as a symbol (*saṁdṛṣṭi*), or in form of an algebraic, arithmetic or geometric figure, and for another artha with the same beginning but with a lengthened accent, a stroke is added so that the variable or constant in the equation of Karma operations, sets as a single letter, has been the fundamental technique adopted in the *Artha saṁdṛṣṭis* of the measures.[25]

The most natural track towards the origination of *Brāhmī*, based on the Sundari's necessity, appears thus as follows where the symbols required lengthening strokes[26]

SYMBOL		NAME		POSSIBLE BRAHMI FORMS
sa		samayaprabaddha		
sā	स	sāgara		
ka	सा	kalpa kāla		
ke	क	kevala jñāna		
ko	के	koṭi		
a	को	atīta kāla		
a	अ	ābādhākāla		
o	आ	apakarṣaṇa bhāgahāra		
	ओ			
The initial alphabets are as under				
la	ल	lakṣa		
ɨ	ɨ	saṁkhyāta		
a	a	asaṁkhāta	( )	
-	-	jagaśreṇī		
ja	ज	jaghanya		
ju	जु	jukta or yoked		
che	छे	cheda rāśi		
pa	प	palya		
gu	गु	guṇa saṁkramaṇa bhāgahāra		
kha	ख	ananta		
va	व	varga śalākās, varga, varṣa		
u	उ	ūrvaṅka		
mū	मू	mūla		
gha mū	घ मू	ghana mūla		
ri	रि	riṇa	other symbols are	
jo	जो	joga		
dha	ध	dhana	other symbols are	
			sadhika e.g. sa ' means	
			sadhika samayaprabaddha	
ma	म	madhya	gaps filled up through 000	
jñā	ज्ञा	jñāna		
la, ko	ल को	lakṣakoṭi		
ja, jña	ज ज्ञा	jaghanya jñāna		
ko	को	koṭi		
ko २	को २	koṭākoṭi		
aṁ ko २	अं को	antaḥ koṭākoṭi		
mū २	मू २	dvitīya mūla		
४		saṁkhyāta		
५		saṁkhyāta		
a		asaṁkhyāta		
८		asaṁkhyāta		

SYMBOL		NAME	POSSIBLE BRAHMI FORMS
७		asaṁkḥyāta	
		asaṁkhyāta	
६५ =		paṇṇaṭṭhī	
४२ =		vādāla	
१८ =		ekaṭṭhī	
=		etc., prabhṛti	
vi		viralana rāśi	
de		deya rāśi	
mū २	मू २	second square root	
mū ४	मू ४	fourth square root	
2		sūcyaṅgula	
4		pratarāṅgula, āvali, pratāravali	
6		ghanāṅgula	
8		ghanāvalī	
1		sarva saṁkramaṇa bhāgahāra	
2		vidhyāta saṁkramaṇa bhāgahāra	
a a			
2		udvelana bhāgahāra	
a			
che	छे	adhaḥpravṛtta bhāgahāra	
a a	a a		

The above forms in their original, should date back to the period of the initiator, Candragupta, except the place-value notation, for writing of decimal numerals. The above are a few symbols in the ASG and ASL which ought to have been taken into consideration while originating or inventing a new script, *Brāhmī*, so that it could work well with *Sundarī* for the symbolic mathematical theory of Karma. There is no doubt that in the whole of India, leaving the extreme north above Kashmira or beyond northwest, there was not in existence so rich a source of literature in the Karma theory with measures manipulation, hence it is quite natural to draw the attention of the historians towards Bhadrabāhu and Candragupta (Prabhacandra), in whose period there was no script in India, except the unknown and unintelligible Sindhu-Harappana script. It is also well known that Candragupta was not only in contact with the Greeks, while as a student or as an emperor, defeating Selyukas and marrying Hellen (?), the daughter of Selyukas, must also have been in possession of some script influenced by the Greek script those days, which had many Asian offshoots. However, the genius of Bhadrabāhu and Candragupta, may well be appreciated by the two following remarks of D. Diringer[27] if it is proved not otherwise"
I. The Indian Alphabet is in no respect an independent invention of the people of India, who, however, elaborated to a marvellous extent a loan, which they had received from others.
II. The idea of representing Vowel and Consonant Sounds by symbols of a pure alphabetic character was derived from Western Asia beyond any reasonable doubt". (The Indian characters, however, are semi-alphabetic and not pure alphabetic). "Some scholars hold that, as the Indian writing is in appearance a syllabary, it could not have been derived from an alphabet; alphabetic script being obviously more advanced than syllabic. These scholars seem to have forgotten that the Semitic alphabet did not contain vowels, and whilst the Semitic could, if necessary, disperse with vowel-signs, the Indo-European

vowels, and whilst the Semitic could, if necessary, disperse with vowel-signs, the Indo-European language could not do so. The Greeks solved this problem satisfactorily; but the Indians were less successful. It may be that the inventor of the *Brāhmī* did not grasp the essence of the alphabetic system of writing. It is quite possible that the Semitic script appeared to him as semi-syllabic, as it could seem to any speaker of an Indo-Aryan language."

With all the resources of his empire at his feet, whatever could have been learnt by Candragupta, he must have utilized all his learnings, on becoming an ascetic, as disciple of Bhadrabāhu, the so called heard-knowledge omniscient.

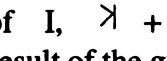
S. R. Goyal has considered in detailed discussions and found that Brāhmī script is an invention of the early Mauryan period. He has taken into consideration all his predecessors' opinions and findings and has disposed them off after factual findings and arguments based on them. This research may be summarised as follows:[28]

1. From the archaeological point of view, the inscriptions of Asoka are the most ancient inscriptions of the historical period of India (c. 18th century B.C. to the 3rd century B.C. being the period of no inscription). This shows that during this period the Indians were not acquainted with the art of writing.
2. Megasthnese statement mentioned by Strabo, that,".....they have no knowledge of art of writing..." Leaving apart the northwest lands, upto early period of Mauryan empire. He also states further that Sandrokottas (Candragupta) regulates all things through memory.
3. The distinction between writings of inscription is due to scribes artist and not due to provincial distinction.
4. The Aśokan period was the period of origination and its experimental state. [This leads to the fact and purpose of its origination, for some great cause, linked with memory of *Brāhmī* and *Sundarī*, mysteriously kept secret at Śravaṇabelagola, soon after the initiation of Candragupta and 12 years of isolation in the company of Bhadrabāhu.]
5. *Brāhmī* was not developed gradually, but was invented at an instance, this fact is proved due to the relation of *Brāhmī* with Sanskrit grammar and phonetics which were already perfected in Mahaviran era or later, prior to Candragupta, as follows:[29]

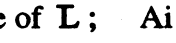
a. The development of the five nasal letters as well as of a complete set of signs for the long vowels- The latter is necessary for phonologists and grammarians but not for men of business, and is, therefore unknown in other ancient alphabets.
b. The use of separate signs for the Śa, Ṣa and Sa
c. Through *samprasāraṇa*, the notation of U by the half of Va
d. The non-expression of medial A.
e. Derivation of the other vowel signs from the three basic ones, for example,

A , I and U, L

according to the grammatical rules of guṇa and vṛdhi sandhis. the letter Ā,  is obviously lenghened form of  , I  , lenthened of I 

and Ū,  is lengthtened form of U, L and E is the result of the guṇa sandhi of A and I, dots of I,  the strokes of the letter A are added to the dots of I, O is the result of the guṇa sandhi of the medial Ā and Ū



in this case the the medial sign of Ā is placed to the left because we have another letter Ṅ which has the shape of  ; Ai is formed by adding the medial sign of A in E  Au is formed by putting a medial sign A in O  ;



and Am is shown by putting a dot to the right of A

f. The non-expression of A by the difference between Ā and A and of the remaining medial vowels by combinations of the initial ones or the cursive simplifications of the same with the consonants.

g. The use of independent and indubitable signs for all pronounced sounds, identify between pronounced and written letters, separate signs for anusvāra and anunāsika ṁ and ṁ and also for visarga and the classification of letters into vargas according to the place of their pronunciation. [This originality is due to the Prakrit language of the Karma theory and its absence is found in all ancient alphabets.]

h. The use of the independent or primary forms for the letters of first and third letters, that is the unaspirated consonants of the each varga, some other letters of these vargas, semivowels Ya, Ra. and La and Va, sibilants Śa and Ṣa and the aspirate Ha and the derivation of other letters from them. It also appears in the following derivations, mathematical Sundarī has been very mysteriously adopted through geometric point, straight line and circle[30].

LETTER	DERIVED LETTER	DERIVED OUT OF	
Kha		Ga	
Ṅa and		dental Na	
Ṇa (central)			
Chha		Cha	
Ña		Jha	
Ṭha and		Ta	
Ṭha			
Ḍha		Da	
Ḍha		Ḍa	 or vice versa
Pha		Pa	
Śha (ṣ)		Sa	

6. Absence of Written Documents in the pre-Aryan Times-

Some believe that the Vedic Āryans knew the art of writing and insist that it is merely *argumentum ex silentio* and that the Vedic records were possibly written on perishable materials, which could not be preserved for a long time. But one cannot produce a positive evidence to prove the nonexistence of something. Further intensive excavations in the post-1947 period of a large number of sites associated with the Āryans, it has become totally untenable.

7. Absence of Regional Variations in the Aśokan Script.

8. *Brāhmī* has not been derived from the Indus Script.

[The Jaina school asserts some objects through a pair of words, as pud-gala, *Brāhmī-Sundarī*, *Hīnākṣarī-Ghanākṣarī* and other pairs which are of far reaching implications with the background of Karma theory. Connecting links are *Brāhmī-Kharoṣṭhī* and *Lipi-Dipi* of Aśokan inscriptions.]

9. Need of the Script:

[The Karmic theory material, having mathematical and calculation aspects could be preserved upto Bhadrabāhu and Candragupta (Prabhācandra) and then there was a fear of it being extinct due to gradual loss of memory and due to its rigid mathematical manipulation which could only be possible through symbolism and not through sentential description alone.]

10. The primary forms appear to be pictorial representation of material objects. This again gives a connecting link with the Karma theory and astro-learnings in which Bhadrabāhu is said to have excelled.

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11. Employment of the Scribes of the North-West:

If Candragupta, while as disciple of Bhadrabāhu, invented the *Brāhmī -Sundarī* script, through his knowledge of the Greek script or its off-shoot, it might have been quite possible for Aśoka to have called for the scribes of the land where the Greek script or its off-shoot might have been in use. The opening formula of the Aśokan edicts is based on a similar Iranian formula found in the Achaeminic records. The practice of engraving the Royal Proclamations on rock came from Iran. The terms lipi and dipi have been used for the*Brāhmī* and *Kharoṣṭhī* by Aśoka, taken from Iranian inscriptions.

12. Analogy of Invention of Tibetan Script:

The king Srong-tsen Gam-po clearly saw that a written language was most essential for the establishment of religion. He, therefore, sent Thon-mi Sambhota with sixteen companions to Kashmira and instructed them to devise means for the invention of a written language for Tibetan. [Similar might be the case for *Brāhmī-Sundarī* for which the *Labdhisāra* project is sufficient to prove that Bhadrabāhu and Candragupta must have attempted to invent the *Brāhmī-Sundarī* scripts.]

13. References to Writing in the Pali Canon:

The Śvetāmbara Jainas' claims and the Buddhists' claims for earlier writings have been refuted through reasoning based on documentary records of the 6th century A.D. and 29 B.C., respectively.

14. Illiterate State of the Society in the Pāli Canon:

It was in the Ceylonese Council, convened by Vattagumini in 29 B.C., that the canon was given a written form so that it was not lost or corrupted. It is evident that if books were known and used in the pre-Aśokan India, they would have played an important role in the daily life of the monks. Evidence from *Aṅguttara* (3.107) is the mention of the dangers that may fall upon the faith are discussed. One of them is that the monks will listen and think only when poetical and ornate suttas are repeated but will neglect the deeper and more subtle treatises. Similar mention is in *Aṅguttara* (2.147, 5.136) and *Vinaya* rules. Thus, if some portions of the pāli Canon are aware of the prevalence of writing, some others depict, even the highest strata of the contemporary Indian Society, as illiterate.

15. Evidence of the Post-Vedic Brahmanical Literature:

The post-Vedic Sanskrit Works such as the *Aṣṭādhyāyī* of Pāṇinī, the *Arthaśāstra* of Kauṭilya, and the *Dharmasūtras* of Vaṣiṣṭha, Viṣnu and Gautama refer to the art of writing, but some of these works are of doubtful antiquity and in some cases their evidence cannot be applied to the whole country, Pāṇini belonged to Śalātūra in Gāndhāra, an area which was at that time under the hegemony of the Achaeminid emperors of Iran in the east of which *Kharoṣṭhī*, Greek and Aramaic were prevalent. No wonder, therefore, if he knew writing and used the terms lipi (libi), *lipikāra*, *Yavanānī* and *grantha* etc. Similar may be mentioned about Yakṣa. This approach also explains the testimony of Nearchos, one of the Generals of Alexander, who inform us that the people of Indus region knew the art of manufacturing paper out of cotton and tattered clothes, this region was under the hegemony of Iran, alone. The *Dharmasūtras* were composed sometime in the last centuries of the pre-Christian era, or post-Aśokan period. Many scholars place the *Arthaśāstra* in the centuries following the birth of Christ, posterior to Bhāsa. Bhāsa flourished after the composition of the Manu Smṛti which is usually assigned to second century B.C., and before Kālidāsa. Thus Kauṭilya could have hardly flourished earlier than the beginning of the Christian era. The number of varṇas according to the Arthaśastra was 63, while Aśokan scribes were acquainted with about 46 letters only. Kauṭilya refers not to the number of the varṇas in the written alphabet, but to the number of the varṇas of the vocal varṇamālā of the grammarians.

16. Evidence of Vedic Literature:

There is no explicit mention of writing in the Vedic literature. Even the supporters of the hoary antiquity of the Indian Art of writing only argue that the prevalence of the various kinds of meters

(*Chandas*) and reference to high numerical figures in the Vedic literature imply the existence of writing. They are refuted in view of Buddhist literature depicting the pre-Aśokan society as illiterate. Archaeological records also tell this. The Indian system of education and learning was a legacy of the Vedic age and the early Buddhist periods on account of oral teaching and transmission of texts from one generation to another. That is why the *Vedas* were designated as *Śruti*, the learned were called *bahuśruta*, only mukhasthavidyā was held in esteem and, when writing came into use, the manuscripts were designated as *Sarasvatīmukha*. In the Vedic religion there was no God of writing. *Sarasvatī* was the goddess of only speech in this period.

CONCLUDING REMARKS

Thus, Goyal concludes that *Brāhmī* script was invented between the period after Candragupta was initiated and before the actual epigraphic records of Aśoka. Through the above arguments he also explains the post-periods, through his unprecedented approach, of the pre-Aśokan *Brāhmī* Coin, Legends, and Epigraphs as also Eran Coin-Legend, Taxila-Coin-Legends, Piprahwa Buddhist Vase inscription, Mahasthan Fragmentary Stone-Plaque Inscription, Sohagua Bronze Plaque Inscription, Barli Fragmentary Stone inscription, Bhṭṭiprolu Relic-Casket Inscriptions and Purtham and Patna Image Inscriptions. To his original approach, the substantial records of *Brāhmī-Sundarī* as detailed here and elsewhere, give now the strong support, unless otherwise some other records are discovered as epigraphic facts. Bhadrabāhu and initiated Candragupta have not been lost, they live in the*Brāhmī* and *Sundarī* scripts as well as in the monumental Karma theoretic and beyond records. So also Koṇḍakunda still lives in the hearts of the spiritualists as well as the mathematicians pursuing things beyond states of Karma. We have given here some of the relevant reprints of some important publications for further studies.

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ON THE VIKRAMA ERA

INTRODUCTION

The Vikrama era has a great relevance to *Jaina* works. After 413 years of Vīra Nirvāṇa, King Naravāhana ruled for 40 years, Gardabhilla for 13 years and the Śaka king for 4 years. During this period Revatīmitra led the *Jaina Saṁgha* for 36 years and Āryamaṅgu for 20 years. Thus according to *Śvètāmbara* tradition, 470 years lapsed after *Vīra Nirvāṇa*. Kālakācārya got the Kingdom of Gardabhilla smashed away and his son, Vikramāditya, ruled for 60 years. During this period, in the *Jaina Saṁgha Bahula, Śrīvrata, Svāti, Hari, Śyāmārya, Saṇḍilya,* etc. survived. The tradition of *Pratyeka Buddha* and *Svayaṁ Buddha* terminated, and the preceptor Bhadrabāhu, Śrīgupta, Vajrasvāmī, survived.

The above facts have a relevance with a *kathānaka-vṛtti* [1], of Devendra sūri (Vikrama era 1146), according to which Kālaka was a prince and became an ascetic alongwith his younger sister, Sarasvatī, initiated by ascetic Guṇakara. The king of Ujjain, Gardabhilla, captured Sarasvatī in his queen's palace, as he was charmed. *Ācārya* Kālaka, being unsuccessful, went to Śaka land and got Gardabhilla defeated by Śaka king and got his sister back in the *Saṁgha. The* dynasty in Ujjain was then exterminated by king Vikramāditya who established his era at the instant.

In Indian chronology, the dark age is the first century B.C. to first century A.D., the golden period in the history of India. While on the one hand, traditionalists are so dogmatic that they do not let the historical data decide the issue, the historians, on the other hand, display blind preference for epigraphic and numismatic evidence. R. L. Handa [2] has surveyed this situation by describing the tradition as being challenged by historians as follows:

1. The era has not throughout been associated with the name of Vikramāditya. The earliest name of the era was *Krita,* whatever that may mean. After having been known by this name only for 500 years, it came to be called sometime as *Krita* and sometime as *Mālava.* It was only after 800 years that a proper name, Vikrama appeared. Out of the 18 known records of these 800 years, one describes i.e. as *Mālava,* one as *Vikrama* and 16 call it as *Saṁvat* only. Out of 36 inscriptions of the 10th century, 32 describe it simply as *Saṁvat,* one as *Malavaskāla* and one as *Vikramakāla.* According to A. S. Altekar, only after 12th century, *Vikrama* came always to be associated with the era and its founder designated as king.
2. Confused genealogist and conflicting data in literary works like *Kathā-sarit-sāgara* etc. make them unreliable about historicity of Vikrama.
3. The non-mention of any tribe or king during his digvijaya challenges their authenticity.
4. There are flaws in Jaina traditional Kālaka's stories and *Paṭṭāvalis* as they do not contain clear references to Vikrama episode. The versions belong to period not earlier than 12th century A.D. Even *Harivaṁśa purāṇa* (783 A.D.) does not refer to foundation of *Vikrama* era, and Yuan Chuwang traveller (first century B.C.) does not refer to any king Vikrama. So also any purāṇa does not refer to his name, when he was a great patron of Sanskrit and Brahmanical faith (?).
5. The folklores and tradition vary regarding the parentage of Vikramāditya. According to *Kathā-sarit-sāgara* and *Bṛhat kathā mañjarī* he was son of king Mahendrāditya, but *Prabhāvaka caritaṁ* and Kālaka stories describe him as son of Gardabhilla. Some Jaina tradition describe him as of Hūṇa extraction, some stories describe him as son of a widow.

However it may be noted that in spite of the acceptance of *Śaka* era by Govt. of India in 1963, the people of India have been working in *Vikrama* era, as before. Before any solid evidence, one could justify the historicity of Vikrama for the following facts of history:

1. It is difficult to explain the grip of Vikrama legend over millions of people for 2000 years if it is not regarded as a reality of facts. 2. Jaina tradtion of Kālaka stories and evidence of Periplus confirming the presence of Śakas in Sind suggest the possibility of their having occupied Saurāṣṭra, Gujrat, and Ujjain

in or round about 60 B.C., and the *Vikrama* era may have been founded to commemorate the expulsion of Śakas from Ujjain. 3. The reference to Vikrama and founding of an era mentioned in Hala's, *Gāthā sapta śatī*, *Vetāla pañcaviṁśati*, *Kathā-sarit-sāgara*, *Siṁhāsana battīsī* and *Bṛahat kathā mañjarī* can not be dismissed as entirely baseless. 4. The Jaina traditions, which have a definite historical background, make clear reference to Vikramāditya of Ujjain who fought and defeated Śakas creating a golden age of history.

A. Cunningham [3] gives the following details:

1. The *Vikrama* era is reckoned from the vernal equinox of the year 57 B.C., and the completion of the *Kali* Yuga year 3044. All over northern India, except in Bengal, where the *Śaka* era has been generally adopted, the *Vikrama* era has been in use, as also in Telingana and Gujrat, In Gujrat, however, the year begins with the first of *Kartika-White*.

2. In 585 of Gupta era, the Raja Jaika got inscribed an epigraph, the earliest dated so far, has been read by Pandit Bhagwan Lal as follows, "In the *Vikrama* Saṁvatsara 94, in addition to 700, on the 30th day (*amāvasyā*) of the dark half of the month of *Kārtika*, Sunday, in the afternoon (?) on the occasion of a solar eclipse."

The date of the above inscription has been translated by Bühler is as under, "When seven hundred years of Vikrama exceeded by ninety-four (in figures) 794 (had passed) in the second half of the month *Kārtika*, at the new moon, on a Sunday, under the constellation *Jyeṣṭhā* on the occasion of an eclipse of the sun."

Cunningham, however, finds that although the eclipse day was 18th October 738 on Saturday, both being inauspicious, the grant might have been inscribed on Sunday in first day of *Kārtika* in stead of *Āśvina* 794.

3. Still earlier inscription of Jayabhaṭa, Gujrat, presumably of *Vikrama* era, reads, "*Saṁvat* 486, Sunday, the tenth day of the bright half of *Āṣāḍha-Sudī*, when the sun entered the sign of the scorpion."

Cunningham, again basing his calculation for the *Vikrama* saṁvat year 486 beginning in Gujrat, finds according to the present reckoning, on the 1st *Kārtika-sudī* or 28th September A.D. 429, so that the 10th of *Āṣāḍha-Sudī*,would have fallen in the following year, A.D. 430. This contradicts the day, hence he advises 497 to be the correct replacement for 486.

4. *Śatruñjaya Māhātmya* professes to have been written 477 years after Vikrama (A.D. 420). From the way in which King Śilāditya of Vallabhī is spoken of as "honouring the advice of Siddhasena suri as the words of *Jaina*,"it appears that Vikramāditya was a *Jaina*, which would account for the use of his era in the *Jaina* books, as well as for the non-mention of it in early Brahmanical inscriptions.

Cunningham has further pointed out the errors of Colebrooke who used the erroneous equation of 56, and those of Tod. He concludes the reckoning of the *Vikrama* era in Gujrat from the *Kārtika-sudī* and not from March to March. Moreover, the reckoning is 56 and 1/4 rounded to 56 for Gujrat.

Now Franklin Edgerton's findings on *Vikrama's Caritra* [4] or Vikrama's Adventures (*Siṁhāsana-dvātriṁśaka* or The Thirty-two Tales of the Throne) are as follows:

1. He studied the four recensions (SR, MR, BR, JR) and undertook the problem of their date and authorship as also the question of the historic basis of its hero, King Vikrama. He also refers to Hertel's article, "Uber die Jaina-Recensionen des *Pañcatantra*," Ber. ii. d. Verh. d. kgl. dschs. Ges. d. Wiss. ph.-hist. Kl., vol. 54, specially pp. 114 ff. He also studies (Ver R) recension. He finds that all of the versions JR shows the most marked individuality. Weber and Hertel regard that the original *Vikrama-carita* was Jainistic. Edgerton found that the present JR is that now he had was deliberately changed. In style, the JR was found by him to be the best, simple, straightforward, lucid and unhistorical. He was inclined to call the author of JR as the greatest literary artist of any of the redactors.

2. *Vikrama Caritra* has in common with *Jaina* Merutuṅga's *Prabandhacintāmaṇi* (Wishing Stone of Narratives). Some stories in JR have been drawn from some Jainistic *Prabandha* and inserted secondarily in *Vikrama Caritra*, by the redactor of JR, of course from Jainistic work on Vikrama.

The story-29 has been substituted by the story of Vikrama's offer to sacrifice himself in the interests of the "Science" of sign-reading (perhaps also related with *artha-saṁdṛṣṭi* of Digambara Jaina tradition

in their mathematical theory of *Karma* in its symbolic form [5]), drawn from the same Jainistic legend-book (not traceable at present). The JR tends to avoid the mention of Brahmanic gods, and the word, Brahman. JR mentions Avanti in place of Ujjayini. It represents Vikrama as having been in exile throughout Bhatṛhari's reign, perhaps for insertion of Agnivetāla episode in which the exile returns in cognito and wins the kingdom. This links the life of Vikrama with that of Khārvela who is said to have organized the army of the *Bhīlas* synonymous with the name of the Gardabhilla, the father of Vikrama.

Weber and Hertel saw in the use of the word *Digambara* (SR, BR) an attack on the Jaina sect of that name. The shortening of the account of *Vikrama's struggle with Śālivāhana* in JR is perhaps retold. The general idea of *Karma* and transmigration in Jainistic form has been placed in JR. The SR was called *Vikramārkacarita* and JR certainly *Siṁhāsana dvātriṁśaka.*

3. The *Vikramacaritra* mentions the second hero, the king Bhoja who discovered the throne of Vikrama, is the famous Bhoja Paramāra king of Dhārā, the nephew of Muñja, and reputed author of various literary and scientific treatises, reigned from 1018 to 1060 A.D.

4. In *Vikramacarita*, Vikrama's adventures with the false ascetic and the Vetāla- the frame story of summarizing a story is the noteworthy peculiarity of JR. This could also be found in the Jainistic archetype of the *Pañcatantra*, a collection of ancient Hindu tales, in the recension (called *Pañcākhyānaka*, and dated 1199 A.D.) of the *Jaina* monk, Pūrṇabhadra, critically edited in original Sanskrit [in *Nāgarī* letters] by Johannes Hertel, [6].

5. The early part of the eleventh century is the earliest possible date for this work. There is also a strong indication that the writer of the original *Vikramacarita* knew Hemādri's work, make it so far to say that it dates from a time not earlier than the 13th century. The *Vetālapañcaviṁśatikā* also was older than 11th century, since Somadeva (who lived then) includes a version of it in his *Kathāsaritsāgara.* Individual recensions of *Vikramacarita* mentions various other works of Sanskrit literature, such as the *Arthaśāstra* of Cāṇakya (Kauṭilya?), the *Pañcatantra*, and Kāmandaki's *Nītisāra.* The SR quotes the first verse of Bhavabhūti's *Mālatīmādhava.* Only the outside cover of a mss. of MR mentions "Nandīśvara yāgikṛta." Kālidāsa and Vararuci have also been mentioned in other colophons.

6. However, two stanzas in Aufracht's catalogues, Catalogarum, s.v. *Siṁhāsana dvātriṁśat* (3, p. 717, and III, p. 148) mention that JR was compared in Sanskrit on the basis of a *Mahārāṣṭrī* original by one Kṣemaṅkara Muni, who was a Śvetāmbara ācārya who compared *Satpuruṣacarita.* It may be carefully noted that the *Jaina Mahārāṣṭrī* was the Prakrit language of the Digambara sect. (S is distinctly anti-Jainistic in tendency, and this is, probably, the reason for such charges: eliminating a Jaina teacher as author and a specifically Jainistic Prakrit is the original dialect of the work.) [7]

7. Who was Vikrama? When was the Vikrama era started ?

A. At the end of the (secondary) JR VII of the *Vikramacarita* we are told that Vikrama, in his pious exaltation after listening to the instruction of the Jaina teacher Siddhasena Divākara, freed the whole earth from debt, and (in so doing), effected a change (literally, a turning point) in the era of Varddhamāna; so I render doubtfully, Varddhamāna *saṁvatsara-parivartana akarot.* According to Elgerton, this is a secondary intrusion into *Vikramacarita* by the *Śvetāmbara* sect ascetic author. Other sources of Jainistic tradition corroborate this statement and almost uniformly place the date of this change in reckoning and almost uniformly place the date of the change in 470 years after Varddhamāna's *nirvāṇa.* Jacobi, however, is the *authority* for the statement that the *Digambara Jainas* put 605 years instead of 470, between Vikrama and Mahāvīra. Jacobi argued that figure 470 is too large by 60 years, hence 605 is correct.

B. The well known *Hindu* era, now called *Vikrama* era, begins with 58 or 57 B.C., and the *Vikrama* era took its Vikrama of the Jaina tradition and was presumably established by him, a belief of the Hindus and others, for many centuries, having documentary evidence since 1200 A.D.

C. Doubts were cast on the tradition by Fergusson, Kielhorn and others. Even the Hindu themselves

had to resort to the expedient of declaring that there had been two or more Vikramas. Albiruni (973-1048 A.D.), according to Sachau, says that the *Śaka* era (78 A.D.) was founded by king Vikramāditya (not the same as the king of Malava who founded the Vikrama era), in celebration of his defeat of a prince named Śaka at Kerur in the Punjab. This title became later on, an honorific epithet like Caesar. It was then pointed out that there is no *epigraphic* nor *numismatic* evidence for the existence of such a king in the first century B.C. Fleet upheld that Kaniska founded the Vikrama era 58 or 57 B.C., so also by Kennedy. Barnett and Longworth Dames. This was opposed by Rapson, Vincent Smith, Waddell and Thomas. John Marshall's archeological evidence showed that Kaniṣka cannot have been living in 58 B.C., and suggested that the era dates from the founding of the (aligarphical) constitution of the Mālava tribe; "This is also disputed. The theory of Azes I, the Śaka king of Gāndhāra was also based on a disputed interpretation of Ayass.
D. According to reliable Jaina chronicles, there was no king like Vikrama in 57 B.C.
E. There has been a Jaina story, *"Kālakācārya kathānaka"* (Jacobi, ZDMG.34.247 ff., esp. 286). This work tells how the Śakas conquered Gardabhilla, (father of Vikrama) or Gandharvasena, king of Ujjayini, but later on were expelled by Gardabhilla successor, Vikramāditya, who freed the world from debt and in celebration of this generosity, established a new era. After 135 years, however, another Śaka king returned and overthrew the dynasty of Vikramāditya, founding another era (the Śaka era of 78 A.D.). Konow brings this account into relationship with certain Chinese historical records of the doings of the Saka and Kuṣāṇa dynasties. He makes out at least *a plausible case* for the historicity of Vikrama as king of Mālava, and founder of the era of 58-57 B.C. Vincent Smith and Charpentier agree with this view. They also hold the view that Candragupta II (375-413 A.D.) may be Vikramāditya as proposed by Bhanḍārakar (JBBRAS, 20, p. 398, 1900). Yaśovardhana (first half of 6th century A.D.) was also proposed but to no purpose.

EMPEROR KHĀRAVELA AS ALTERNATIVE PROPOSAL FOR VIKRAMĀDITYA:

We do not come down but look to the upper level of the chronology which may provide a clue to the solution of the problem of recognizing the correct Vikramāditya, who had also freed the world from debt. If Gandharvasena was defeated by the Śaka king led by Kālakācārya, it might not have taken much time by his son to defeat the Śaka king from an alternative kingdom, placed at a reasonably safe distance from Ujjain and where people of his clan or tribe Bhīla (from *bhilla* or Gardabhilla, the nickname of Gandharvasena so denominated by Kālakācārya as a revengeful attitude) resided. The historic tradition of Khāravela may be connected to the Jaina story of Gardabhilla who insulted the saint Kālakācārya when he visited Ujjain. By this period the *Digamabaras* and the *Śvetāmbaras* had already separated into two sects. Kālākācarya moved to the Śaka dvīpa and invited the Śakas. They moved in hoards and came via the Gujrat region into Ujjain. They defeated Gardabhilla and drove him out. Later, Vikramāditya, of Gardabhilla family, took up the cause and drove out the Śakas out of Ujjain. This was recorded in the Jaina tradition.

Subsequently, Vikramāditya moved towards Orissa, and other northern Indian states and established himself as the propagator of *Digambara Jaina* faith. He also moved to south and established Jaina centres. One was Vaḍḍamānu on the banks of the river Krishna. He left his successors at Vaḍḍamāṇu, who asserted themselves as *Sadas* and started their own dynasty which ruled for nearly 100 years. They were, later on supplanted by the Sātavāhanas. The Śaka king, Nahapaṇa, who was driven away by Vikramāditya (Khāravela) migrated to the Krishna region because of its richness.

It seems that the things went this way. However, the proposal for identifying Khāravela with Gardabhilla, the father of Vikramāditya of Ujjayini, had been proposed by K. P. Jaiswal [8] and H. C. Seth [9]. Actually, the following circumstances may be able to show whether Khāravela may be identified with Vikramāditya , the hero of the *Siṁhāsana dvātriṁśaka* and the well known *Vaitāla pañcaviṁśatikā*:
1. After the defeat of Gandharvasena by the Saka king, second or third dynasty of Gandharvasena ought to have waged a military strategy of rooting out the Śaka dynasty of Ujjain. If Bhartṛhari and Vikramāditya are

two brothers identified as two sons of Gardabhilla, Vikramāditya may be regarded as third in the dynasty[10].

2. The veil of darkness that covers the history of Orissa, since Asoka is only lifted by the Hathigumpha inscription of Khāravela at Udayagiri (Puri), consisting of 17 lines, badly damaged, recording the chronological events of unknown Khāravela. He belonged to Cheti or Chedi and his titles were *Aira* (*aila*) Mahārāja, Mahāmeghavāhana Kalingādhipati (*Airena* Mahārājena Mahāmeghavāhanena Cheti-rājā-vasa vaḍhanena..... Kaliṅgādhipatinā Siri Khāravela) [11] , belonging to *Bhīla* dynasty which is confirmed by an old Oriya manuscript. There are seven types of *Bhīlas*: *Aira, Khara, Sura, Nara, Dara, Sara,* and *Khara II Bhīlas*. Out of these, Khāravela may be *Aira Bhila* (The well known Digambara ascetic, Kundakundācārya, was also called *Ailācārya*.). This explanation of Jaiswal is accepted by R. C. Majumdar, D. C. Sircar, E. J. Rapson and Raychaudhary. It seems thus natural that Vikramāditya must have either been born here in shelter of some tribe paying allegiance to Gandharvasena or his family and afterwards he might have gained power to be able to attach Avantikā to drive away the Śakas in his digvijayin.

3. Khāravela has auspicious bodily marks [12] and from his 15th year he excelled in royal correspondence (*lekha*), currency (*rupa*), financial accounts (*gaṇana*), civil and religious laws (*vavahāra vidhi*) and knowledge of *sava-vijā-vaḍalena*. [13] He is recognized as a great invincible conqueror Vena, in all of which simile could be given to Vikramāditya.

4. The king disregarding Sātakarṇī (Āndhra Sātavahana ruler) sent westward his forces upto Krishna and disturbed the city of Musika (Asika). The same year he learnt *Gandharva* vidya and entertained the capital with festivities, and Samāja. Here adversary is unknown. *Samāja* is a semi-religious festival of dancing, music and theatrical performances, in which Vikramāditya also excelled.

5. In the fourth regnal year, Khāravela humbled the Rathikas and Bhojakas (Marāthā countries) and (the Yavanas, Kambojas and Gāndhāras). Vikrama's expeditions also appear to mark such lands.

6. In the fifth regnal year, Khāravela excavated canal in the year 103 or 300 of king Nanda, and remitted taxes of public to extent of hundreds and thousands of coins. From a rough inscription, line 7 indicates a queen of family of *Vajira* (*Vajra* ?) and the chief queen from Mañcapurī cave inscription was daughter of greatgrandson of Hastisiṁha, the king of Lālaka or Lāla (Rāḍha ?) [14].

7. In the eighth year of his reign, Khāravela, causing destruction to Gorathagiri, attacked Rājagṛha (Rājgiri, Bihar) with a vast army, being the first great northern campaign of the Chedi kings, expelled Yavan king Dimita to Mathura. Like Kalpa-bṛkṣa (wish fulfilling tree) the king made gifts of elephants, chariots, houses, and exempted the Brahmana caste from taxes. This was also the character of Vikrama who has been described as the unprecedented donor in the 32 tales of *Vikramacarita*.

8. In the 10th year of his reign, Khāravela, following the threefold policy of chastisement (*daṇḍa*), alliance (*samadhi*), and conciliation (*samamavo*) directed his second northern campaign towards Bhāratavarṣa. This seems to be the campaign against kings who had expelled Gardabhilla or Gandharvasena, the father of Vikrama, and upper India was cleaned from the Śakas, bringing a great amount of jewels and precious things. (Perhaps this year he might have established the *Vikrama* era in the name of Mālava land and its people.)

Next year he is said to have caused the market town of Pithumda (founded by the Ava kings) to be ploughed down by a plough of *asses. (It may be noted that Gardabha also means an ass, a name for the king Gandharvasena who had been the target of Kālakācārya).* This king has been referred by Ptolemy as Pityndra; the metropolis of Maisoloi (between Kṛṣṇā and Godāvarī). Then he crushed the enemies of Tamira daha (Kolair lake) which has been a cause of threat for 13 or 113 years.

9. In his 13th regnal year, the king abandons war and turns his attention to ways of peace, erects pillars in the vicinity of the residences of the *Arhats*, and distributes royal maintenances amongst the monks, understanding the nature of bios (*Jīva*) and body (*deha*). [15]

10. Regarding placing of Khāravela late, there has been opinion about his existence from 4th century

B.C. to 1st century B.C. by various scholars:

a. R. L. Mitra (Antiquities of Orissa, II, pp.16 ff) places him to the 4th century B.C.

b. J. F. Fleet (JRAS, 1910, pp. 242 ff and 824 ff) and Luders' list No. 13315; E9, X, p. 161) are inclined to assign him to the 3rd century B.C.

c. Bhagwan Lal Indraji (Actes du Sixience Congress International des Orientalistes, pt. III, pp. 152-172) thinks that Khāravela belonged to second century B.C. Sten Konow (Acta Orientalia, I, pp. 12 ff.), K. P. Jaiswal (JBORS, III, pp. 426 ff.; JBORS, XIV, pp. 150 ff) and R. D. Banerji (JBORS, IV, pp. 486 ff) are inclined to accept this date.

d. Scholars like R. P. Chanda (MASI, No.1, p.10), H. C. Ray Chaudhuri (PHAI, pp. 377 ff and p. 418), B.M. Barua (Old Brāhmī Inscriptions, pp.268 ff), N. N. Ghosh (Early History of India; pp. 187-194), Dr. D. C. Sircar (Select Inscriptions, I, p. 206), etc. place Khāravela in the 1st century B.C.

e. C. L. Shah (Jainism in North India, pp. 151-186) holds his opinion as follows:

Even then, if it must be admitted that the Hāthīgumphā inscription is undated, there is reason to believe that the date of Khāravela would fit with the dates of Demetros and Sātakarṇī in the first half of the second century B.C. Moreover, as the rise of both the Āndhra and Kaliṅga dynasties must no doubt date from the same period, when the Maurya power began to decline, the probability that these two kings were contemporary is great indeed as is maintained by Shah.[16] But for this inference the *Vīra Nirvāṇa* and *Vikrama* era will be required to be studied in view of the difference of 135 years between the confusing records of dates whether in the *Vikrama* Saṁvat or *Śaka* Saṁvat.

Out of the above one could easily assign the date of Vikramāditya as fitting in the second or first century B. C. It may be either 70 B.C. or (135 + 70) or 205 B.C. according to *Digambara Jaina* tradition. Khāravela flourished probably 300 years after the Nandas (or 103 years after which is not tenable). He had a meteoric career, so also the hero of *Vikramacarita*, an invincible king and a noble and mighty builder. Like the Rāṣṭrakūṭa king Govind III, he snatched away the imperial sceptre from Pataliputra to the South. His formidable army terrorised and humbled the rulers of Northern and North-Western India. He was as great in war as in peace (Khemarāja), also Vadharāja and Bhikhurāja and Dhanarāja, respecter of every sect and repairer of all temples, glorifying the Chedi family from obscurity and adoring it with grandeur of imperiality. Neither the earlier king nor the later king of Khārvela is known. If Gandharvasena was a Digambara Jaina king, so also could be his son Vikrama, so similar to Khāravela (The new word, Khārabhila, akin to Khāravela, could also mean somehow related to Gardabhilla) and on this basis Gardabhilla seems to have been compared to stand with Khāravela which does not hold water. The establishment of the *Vikrama* era, thus appears to be after his death, perhaps a number of years later in commemoration of his memory by the later democracy of the Mālava region, in case we regard Vikrama as fitting in with Khāravela.[17]

We may give certain remarks from the studies of Khāravela by C. J. Shah. He is that imperial king about whose dynasty the historians know hardly anything and about whose career there is absolutely no historical source but the long yearwise inscription, which also, as usual, could not escape the ravage of time. According to Shah, it will not be surprising if on some happy day a scholar were to come across a better and more comprehensive document about this Dharmarāja, "the illustrious descendent of the dynasty of royal sages", perhaps having a link with those of the Vikramāditya dynasty in the Gardabhilla garb. It is really strange, may unbelievable, that the Jainas have nothing to say about one whose contribution to Jaina history is second to none.[18]

There are some scholars who do not approve of the reading regarding the Greek king of Mathura as Dimita as the inscription has not been found to be in readable condition. Some scholars try to place Khāravela with the Sātavāhana dynasty through the *Purāṇas*. According to the *Purāṇas*, Śuṅga kings reined for 112 years after 137 years of Candragupta Maurya. After Śuṅga kings Kaṇva king ruled for 45

years. Thus taking 324 B.C. as the coronation date of Candragupta Maurya and subtracting from it the sum of 137 + 112 + 45 = 294 years, we are left with 30 years B.C. which is the year of coronation of Sindhuka (Sisuka or Simuka). He ruled for 22 years and his successors Kaṇhva or Krishna is said to have ruled for 18 years. Thus the coronation of his successor, Sātakarṇī is also given the reign of 18 years. In this way, he ruled between 10 A.D. to 29 A.D. Thus Khāravela, being his contemporary, may be placed with the period of Vikramāditya, quite reasonably, with approximate dates, as one who was responsible for the establishment of his *Vikrama era* in 57 B.C. This is confirmed also by the shapes of the letters written in the Hāthīgumphā cave, slightly moving towards the angularity as suggested by T. P. Verma.[19]

VIKRAMĀDITYA IN THE LIGHT OF VAḌḌAMĀṆU EXCAVATIONS

This information is in view of excavations carried out by T.V.G. Shastri[20] et al during 1981-85 at Vaḍḍamāṇu village in Guntur district, South India, which is 8 kilometres away from the ancient internationally known Buddhist sight of Amaravati on the right bank of the Krishna river. There are archaeological evidences of the rule of Vikramāditya.

The Rāsabha kings of Gardabhilla line were originally of Chedi origin (Bundelkhand)[21] The evidences from the archaeological remains in the ancient sites at the Krishna-Godavary basin of Andhra Pradesh may be listed as follows:

1. The local tradition of Vikramāditya at Bhaṭṭiprolu[22]
2. Presence of Vikramāditya in Āndhra is well authenticated in the Hāthīgumph inscriptions
3. A number of coins of his descendents, the Sadas, from Amaravati, Bapatla, Kolanukonda[23] etc.
4. The pillar inscriptions of Siri Sada from Guṇṭūpallī[24]
5. These are further substantiated from the Vaḍḍamāṇu excavations conducted by T.V.G. Shastri between 1981-85.[25]

The details are as follows as given by him-

The excavations on the hillock Peḍḍakoṇa (a height of 100 km above ground level, brought to light, besides others, two important periods of structural activity which were associated with Jaina from 200 - 50 B.C. and 50 B.C. - 50 A.D. The antiquarian remains obtained may be classified as under -

a. *Structural:* They showed the existence of two stupa and ellipsoidal structures[26]

These are architecturally different from those found in the Buddhist sites of Amaravati and Nagarjunakonda indicating their dissociation with those of the Buddhists.[27]

b. *Inscriptions:* The inscriptions recovered indicate that the monastery on Vaḍḍamāṇu hill (VadamVaḍḍamāṇuna Pavate) was subsidized by Jaina Sangha from Vaisali, Kasi, Vidisa, Pithudapura (Āndhra) etc.[28] At least the inscriptions on three potsherds show reference to the successors of Vikramaditya. They read as Chedirājno Sātho (108) (2) Chedi rājno 930 Cheti Rāj (no).[29]

Evidently, all the three indicate of the country (Chedi) from which the Rāsabha things originated.

Now the rule of the descendents of Khāravela came to light from the pillar inscriptions found at Guntupalli in West Godavari district. They refer to the king Siri Sada who had the titles Mahārāja, Kalingādhipati and Mahisamādhipati.

c. *Coins:* The coins of Vikramāditya's successors, "Sadas" were found from the levels of the second period at Vaḍḍamāṇu, their names being Siri Sada, Mahāsada, Sivānaka Sada, Asaka Sada.

With the above evidences it has been suggested that Khāravela was a *Jaina* by birth, the Sadas being his descendants could also be noted as Jaina kings. This is also confirmed by the structural embellishments of the railing to *stūpas* of Vaḍḍamāṇu and the sculptures displayed therein. They have also close resemblance with those found in the caves of Udayagiri and Khaṇḍagiri. So far as the Vikrama era is concerned, Shastri confirms it to be 78 A. D. Besides Vaḍḍamāṇu, another important *Jaina* centre in the Krishna valley could be shown as Bhaṭṭiprolū. Being in the same district even now and not far off from each other, Jainism in Bhaṭṭiprolū might have been continued even during the region of Sada kings

who ruled the area. The *Jaina* tradition, we have already seen, had its origin in the Mauryan period. It was later linked up with the king Vikramaditya of Ujjain. At Bhaṭṭīprolū, according to the local legends, the region was ruled by a king named Vikramāditya. Again from the name, Bhatti was the brother of Vikramāditya though through different mothers. From the *Jaina* and the historical accounts, Gardhabhila, the king of Ujjain, was dethroned by Sakas who were instigated by the famous *Śvetāmbara Jaina* teacher, Kālakācārya, for his misdeeds towards his initiated sister. But the heroic Vikramaditya regained the kingdom back and established at Ujjain, the *Jaina* order. Vikramaditya's exploits were known from the legends at Bhaṭṭīprolū.[30] This was hailed as a great event and the Vikrama era was thus established as a mark of the defeat and expulsion of the foreigner rulers from the land. This shows that Vikramaditya belonged to the *Digambara Jaina* sect who face opposition very often from the *Śvetāmbara Jaina* sect, their literature being far from similarity, and quite different in so far as the *Āgamas* are concerned.

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5. Cf. INSA project,"The *Labdhisāra* of Nemicandra Siddhāntacakravartī" by L. C. Jain (1984-1987).
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8. Vide *Journal of Bihar and Orissa Research Society,* vol. xiv, pp. 191 et seq.
9. Vide *Nagpur University Journal,* no. viii, Vikrama volume, pp. 539-545.
10. Details of Hāthigumphā inscriptions of Khāravela, in Das, D.,"The Early History of Kalinga", Calcutta, 1977, p. 56.
11. One of the names of Kundakundācārya was *Ailācārya.* For the dynasty, "Cheti-rāja-vasa-vaḍhanena" is inscribed, and descent from Vasu, but another view is that Khāravela belonged to the *Bhīla* dynasty of Kalinga founded by *Aira Bhīla.*
Vide JBORS, xvi, 1930, pp. 189-205, and Jai Sinha, Prachina Utkala.
12. EI, xx, pp.79, 86. B.M. Barua, "Old Brahmi Inscriptions", pp. 40 et seq.
13. EI, xx, p. 81. *Mahāvagga,* SBE, xiii, p. 201. Vide also ASG and ALS.
14. Matrimonial relations between Kalinga and Radhe, might also be bearing a political motive for a northern campaign
15. Vide Stevenson, The Heart of Jainism, ch. viii.
16. Vide C. L. Shah, Jainism in North India, London, 1932, p. 164. According to the *Digambara* Jaina tradition, the *Vīra Nirvāṇa* saṁvat has some relevance to the *Vikrama Saṁvat* records which have been leading to the 2662 years lapsed now after *Vīra Nirvaṇa* in 2000 A.D. Vide, "*Śrī Mahāvīra Nirvāṇa Kāla Nirṇaya*" by Kulabhushan, Durg, 1961.
17. Ibid., p. 163. 18. Ibid., pp. 161-186.
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20. Vide, An Earliest Jaina Site in the Krishna Valley, Arhat Vacana, vol. 1, (34), June-Sept. 1989, 23-54.
21-30. Vide, Ibid.

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ZEROS AND INFINITIES OF ANCIENT INDIA

INDIA, our glorious motherland, has recently covered a few paces with the average achievements in modern mathematics at the primary and secondary stages of education. Their courses in mathematics are now being based on set-theoretic foundations through which we can stand the present strides in the technological world. Set theory and its allied sister theories form the very heart of the techniques in modern social and technical arts and sciences. In ancient India, however, these theories exist as common features of the unprecedented mathematico-philosophic discourses in the *Ṣaṭkhaṇḍāgama* (c. 2nd century A.D.) [abbr. SKG], the *Kaṣāya Prābhṛta Sūtra*(c. 1st century A.D.) [abbr. KPS] alongwith their various summary texts, the *Gommaṭasāra Jīvakāṇḍa*,the *Gommaṭasāra Karmakāṇḍa*, the *Labdhisāra* and the *Kṣapaṇāsāra* (c.10th century A.D.) [abbr. GJK,GKK, LDS, and KNS] as well as their commentaries. The zeros and infinities simply float in the ocean of their theory of Karma. They are based on the *Tiloyapaṇṇattī* (c.5th century A.D.)[abbr.TPT] and the *Trilokasāra*(c.10th century A.D.)[abbr. TLS].

Apart from the mysteries of zeros and infinities, this wonderful nation of the truly brave people, with serene character and ingenious mind, was well-known far and wide for its optimality in karmic ways of living in its chivalrous way and coping with wordly problems through their infinite capacity to forgive and forget. The culture of non-violence, the prodigy of snake-bite cure through magical chants, the rope-trick (indrajāla), entrance into another body (parakāyā-praveśa), the pārasa alchemy and the breath control yogic feats attracted saints and philosophers, politicians and scholars from all parts of the world. The core of the problems with them was concerned with the victory, not over the lands with ruthless selfish motives, but over passions of love and malice of material delusion, on which the Kurala and the Gita hymned through ages, while their mathematical secrets flew through undercurrents in Prakrit texts.

Playing with numbers was an easy task for the ancients because they signified certain material sense. Zero implied nothing or absence. Similarly, infinity was some vague extension, in quantity or quality, whose domains and ranges could not be explored through logic and intuition of the primitive world. India, with the wake of civilisation, came forward with answers to the unseen and the unaccounted for events It also accepted the challenge for having a probe into the cycles of births and rebirths (a deep rooted problem of biophysical phenomenon), which had baffled the western and eastern minds for generations. For investigation into the deepest realms of the invincible truth it took recourse to evolve the philosophical theories on the basis of mathematics of zeros and infinities. Our people also took resource to evolve the experimental environment in 'self' on the basis of mathematics of sets with zeros and infinities of cardinals and ordinals as means of measures.[1] There is no wonder if its impulse and impetus moved the mathematics of the world to produce monumental scientific researches down to the present century.

It may be made quite clear, at the outset, that this branch of mathematics was known as post-universal (Lokottara) and it is no wonder if its motivation, aims, objects and purpose moved the mathematicians of the world to produce monumental works on the secrets of nature from the era of science-awakening down to the present century in harmonious phases.

Studies in post-universal mathematics were probably stimulated to unravel the accomplishments of 'own' soul in all its perspectives. Common and extra-ordinary characteristic properties of souls and non-souls led to the method of one-to-one correspondence which, in turn, might have exposed not a single type of infinity but several types of infinite sets. Indians did not stop here. They proceeded with several tools of analysis, for example, the logarithms, sequences, permutations and combinations and the like in order to tackle the problem of the comparability (alpa-bahutva) of the finite and transfinite sets (rāśis), hundreds of years before the birth of the theory of transfinite numbers, (first article appearing in March 1895) by Georg Cantor.[2]

UNTOLD STORY OF ZEROS

In the theory of Karma, several contexts arise where the concepts of negation, non-existence, non-expressibility, absence, void, nothingness, gap etc., arise. (cf. SKG, 3, 2, 59 and 5, 3, 90, and KSP, 49, etc.). Naturally, the mathematical trend led to the old denomination of zero as cipher, zero and naught. Indians called it *śūnya*, meaning 'void', and this term passed over into Arabic as as-sifr. The Greek name is omicron. It has also been characterized as Zephirum by Fibonaccei, tziphra by Planudos, and zeuro or zepiro by the Italians. It was also known by such names as sipos, tsiphron, zeron, rota, circulus, galgal, theca, null and figura nihili. The *Kapila Gītā* mentions as many as five kinds of zeros.

The present form of the zero may have been suggested by an empty circle, by the Greek use of omicron (O) to indicate a lacuna, (being the intial of ouden which means nothing). It may also have been suggested by the horned circle used in the Brāhmī symbol for ten, or by the Indian use of a small circle (O), as well as a dot (bindu) to indicate a negative, or in some other way destined to oblivion.

According to Neugebauer, no definite answer could be given to the question when the zero sign was introduced in Babylonian mathematics. He feels sure that it did not exist, say, before 1500: and he finds it in full use from 300 B.C. onwards. A table of squares, found at Kish, tentatively dated by the excavator, S.Langdon, to the period of Darius (500 B.C.), is said to have contained four cases of a 'zero'. The Babylonian records of many centuries later, of about 200 B.C., give a symbol for zero which denotes the absence of a figure but apparently was not used in calcualtion. Round about 130 A.D., Ptolemy used in his *Almagest* the Babylonian sexagesimal fractions and also the omicron (O) to represent blanks in the sexagesimal numbers. This zero was not used as a regular zero. It is clear to us that the Babylonians had the principle of local value, and also a symbol for zero, to denominate the absence of a figure, but did not use this zero in computation. Probably, five or six centuries before the appearance of the Indian systematic exposition of their decimal number system with its zero and principle of local value, the Maya, in the flat lands of Central America, had evolved systematically, a bigesimal number system employing a zero and the principle of local value. In the Maya number system, found in the codices dating from about the beginning of Christian era, the ratio of increase of successive units was not ten, but it was twenty in all positions except the third. The zero was represented by a symbol that looked roughly like a half-closed eye.

In India, the zero symbol has been found to be used in metrics by Piṅgala (before 200 B.C.) in his *Chandaḥ-sūtra*. A number of inscriptions using a point-symbol as well as a circular symbol for zero fitted in decimal place-value system are the Khemre inscription at Sambor (683 A.D.), the Malay inscription at Palembang (684 A.D.), and the Dinaya inscription at Java (760 A.D.). The earliest of epigraphical records of the use of zero was found in the Ragholi plates of Jaiwardhan II (c. eighth century A.D.). The Gwalior inscriptions of the reign of Bhojadeva were also found to contain zero. The symbol of zero was used for filling up the gaps in the *Mahābandha* (c. 2nd century A.D.). It also appears, as a small circle in several texts as the *Dhavalā* and the *Jaya Dhavalā* commentaries (c. 9th century A.D.) for various uses. It stands for a negative sign, for absence, for one sensed soul, two sensed soul, etc., for the *agṛhīta* stage in which a soul does not assimilative Karma during a material change, for filling up gaps, for a place value as a distinct numerical symbol, as well as for abbreviations.

In all works of arithmetic (*pātigaṇita*), zero has been used as back as third century A.D. to denote the unknown. This is not in algebra. In arithmetic, zero for the unknown denotes the absence of a quantity in problems on proportion, the rule of three etc. The Indian mind did not rest satisfied till the complete arithematic of zero was developed by them. The operations of addition and subtraction of zero are mentioned in the *Pañca Siddhāntikā* of Varāhmihira. The decimal arithmetic can be traced in the commentary of Bhāskara (c. 525 A.D.) on the *Āryabhatīya*. *Mahāvīrācārya* gave operational rules for manipulating zero on a set-theoretic basis. When out of a number of things, distribution is to be made to none, the number of things remains unaltered. This was what he intrepreted as division by zero. Bhāskara, on the other hand,

treated the zero on the basis of limits.

The earliest Indian treatment of zero in algebra is found in the *Brāhma-Sphuṭa-Siddhānta* of the seventh century. Bhāskara interprets the division of a number by zero as kha-hara (i.e. a number with zero as denominator). The idea of zero as an infinitesimal is more in evidence in his eminent works. He used quantities which ultimately tend to zero, and got evaluated the differential coefficients of certain functions, centuries before the advent of Newton's and Leibnitz's works on calculus (c. 16th century A.D.). Regarding *kha-hara*, Bhāskara remarked, "In the quantity consisting of that which has a cipher for its divisor, there is no change taking place in the infinite and immutable God, at the period of the destruction or creation of worlds, though numerous classes of beings are absorbed or put forth."

In this way, in simple contrivances of the zeros, mathematics received one of the most powerful impulses. They were as valuable and as manageable in an infinitely descending order as in an infinitely ascending series and sequences.

HISTORY OF DARK PERIODS OF INFINITIES

Let us now rise the curtain and open the three broad vistas of infinities, noted as philosophical, potential and actual. In the history of western philosophy the term 'Infinite' is met with, perhaps for the first time, in the teaching of Anaximander (6th century B.C.), in religious and metaphysical contexts, the notion of the absolutely infinite was developed, which implied the idea of something whose size, number, degree, etc., could not be measured in any way, whatsoever. It was therefore thought to be omni-comprehensive and omni-potent. This trend did not change, and later philosophers like Parmenides, Aristotle, Descartes, Spinoza, Leibnitz, Locke, Berkeley, Hume, Kant and Hegel could not expand the frontiers of the knowledge of infinity, beyond the difficult and doubtfully consistent philosophical arena.

Potential infinity is also known as mathematical infinity. The concept of potential infinity was implicit in early Greek geometry, where the assumption prevailed that a straight line could be produced indefinitely in either direction of infinite space. In the Jaina School of Mathematics, ten types of infinities were established: the infinite in denomination, infinite as an attribute, infinite of fluents, calculation-transfinite, dimensionless infinitesimal, mono-directional infinity, bidirectional infinity, areal infinity, spatial infinity, infinity of knowledge and infinite in time. Similar conceptions lay in Greek ideas of asymptotes, projective geometry and circular points at infinity. Zeno (c. 450 B.C.) of Elea is also famous for having touched on the problem of infinite divisibility or otherwise, of finite segments of space and time in his paradoxes of 'Achilles and the Tortoise' as well as 'The Arrow'.[3] These paradoxes baffled the contemporary Greeks and the scholars round the civilized nations, till the end of nineteenth century. They realized that Zeno's arguments were fatal to infinitesimals and tried to avoid the difficulties by once for all banishing the idea of the infinite, even the potentially infinite, altogether from their science. They, thenceforth, did not make use of magnitudes, increasing or decreasing *ad infinitum*, but contented themselves with finite magnitudes which could be made *as great or as small as they pleased.* Similar was the fate with Galileo (1564-1642), Cauchy (1789-1857). Gauss (1777-1855) and Bolzano (1781-1848) who failed to perceive the stadium of *actual* infinities.

PARADISE OF ACTUAL INFINITIES

It was only due to an extra ordinary energy and untiring perseverance of Georg Cantor(1845-1918) who, under persistent opposition, from several mathematicians gained a victory over the cardinals and ordinals of the transfinite, capable of arithmetical manipulations and set-theoretic operations.These are similar to the simile (*upamā*) and number (*saṁkhyā*) measures of the post-universal mathematics detailed in the Karaṇānuyoga group of Prakrit texts in the Jaina School. Fraenkel asserts that this conquest may be considered as an expansion of our scientific horizon to no less an extent than the Copernican system in astronomy, and the theory of relativity, or even of quanta, in physics. India should also be proud of the facts asserted by Singh and Datta, the world famous authors of 'History of Hindu mathematics'

and several other research articles on ancient Indian works. They found parallel contributions to those of Georg Cantor in Indian Prakrit and Sanskrit texts which were composed several centuries before Cantor's vision.

Of the so called Paradise Of Actual Infinities, A. N. Singh remarked,"The following will show that in India the Jaina philosophers succeeded in classifying the various notions connected with the term infinite, and in evolving the correct definition of the numerical infinite."[4]

We open the chapter by introducing Cantor's work on which Hilbert (1862-1943) was led to say, "Cantor thereby created one of the most fertile and powerful branches of mathematics: a paradise from which no one can drive us out." Cantor had ingeniously generalized the laws and rules applied to finite numbers in such a way that they would extend beyond the domain of these numbers. He devised the diagonal method for proving that the transfinite set of natural numbers is smaller than the transfinite set of real numbers which include natural, rational, irrational and transcendental numbers. He also gave the method of producing a greater infinity from a smaller infinity. Apart from the point-set theory he put up the still unestablished continuum hypothesis and accepted the well-ordering theorem which had far-reaching effects in the formulation of foundations of set theory.

The mathematical laws of addition, subtraction, product and division regarding the actual infinities are not the same as they are for finite quantities. For them a set theoretic approach is made. A universe of elements is defined, and sets of the universe at the operations of union, intersection, as well as complementation produce other sets which are to be never greater than the universe itself. A glimps of this is probably implied in the following first sūtra of the *Bṛihadāraṇyaka Upaniṣada*:

"Oṁ pūrṇa madaḥ pūrṇamidaṁ, pūrṇāt pūrṇamudacyate
pūrṇasya pūrṇamādāya pūrṇamevāvasiṣṭyate"

Similarly, other adequate material may be traced in the various *Upaniṣadas*. In Prakrit texts, next to zero anything that exists either as an indestructible substance or as a concept is taken as unity. The unity, as an element, might be either an infinitesimal or otherwise. The collection or aggregate of such elements was known as *rāśi*. Words like *trairāśika, nakṣatra rāśi, jīva rāśi* etc. were used in several contexts. The subjects treated in Indian mathematics of the early renaissance period consists of *rāśi* calculations as appears form the following *sūtra* (747) of the *Sthānaṅga,*

"Parikammaṁ vavahāro, rajju rāsi kalāsavaṇṇe ya
Jāvantāvati vaggo ghaṇo, tataha vaggāvaggo vikappo taṁ"

In Prakrit texts, infinitesimal elements constituting various types of transfinite structural and existential sets (*rāśis*) are either fluents, concepts, space-points, time-instants, controls and events, indivisible-corresponding-sections of controls and yogic or mohic states of advenience or efforts for motive of material gains. The infinitesimal element, constituting sets, is either a space-point which is the space occupied by an ultimate particle of matter or an indivisible samaya (instant) which corresponds to the event of an occurrence in a substance. The elements may also be indivisible-corresponding-sections of knowledge or other types of qualities as states of advenience (and so on) in a mundane soul.

Thus, instants in the past or future, points in whole infinite space, etc., form various types of sets. The greatest universe is the set of indivisible-corresponding sections of omniscience. All such types of sets are compared with the help of formation of various types of transfinite sequences, with these sets lying in comparative order, as if the well-ordering theorem of Cantor were accepted as true.

The notion of attaining a covering set by Cantor also appears as if parallels to the method of spread, give and multiply in Prakrit texts. Besides the comparability results of *rāśis*, the account of gaṇaṇānanta which is one of the eleven kinds of infinities, is exhaustive and rigorous. In the gaṇaṇānanta, the *asṁkhyāta* (innumerate) *rāśi* lies between the *saṁkhyāta* (numerate) and the *ananta* (infinite). All these approaches are not only semantic but also symbolic and there lies a deep rooted aximomatic as well as intuitionistic formalism in the exposition of these Indian infinities of qualities as states of advenience

(and so on) in a mundane soul. Thus, instants in the past or future, points in whole infinite space, etc., form various types of sets.

All these approaches are not only semantic but also symbolic and there lies a deep rooted aximomatic as well as intuitionistic formalism in the exposition of these Indian infinities.The sets are also analysed through methods of logarithms as well as eight types of abstractions or choices (vikalpas).[5] These are the methods of cut, division, spread, deduction, reason, abstractions and so on. These are all mathematical techniques of dealing appropriately with the transfinite numbers.

Regarding the method of one-to-one correspondence, introduced first by Galileo and then by Cantor, Dr A. N. Singh remarked, "As already pointed out, the method of one to-one correspondence has proved to be the most powerful tool for the study of infinite cardinals, and the discovery and the first use of the principle must be ascribed to the Jainas." Yet, one may also find the use of one-to-many and many to many as well as vice-versa in Prakrit texts of the *Karaṇānuyoga* group. The principle of correspondence was also used in atomic theory by Bohr. Analytically, the Jaina school divides the domain of number measure into three divisions: *the numerable, the innumerable and the infinite.* Then these are subdivided into three, nine and nine subdomains, respectively, located through the projection of various existential sets.

Thus, the mysteries and miracles lose part of their incomprehensibility in an Indian congenial atmosphere pervaded with the heavenly bliss of infinities. It is hoped that the research scholars will take interest into these realms of mathematical pursuits, still unexposed to the world of frontiers of scientific knowledge.

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APPENDIX - 5

Names of ancient Prakrit texts mentioned in the TPT

Aggāyaṇī	4-1982
Mūlācāra	8-532
Loya viṇicchaya	4-1866' 1905, 1982, 2028; 5-69, 129, 167; 7-203; 8-270, 386, 9-9.
Loya vībhāya	1.281, 4-2448, 2491; 7-115; 8-935
Loyāyaṇī	8-530
Logāiṇī	4-2444
Saggāyaṇī	4-217, 1821, 2029
Saṁgāiṇī	4-2448
Saṁgāyaṇī	8-272
Saṁgāhaṇī	8-387
Saṁgoyaṇī	4-219

Note : The LVG quotes several verses from the TPT, and TLS.

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APPENDIX-BBP3

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APPENDIX- 6

4.72. GEOGRAPHICAL TERMS (TPT)

(NAMES OF MOUNTAINS, RIVERS, ISLANDS, PEAKS, CITIES ETC.)

NAME	CHAPTER-VERSE	NAME	CHAPTER-VERSE
AKṢOBHA	4.124	AAKRĀNTA	2.41, 2.119
AGNIJWĀLA	4.122	AVATAṀSA KŪṬA	4.2130
ACYUTA	8.16, 120	AVADHI STHĀNA	2.45, 2.156
ATINIRODHA	2.51	AVIDYA	2.48
ATINISAKTA	2.50	AŚOKA	4.120, 8.397
ATIPIPĀSĀ	2.47	AŚOKĀ	4.2299, 5.76
ANITYA	2.48	AŚMA GARBHA	4.2766
ANUTTARA	1.162, 8.117	AŚVATTHA FOREST	4.666
ANUDIŚA	8.117	AŚVA PURĪ	4.2299
ANTARADVĪPA	4.2240, 4.2490	AṢṬAMA PṚTHIVĪ	2.24, 8.652
APARAVIDEHA	4.1758	ASAṀBHRĀNTA	2.40, 2.144
APARĀJITA	4.114, 523, 8.100	ASĀRAGALLA	2.16
APARĀJITAKŪṬA	5.156	ASURA	8.91
APARĀJITĀ	4.2297, 5.77	AHINDAVARA	5.22
ABADHYĀ	4.2300	AṄKA	2.17, 8.13
ABBABAHULA BHĀGA	2.9, 19	AṄKA KŪṬA	4.2767, 4.5123
ABHAYENDRA	8.92	AṄKAPRABHA	5.123
ABHIṢEKA ŚĀLĀ	3.58	AṄKA MAYA	4.1634, 4.1734
ABHIṢEKA SABHĀ	5.202	AṄKĀ	4.2297
ABHRA	8.13	AÑJANA	2.16, 8.14
AMALA	8.94	AÑJANA KŪṬA	4.2766, 5.145
AMITA	8.301	AÑJANA GIRI	5.57
AMITA BHĀSA	8.96	AÑJANA BHAVANA	4.1843
AMOGHA	8.16	AÑJANA MŪLA	2.17
AMOGHA KŪṬA	5.153	AÑJANAMŪLA KŪṬA	4.2767, 5.145
AMOGHA SPARŚA	8.95	AÑJANAVARA ISLAND	5.25
AYODHYĀ	4.526, 4.2300	AÑJANA ŚAILA	4.2103
ARAJASKĀ	4.114	AÑJANĀ	1.153
ARAJĀ	4.2299, 5.76	ANDIŚA	8.92
ARIṢṬA	8.14, 8.298	ANDHA	2.151
ARIṢṬAPURĪ	4.2293	AṀBARĪKA	4.1769
ARIṢṬA VIMĀNA	4.1844	AṀBARA TILAKA	4.121
ARĪṢṬĀ	1.153	ĀTMĀÑJANA	4.2211
ARIÑJAYA	4.113	ĀDITYA	8.17
ARUṆA	8.12	ĀNATA	4.524, 8.15
ARUṆAVARA DVĪPA	5.17, 8.597	ĀNATA KALPA	1.161
ARUṆAVARA SEA	5.17	ĀNANDA KŪṬA	4.2058
ARUṆĀBHĀSA	5.17	ĀRA	2.44, 2.141
ARUṆĪ	4.118	ĀRAṆA	1.160, 8.16
ARJUNĪ	4.118	ĀRAṆA YUGALA	4.523
ALAKĀ	4.121	ĀRYA KHAṆḌA	4.267
ALAṄKĀRA SABHĀ	5.203	ĀVARTĀ	4.2206

ĀŚĪ VIṢAKA	4.2213	KACCHA	4.2060
ĀŚCARYA	4.1664, 4.1734	KACCHAKĀVATĪ	4.2206
ĀSANA GṚHA	3.59	KACCHĀ	4.2206
INDU DRAHA	4.2126	KACCHĀ KŪṬA	4.2260
INDRAKA	2.36	KAJJALA PRABHĀ	4.1962
ILĀ KŪṬA	4.1632	KAJJALĀ	4.1962
IṢVĀKĀRA	4.2532	KAGAMBAKA	4.2410
ĪŚĀNA	8.120	KADALI GṚHA	3.59
ĪṢATPRĀG BHĀRA	8.656	KANAKA	8.95
UGRAVANA	4.647	KANAKA KŪṬA	4.2767, 5.122
UJJVALITA	2.43, 2.138	KANAKA PRABHA	5.122
UTTARA KURU	4.2060	KANAKA DHARĀDHARA	1.51
UTTARA BHARTA KŪṬA	4.148	KAMALA	8.93
UTPALA	4.1665, 8.93	KARṆA	8.95
UTPALA GULMĀ	4.3946	KARVAṬA	4.2238
UTPALĀ	4.1946	KALAŚA	8.91
UTPALOJJVALĀ	4.1946	KALAPA BHŪMI	1.163
UDAKA	4.2464	KALPĀTĪTA MAHĪ	1.163
UDAKĀBHĀSA	4.2464	KAÑCANA	8.12, 8.94
UDITA	8.94	KAÑCANA KŪṬA	4.2031, 5.145
UDBHARĀNTA	2.40, 2.112	KAÑCANA ŚAILA	4.2094
UNMAJHĀ	4.237, 4.1340	KAMPILĀPURĪ	4.538
UNMATTAJALĀ	4.2215	KĀKANDĪ	4.534
UPAJALADHĪ	4.1305	KĀPIṢṬHA	1.160
UPANANDANA	4.1806	KĀMAPUṢPA	4.115
UPAPĀNḌU	4.1806	KĀLA	2.53
UPAPĀDA SABHĀ	5.201	KĀṄKṢĀ	2.47
UPASAUMANASA	4.1806	KĀÑCANA KŪṬA	4.2357
UPĀRDHA	8.93	KĀÑCANA DVĪPA	5.24
ŪRJAYANTA	1.22	KILAKILA	4.118
ŪRMIMĀLINĪ	4.2216	KINNARA GĪTA	4.112
ṚJUKŪLĀ (RIVER)	4.701	KINNĀMITA	4.112
ṚTU	8.12	KUKṢINIVĀSA	4.2240,
ṚTU ĀVARTA	8.87	KUMUDA	4.121, 8.93
ṚTU PRABHA	8.87	KUMUDA KŪṬA	5.150
ṚTU MADHYAMA	8.87	KUMUDA PRABHĀ	4.1966
ṚTU VIṢIṢṬA	8.87	KUMUDA ŚAILA	4.2112
ṚDDHĪŚA	8.12	KUMUDĀ	4.1966,4.2208
ṚṢI ŚAILA	1.66	KURU	4.2091
EKA ŚAILA	4.2210	KUŚAVARA DVĪPA	5.20
AIRĀVATA	4.91, 4.2365	KUSUMA	8.91
AIRĀVATA KŪṬA	4.1661	KUṆḌALA	8.96
AIRĀVATA DRAHA	5.2126	KUṆḌALA KŪṬA	5.156
OLAGAŚĀLĀ	3.58	KUṆḌALA GIRI	4.1479, 5.117
AUṢADHA NAGARĪ	4.2294	KUṆḌALA DVĪPA	5.117
AUṢADHA VĀHINĪ	4.2216	KUṆḌALA NAGARA	4.549

KUṆḌALA VARA DVĪPA	5.18
KUṆḌALĀ	4.2297
KUNDA	4.121
KŪṬA	3.40
KETUMĀLA	4.120
KEŚARĪ DRAHA	4.2116
KAILĀŚA	4.118
KOKANADA	8.93
KAUŚĀMBĪ PURA	4.531
KAUSTUBHA	4.2460
KAUSTUBHĀSA	4.2460
KRAUÑCAVARA DVĪPA	5.20
KṢĪRAVARA DVĪPA	5.15
KṢĪRODĀ	4.2216
KṢUDRA HIMAVĀNA KŪṬA	4.1661
KṢEMAPURA	4.114
KṢEMAPURĪ	4.2293
KṢEMAṄKARA	4.116
KṢEMĀ NAGARĪ	4.2268
KṢAUDRA VARA DVĪPA	5.16
KHAḌA KHAḌA	2.44
KHAḌGAPURĪ	4.2300
KHAḌGĀ	4.2293
KHAṆḌA PRAPĀTA	4.147, 4.176
KHARA BHĀGA	2.9, 3.9
KHALA KHALA	2.147
KHEṬA	4.2237
GAGANA	8.94
GAGANACARĪ	4.115
GAGANA NANDANA	4.120
GAGANA VALLABHA	4.121
GAJA	8.14
GAJA DANTA	4.2101
GABHĪRAMĀLINĪ	4.2216
GARUḌA	8.14
GARUḌA DHVAJA	4.113
GARBHA GṚHA	3.59
GAṄGĀ	4.196
GAṄGĀ UPAVANA VEDĪ	4.1306
GAṄGĀ KŪṬA	4.210
GAṄGĀ KŪṬA PRĀSĀDA	4.223
GANDHA MĀDANA	4.2015,4.2057
GANDHA MĀLINĪ	4.2206
GANDHARVA PURA	4.122
GANDHAVATĪ	4.2357
GANDHA VYĀSA	4.2057
GANDHĀ	4.2209
GANDHĪḶĀ	4.2209
GIRIŚIKHARA	4.124
GOKṢIRA PHENA	4.124
GOMEDAKA	2.16
GRĀMA	4.2266
GRĀHAVATĪ	4.2215
GRAIVEYA	8.117
GRAIVEYAKA	1.161
GHARMĀ	1.153
GHĀTA	2.41, 2.125
GHṚTAVARA	5.15
CAKRA	8.14, 8.93
CAKRAPURĪ	4.2300
CATURMUKHA	4.114
CANDANA	2.17, 8.94
CANDRA	4.117, 8.12
CANDRA KŪṬA	5.150
CANDRAGIRI	4.2213
CANDRA PURA	4.533
CANDRĀBHA	4.116
CAMARA	4.119
CAÑCAT	8.12
CAMPĀPURA	1.22, 4.537
CĀPA	8.91
CITRA KŪṬA	4.116, 4.2210
CITRAGṚHA	3.59
CITRANAGA	4.2124
CITRĀ	2.14, 4.1400
CŪḌĀMAṆI	4.118
CAITRAVANA	4.664
CHATRA	8.91
CHINNA	1.67
JANMA ŚĀLĀ	3.58
JAMBŪ DVĪPA	5.179
JAYANTA	4.115, 4.523 8.100
JAYANTA KŪṬA	5.156
JAYANTAH	4.2300
JAYANTĪ	5.77
JAYA PURĪ	4.113
JAYĀ VAHA	4.123
JALAKĀNTA	8.96
JALA PRABHA	4.1848, 8.298
JALASTAMBHA	4.1309
JAMBŪ VṚKṢA	4.2195

JINAKŪṬA	4.1664	DRAHAVATĪ	4.2215
JINA BHAVANA	3.43	DVĀRĀVATĪ	4.643
JIHVAKA	2.42	DROṆA MUKHA	4.2239
JIHVĀ	2.42	DHANAÑJAYA	4.123
JYOTIRASA	2.16	DHARIṆĪ	4.124
JHAṢAKA	2.45, 2.150	DHARMAVARA	8.95
TATVA	2.44, 2.144	DHĀTAKĪ KHAṆḌA	4.2527
TANAKA	2.41, 2.122	DHŪMA PRABHĀ	1.152, 2.21
TAPANA	2.43, 2.134	NAKṢATRA	8.94
TAPANA KŪṬA	4.2045, 5.145	NAGARA	4.2237
TAPANĪYA	8.13,	NANDANA	4.1806, 8.12
TAPANĪYA KŪṬA	4.2768		8.94
TAPTA	2.40,2.116,2.132	NANDANA KŪṬA	4.1970
TAPTAJALĀ	4.2215	NANDANA VANA	4.1988
TAMAKA	2.44, 2.145	NANDAVATĪ	5.62
TAMASTAMAḤ-PRABHĀ	2.21	NANDĀ	3.45, 5.62
TAMAḤA PRABHĀ	1.152, 2.21	NANDI GHOṢĀ	5.62
TĀPANA	2.43, 2.135	NANDĪŚVARA	1.26, 5.16
TĀRA	2.44, 2.143	NANDOTTARĀ	5.62
TIGIÑCHA	4.1761	NANDYĀVARTA	8.14
TIMIŚRA	2.45,152, 8.93	NANDYĀVARTA KŪṬA	5.169
TIMIŚRA GUPHĀ	4.176	NARAKĀNTĀ	4.2337
TIMIŚRA GUHA	4.148, 4.2260	NARAKĀNTĀ KUṆḌA	4.2338
TILAKA	4.121	NARAGĪTA	4.112
TRASANĀLĪ	2.6	NALINA	8.12
TRASITĀ	2.40, 2.117,	NALINA KŪṬA	4.2210, 5.150
ṬRIKŪṬA	4.116, 4.2211	NALINA GULMĀ	4.1966
TRIBHUVANA-CŪḌĀMAṆI	4.2109	NALINĀ	4.1946, 4.2208
TRIBHUVANA-TILAKA	4.1859	NĀGA	8.14
DAKA PARVATA	4.2468	NĀGAGIRI	4.2213
DAKA VĀSA	4.2468	NĀGPURA	4.543
DADHI MUKHA	5.65	NĀGARAMAṆA	4.1805
DIKSVASTIKA	8.92	NĀGAVARA	5.53
DIGU	8.92	NĀTHAVANA	4.667
DIGGAINDA	4.2103	NĀBHIGIRI	4.2395
DIVYATILAKA	4.122	NĀRAKA BILA	2.26
DURGA	4.124	NITYA VĀHINĪ	4.117
DURGĀṬAVĪ	4.2240	NITYĀLOKA KŪṬA	5.160
DURDHARA	4.124	NITYĀLOKA	5.177
DUḤKHĀ	2.49	NITYODDYOTA	4.117
DEVA KURU	4.2139	NITYODDYOTA KŪṬA	5.160
DEVA KURU KŪṬA	4.2031	NITYODDYOTĀ	5.177
DEVA MĀLA	4.2213	NIDĀGHA	2.43
DEVARAMAṆA	4.1805	NIMAGNĀ	4.237, 4.1340
DEVAVARA	5.23	NIRAYA	2.40, 2.109
DEVĀRAṆYA	4.2201	NIRODHA	2.50, 2.51

NIṢADHA	4.94, 4.1750
NIṢADHA KŪṬA	4.1758
NIṢADHA DRAHA	4.2091
NISṚṢṬHA	2.50
NĪLA	4.94
NĪLA GIRI	4.2327
NĪLA DIGGAJENDA	4.2134
NĪLA DRAHA	4.2126
NĪLA VANA	4.663
NĪLA VĀN	4.1774
NĪLĀ	2.52
NAIMIṢA	4.122
PATTANA	2.2238
PADMA	8.42
PADMAKĀVATĪ	4.2208
PADMA KŪṬA	4.2045, 5.150
PADMA DRAHA	4.195, 4.1658
PAKMANĀBHI GIRI	4.2336
PADMAMĀLA	8.13
PADMĀVATĪ	4.2297
PADMOTTARA DIGGAJENDRA	4.2134
PARIDHI	5.35
PALĀŚAGIRI	4.2112
PAṄKA PRABHĀ	1.152, 2.21
PAṄKA BAHULA BHĀGA	3.7
PAṄKA BHĀGA	2.9, 2.19
PAṄKA VATĪ	4.2215
PAṄKA	2.52
PAÑCA ŚIKHARĪ	4.1662
PAÑCA ŚAILA NAGARA	1.65
PĀNDU	1.67, 4.1806
PĀNDUKA PRĀSĀDA	4.1851
PĀNDUKAMBALĀ	4.1830
PĀNDU ŚILĀ	4.1818
PĀTĀLA	4.2408
PĀVĀ NAGAR	1.22
PĀṢĀṆA	2.18
PĀSA	8.93
PIPĀSĀ	2.47
PUṆḌARĪKA	4.112, 8.93
PUṆḌARĪKA DRAHA	4.2344
PUṆḌARĪKIṆĪ	4.2294
PURIMATĀLAVANA	4.679
PUROTTAMA	4.116
PUṢKARAVARA	5.14
PUṢKALĀ	4.2206
PUṢKALĀVATĪ	4.2206
PUṢPAKA	8.15
PUṢPA CŪLA	4.118
PUṢPA VANA	4.652
PUṢPOTTARA	4.524
PŪRṆA KŪṬA	4.148
PŪRṆA BHADRA	4.2061
PṚṢṬHAKA	8.14
PRAKĪRṆAKA	2.36,
PRAJVALITA	2.43, 2.137
PRATISĪTODĀ KUṢḌA	4.2067
PRABHA	8.14
PRABHAṄKARA	8.14
PRABHAṄKARĀ	4.2297
PRABHAÑJANA KŪṬA	4.2768
PRABHĀSA TĪRTHA	4.264
PRABHĀSA DVĪPA	4.2254
PRAVĀLA	2.16
PRAVĀLA KŪṬA	4.2767
PRĀṆATA	4.524, 8.15
PRĪTIṄKARA	8.17
PHENAMĀḶINĪ	4.2216
BAḌAVĀMUKHA	4.2410
BALABHADRA	8.14
BALABHADRA KŪṬA	4.1978,4.1997
BAHUKETU	4.112
BAHUMUKHA	4.114
BAHULA	2.17
BĀLUPRABHĀ	1.152
BRAHMA	8.15
BRAHMA HṚDAYA	8.15
BRAHMOTTARA	8.15, 8.159
BHADDILA	4.535
BHADRA	8.92
BHADRA ŚĀLA	4.1805
BHADRĀŚVA	4.123
BHARATA	4.91
BHARATA KŪṬA	4.147, 4.1632
BHUJAGAVARA	5.19
BHŪTARAMAṆA	4.1805
BHŪTA VARA	5.23
BHŪTA HITA	8.95
BHŪTĀRAṆYA	4.2203
BHŪMI TILAKA	4.122
BHŪṢAṆAŚĀLĀ	3.58
BHṚṄGANIBHĀ	4.1962

BHṚṄGA	4.1962
BHRAMAKA	2.45, 2.149
BHRĀNTA	2.40, 2.111
MAGHAVI	1.153
MAṬAṀBA	4.2238
NAṆI KĀÑCANA	4.2357
MAṆI KŪṬA	5.123
MAṆI PRABHA	5.123
MAṆI VAJRA	4.123
MATTA JALĀ	4.2215
MANAKA	2.41, 2.123
MANAḤ ŚILA	5.26
MANOHARA	8.91
MANOHARA UDYĀNA	4.649
MARUT	8.12
MAHADUḤKHĀ	2.49
MAHAKACCHĀ	4.2206
MAHĀKĀLA	2.53
MAHĀKĀṄKṢĀ	2.47
MAHĀ KŪṬA	4.116
MAHĀ JVĀLA	4.122
MAHĀTAMAḤ PRABHĀ	1.152
MAHĀ NIRODHA	2.50
MAHĀ NINDYA	2.48
MAHĀ NĪLA	2.52
MAHĀ PADMA	6.1727
MAHĀ PADMĀ	4.2208
MAHĀ PAṄKA	2.52
MAHĀ PUṆḌARĪKA	4.2360
MAHĀ PURĪ	4.2299
MAHĀ PRABHA	5.122
MAHĀ RAURAVA	2.53
MAHĀVATSĀ	4.2207
MAHĀ VAPRĀ	4.2209
MAHĀ VIDEHA	4.1774
MAHĀ VIDYA	2.48
MAHĀ VIMARDANA	2.51
MAHĀ VEDĀ	2.49
MAHĀ ŚAṄKHA	4.2466
MAHĀ ŚUKRA	1.160, 4.525, 8.15
MAHĀ HIMAVĀN	4.1717
MAHĀ HIMAVĀN KŪṬA	4.1724
MAṄGALA KŪṬA	4.2031
MAṄGALĀVATĪ	4.2207
MAÑJŪṢĀ	4.2293
MANTRA SABHĀ	5.204,
MANDARA	4.121, 8.397
MANDARA ŚAILA	4.1780
MĀGADHA TĪRTHA	4.244
MĀGADHA DVĪPA	4.2254
MĀGHAVĪ	1.153
MĀṆIBHADRA KŪṬA	4.147, 4.2260
MĀNUṢOTTARA FOREST	4.1805
MĀNUṢOTTARA ŚAILA	4.2748
MĀNASTAMBHA	3.39
MĀRA	2.44, 2.142
MĀLYAVĀN	4.2015, 4.2060
MĀHENDRA	1.159, 4.1231, 8.120
MITRA	8.14
MITHILA	4.544
MUKTĀHARA	4.122
MURAJA	8.92
MṚṢATKĀSĀRA	8.397
MEKHALĀPURA	4.114
MEGHA	8.13
MEGHA KŪṬA	4.117
MEGHĀ	1.153
MAITHUNA ŚĀLĀ	3.58
MLECCHA KHAṆḌA	4.268, 4.1333
YAKṢAVARA	5.23
YAMA KŪṬA	4.2276
YAMAKA ŚAILA	4.2075
YAŚODHARA	8.16
YŪPA KEŚARĪ	4.2410
RAKTA KAMBALĀ	4.1834
RAKTAVATĪ	4.2357
RAKTA ŚILĀ	4.1832
RAKTĀ	4.2357, 4.2369
RAKTODĀ	4.2370
RAJAT	4.1970, 5.122 8.397
RAJATA PRABHA	5.122
RATIKARA	5.67
RATNA KŪṬA	4.2768, 5.156
RATNAPURA	4.125
RATNA PRABHA	5.173
RATNA PRABHĀ	1.152, 2.20
RATNA SAÑCAYĀ	4.2297
RATNĀKARA	4.125, 4.2241
RATNOCCAYA	5.174

RATHANŪPURA	4.114	VAJRĀḌHYA	4.113
RAMAṆĪYĀ	4.2207, 5.78	VAJRĀRGALA	4.113
RAMYAKA	4.2335	VAJRĀRDHA TARA	4.124
RAMYĀ	4.2207, 5.78	VAJRĀVANI	8.99
RASA DEVĪ	4.2357	VATSAKĀVATĪ	4.2207
RĀJAGṚHA	4.545	VATSĀ	4.2207
RĀJYAKŪṬA	5.153	VANAKA	2.41, 2.124
RĀJYOTTAMA	5.153	VANAMĀLA	8.14
RIṢṬĀPURĪ	4.2293	VAPRAKĀVATĪ	4.2209
RUKMĪ	4.2340	VAPRĀ	4.2209
RUCAKA	4.1664, 5.123	VARATANU	4.2254
	8.13	VARCAGATA	2.17
RUCAKAVARA	5.19, 5.141	VARDALA	2.45, 2.124
RUCAKĀBHA	5.123	VARDHAMĀNA	5.169, 8.92
RUCAKOTTAMA	5.174	VALĀHAKA	4.119
RUCIRA	8.13	VALGU	8.12
RUDHIRA	8.12	VALGU PRABHA	4.1852, 8.298
RŪPYA KŪLĀ	4.2352	VAŚIṢṬA	4.2031
RŪPYAVARA	5.24	VASUMATĪ	4.219
RAIVATA	4.2375	VASUMATKĀ	4.19
ROCANA KŪṬA	4.2130	VAMŚĀ	1.153
RORUKA	2.40, 2.110	VAMŚĀLA	4.118
ROHIT	4.1735, 8.29	VĀDA	2.44, 2.146
ROHITĀSYĀ	4.1694	VĀNĀRASĪ	4.548
RAURAVA	2.53	VĀRAṆĪ	4.124
LAKṢAMĪ	4.2357, 8.99	VĀRĀṆAṢĪ	4.532
LAKṢMĪMĀLINĪ	8.99,	VĀRUṆIVARA	5.14
LALLAṄKA	2.4, 2.155	VĀLUKĀ PRABHĀ	2.21
LAVAṆA SAMUDRA	4.2398	VĀVILA	2.45
LĀṄGALA	8.14	VIKRĀNTA	2.241, 2.120
LĀṄGALĀVATĪ	4.2206	VICITRAKŪṬA	4.117, 4.2124
LĀNTAVA	8.15, 8.120	VIJAṬĀVĀN	4.2213
LOKAKĀNTA	8.95	VIJAYA	4.522
LOLA	2.42, 2.129	VIJAYACARĪ	4.115
LOLAKA	2.42, 2.130	VIJAYA NAGARA	4.123
LOHĀRGALA	4.113	VIJAYA PURĪ	4.2299
LOHITA	8.13	VIJAYAVĀN	4.1745
LOHITAKA	8.96	VIJAYANTA	8.100
LOHITA KŪṬA	4.2057	VIJAYĀ	4.2300, 5.77
LOHITA PRĀSĀDA	4.1836	VIJAYĀRDHA	4.107, 4.2257
LOHITĀṄKA	2.16	VIJAYĀRDHA KUMĀRA	4.148
VAKRĀNTA	2.41	VIDEHA	4.91, 4.1758
VAKṢĀRA	4.2012,4.2200	VIDYĀDHARA ŚREṆĪ	4.109
VAJRA	5.122, 8.13	VIDYUT DRAHA	4.2091
VAJRAPRABHA	5.122	VIDYUT PRABHA	4.118, 4.2015
VAJRAVARA	5.24	VIPULĀCALA	1.65

VIBHAṄGA SARITĀ 4.2200
VIBHRĀNTA 2.4, 2.115
VIMARDANA 2.51
VIMALA 8.12, 8.94
VIMALA KŪṬA 4.2031
VIMALA PRABHA 8.88
VIMALA MADHYAMA 8.88
VIMALA VIŚIṢṬA 8.88
VIMALĀ 5.177
VIMALĀVARTA 8.88
VIMUKHĪ 4.117
VIMOCITĀ 4.113
VIRAJASKĀ 4.114
VIRAJĀ 4.2299, 5.76
VIŚOKA 4.121
VĪTAŚOKA 4.121
VĪTAŚOKĀ 4.2219, 5.76
VĪRA 8.12
VṚTTA 8.91
VṚṢABHA 4.215, 8.91
VṚṢABHAGIRI 4.269, 4.1351,
VṚṢABHA ŚAILA 4.2291, 4.2395
VEDA 2.49
VEDĪ 3.28
VELAMBA KŪṬA 4.2769
VAIJAYANTA 4.115, 4.522, 4.1315, 5.156 8.100
VAIJAYANTĀ 4.2300,
VAIJAYANTĪ 5.77,
VAIḌŪRYA 2.16, 4.1724 5.24, 5.150 8.13
VAIBHĀRA 1.66
VAIŚRAVAṆA 4.148, 8.95
VAIŚRAVAṆA KŪṬA 4.117, 4.1632 5.150
ŚAKAṬAMUKHĪ 4.113
ŚATAUJVALA 4.2046
ŚATĀRA 4.524
ŚATRUÑJAYA 4.120
ŚABDĀVANI 4.1704
ŚARADA 8.95
ŚARKARĀ PRABHĀ 1.152, 2.21
ŚAŚI PRABHA 4.118
ŚAṀKHA 4.2466
ŚAṀKHARATNA 5.174
ŚAṀKHAVARA 5.18
ŚAṀKHĀ 4.2208
ŚĀTAṀKARA 8.16
ŚĀLIVANA 4.658
ŚĀLMALI 4.2147
ŚIKHARĪ 4.94 4.1665 4.1734
ŚIVAMANDIRA 4.119
ŚIVAṄKARA 4.119
ŚĪTA 2.43
ŚUKRAPURĪ 4.115
ŚUBHĀ 4.2297
ŚAILA 2.17
ŚAURĪPURA 4.547
ŚYĀMA 5.25
ŚRADDHĀVĀN 4.2213
ŚRĀVASTĪ 4.528
ŚRĪKĀNTĀ 4.1964
ŚRĪKŪṬA 4.1632
ŚRĪDHARA 4.113
ŚRĪNIKATA 4.123
ŚRĪNICAYA 4.1660, 4.1730
ŚRĪNILAYA 4.1964
ŚRĪNIVĀSA 4.123
ŚRĪPRABHA 4.113
ŚRĪBHADRĀ 4.1964
ŚRĪMAHITĀ 4.1964
ŚRĪVṚKṢA 5.162, 8.91
ŚRĪSAÑCAYA 4.1662, 4.1732
ŚRĪSAUDHA 4.119
ŚREṆĪBADDHA 2.36
ŚVETAKETU 4.112
ŚANAT KUMĀRA 1.159, 8.120
SAPTACCHADA 8.397
SAMUDITA 8.94
SARITĀ 4.2208
SARVATOBHADRA 8.92, 8.301
SARVATOBHADRĀ 5.78
SARVARATNA 4.2769, 5.156
SARVĀRTHAPURA 4.120
SARVĀRTHA FOREST 1.465
SARVĀRTHA SIDDHI 4.522, 8.17
SAHAKĀRA FOREST 4.665
SAHSRĀRA 1.160 8.15

SAHETUKA FOREST	4.655	SUVIŚĀLA	8.16
SAṀGHĀTA	2.41	SUSĪMĀ	4.2297
SAṀJAYANTA	4.115,	SŪRA DRAHA	4.2091
SAṀJVALITA	2.43, 2.139	SŪRYA	8.94
SAṀPRAJVALITA	2.43, 2.140	SŪRYA DVĪPA	4.2471
SAṀBHRĀNTA	2.40	SŪRYA PARVATA	4.2213
SAṀVĀHANA	4.2239	SŪRYA PURA	4.117
SAṀSTHITA	8.91	SŪRYĀBHA	1.116
SĀKETA	4.527	SOMA	8.94, 8.301
SĀGARA	4.2060, 8.94	SOMAKA	8.93
SĀGARACITRA	4.1970	SOMARŪPA	8.124
SIDDHA KŪṬA	4.147, 4.1632	SOMĀRYA	8.124
SIDDHA KṢETRA	1.278	SAUGANDHĪ	4.2766
SIDDHĀNTA	8.96	SAUDHARMA	8.120
SIDDHĀRTHA FOREST	4.644	SAUMANASA	4.1806
SIDDHIKA	4.2103	SAUMANASA GIRI	4.2015
SINDŪRA	5.25	SAUMANASA FOREST	4.1937
SINDHU	4.252, 4.259	SAUMYA	8.96
SIṀHA	8.91	SKANDHA PRABHĀ	4.1328
SIṀHADHVAJA	4.112	STANAKA	2.41, 2.121
SIṀHAPURA	4.536	STANALOLUKA	2.42, 2.131
SIṀHA PURĪ	4.2299	SPHAṬIKA	2.17, 4.2058
SĪTĀ	4.2116, 4.2061	SVAYṀPRABHA	4.1840, 5.160
SĪTODĀ	4.2103, 4.2216		5.2338, 8.298
SĪMANTAKA	2.40, 2.108	SVAYAṀ PRABHĀ	5.177
SUKACCHĀ	4.2206	SVAYAṀBHŪ RAMAṆA	5.22, 5.238
SUKHĀVAHA	4.2213	SVARĀNTA	8.13
SUGANDHĀ	4.2209	SVASTIKA	4.2045, 5.153
SUGANDHINĪ	4.124,	SVASTIKAGIRI	4.2130
SUDARŚANA	4.124, 8.16	SVASTIKA DIŚĀ	5.145
SUDHARMA SABHĀ	5.199	HARI	4.93
SUPADMĀ	4.2208	HARI KĀNTA KŪṬA	4.1724
SUPRABHA	4.2153, 5.123	HARIKĀNTĀ	4.1746
SUPRABHĀ	5.78	HARI KŪṬA	4.1724, 4.1758
SUPRABUDDHA	8.16	HARI TĀLA	5.26
SUBHADRA	5.145, 8.16	HARIT	4.1770
SUMANASA	8.16	HARI VARṢA	4.1738, 4.1724
SUMUKHĪ	4.117	HARISAHA KŪṬA	4.2161
SURAPATI KĀNTA	4.120	HASTINĀGAPURA	4.141
SURAMYAKĀ	4.2207	HAṀSAGARBHA	4.119
SURA	8.91	HĀRIDRA	4.1847, 8.13
SURA SAMITI	8.15	HIMA	2.45, 2.153
SURĀ KŪṬA	4.1632	HIMAVĀN	4.94, 4.1624
SULASA DRAHA	4.2091	HIṀGULA	5.25
SUVATSĀ	4.2207	HEMAVANTA KŪṬA	5.123
SUVAPRĀ	4.2209	HAIMAVATA	4.91, 4.1698, 5.153
SUVARṆA KŪṬA	4.116	HAIRAṆYAVATA	4.91, 4.2350

THE SAMVATSARAS

S.N.	Name of Samvatsara (Year)	Month in a Yuga	Month					Samvatsara				
			Days	Muhūrta	Part	Muhūrta	Part	Days	Muhūrta	Part	Muhūrta	Part
1.	Naksatra (Constellation)	67	27		21/67	819	27/67	327	00	51/67	1832	56/67
2.	Candra (Moon)	62	29		32/62	885	30/62	354	00	12/62	10625	50/62
3.	Rtu (Season)	61	30		00	900	00	360	00	00	10800	00
4.	Āditya (Sun)	60	30½		00	915	00	366	00	00	10980	00
5.	Abhivardhana (Inter Calary)	57 3/13	31	29	17/62	959	17/62	383	21	18/62	11511	18/62

S.N.	Name of Samvatsara (Year)	Days	Muhu-rta	Part 62nd	Part 62 × 67th		Muhū-rta Total	Part 62nd	Part 62 × 67th
1.	Naksatra (Constellation)	327	22	51	55		11832	51	55
2.	Candra (Moon)	354	05	50	00		10625	50	00
3.	Rtu (Season)	360	00	00	00		10800	00	00
4.	Āditya (Solar)	366	00	00	00		10980	00	00
5.	Abhivardhana (Inter Calary)	383	21	18	00		11511	18	00
Sum		1791	19	67	55		53749	57	55

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THE TABLE FOR CONJUNCTION OF THE CONSTELLATIONS WITH THE MOON



S.N.	Constellation	Conjunction with Moon		Conjunction with Sun		Mor -ning	Eve.	Day of Yuga	Completion of Const. in Day			Completion of L+. Const. in Day			Completion of Const. in Night			Completion of L+. Const. in Night			Direc -tion	Celestial Parts
		Muhūrta	67th Part	Aho -rātri	Muhū -rta				Muhu -rta	61th Part	61*67th Part	Muhu -rta	61th Part	61*67th Part	Muhu -rta	61th Part	61*67th Part	Muhu -rta	61th Part	61*67th Part		109800
01.	Abhijit	09	27	04	06	00	01	01	09	24	39	08	34	28	00	00	00	00	00	00	SW	5616
02.	Śravaṇa	30	00	13	12	00	01	02	09	24	39	08	32	28	00	00	00	00	00	00	SW	6018
03.	Dhaniṣṭā	30	00	13	12	00	01	03	09	24	39	08	31	28	00	00	00	00	00	00	SW	6420
04.	Śatbhiṣā	15	00	06	21	00	01	03	00	00	00	00	00	00	06	30	39	05	36	28	W	6621
05.	Pūbhādrapada	30	00	13	12	01	00	04	00	00	00	00	00	00	06	32	39	05	36	28	ES	7023
06.	Uttrābhādrapada	45	00	20	03	01	00	06	09	24	39	08	24	28	00	00	00	00	00	00	EW	7626
07.	Revatī	30	00	13	12	00	01	07	09	24	39	08	22	28	00	00	00	00	00	00	SW	8028
08.	Aśvinī	30	00	13	12	00	01	08	09	24	39	08	20	28	00	00	00	00	00	00	SW	8430
09.	Bharaṇī	15	00	06	21	00	01	08	00	00	00	00	00	00	06	40	39	05	36	28	W	8631
10.	Kṛtikā	30	00	13	12	01	00	09	00	00	00	00	00	00	06	42	39	05	36	28	ES	9033
11.	Rohiṇī	45	00	20	03	01	00	11	09	24	39	08	14	28	00	00	00	00	00	00	EW	9636
12.	Mṛgaśīrṣa	30	00	13	12	00	01	12	09	24	39	08	12	28	00	00	00	00	00	00	SW	10038
13.	Ārdrā	15	00	06	21	00	01	12	00	00	00	00	00	00	06	48	39	05	36	28	W	10239
14.	Punarvasu	45	00	20	03	01	00	14	09	24	39	08	08	28	00	00	00	00	00	00	EW	10842
15.	Puṣya	30	00	13	12	00	01	15	09	24	39	08	06	28	00	00	00	00	00	00	SW	10980
																						264
16.	Aśleṣā	15	00	06	21	00	01	15	00	00	00	00	00	00	06	54	39	05	36	28	W	465
17.	Maghā	30	00	13	12	01	00	16	00	00	00	00	00	00	06	56	39	05	36	28	ES	867
18.	Pūrvāphālgunī	30	00	13	12	01	00	17	00	00	00	00	00	00	06	58	39	05	36	28	ES	1269
19.	Uttrāphālgunī	45	00	20	03	01	00	19	09	24	39	07	59	28	00	00	00	00	00	00	EW	1872
20.	Hasta	30	00	13	12	00	01	20	09	28	39	07	57	28	00	00	00	00	00	00		2274
21.	Citrā	30	00	13	12	00	01	21	09	24	39	07	55	28	00	00	00	00	00	00		2676
22.	Svāti	15	00	06	21	00	01	21	00	00	00	00	00	00	07	05	39	05	36	28	W	2877
23.	Viśākhā	45	00	20	03	01	00	23	09	24	39	07	51	28	00	00	00	00	00	00	EW	3480
24.	Anurādhā	30	00	13	12	00	01	24	09	24	39	07	49	28	00	00	00	00	00	00	SW	3882
25.	Jyeṣṭhā	15	00	06	21	00	01	24	00	00	00	00	00	00	07	11	39	05	36	28	W	4083
26.	Mūla	30	00	13	12	01	00	25	00	00	00	00	00	00	07	13	39	05	36	28	ES	4405
27.	Pūrvāṣāḍhā	30	00	13	12	01	00	26	00	00	00	00	00	00	07	15	39	05	36	28	ES	4887
28.	Uttrāṣāḍhā	45	00	20	03	01	00	28	09	24	39	07	41	28	00	00	00	00	00	00	EW	5490

+ Lower

Note : The above table thus gives an idea of the movement of the moon among the stars and constellations, in angular measure corresponding to time parts in days and muhūrtas as well as its 61^{th} and 61×67^{th} parts. This cycle goes on.

Appendix : CH-2.1

THE FIRST SAMVATSARA (YEAR) OF YUGA

White Half										Dark Half									
Parva	Month	Tithi	Days of Yuga	Muhū -rta	62nd part	Month of Nakṣatra	Muhū -rta of Nakṣatra	62nd part	62 × 67th part	Parva	Month	Tithi	Days of yuga	Muhū -rta	62nd part	Month of Nakṣatra	Muhū -rta of Nakṣatra	62nd part	62 × 67th part
01	Śrāvaṇa W	15	29	14	02	02	02	51	65	01	Śravaṇa D	30	14	06	48	01	16	10	66
		30	30	15	30	02	26	42	02			15	15	22	46	01	13	21	01
02	Bhādra W	15	59	28	34	03	11	46	64	02	Bhādrapada D	30	44	21	18	02	25	05	65
		60	60	00	60	03	17	47	03			45	45	08	14	02	04	26	02
03	Āśvina W	15	88	13	04	04	20	41	60	03	Āśvina D	30	73	05	50	03	04	00	64
		90	89	16	28	04	08	52	07			75	74	23	44	03	25	31	03
04	Kārtika W	15	118	27	36	05	00	25	5 lapsed	04	Kārtika D	30	103	20	20	04	12	57	63
		120	119	01	58	05	29	57	05			105	104	09	12	04	16	36	04
05	Mṛgaśira W	15	147	12	06	06	08	31	61	05	Mṛgaśira D	30	132	04	52	05	21	52	62
		150	148	17	26	06	21	00	06			135	133	24	42	05	07	41	05
06	Pauṣa W	15	177	26	38	07	12	35	7 lapsed	06	Pauṣa D	30	162	19	22	06	00	47	61
		180	178	02	56	07	42	05	07			165	163	10	10	06	28	46	06
07	Māgha W	15	206	11	08	08	11	26	34	07	Māgha D	30	191	03	54	07	08	42	60
		210	207	18	24	08	18	05	33			195	192	25	40	08	09	24	66
																08	11	26	08
08	Phālguna W	15	236	25	40	09	05	16	58	08	Phālguna D	30	221	18	24	09	11	00	58
		240	237	03	54	09	24	15	09			225	222	11	08	09	15	00	00
																09	02	31	09
09	Caitra W	15	265	10	10	10	14	16	32	09	Caitra D	30	250	02	56	10	08	04	10 lapsed
		270	266	19	22	10	15	15	35			255	251	26	38	10	37	36	10
10	Vaiśakha W	15	295	24	42	11	06	55	11 lapsed	10	Vaiśākha D	30	280	17	26	11	00	52	56
		300	296	04	52	11	36	25	11			285	281	12	06	11	28	41	11
11	Jyeṣtha W	15	324	09	12	12	02	01	55	11	Jyeṣṭha D	30	309	11	58	12	09	47	55
		330	325	20	20	12	15	00	00			315	310	27	36	12	19	46	12
						12	12	30	12										
12	Āṣāḍha W	15	354	23	44	13	11	01	29	12	Āṣāḍha D	30	339	16	28	13	18	42	54
		360	355	05	50	13	18	30	38			345	340	13	04	13	10	51	13

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White Half										Dark Half									
Parva	Month	Tithi	Days of Yuga	Muhū -rta	62nd part	Month of Nakṣatra	Muhū -rta of Nakṣatra	62nd part	62 × 67th part	Parva	Month	Tithi	Days of yuga	Muhū -rta	62nd part	Month of Nakṣatra	Muhū -rta of Nakṣatra	62nd part	62 × 67th part
13	Śrāvaṇa W	15	383	08	14	15	29	21	27	13	Śrāvaṇa D	30	368	00	60	14	12	39	53
		390	384	29	18	15	00	10	40			375	369	28	34	14	16	56	14
14	Bhādrapada W	15	413	22	46	16	08	11	51	14	BhādrapadaD	30	398	15	30	15	21	32	52
		420	414	06	48	16	21	20	16			405	399	14	02	15	07	61	15
15	Āsoja W	15	442	07	16	17	17	06	50	15	Āsoja D	30				16	14	34	16 lapsed
		450	443	22	16	17	12	25	17			435	428	29	32	16	44	04	16
16	Kārtika W	15	472	21	48	18	11	06	24	16	Kārtika D	30	457	14	32	17	24	22	50
		480	473	07	46	18	15	00	00			465	458	15	00	17	05	09	17
						18	03	25	43										
17	Mṛgaśira W	15	501	06	18	19	10	03	19 lapsed	17	MṛgaśiraD	30	487	29	02	18	18	17	49
		510	502	23	14	19	39	35	19			495	488	00	00	18	11	14	18
18	Pauṣa W	15	531	20	50					18	Pauṣa D	30	516	13	34	19	27	12	48
		540	532	08	44	20	13	59	22			525	517	15	60	19	02	19	19
19	Māgha W	15	560	05	20	20	15	35	45	19	Māgha D	30	546	28	04	20	08	54	20 lapsed
		570	561	24	12	21	22	48	46			555	547	01	28	20	38	24	20
20	Phālguna W	15	590	19	52	21	06	45	21	20	PhālgunaD	30	575	12	36	22	25	27	05
		600	591	09	42	22	01	43	45			585	576	16	58	22	00	46	22
21	Caitra W	15	619	04	22	22	27	50	22	21	Caitra D	30	605	27	06	23	18	22	44
		630	620	25	10	23	10	38	44			615	606	226	23	11	09	23	
22	Vaiśakha W	15	649	18	54	23	18	55	23	22	VaiśākhaD	30	634	11	38	24	27	10	43
		660	650	10	40	24	04	33	43			645	635	17	56	24	02	14	24
						24	15	00	00										
23	Jyeṣtha W	15	678	03	24	24	09	60	24	23	Jyeṣtha D	30	664	26	08	25	06	12	42
		690	679	26	08	25	28	28	42			675	665	03	24	25	23	19	25
						25	01	03	25										
24	Āṣāḍha W	15	708	17	56	26	07	23	41	24	Āṣaḍha D	30	693	10	40	26	15	07	41
		720	709	11	38	26	22	08	26			705	694	18	54	26	14	24	26

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THE THIRD SAMVATSARA (YEAR) OF YUGA

White Half										Dark Half									
Parva	Month	Tithi	Days of Yuga	Muhū -rta	62nd part	Month of Nakṣatra	Muhū -rta of Nakṣatra	62nd part	62 × 67th part	Parva	Month	Tithi	Days of yuga	Muhū -rta	62nd part	Month of Nakṣatra	Muhū -rta of Nakṣatra	62nd part	62 × 67th part
25	Śrāvaṇa W	15	737	02	26	27	15	08	40	25	Śrāvaṇa	D	30	723	25	10	40	09	02 40
		750	738	27	06	28	09	24	66			735	724	04	12	21	05	59	27
26	Bhādrapada W	15	767	16	58	29	19	38	38	26	Bhādrapada D	30	752	09	42	20	17	59	39
		780	768	12	36	29	09	55	29			765	753	19	52	20	11	34	28
27	Āśvina W	15	796	01	28	30	01	28 lapsed	30	27	Āśvina D	30	782	24	12	20	11	54	38
		810	797	28	04	30	60	30	30			795	783	05	20	20	17	39	29
28	Kārtika W	15	826	15	60	31	07	28	36	28	Kārtika D	30	811	08	44	30	20	49	30
		840	827	13	34	31	22	03	31			825	712	20	50	30	08	44	30
29	Mṛgaśira W	15	855	00	30	32	16	23	35	29	Mṛgaśira D	30	841	23	14	30	00	17	31
		870	856	29	02	32	13	08	32			855	542	06	18	30	29	49	31 lapsed
30	First Pauṣa W	15	885	15	00	33	25	18	34	30	First Pauṣa D	30	870	07	46	30	08	39	35
		900	886	14	32	33	04	13	33			885	871	21	48	30	15	00	00
31	2nd. Pauṣa W	15	915	29	32	34	19	13	32	31	2nd. Pauṣa D	30	900	22	16	30	17	34	34
		930	00	00	00	34	10	18	34			915	901	07	16	30	11	59	33
32	Māgha W	15	944	14	02	35	28	08	32	32	Māgha D	30	929	06	48	30	05	54	32
		960	945	15	30	35	01	23	35			945	930	22	46	30	23	39	35
33	Phālguna W	15	974	28	34	36	07	58	36	33	Phālguna D	30	959	20	18	30	14	49	31
		990	975	00	60	36	37	28	36			975	960	08	14	30	14	44	36
34	Caitra W	15	1003	13	04	37	00	60	30	34	Caitra D	30	988	05	50	30	23	44	30
		1020	1004	16	28	37	28	33	37			1005	988	23	44	30	05	49	37
35	Vaiśākha W	15	1033	27	36	38	24	55	39	35	Vaiśākha D	30	1018	20	20	30	17	39	29
		1050	1034	01	58	38	04	38	38			1035	1019	09	12	30	11	54	38
36	Jyeṣṭha W	15	1062	12	06	39	03	50	28	36	Jyeṣṭha D	30	1048	04	52	30	03	27	39
		1080	1063	17	26	39	25	43	39			1065	1048	24	42	30	32	59	39
37	Āṣāḍha W	15	1092	26	38	40	02	16	40 lapsed	37	Āṣāḍha D	30	1077	19	22	40	05	29	27
		1110	1093	02	56	40	31	48	48			1195	1078	10	10	40	15	00	00

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THE FORTH SAMVATSARA (YEAR) OF YUGA

White Half										Dark Half									
Parva	Month	Tithi	Days of Yuga	Muhū -rta	62nd part	Month of Nakṣatra	Muhū -rta of Nakṣatra	62nd part	62 × 67th part	Parva	Month	Tithi	Days of yuga	Muhū -rta	62nd part	Month of Nakṣatra	Muhū -rta of Nakṣatra	62nd part	62 × 67th part
38	Śrāvaṇa W	15	1121	11	08	42	16	03	25	44	Śrāvaṇa D	30	1106	03	54	41	29	24	26
		1140	1122	18	24	42	13	28	42			1125	1107	25	40	41	00	07	41
39	Bhādrapada W	15	1151	25	40	43	29	60	24	39	Bhādrapada D	30	1136	18	24	42	08	19	25
		1170	1152	03	54	43	04	33	43			1155	1137	11	08	42	21	12	42
40	Āsvina W	15	1180	10	10	44	03	55	23	40	Āsvina D	30	1165	02	56	43	17	24	24
		1200	1181	19	22	24	25	38	44			1158	1166	26	38	43	12	17	43
41	Kārtika W	15	1210	24	42	45	12	51	22	41	Kārtika D	30	1195	17	26	44	11	09	23
		1230	1211	04	52	45	16	43	45			1215	1196	12	06	44	15	00	00
42	Mṛgaśira W	15	1239	09	12	46	21	45	21	42	Mṛgaśira D	30	1224	01	58	45	05	04	2
		1260	1240	20	20	46	07	48	46			1245	1225	27	36	45	24	27	45
43	Pauṣa W	15	1269	23	44	47	00	40	20	43	Pauṣa D	30	1254	16	28	46	13	61	21
		1290	1270	05	50	47	28	53	47			1275	1255	13	04	46	15	32	46
44	Māgha W	15	1298	08	14	48	09	36	19	44	Māgha D	30	1283	00	60	47	22	56	20
		1320	1299	21	18	48	15	00	00			1305	1284	28	34	48	06	37	47
45	Phālguna W	15	1328	22	46	49	18	30	18	45	Phālguna D	30	1313	15	30	49	26	14	18
		1350	1329	06	48	49	11	01	49			1335	1314	14	02	49	03	17	49
46	Caitra W	15	1357	07	16	50	27	25	17	46	Caitra D	30				50	05	09	17
		1380	1358	22	16	50	02	06	50			1365	1343	29	12	50	24	02	50
47	Vaiśākha W	15	1387	21	48	51	02	06	50	47	Vaiśākha D	30	1372	14	32	51	14	04	16
		1440	1388	07	46	51	23	11	51			1395	1373	15	00	51	15	27	51
48	Jyeṣṭha W	15	1416	06	18	52	15	15	48	48	Jyeṣṭha D	30	1402	29	02	52	22	61	15
		1450	1417	23	14	52	14	16	52			1425	1403	00	30	52	06	32	52
49	Āṣāḍha W	15	1446	20	50	53	24	10	24	49	Āṣāḍha D	30	1431	13	34	53	01	56	14
		1470	1447	08	44	53	05	21	53			1455	1432	15	60	53	27	37	53

THE FIFTH SAMVATSARA (YEAR) OF YUGA

White Half										Dark Half									
Parva	Month	Tithi	Days of Yuga	Muhū -rta	62nd part	Month of Nakṣatra	Muhū -rta of Nakṣatra	62nd part	62 × 67th part	Purva	Month	Tithi	Days of yuga	Muhū -rta	62nd part	Month of Nakṣatra	Muhū -rta of Nakṣatra	62nd part	62 × 67th part
50	Śrāvaṇa W	15	1475	05	20	54	03	05	13	50	Śrāvaṇa D	30	1461	28	04	54			23
		1500	1476	24	12	55	09	24	66			1485	1462	01	28	54	03	42	54
						55	17	01	55										
51	Bhādrapada W	15	1505	19	52	56	06	25	11	51	Bhādrapada D	30	1490	12	36	55	04	06	12
		1530	1506	09	42	56	15	00	00			1515	1491	16	58	55	24	47	55
						56	08	06	56										
52	Āśvina W	15	1534	04	22	57	14	41	57	52	Āśvina D	30	1520	27	06			06 lap	54
		1560	1535	25	10	57	44	11	57			1545	1524	02	25	56	30	22	56
53	Kārtika W	15	1564	18	54	58	24	15	09	53	Kārtika D	30	1549	11	38	57	17	36	10
		1590	1565	10	40	58	05	16	58			1575	1550	17	56	57	02	05	57
54	Mṛgaśira W	15	1593	03	14	59	03	10	08	54	Mṛgaśira D	30	1579	26	08	58	13	03	58
		1620	1594	26	08	59	26	21	59			1605	1680	03	24	58	43	00	58
55	Pauṣa W	15	1623	17	56	60	12	05	07	55	Pauṣa D	30	1608	10	40	59	10	26	08
		1650	1624	11	38	60	15	00	00			1635	1609	18	54	59	19	05	59
			00	00	00	60	02	26	60										
56	Māgha W	15	1652	02	26	61	06	00	06	56	Māgha D	30	1638	25	10	60	04	21	07
		1680	1653	27	06	61	23	31	61			1665	1639	04	22	60	25		60
57	Phālguna W	15	1682	16	58	62	14	57	05	57	Phālguna D	30	1660	09	42	62	22	41	05
		1710	1683	12	36	62	14	36	62			1695	1668	19	52	62	06	52	62
58	Caitra W	15	1711	09	28	63	23	52	04	58	Caitra D	30	1697	24	12	63	01	30	04
		1740	1712	28	04	63	05	41	63			1725	1698	05	20	62	27	57	63
59	Vaiśākha W	15	1741	15	60	64	17	47	03	59	Vaiśākha D	30	1726	08	44	64	10	31	03
		1770	1742	13	34	64	11	46	64			1755	1727	20	50	64	19	00	64
60	Jyeṣṭha W	15	1770	00	30	65	11	42	02	60	Jyeṣṭha D	30	1756	23	14	65	04	26	02
		1800	1771	29	02	65	17	51	65			1785	1757	06	18	65	15	00	00
																65	10	00	65
61	Āṣāḍha W	15	1800	15	00	66	20	67	01	61	Āṣāḍha D	30	1785	07	46	66	28	21	01
	(First)	1830	1801	14	32	66	08	56	66		(First)	1815	1786	21	48	66	01	10	66
62	Āṣāḍha W	15	1830	29	32	67	15	30	lapsed	62	Āṣāḍha D	30	1815	22	16	67	07	16	00
	(Second)	1860				67	45	00	00		(Second)	1845	1816	07	16	67	22	16	00

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Appendix : CH-4

THE CONSTELLATION IN WHICH THE SIX SEASONS COMPLETE THEIR DURATION AND WHAT CONSTELLATION REMAIN AT THE CLOSURE.

S.N.	Season		Constellation	67th Part of the Day
1.	Hemanta	(Wninter)	Dhaniṣṭhā	2½
2.	Basanta	(Spring)	Aśvinī	32½
3.	Grīṣma	(Summer)	Ārdrā	29
4.	Prāvṛṭa	(Rainy Season)	Pūrvā Phālgunī	59
5.	Varṣā	(Rainy)	Svāti	22
6.	Śarada	(autumn)	Pūrvāṣāḍhā	52

Note : In the texts on Vidyānuvāda, the order of the seasons is different. Śiśira coming after Basanta, is a cool season. Prāvṛṭa and Varṣā mean the same.



Appendix : CH-5

26 COMBINATIONS OF FIVE SAMVATSARAS

S.N.	Nakṣatra Year (Constellation)	Candra Year (Moon)	Ṛtu Year (Season)	Sūrya Year (Solar)	Abhivardhana Year (Intercalary)	Days
1.	67	62	0	0	0	21960
2.	67	0	61	0	0	21960
3.	67	0	0	60	0	21960
4.	871	0	0	0	744	285480
5.	0	62	61	0	0	21960
6.	0	31	0	30	0	10980
7.	0	806	0	0	744	285480
8.	0	0	61	60	0	21960
9.	0	0	793	0	744	285480
10.	0	0	0	780	744	285480
11.	67	62	61	0	0	21960
12.	67	62	0	60	0	21960
13.	871	806	0	0	744	285480
14.	60	0	61	60	0	21960
15.	871	0	793	0	744	285480
16.	871	0	0	780	744	285480
17.	0	62	61	60	0	21960
18.	0	806	793	0	744	285480
19.	0	806	0	780	744	285480
20.	0	0	793	780	744	285480
21.	67	62	61	60	0	21960
22.	871	806	793	0	744	285480
23.	871	806	0	780	744	285480
24.	871	0	793	780	744	285480
25.	0	806	793	780	744	285480
26.	871	806	793	780	744	85480

Appendix : CH-6.2

THE NUMBER OF ORBITS TRAVERSED BY MOON, SUN AND CONSTELLATION, IN A LUNAR MONTH

Lunar Month	Moon's Orbit		Solar Orbit		Constellation Orbit	
	Orbit	62nd Part	Orbit	62nd Part	Orbit	62nd Part
1	14	16	14	47	14	49½
2	28	32	29	32	29	37
3	42	48	44	17	44	24½
4	57	2	59	2	59	12
5	71	18	73	49	73	61½
6	85	34	88	34	88	49
7	99	50	103	19	103	36½
8	114	4	118	4	118	24
9	128	20	132	51	133	11½
10	142	36	147	36	147	61
11	156	52	162	21	162	48½
12	171	6	177	6	177	36
13	185	22	191	53	192	23½
14	199	38	206	38	207	11
15	213	54	221	23	221	60½
16	228	8	236	8	236	48
17	242	24	250	55	251	35½
18	256	40	265	40	266	23
19	270	56	280	25	281	10½
20	285	10	295	10	295	60
21	299	26	399	57	310	47½
22	313	42	324	42	325	35
23	327	58	339	27	340	22½
24	342	12	354	12	355	10
25	356	28	368	59	369	59½
26	370	44	383	44	384	47
27	384	60	398	29	399	34½
28	399	14	413	14	414	22
29	413	30	427	61	429	9½
30	427	46	442	46	443	59
31	442	0	457	31	458	46½
32	456	16	472	16	473	34
33	470	32	487	1	488	21½
34	484	48	501	48	503	9
35	499	2	516	33	517	58½
36	513	18	531	18	532	46
37	527	34	546	3	547	33½
38	541	50	560	50	562	21
39	556	4	575	35	577	8½
40	570	20	590	20	591	58
41	584	36	605	55	606	45½
42	598	52	619	52	621	33
43	613	6	334	37	636	20½
44	627	22	649	22	651	8
45	641	38	664		665	57½

.....Continued.....

46	655	54	678	54	680	45
47	670	8	693	30	695	32½
48	684	24	708	24	710	20
49	608	40	723	9	725	7½
50	872	56	737	56	739	57
51	727	10	752	41	754	44½
52	741	26	767	26	760	32
53	755	42	782	11	784	19½
54	769	58	796	58	799	7
55	784	12	811	43	813	56½
56	798	28	826	28	828	44
57	812	44	841	13	843	32½
58	826	60	755	60	858	19
59	841	14	870	45	873	6½
60	855	30	885	30	887	56
61	869	46	900	15	902	43½
62	884	0	915	0	977	31



THE NUMBER OF ORBITS TRAVERSED BY MOON, SUN AND CONSTELLATION, IN A ṚTU MONTH

Season Month	Moon's Orbit		Solar Orbit		Constellation Orbit	
	Orbit	61st Part	Orbit		Orbit	122nd Part
1	14	30	15		15	5
2	28	60	30		30	10
3	43	29	45		45	15
4	57	59	60		60	20
5	72	28	75		75	25
6	86	58	90		90	30
7	101	27	105		105	35
8	115	57	120		120	40
9	130	26	135		135	45
10	144	56	150		150	50
11	159	25	165		165	55
12	173	55	180		180	60
13	188	24	195		195	65
14	202	54	210		210	70
15	217	23	225		225	75
16	223	53	240		240	80
17	246	22	255		255	85
18	260	52	270		270	90
19	275	21	285		285	95
20	289	51	300		300	100
21	304	20	315		315	105
22	318	50	330		330	110
23	333	19	345		345	115
24	347	49	360		360	120
25	362	18	375		375	3
26	376	48	390		391	8
27	391	17	405		406	13
28	405	47	420		421	18
29	420	16	435		436	23
30	434	46	450		451	28
31	449	15	465		466	33
32	463	45	480		481	38
33	478	14	495		496	43
34	492	44	510		511	48
35	507	13	525		526	53
36	521	43	540		541	58
37	536	12	555		556	63
38	550	42	570		571	68
39	565	11	585		586	73
40	579	41	600		601	78
41	594	10	615		616	83
42	608	40	630		631	88
43	623	9	645		646	93
44	637	39	660		661	98
45	652	8	675		675	103
46	666	38	690		691	108

47	681	7	705		706	113
48	695	37	720		721	118
49	710	6	735		737	1
50	724	36	750		752	6
51	739	5	765		767	11
52	753	35	780		782	16
53	768	4	795		797	21
54	782	35	810		812	26
55	793	3	825		827	31
56	811	33	840		842	36
57	826	2	855		857	41
58	840	32	870		872	46
59	855	1	885		887	51
60	869	31	900		902	56
61	884	0	915		917	61



THE NUMBER OF ORBITS TRAVERSED BY MOON, SUN AND CONSTELLATION, IN A CONSTELLATION MONTH

Const. Month	Moon's Orbit		Solar Orbit		Constellation Orbit	
	Orbit	67th Part	Orbit	67th Part	Orbit	67th Part
1	13	13	13	44	13	46½
2	26	26	27	21	27	26
3	39	39	40	65	41	5½
4	52	52	54	42	54	52
5	65	65	68	19	68	31½
6	79	11	81	63	82	11
7	92	24	95	40	95	57½
8	105	37	109	17	109	37
9	118	50	122	61	123	16½
10	131	63	136	38	136	63
11	145	9	150	15	150	42½
12	158	22	163	59	164	22
13	171	35	177	36	178	1½
14	184	48	191	13	191	48
15	197	61	204	57	205	27½
16	211	7	218	34	219	7
17	224	20	232	11	232	53½
18	237	33	245	55	246	33
19	250	46	259	32	260	12½
20	263	59	273	9	273	59
21	277	5	286	53	287	38¼
22	290	18	300	30	301	18
23	303	31	314	7	314	64½
24	316	44	327	51	328	44
25	329	57	341	28	342	23½
26	343	3	355	5	356	3
27	356	16	368	49	369	49½
28	369	2	382	26	383	29
29	382	42	396	3	397	8½
30	395	55	409	47	410	55
31	409	1	423	24	424	34½
32	422	14	437	1	438	14
33	435	27	450	45	451	60½
34	448	40	464	22	465	40
35	461	53	477	66	479	19½
36	478	66	491	43	492	66
37	488	12	505	20	506	45½
38	501	25	518	64	520	25
39	514	38	532	41	534	4½
40	527	51	546	18	547	51
41	540	64	559	62	561	30½
42	554	10	573	39	575	10
43	567	23	587	16	588	56½

.....Continued .....

44	580	36	600	60	602	36
45	593	49	614	37	643	15½
46	606	62	628	14	629	62½
47	620	08	641	58	643	42
48	633	21	655	35	657	21
49	646	34	669	12	671	½
50	659	47	682	56	684	47
51	672	60	696	33	98	26½
52	686	6	710	10	12	6
53	699	19	723	54	725	52½
54	712	32	737	31	739	32
55	725	45	751	8	753	11½
56	738	58	764	52	766	58
57	752	4	778	29	780	37½
58	765	17	792	6	794	17
59	778	30	805	50	807	63½
60	791	43	819	27	821	43
61	804	56	832	4	835	22½
62	818	2	84	48	849	2
62	831	15	860	25	862	48½
63	831	15	860	25	862	48½
64	844	28	874	2	876	28
65	857	41	887	46	890	7½
66	870	54	901	23	903	54
67	884	0	915	0	917	33½



THE NUMBER OF ORBITS TRAVERSED BY MOON, SUN AND CONSTELLATION, IN A SOLAR MONTH

Solar Month	Moon's Orbit		Solar Orbit		Constellation Orbit	
	Orbit	61st Part	Orbit	61st Part	Orbit	122nd Part
1	14	11	15	1	15	7
2	29	7	30	2	30	14
3	44	3	45	3	45	21
4	58	14	61	0	61	4
5	73	10	76	1	76	11
6	88	6	91	2	91	18
7	103	2	106	3	107	1
8	117	13	122	0	122	8
9	132	9	137	1	137	15
10	147	5	152	2	152	22
11	162	1	167	3	168	5
12	176	12	183	0	183	12
13	191	8	198	1	198	19
14	206	4	213	2	214	2
15	221	0	228	3	229	9
16	235	11	244	0	244	16
17	250	7	259	1	259	23
18	265	3	274	2	275	6
19	279	14	289	3	290	13
20	294	10	305	0	305	20
21	309	6	320	1	321	3
22	324	2	335	2	336	10
23	338	13	350	3	351	17
24	353	9	366	0	367	0
25	368	5	381	1	382	7
26	383	1	396	2	397	14
27	397	12	411	3	412	21
28	412	8	427	0	428	4
29	427	4	442	1	443	11
30	442	0	457	2	458	18
31	456	11	472	3	474	1
32	471	7	488	0	489	8
33	486	3	503	1	504	15
34	500	14	518	2	519	22
35	515	10	533	3	535	5
36	530	6	549	0	550	12
37	545	2	564	1	565	19
38	559	13	579	2	581	2
39	574	9	594	3	516	9
40	589	5	610	0	611	16
41	604	1	625	1	626	23
42	618	12	640	2	642	6
43	623	8	655	3	657	13
44	648	4	671	0	672	20
45	663	0	686	1	688	3
46	677	11	701	2	703	10

.....Continued.....

47	695	7	716	3	718	17
48	707	3	732	0	734	0
49	721	14	747	1	749	7
50	736	10	762	2	764	14
51	751	6	777	3	779	21
52	766	2	793	0	795	4
53	780	13	808	1	810	11
54	795	9	823	2	825	18
55	810	5	838	3	841	1
56	825	1	854	0	856	8
57	839	12	869	1	871	15
58	854	8	884	2	886	22
89	869	4	899	3	902	5
60	884	0	915	0	917	12

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BIO-DATA OF PROFESSOR L. C. JAIN

1. NAME : LAXMI CHANDRA JAIN
2. FATHER'S NAME : SHRI DAMRU LAL JAIN
3. DATE OF BIRTH : 1st July, 1926, Saugar (M.P.)
4.COMMUNICATION ADDRESS :DIKSHA JEWELLERS, 554,
SARAFA WARD,
JABALPUR,
Pin 482002 (M.P.), INDIA
Phone- 9425386179, 9425152301

5. EDUCATIONAL: QUALIFICATION
A. M. Sc. (Applied Mathematics)
B. D. H. B. (State Council of Homeopathy , Bhopal, 1971, (Practice Licentiate.))

6. POSITIONS HELD :

A. ACHIEVEMENTS : Research Associate of Indian National Science Academy, New Delhi, for operating projects on History of Science at Physics Deptt., Rani Durgawati University, Jabalpur, from August 1984.

B. Honorary Ex- Director, D.J. Institute of Cosmographic Research, Hastinapur, 1983.

C. Honorary Director, Acharya Vidyasagara Research Institute, Jabalpur, since 1984, and Honorary Director Kunda Kunda Jñana Pīṭha, Indore (1995)

D. Recognized as one of the TWO GREAT SCHOLARS in the Felicitation Note given by Dr. R.C. Gupta, UNESCO Representative on commission for History of Science in India, and Editor Gaṇita Bhāratī, {vide Gaṇita Bhāratī, vol 12, nos. 1-2 (1990), 39-44}.

7. RESEARCH ACTIVITIES:

A. Research Supervisor, Examiner and Guide of Doctoral Theses on Unified Field Theories, History of Science, and Non-Symmetric Field Theories submitted at various Universities.

B. Proficiency in Mathematical System Theory for guiding Research.

C. Attended International workshop on Mathematical Physics organized by Nagpur University, for invited 5 lectures in 1987,

D. Attended Global Conference (Eddington's Centenary) in 1987, at Nagpur, and presented four papers under joint authorship of M. Samiuddin and R.K. Sharma separately.

E. Visiting fellow in Department of Physics, Rani Durgavati University (1987-88, 1988-89).

F. Honorary Director, Acharya Sri Vidyasagara Research Institute, Pisanhārī Hills, Jabalpur

G. Secretary, Rani Durgavati Society for Advanced Mathematical Sciences, Jabalpur.

H. Secretary, Mother Universe Foundation, Jabalpur.

I. So far operated three INSA projects on History of Science in India (1984-87) and 1989-91), (1992-1995).

J. Editor in board of JSIR, New Delhi , and Arhat Vacana, Indore.

K. Supervisor for Research in Faculty of JVBI, Ladnu, (Raj.).

L. Secretary, Shri Brāhmī Sundarī Prasthāśrama, Jabalpur.

M. Lectures at Department of Jainology, Madras Unversity, 1995.

8. GOVT. SERVICE:

Madhya Pradesh, State Educational Service, (1951-1984), Collegiate Branch :-

S.No.	Name of the College	From	To	Place
1.	Govt. College of Science	1951	1955	Nagpur
2.	Govt. Science College (Old Robertson College & Mahakoshal-Mahavidyalaya)	1955	1959	Jabalpur

3.	Govt. College	1959	1959	Dewas
4.	Govt. Science College	1959	1964	Jabalpur
5.	Govt. College	1964	1964	Balaghat
6.	Govt. College	1964	1966	Damoḥ
7.	Govt. Post-Graduate College	1966	1975	Sehore
8.	Govt. Post-Graduate College	1975	1978	Khandwa
9.	Govt. College	1978	1979	Jaora
10.	Govt. College	1979	1980	Bareli
11.	Govt. College	1980	1981	Sihora
12.	Govt. Post-Graduate College	1981	1984	Chhindwara

NOTE :

a. Lecturer 12 and 1/2 years
b. Asstt. Professor 2 and 1/2 yaers
c. Professor 13 years
d. Principal 6 years

9. EXTRA CURRICULAR :

A. Life Member of :-
i. Einstein Foundation International, Nagpur.
ii. Digambara Jaina Akhila Bharatīya Vidvad Pariṣad.
iii. Indian Society for History of Mathematics, (Gaṇita Bhāratī).
B. Ex-Chairman, Board of Studies in Mathematics, University of Sagar.
C. Ex-Senator, Vikram University, Ujjain
D. Ex-Member, Board of Studies at Vikram University, Ujjain and Bhopal University, Bhopal, Sir H.S. Gaur University, Sagar and Rani Durgavati University, Jabalpur.
E. Active participation in Summer School of Tata Institute for Fundamental Research, Colaba, Bombay (1964) for forty days on Galois Theory.
F. Member, People For Animals.
G. Joint- Editor, Rishabh Bharati. Editorial Board of Arhat Vacana. Founder Member of Śrī Brāhmī Sundarī Prasthāśrama, Kanchan Vihara, Vijaynagar, Jabalpur. Hon. Director, Acharya Shri Vidyasagar Research Institute, Kanchan Vihar Jabalpur.

10. LINGUISTIC PROFICIENCY :

Name of Language	Read	Write	Speak	Understand	Proficiency
a. Hindi	Yes	Yes	Yes	Yes	Yes
b. English	Yes	Yes	Yes	Yes	Yes
c. Prakrit & Sanskrit	Yes	Yes		Yes	
d. Urdu	Yes			Yes	
e. Russian, German, Scientificabstract, excerpts, etc.	Yes	Yes	Yes		
f. French, Marathi, Gujrati, Kannada, Scientific abstracts, excerpts, etc.	Yes			Yes	

11. PRESENTATION OF RESEARCH PAPERS (1951-1997):

	Topic / Subject	Place
A.	Summer School, History of Science	Sagar
B.	Seminar on Philosophy of Mathematics at University of	Sagar

C. Seminar History of Science Gaya
D. Two Seminars History of Science Jaipur
E. Two Seminars History of Science at J.V.B. Ladnun
F. Two Seminars History of Science & Philosophy Indore
G. Aryabhaṭa Conference at Indian National ScienceAcademy, New Delhi .
H. International Conference, Paper on History of Jaina Mathematical Philosophy (in Absentia), London.
I. Seminar at Rani Durgavati Museum, Jabalpur.
J. Two Seminars in Deptt. of History at University of Saugar.
K. International Conference on Jain Cosmology, Meerut, Hastinapur, DJICR, (in **Absentia**).
L. Einstein Centenary Symposium, EFI, Nagpur University Nagpur
M. Sir Arthur Eddington Centenary Symposium, EFI , Nagpur
N. Seminar on Bio-Fluid Dynamics at IIT, Kanpur.
O. Seminar on Jaina Philosophy at faculty of Religions Patiala University **Patiala.**
P. Seminar by INSA on History of Science & Technology, Delhi, 1400-1800, (in **absentia**).
Q. Indian Oriental Conference, (in absentia) , Ujjain & Calcutta.
R. International Astronomical union, colo, 91, 1985, New Delhi.
S. Seminar at L.B. Instt. of Indology in 1985 & 1986 New Delhi
T. Seminar at L.B. Instt. of Indology in 1983 at DJICR, Delhi.
U. Seminar at DJICR (in absentia) 1985, Hastinapur.
V. Seminar at Kumaun University (in absentia), 1985, Nainital.
W. Seminar at Asiatic Society (in absentia), 1987, Calcutta.
X. International seminar at INSA on History of Astronomy, New Delhi.
Y. Seminar by Kundakund Bhāratī on Prakrit Linguistics. New Delhi.
Z. Seminars by Kundkunda Jñānapīṭha. Indore.

12. PUBLICATIONS :

(A) ON EINSTEIN UNIFIED FIELD THEORY & RELEVANT TOPICS

(1) On the Non-Symmetric Field Theory, I (Co-author:-R.C. Jaiswal, Gaṇita,Vol.27,1976, pp.109-116).

(2) On the Non-Symmetric Field Theory, II (Co-author: R.C. Jaiswal) Prevenient Natural Philosophy, Post-RAAG, Japan, No.125, May 1981, pp.1-12.

(3) On the Foundation of Unified Field Theory (Co-author: R.C. Jaiswal et al.), Proceedings on Einstein Centenary Symposium, Vol.II, Ed.K. Kondo and T.M. Karade, Nagpur, 1980, pp. 475-487.

(4) On the Non-Symmetric Field Theory-III, (Co-author: R.C. Jaiswal), Prevenient Natural Philosophy, Post-RAAG, Japan, No.136, Jan1982, pp. 1-13.

(5) On Tachyons and Reality Relations -I, (Co-author: R.C.Soni), P.N.P., Post RAAG, Japan, No.153, April, 1983, 1-9.

(6) On Tachyon and Reality Relations -II, (Co-author: R.C.Soni) P.N.P., Post RAAG, Japan, No.157, August 983, 1-15.

(7) On the Non-symmetric Field Theory-IV (Co-author, K. Keller), P.N.P., Post-RAAG, Japan, No.159,1983, pp. 1-8.

(8) On the Theory of Tachyons in an Analogous Galilean Space-time (Co-author: R.C. Soni), P.N.P., Post RAAG, Japan, No.162, 1983, pp.1-8.

(9) On the Limitations of the Velocities of Bradyons and Tachyons (Co-author: R.C. Soni), P.N.P., Post RAAG, Japan, No.163, 1983, pp.1-8.

(10) Path Integral Quantization of Einstein's Gravitaion Therory under Restrictions of Minimal Velocity

and Time, (Co-author: K. Keller), P.N.P., Post RAAG, Reports, Japan, No.171, 1984, pp 1-16.
(11) Group Theoretic Approach in Quantization on Functional Non-Symmetric field Theory, (Co-author K Keller), P.N.P., Post RAAG Reports, Japan, No. 172, 1984, pp.1-8.
(12) On the Non-Symmetric Field Theory-V: The Interpretation of Non-Symmetric as four Current vectors, (Co-author: K Keller), P.N.P., Post RAAG, Reports, Japan, No. 174, 1984, pp.1-16.
(13) On the Role of First Quantized Non-Symmetric in Cosmology, (Co-authors, K.Keller and S.S. Lishk) P.N.P., Post RAAG Reports, Japan, No.176, 1984, pp 1-8.
(14) On Kazuo Kondo's Quantized-Covariant System Theoretic Approach in Elementary Particle Theory (Co-author: K Keller) with an appendix by Kazuo Kondo "On the Gaussian Probablistic Approach to Space-time", P.N.P., Post-RAAG Reports, Japan, No.185, 1985, pp.1-19.
(15) Kondo's Approach to Tristimulus Principle and Quantization of Functional Non-Symmetric Field Theory, (Co-author: K.Keller) P.N.P., Post-RAAG, Japan, No. 167, 1984 pp. 1-9
(16) Quantization of Generalized theory of Gravitation Extended in view of Kondo's Principle of Observational Relativity, (Co-author: K. Keller) P.N.P., Post RAAG, Japan, No. 190, 1985, pp 1-24
(17) On the Recognition of Sub-groups of group of certain Functional Transformations Adjoint to a Functional Metric Form (Co-author: Anupam Kumar) Proceeding of EFI, Nagpur, vol. 3, no.2, 1986, pp 81-86.
(18) A New Principle of Correspondence and Secret of Nuclear Energy, (Co-author: Kumudini Keller) Post- RAAG, Japan, No.166, 1984, 1-9.
(19) On Behaviour of the Thermodynamical Quantities under Functional Transformation of Frames (Co-author K.Keller, R.M. Keller, M. Jain) Post RAAG, Japan, No.206, oct. 1986, pp.1-8
(20) Principle Theoretic Approach of Kazuo Kondo and Construction Theoretic Formalism of Gauge Theories, 1983 Plenary Address at Sir Arthur Eddington Centenary Symposium in Gravitational Radiation and Relativity, Ed. J. Weber, T.M. Karade, World Scientific, Singapore, 1986 pp. 271-282.
(21) On Junction Conditions and Shock waves in functional Non-symmetric Field Theory. (Co author: R.K. Sharma), Reports, Post-RAAG No. 224, 1988 (Japan), pp. 1-16
(22) Conceptual foundation of a New Metric, (Co author: M. Samiuddin), Proc. Einstein Foundation International, Nagpur, Vol.8, 1991, 1-15.
(23) Film Space Picture of the functional Non-Symmetric Dynamical Theory of Energy Conversion (Co author M. Samiuddin), P.N.P., Post- RAAG, Japan, No. 238, March 1991, pp. 1-15.
(24) Shock Waves in Functional Non-symmetric Field Theroy-II, Electromagnatic and Nuclear Field Aspects, (Co author R.K. Sharma, M. Samiuddin), Post RAAG, Japan. No-253 July 1992, 1-16

(B) ON RESEARCH AND ADVANCED LEARNING ON INDIAN MATHEMATICAL SCIENCES

(1) Tiloyapaṇṇattī kā Gaṇita, Reprinted from introduction to Jambūdīvapaṇṇattī Saṁgaho, Jivaraj Granthamala, Sholapur, 1958, pp 1-109.
(2) Lokottara Gaṇita Vijñāna ke śodha patha, Bhikshu Smrit Grantha,Calcutta, 1961, pp. 222-231.
(3) Gaṇitasāra Saṁgraha of Mahāvīrācārya, edited with Hindi translation, connotations and introductory survey of History of World Mathematics, in view of recently translated Prakrit texts, Jivaraj Granthamala, Sholapur, 1963, pp 390 appr.
(4) On the Jaina School of Mathematics, Chhote Lal Smriti Grantha, Calcutta, 1967 pp. 266-292.
(5) Research on Jaina Mathematics, Jñāna Pīṭha Patrikā, Śodha Viśeṣāṅka, Delhi, Oct-Nov. 1959, pp.33-41.
(6) Bhāratīya Gaṇita Śāstra aura Jaina Lokottara Gaṇita, Anusandhāna Patrikā, Jaina Vishva Bharati, Ladnun, Apr-Jun. 1973, pp 20-37.
(7) Mathematical Foundations of Karma : Quantum System Theory I, Anusandhāna Patrikā, JVB,

Ladnun, Oct-Dec. 1973, pp.1-19.
(8) Set theory in Jaina School of Mathematics, Ind. Jour. of Hist. of Sc., Calcutta, vol.8, No.1. 1973, pp. 1-27.
(9) Role of Mathematics in Jainology, Journal of Birla Institute of Arts and Music, (Prācya Pratibhā), Vol.11, No.1.
(10) Kinematics of the Sun and the Moon in Tyloyapaṇṇattī, Tulsī Prajña, JVB Ladnun, Feb-March, 1975, pp. 60-67.
(11) Jaina School of Mathematics, (A study in Chinese Influences and Transmissions), published in contribution of Jainism to Indian Culture, edited by Dr. R.C. Dwivedi, Motilal Banarsidas, Varanasi, 1975, pp. 206-220).
(12) Āryabhaṭa, the Astronomer and Yativṛṣabha, the Cosmographer, Tīrthaṭkara, Vol.1, Nos.7-12, 1975 pp.102-106.
(13) Zeros and Infinities of ancient India, Tīrthaṭkara, Vol.I, Nos. 7- 12, 1975 pp. 93-97, 106.
(14) On analytical treatment of Transfinite Number in Dhavalā, Chainsukhdas Nyayatirtha Smriti Grantha, Jaipur, 1976, pp. 173-188.
(15) The kinematic Motion of astral real and counter Bodies in Trilokasāra, I.J.H.S. Calcutta, Vol.11, No.1, 1975, pp. 58-74.
(16) On certain Mathematical Topics of the Dhavalā Texts, I.J.H.S. Vol.II, No.2, 1976, pp. 85-111.
(17) Principle of Relativity in Jaina School of Mathematics, Tulsī Prajñā JVB, Ladnun, 5, 1976, pp. 20-28 and also in Tīrthaṅkara, vol.2 No.1, 1976 13-20-26.
(18) The Jaina Theory of Ultimate Particles, published in Jaina Darśana evaṁ Saṁskṛti, Ādhunika Saṁdarbha meṁ, Indore Univeristy, 1976, pp. 43-45.
(19) Ādhunika Gaṇitīya Śodha ke Saṁdarbha meṁ Jaina Gaṇita kā Pūrvekṣaṇa (with Co author V.K. Agrawal),Tulsī Prajñā, 6, 1976, pp. 67-78.
(20) On certain Physical Theories in Jaina Astronomy, The Jaina Antiquary, Vol. 29, Nos. 1&2, 1976, pp 9-16.
(21) Distinct Features of Indian Astronomy upto Āryabhaṭa-1, Prācya Pratibhā, Vol. IV, No. 2, Jul.1976 pp.118-123.
(22) Certain Mathematical Methods in Archaeology, Prācya Pratibhā, Vol.3, No.2, 1976 pp. 91-92.
(23) Mathematical Foundations of Jaina Karma System, pub. in Bhagvāna Mahāvīra and his Relevance in Modern times, Bikaner ,1975, pp.132-150.
(24) Divergent Sequences Locating Transfinite Sets in Trilokasāra, I.J.H.S., Vol.12, No.1, May, 1977, pp.57-75.
(25) On the Contributions, Transmissions and influences of the Jaina School of Mathematical Sciences, Tulsī Prajñā, J.V.B., Ladnun, Vol.3, No.4, 1977, pp.121-134.
(26) Mathematical Contributions of Ṭoḍaramala of Jaipur, the Jaina Antiquary, Vol.XXX, No.1, Jul.1977, pp.10-23.
(27) Jaba Gommaṭasāra Prakāśita huā..... kintu aba? , Tīrthaṅkar (Hindi, year 7, No.7-8, Nov. Dec. 1977, (79-80), pp. 157-161.
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13. POPULAR ARTICLES AND RADIO TALKS:

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14. DUE FOR PUBLICATION ON RESEARCH, ADVANCED LEARNING AND TRANSLATION ETC.

(1) Vartamāna Saṁdharbha meṁ Karmoṁ Ke Prabhāva Kṣetroṁ Sambandhī Jaina Gaṇita, (Paper read at Seminar, Magadh Univeristy, Gaya, 1974).
(2) Certain Basic Concepts of Jaina Philosophy needed for Mathematical Studies.
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15. AWARDS :

(1) Awarded Rs 11001= 00 by Prakrit Jñāna Bhāratī (1993) for outstanding Scientific Studies in the field of Prakrit Literature.
(2) Awarded Rs. 25001= 00 (1994) For the "Tao of Jaina Sciences" by Kundakunda Jñāna Pīṭha, Indore.
(3) Awarded Rs. 31,000 = 00 (2003) for the unpublished INSA projects by the Shrut Saṁvardhanī Samiti, Meerut.
(4) Awarded Rs. 31,000 = 00 (2004) by Ahimsa International, New Delhi.
(5) Awarded Rs. 21,000 = 00 (2005) as Mahāvīra Award at Mahāvīraji.

(1) Jain, L. C. and Kumari Br. Prabha Jain, Maurya Emperor Chandragupta : On the date of Renunciation (Jaina Initiation), and his contribution to the Invention of thr Brāhmī and Sundarī Scripts in India, published in ṚiṣiKalpa (Dr. Hira Lal Jain Memorial volume), edited by D. C. Jain, Jabalpur, 2001, pp.375-390.
(2) Jain L. C. and Kumari Br. Prabha Jain, Ādhunikatama Mastiṣka Sambandhī Khojeṁ (Jaina Karma Siddhānta ke Paripreksya meṁ), Arhat vacana, vol.-14, issue-1, 2002, 75-86.
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(5) Jain, L. C., Scientific Ideas in Jain Canonical Writings and Tradition, Published in History of Science, Philosophy and Culture in Indian Civilization, vol.1, Part 2 , Life, Thought and Culture in India, (from c. 600 B.C. to c. A.D. 300), ed. G. C. Pande, Centre for Studies in Civilizations, New Delhi, 2001, pp.813-841.

For Information

The publications based on the three INSA projects operated by Prof. L. C. Jain in collaboration with Kumari Br. Prabha Jain, M.A., M. Phil., Ph.D. (Sanskrit) are under process at the Shrī Brāhmī Sundarī Praṣthāṣhram, Kanchan Vihar, Vijaynagar, Jabalpur. Recently, the volumes 1, 2 and 3 on The Exact Sciences in the Karma Antiquity have been published. Volume 4 has also come out of Press.

Additional Information:

Activities during the period 1997-2000 in the field of History of Science.

1. "On Higher Order Geometrical Theory of Elementary Particle Structure and Bio-Construction by Kazuo Kondo and F.N.F.T.", published in Frontiers of Fundamental Physics, Orient Longman, Hyderabad, pp.124-134, 1998 and in Post-RAAG Reports (modified), no.321, April 1998.(co-author-Smt. Meena Jain).
2. Publication of the third INSA Project (1992-95), on "Mathematical Contents of the Digambara Jaina Texts of the Karaṇānuyoga Group", in Progress at the Kundkund Jñānpīṭha, Tukoganj, Indore.
3. Jointly supervised Thesis on "Śrīdharācārya kṛta Pāṭīgaṇita kā Vivechanātmaka evaṁ Tulanātmaka Addhyayana" at the R.D. University, submiitted for award of Ph.D., by research scholar, C. S. Shukla.
4. Jointly supervised Thesis on "Search Stations in Jaina Karma Theory" (Hindi), submitted by research scholar, Ku. Sunita Jain, at the R.D. University.
5. Jointly supervised Thesis on "Group Theory as applied to Unified Field", awarded Ph.D. to research scholar, Smt. Meena Jain by the R.D. University.
6. Jointly supervised Thesis on "Jaina Citra Śailī meṁ Abhivyañjita Nārī Saundarya" by research scholar, Ku. Beohar Rolli, for award of Ph.D. at the Indira Kala Sangeet Vishvavidyalaya, Khairagarh.
7. Have prepared four more research papers on "System Theory in Jaina School of Mathematics" to be sent for publication in the IJHS or elsewhere on history of science in India.Further, The research articles have also been prepared on the "Vikrama Era", and on " Mauryan Emperor Candragupta [On the Date of Renunciation (Jina Initiation) and His Contribution to Origination of the Brāhmī and Sundarī Scripts in India]".

(8) Guided Theses by Research Scholars Awarded by Various Universities in India on Jainoloy, History of Science in India, and Functional Non-Symmetric Field Theory in capacity of Supervisor or otherwise.
(9) At present engaged in computerizing the Karma System Theory and Cybernetics through object oriented programming in microsoft C/C++. As well as building up the independent model of the Karma Theory through modern contemporary techniques and unified field theories in various branches of science and technology dealing with bios and matter.
(10) Jain, L. C. and Kumari Br. Prabha Jain, Maurya Emperor Chandragupta : On the date of Renunciation (Jaina Initiation), and his contribution to the Invention of thr Brāhmī and Sundarī Scripts in India, published in RṣiKalpa (Dr. Hira Lal Jain Memorial vlolume), edited by D. C. Jain, Jabalpur, 2001, pp.375-390.
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(12) Dongaonkar, U., Karade, T.M., and Jain L.C., "A Brief Review of the Literature of Jaina Karma Theory, Arhat vacan, vol. 14.2-3, 2002, pp. 69-77. Vide also, Gaṇita Bhāratī, vol.24, nos. 1-4, 2002 pp.

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(14) Jain L.C., Trivedi, R.K., Philosopher Karma-Scientists pub. Shri Brāhmī Sundarī Praṣthāshram, Kanchan Vihar, Vijay nagar, Jabalpur.
(15) Jain L.C., Prabha Jain, The Tiloyapaṇṇattī as vol.1, the Trilokasāra as vol.2, The Lokavibhaga and Jambudīva Paṇṇattī Saṁgaho as vol. 3, in Exact Sciences in the Karma Antiquity, pub. Shri Brāhmī Sundarī Praṣthāshram, Kanchan Vihar, Jabalpur , 2004 & 2005.

ESTABLISHMENT OF THE GULAB RANI KARMA SCIENCE MUSEUM :

It may be informed that at present the location of the established Gulab Rani Karma Science Museum has been at the building, above the Diksha Jewellers, 554, Sarafa, Jabalpur, under the auspices of the Rani Durgavati Society for Advanced Mathematical Sciences. This will impart all the information about all the new and old researches on the theory of Karma all around the world. This has the whole of the personal library Professor L.C. Jain. All this is in the sacred and cherished memory of his beloved wife, Late Shrimati Gulab Rani (Basanti Devi), who was born at Sagar, on 8th Feb., Basant Panchami, 1935, at 10 P.M., and died at Jabalpur on the 25th December, 2002, at 8 A.M. Professor L.C. Jain was also born at Sagar on Sunday, the 1st July, 1926 at 4 A.M.

THE SELF AND THE WORLD AS I SEE AND KNOW THEM

Mo. 9425357138

LIVES OF GREAT MEN ALL REMIND US
WE CAN MAKE OUR LIVES SUBLIME,
AND, DEPARTING, LEAVE BEHIND US,
FOOTPRINTS ON THE SANDS OF TIME.

I was born at Pindrai, district Mandla, in Madhya Pradesh, India, on the fourth october, 1962. My father, shri Veerchand Jain, was born on 13th october, 1920, in a middle class family. He was also born at Pindrai. His father's name was Munnalal Jain and his mother's name was Dropadī. He had three brothers, shri Mangalchand Jain, Shri Khemchand Jain and Shri Bhagchand Jain. My father had only one sister named Sundari. She was married at Junnardeva.

I have five brothers, the eldest being Suresh, who is just like Yudhiṣṭhira (Dharmarāja). He is truthful and takes care of everybody. He is very kind and polite. He is like an yogi and curious to know the secrets of nature. He loves me very much. When I was of one year old, he had to go for his further studies in engineering to Jabalpur, but due to affection towards me, he used to feel very upset. He told mother, 'I am not going for study because I can not forget my loving sister.' Even after all that he went away for a better cause. Then he started writing letters to his mother, father and his dear sister.

When I was five years old, I suffered from typhoid. Doctor gave treatment, but due to some side effect of medicine I became serious. When my elder brother saw me in this condition, he became furious and ran away to fight with doctor. Although at that time he was also only 21 years old. He shouted telling, "If there happens something wrong with my sister I will treat the Doctor himself." My parents made him cool some how or other. My life was, in his intuition, perhaps far more superior to any thing else in this transitory world.

He got appointment of an enginear's job after getting the diploma in B.E. Then he started his new life. Even after his marriage, he did not think only about his own family, but also he had always been dutiful and cooperative in effecting the shining future of his brothers and sisters.

Second brother, Ramesh, is also very much concerned about his brothers and sisters. He could not get higher education due to his interest in business in his earlier age. He was a good farmer, but now he is a successful businessman.

Third Brother, Abhay, is a unique personality. He did not like to talk much in his childhood. He did not take any thing except his mother's milk, till his five years of age. That is why he became one of the gymnasts of the village. Everybody was afraid of him. He was skilful in sports. He won many shields in kabaṭḍḍī and other Indian games. Now he is a good buṣinessman. He is an excellent farmer also.

My fourth brother, Sudarshan, is just like as his name is, very handsome. He was also like a yogī by birth. His dress of childhood was: totally naked, little shoes on feet, a stick in one hand, a pet cat in the other and a good cap on his head. Every body used to laugh after seeing him in this funny uniform. His toys were the idols of god, made of soil or stone, placed here and there. He always stood first in his class. Thus he appeared religious while inspiring everybody to follow him. Due to his learning and inspiration, his all the three sisters as well as his younger brother Viveka renounced the worldy life and became nuns (Sādhvīs) and ascetic.

My younger sister, Meena, is very beautiful, intelligent and religious. She is celebate and following the path of freedom. She studied Jain literature in Indore Udāsīna Śrāvikā Āśrama under Pt.

Ratanalal Jain. She finished her M.A. in Hindi. Now she is doing Ph.D. in Jain Jyotiṣa.

My youngest sister, Shikha, is also a genius. She could study only upto the Matric, because she adopted celebecy and afterwards took initiation of female ascetic from Acharya Shri Vidyasagar.

My youngest brother, Vivek, in the same year 1985, joined the order of Acharya Shri Pushpadant sagar, only after his seventh class of school life. All these events took place, all of a sudden in our family and this phenomenon also inspired me to take a decision to follow the path of asceticism. Because, I did not like either worldy married life or a layman's life.

My village lay in the deep interior of the forests, where there was silent and roaring flow of streams. A river flew among the mountainous peaks and the greeneries. I was born and brought up as a son with full freedom to play sport, sing and dance. Every day, I could swim across the river which flows under a bridge, and used to sport with my friends.

NATURE AND HABITS

My mind was greatly influenced in the natural environment. I felt kindness towards every creature and person and liked truthfulness and sincerity. I was regarded a very attractive and graceful girl. I was always busy in some or other kind of study and felt a lot about the fate of every living being in this transitoryand miserable world.

My sports were swimming, races, badminton, ring ring, Pittū, Garhā genda, Deeb race, play-cards, caram, snake ladder while winning first prize during my educational career. I liked trips, tours and walking. I learnt by heart many poems like the Pañcavaṭī. I liked milk preparations along with salad and green vegetables, ice-creem, lemon syrup and hot drinks. I liked melodious songs. All the same, I never liked that anybody may interfere in my matter nor I ever wished to interfere into the matter of others. I never liked to make other miserable and never made a complaint against any one who worked against me.

I was always in good mood, smiling and laughing so that people use to call me ever flourishing and blooming. I could make friends very easily and they were quite a large in number. I was fond of sports and used to read stories, jokes and puzzles. I liked to read Kadambiny, Sarita, Sarvottam, Mukta, and various pocket books of that time. I also visited films and liked the acting of the famous heroes Manojkumar, Sanjivakumar, Amitabh, as well as Aruna Govil. However, out of all of them, the prince of actors, Sanjeev kumar, appeared to be graceful in all respects. Out of many film songs I liked, 'Hai prīti Jahāṁ kī rīti sadā..... and 'Suhānā safara aura ye mausama haṁsṁ.... . The first picture which I visited was 'Sītā aura Gītā, along with my father.

I always dreamt that I shall become a collector and spend my life as unmarried and shall ever live like the Europians in India or spend the life as a writer of History or as a poetess. I also thought of residing in some isolated hillock region after building up a small bungalow therein. I also wished to have a small car with a small park and parking and wished to move all alone over the hills, springs, river, dales, forests and jungles. Thus the wild nature had a great attraction and charm for me. I used to sleep late in night and wake up late in the morning because I used to study mostly, till three o' clock in the night. Due to that, for many a day I could not see the rising sun in the East. On very rare occasion, when I saw the rising sun I was overjoyed. I used to play with small children and enjoyed their sweet talks and made them laugh at playful games. I also felt that children are not to be in the same level and should not be given lift. I never liked that a child may try to disobey or dishonour and object over my ideas, my talks and my style of living. Yet I liked to go for picnic often with my friends and fans and enjoyed jokes while reciting sher and shairy. However, I did not like to remain with various types of people for long, when they were of different nature and behaviour. I liked a decorated room in which

there might be very well arranged books. Thus, many hours used to be spent in arranging and rearranging books and many other things of the room.

I disliked garments, which were fashionable and styled. I also disliked jewellery. Yet it was my hobby to wear dresses as those worn by princesses, sandles of velvet and of various colours. It was not in my habit to put on the same dress next day. However, the dress was sober. I liked the dresses as per cultured wishes of the elders. It was my nature to read the minds of the elders without their outspoken expression. I used to do whatever they liked, before any instruction could be given to me. Thus I could keep everybody happy. In the natural environment, I liked to wear clothes which were of pink, maroon and dark green colours.

At home, there was plenty of land, and domestic animals, so that we all could have pure milk and ghee with all nourishing material. I took my school education at Pindrai in Mandla district, always excelling in sports and studies as well as in every competition.

I was well balanced in every one of my role. I had learnt all yogic postures and symbolic mudrās. I also learnt Reiki at Calcutta. I never told a lie and never spoke ill of others. However, I was envious of my friends and could not resist hurling sarcastic remarks on every one who liked to be in my company and sought my cooperation. I used to wear male dresses and drove cycle without any hesitation. At home, I was nicknamed as Baddi, Dhushmush, Sampata and Maināsundarī. It was unbearable for me whensoever my loving friends deserted me. I was always smiling, frank, fearless and out spoken. I could not bear criticism of my own people and always wished that my friends may also be equally loved by all. My tendency always remained to be in service to whom I appreciated and I could give him even my dearest possession. I remained just, natural, undisposed towards undesirable persons. I could never like the liars. I liked the innocent people and children alike. I always had a desire to be familiar and keep friendship with the learned. I took pleasure in cutting jokes with my youngsters. I was given Tantric tactics by an old wise Brahmin woman of the town whom we called Dādī (grand mother). She showed me how to prove the spells at the night of an eclipse.

My mother was one of the most brilliant women of the town. I still remember her some of the proverbs, folk songs and stories. She was ever pleased to see her son and daughters renunciating the world. She was with me from 1990 till the time of her death when she was offered Sallekhanā under 'Samādhi Samrāṭa, 'Acharya Shri Vidyasagar ji', which she performed successfully.

I was never influenced by others accept by the wise and the learned. I was ever obedient to my teacher and could forget the place and the persons whom I left. Thus, any new place was a happy resort for me. During my studies in M.Phil. and Ph. D., I could get a very small room by the side of the Hanumantal temple, facing a beautiful pond. There was a very decorated sculpture image of Lord Ṛṣabhanātha with Apsaras, elephants on the lotus and three crowns etc. in the temple, which was brought from Tripurī, of the Kulturi period. I completed my M. Phil in 1991. One of my professors was blind, named Shri Purohita, who liked my Sanskrit pronunciation and got prepared some cassetes on the Rasagaṅgādhara, etc., by me for teaching. The professors who cooperated as well as appericiated my debate, lectures and other activities, were Dr. Chaturvedi, Dr. Vimal prakash, Dr. Shukla, Dr. Tripathi and Dr. Trivedi. I used to see only the virtues of others and not their vices.

During the Gajaratha at Jabalpur in 1993, at Pisanahārī Maḍhia, I wished to be iniciated. The whole order had assembled. I got an opportunity to learn mathematics contained in the text of the karma theory along with Pūjya Āryikā Gurumati. And I studied after sometime with my ascetic teacher Saral sagar. I was invited to deliver lectures at Hanumantal during Paryūṣaṇa festival in 1995. Thousands of audience used to assemble for my preachings. I was also invited from several cities of Asam, Calcutta and Bombay as well as Delhi to deliver lectures, mostly in Paryūṣaṇa. I was also given the work of

English translation of the Bhaktāmara poetry after I had published my collection,"Prabhu Bhakti Saṅgraha". I became the editor of Rishabha Bharti, a monthly Journal, in which most selected articles used to be published. By this time I could purchase a plot in Kanchan vihar and got build up a grand Jain temple, along with a large and substantive library, called Sarasvatī Prajñā Mandira.

I had determined to help in the work of mathematical contents of the Prakrit and Sanskrit texts with a heritage of twenty-three hundred years in the theory of Karma. This was a very hard task. However, so far, we have been able to bring out a series of four volumes in, "The Exact Sciences in the Karma Antiquity".

Now we are engaged in the composing and the publication of, "The Mathematical Sciences in the Karma Antiquity".

The destination of the freedom is a pathless land which is as complex and rather more perplexing to understand than the splitation of the bonds of the nuclei of atoms and molecules. The bond of a mundane soul is karmic which is between the bios and matter and requires a profound and a vast study before its experimental verification.

For the purpose of some field work to enrich my thesis I took a tour of important cities to come in contact with some ascetics, to get their opinion regarding enriching my thesis with their advice and other instructions. There was definitely some scientific basis in the karma theory in Jainism which had attracted and inspired me to have this scientific perspective. This science was also based on various types of mathematical manoeuvre due to which the karma theory could not become controversial and could be further elaborated.

This cooperation is still subsisting in spite of various persistent attraction of joining the order as a female ascetic. No doubt, if I become a female ascetic I shall be able to destroy a greater proportion of my karmic bond state. However my collaboration work on the theory of karma, its composing and publication may serve not only my cause but also may be a cause of the care of many a living beings.

My college career started after my education was completed as a matriculate at Pindrai. I joined my brother at Chindwara where he was a sub-engineer. My sister-in-law gave me all facilities as my mother and I felt as free as I was at Pindrai. The College was a private one for the studies in Sanskrit which was not introduced at the Govt. Post Graduate College at the Dharama Tekri, a big mount among the forests in its outskirts. It was a high hillock where people used to go for a walk and there was a small maḍhiyā as well as a majāra where a faquīra used to practise austerities. I had an aptitude for studies in science and mathematics but being unaware of the advantages of science, as a woman, I had selected Sanskrit language, as that was the only alternative left for me as destiny would have it. I had secured first class in matric with distinction in various subjects.

It was indeed lucky that I studied Sanskrit and Prakrit languages in which the whole of the karma theory was laid in about forty volumes, each covering about five hundred pages in A4 size. Apart from these there were five volumes more in which the karma theory was laid as summary texts with coomentaries containing symbolic mathematics in algebraic, arithmetical and geometrical symbols. I had felt that I should meet the Principal of the Govt. Post Graduate College, who had been working on the history of karma science in India, but I could not as my intuition was not developed to the extent that I might foresee my future which was to follow in the later years of my life. I passed B.A in first class first, then M.A. examination from the Sagar University in 1984, securing second division. I had already joined a service at the post office during my leisure hours and I was earning while I was learning.

As luck would have it, I reached home during holidays in service. There I came in contact with my school mates and others who were studying some religious books from an ascetic who excelled in language and logic as well the canonical texts. I joined the class after being initiated as Bramcāriṇī which is necessary for any disciple of an ascetic. I became so much interested in these studies that I resigned from the service and joined the order of the ascetic.

Naturally, I was given full freedom again by my parents to adopt the rituals and continue my religious higher studies. My Guru ascetic taught me grammar and also gave me full freedom to study logic under a retired and learned professor of the Banaras Hindu University, Dr. Darbrilal Kothia. This study continued from 1985 upto 1989. During this period I was exchanging my learning and the knowledge of the scriptures with my Guru ascetic. I was also engaged in every sort of ritual practices, and austerities as is needed for becoming a female ascetic. **The life of a Digambara Jaina female ascetic is very difficult, though full of all welfare,** she has to remain often on fast or one time meal with water to be taken at the time of the meal only. She can not express her illness nor even take any thorn out which might be pierced during her bare feet walk for the purpose of religious duties. She is to bear all types of behaviour from the society on whom she is more or less dependent. She keeps only two Saris with her which are her only possession along with a Kamaṇḍalu for keeping pure and bioled water. She has a picchikā of peacock feathers for saving the creature from injury to them when needed. She may keep holy scripture with her for study. She has to walk in such a way that no living being is killed, hence all such activities are totally stopped for the whole night. She has to suffer cold winters, hot summers and a four months stay at a single place during the rainy season. She has to take very limited food without delicious meals. She cannot talk to any single male and has to remain completely aloof even from her Guru ascetic. She has to bear the bites of mosquitoes and any other creature. If any creature covers her during her meditation, whether ant, scorpion or snake or if she is attacked by a beast she will never do anything to defend herself and remain in the meditative pose till the infliction is over. The votaries alone could save her from all these inflictions. She is also required to move from place to place according to the order commands as "Ramatā Jogī, Bahatā pānī" is the maxim. I decided to take initiation for the rank of a female ascetic and took permission from my parents that it was the only way to attain freedom from transmigration. Every one in the family tried to prevent me by explaining me that I was not matured enough to take up initiation but all was in vain and I started for the other destination alongwith the Guru ascetic. I was then moving from one village to another and from one town to another city. Everywhere we were being given grand reception, respect and all sorts of facility. All types of assurances and cooperation were being offered for my sacred types of studies from place to place and the rich as well as the poor families were affording all types of reverence to us. This period was from 1984 to 1987.

It was the summer of 1988 when my Guru ascetic planned to initiate me as a female ascetic in his order. It was the village named Silvani chosen for the performance of initiation.It was a strange experience to me while I was staying and moving alongwith several sister-Brahmacāiṇīs. I could not imagine at all what I am going to do, to be what I shall, what would be in future? All these thoughs had disappeared from my mind which had become perfectly still. The sisters had taken vows for remaining celebate for their whole life and remain in my company for all times to come after my ascetic initiation. All the preparations were made by the society and my Guru for the rituals and the hour had arrived for the performance.

But something else awaited for my life. "Man proposes and God disposes". All the preparations were over, all around the publicity was given and a great assembly of people had assembled from all the surrounding villages, towns and cities.

All of a sudden there was an interruption as there was a message sent by the Great Guru who had given initiation to my Guru. The message was read before the whole assembly that the celebration of the initiation was not according to the Mūlācāra, according to which my Guru was not competent to give me initiation. Mūlācāra is a sacred book which prescribes the rules and regulations for the ascetics. The society leaders came forward to understand the matter and the function was stopped. My Guru and the order had to proceed to another town. This function could have been successfully operated and I might have become a female ascetic, moving freely on the path to freedom.

This event closed a chapter of my life, once for all, perhaps. We all proceeded ahead and reached

Gairatganj where we spent the Cāturamāsa (four months stay during rainy season). Then we reached Bina where I decided to study logic with the permission of my Guru. The professor of logic began to give me lessons on the logic and I studied logic for a period of five months from him. After that our stay was at Ajanas near Khategaon, where there was again our Cāturmāsa. I learnt there, that there is professor of mathematics has been working on mathematical parts of the karma theory and on the karaṇānuyoga as well. He was the same person who was the Principal at Chindwara and with whom I could not have contact during those years of my college studies. I decided to study this part of the holy scripture or of the canonical texts from him. My Guru permitted me and arranged for my study at Khategaon. Three persons of the society were sent to the professor to bring him there to teach me but he refused to come to Khategaon.

THE ALGEBRAIC TOPOLOGY AND THE ALGORITHM IN MY LIFE

I was destined to work for something else as I thought but it was all that opened the secrets of various learnings set apart by the readers those days. The theory of karma contained all those types of modern mathematics in naive and ancient form which had become obsolete due to it being abstruce and difficult to make out. It was all that was left when the theory of karma was studied for examination in the Gommaṭasāra as well as all such texts. Without the deep study of the tattvas (tautos), the vision could not be attained and at least the path to freedom must be clearly seen first before we put aside the Āgama texts necessary to create a vision. It gives a calculated path with the precise, brief, deep and most extensive, all pervading mathematics, the queen of all sciences.

Ultimately the time arrived for the insatiated desire. I had to study that still unknown and neglected part of the revelation maintained preserved for about twenty three centuries in various forms in temples of India and perhaps in Germany as well. I took leave from my Guru and came to Jabalpur, called as the saṁskāradhānī (cultural-capital) by Vinoba, the veteran follower of Gandhi, near which there is the Tripuri, the capital of the Kalchuris. Subhash Chandra Bose was made the President of the Congress party here, against the will of Gandhi ji as he led the leftists. This city was also famous for the Gondwana queen, Rānī Durgāvatī who had fought against the invasion by the mugal emperor, Akbar. Moreover it was also very well known for the most secret cult of the Tāntrikas. The Nermada flows across and worshipped as the virgin among all rivers of India as it could not be bridged upon. There has been many mentions of it in mythology and other holy Hindu texts about its greatness. It was its bank on which Jābāli Ṛṣi performed austerities and perhaps the austerity resort of the Accoplished.

Thus with the kind permission of my Guru, I started for Jabalpur. I contacted the professor who instructed an engineer teacher to teach me relevant mathematics. My sister Meena, Canda didi and Maniprabha were also attending the classes. I was searching for a residence to live and I got a room in the Hanumantal temple. It was a very small room without any facility. However, after a few days we returned and were engaged in other studies. While on tours I had taken the notes from the professor and it was a register with about forty pages. It contained the basic mathematical material in symbols alone and I copied it during my wanderings. I was still in touch with the professor and was writing to him all along about my wish for further study. He gave time and I reached again Jabalpur where I was advised to appear at the entrance examination for the admission to M.Phil. in Sanskrit. I appeared at the examination and was admitted to the M.Phil course at the Sanskrit Department of the Rani Durgavati University. There were very brilliant lecturers, readers and professors who taught me various courses. Thus I was again in the educational environment at the university level. I had chosen the topic of thesis on 'The Jaina Paramāṇuvāda' (Jaina Atomistics) and felt very little difficulty in submitting the thesis. I enjoyed debates, trips, lectures, discourses and various other activities in the company of very good scholars. There were festivals, seminars and all these gave me a life full of freedom and bliss.

In this environment I learnt the style of carrying a research work in its faithful aspects, presentation of research papers, writing of research articles, participation in discussions and the manner of guidance.

I also learnt about the library upkeep and preservattion of records. My attitude was changing and I was becoming more and more selfless, impartial and unprejudiced. I began to visit various libraries of universities and institutes: as the National Library Calcutta, Library of Ladnun, Jaipur, Delhi, Pitsberg Newyork and Toranto as well as records in the temples famous for a good store of holy scriptures. Thus my journeys to many places was leading me to be more universal and cosmopolitan with a broader vision of the path of freedom.

I topped the list at the examination of the M.Phil. in the whole of the University. When the teachers learnt that I was inclined to do Ph.D., every one of the professors was ready to pick me as his research scholar. I was registered under the supervisorship of the Head of the Department on the topic,'Jaina Dharma - Vaijñānika Pariprekṣya meṁ' (Jainism in Scientific Perspective), with special reference to disposition. My co-guide was professor L.C.Jain. The topic was vast and difficult for me as I was not a science student. My guide was feeling that I was a good preacher and this study needed a research pursuit.

In the mean time I got an invitation from the United States of America to attend a religious convention. Some time before I had been preaching at the Jaina Temple in the Model Town of Delhi. They got the news and helped me in every way to proceed to USA. I took a flight with my sister, Meena, and enjoyed as well as learnt many things in a foreign land where there was also a mixed culture of various societies, religions, and life styles. My host gave a grand reception and with all reverence they cooperated with me in various activities as well as trips to various places as the Niagra water fall.

At the Model Town, Delhi I received the news of the death of my father. It was 1992. This was first shock of my life. I could not forget my father till today, because I loved him very much and he also had a great affection towards me. Before the death of my father, my younger sister, Chintanmati, had taken the initiation of a female ascetic. Meena had also left as a Brahmacariṇī. My youngest brother, Viveka was also initiated as an ascetic, (Prajñāsāgara), and the exodus of we four persons from the same house perturbed my parents and the family. All the brothers were also in the scylla and charybdis what to do what not to do. However, the events became a normal affair as there was a great number of the virgins taking initiation as ascetics and life-long vow of celebacy. By 1999, it was found that the total number of the initiates in an order, in various capacity, was 790 which increased to 1008 in the year 2004. It was a psychological secret why the youths were taking initiation in such a large number. They had not even completed their education in higher classes and left it where they were. It was taking place in the Bundel khand. Could it be the feeling for getting the freedom from the worldly affairs to attain the ultimate frredom or some mass hypnotic influence? Some years ago the same type of influence was felt at Songarh, Gujrat, where the order influenced a large majority from both the sects of the Jainas to follow up another way for attainment of freedom. This was the literature written by Kundakundācārya in the third century A. D.

Thus it has been the way of the world that wheresoever it feels even a bit of freedom, the masses take a turn towards it. New faiths always carry with them the constituent elements of freedom. But what freedom could be felt in a Digmbara Jaina Ascetic order which is so full of bounds and troubles and inflictions? It is the spiritualism whose bliss surpasses all the pains and miseries. Bundelkhand abounded in poverty, child marriage, dowery system, no higher education to girls, suttee system, purdah system, orthodoxy and other such evil conventions. The virgins were not allowed to much freedom of any type as it was told that they have ultimately to join the "Culhā aura Cakkī". They were forbidden to take nourishing food so that there may be delay in their marriage. Thus, from this region we find about 57 male ascetics and 109 female ascetics initiated in an order in 2004. All of them have to be dependent, practically upon the society for their care, although they never feel even a bit that they are dependent upon them. They move in their sādhanā as a lion, fearless and with valour without any help.

I visited Madras, Bangalore, Girinar, Jaipur and many other centres of learning in search of knowledge about the theory of karma discussing it with many a learned scholars. I wished to know how it was that there was a bondage of karma which is material, with the soul which is absolutely non-material.

Then how is it that the bond could be created and could also be annihilated. That there are creative operators and also annihilative operators. The anger, pride, deceit and greed are said to be creative operators and their counter-parts as pardon, courtesy, simplicity and contentment are their annihilators. All these topics have been dealt with in the monumental and mathematical theory of karma. To some extent I placed it in my Ph.D. thesis which I completed in 1997. I was awarded the degree soon and I left again for visiting various other parts of India. During this period, I again wished to join the ascetic order but it was not destined again and I returned to Jabalpur again. During this time Brahmacari Sanjaya Bhaiya of Panagar came to Guru Saralsagar, and he met me. He expessed his deep desire to learn Kātantra Grammar from me. I permitted him. He also appeared at the M.A. examination in philosophy. After which we both decided to settle at Jabalpur for fulfilling the wish of Professor L.C. Jain about arranging a central library. The room at Hanumantal had to be vacated and we purchased a plot at Kanchan Vihar, Vijaynagar, for fulfilment of our devotion towards learning.

Ultimately, I began to cooperate in the publication of the professor who was working without any help and cooperation from anyone. I have still been cooperating in the publication of his INSA projects. We also organized the celebration of an elephant chariot on an immense scale in 2003 at the instance of the great ascetic, Prajñāsāgara, under the patronage of the Āśama and other state disciples, just after completing the construction of a beautiful Jina temple. It accommodates a very big library for helping the ascetic orders and researchers. We are also busy with the translation work of the Ṣaṭkhaṇḍāgama, the Kaṣāya Prābhṛta, the Padma Purāṇa and other holy scriptures into English. Our monumental publication include the Labdhisāra, vol. 1, the Tao of Jaina Sciences and the "Exact Sciences in the Karma Antiquity" in four volumes. We had also published translation of the Bhaktāmara Stotra in English which was sold in America in a lot. I had already compiled a compendium of Jaina riruals named as Prabhu Bhakti Saṁgraha.

Thus my life has been taking sudden turns. I fell ill due to some odd circumstances and when I went to Bombay for preaching all facilities and care were offered by the society.

Till now, I read so many books about the history of Indian woman. Some of them are the 'Lajjā', 'Strī Upekṣitā', Dāsa Prathā, Apsarā, Baḍhiya Strī, works of Raja Ram Mphan Rai, To the Women, Rambles and Recollections of an Indian Official, Bauddha Vāṅgamaya me Nārī, Nāri Ratnamālā, Śāntalā, Rānī Dugāvatī, Women of India and so on and I found that in the ancient and medieval periods and still at present the state of a woman has not been as desirable..

THE STATE OF WOMEN IN INDIA

The problem of an Indian woman in spite of her religious fevour is very complex and vast. It covers a span of history of five thousand of years. No generalization of Indian history can be any thing but half a truth due to the Sindhu Harappan script which went into oblivion and after the great invasions the scripts were lost to tell any thing about the women of that period. India is so much complex as is its architecture of its temples as well as the cultural arts. This is because of the history and the combination of many religions, races, castes and communities and various life styles. These function independently from each other because of the various religious rulers who ruled as the Hindu, the Buddhist, the Jaina, the Muslim and the Christian, patronizing all the prevalent religions of their period to each of their extent.

During the earliest period there was an impact of the Āryana society which was patriarchal, a society of nomads with a moving paternal force with power vested in the tribal chief, king, priest or father. The impact was with the Draviḍian civilization which had a matriarchal system in the whole of South Asia. Hinduism resulted from the sacred books from the Vedas to the Upaniṣadas and Shastras. They are considered as written by the superhuman. They are not regarded as revelations like the Budhist, Jaina, Islam and Christian holy texts. All these works guide the population from birth to death and even beyond.

The complexity starts perhaps from the period of the invention of the Brāhmī and the Sundarī scripts after the Maurya emperor Candragupta who took initiation under Ācārya Bhadrabāhu and studied

from him the knowledge of ten pūrvas. It seems possible that he, alongwith his scriptural knowledge of some script as the Greek, might have invented the scripts for his purpose of study in the karma theory which seems to have created revolution among the masses and might have gone a long way to change the status of women after a gap of the period of a few thousand of years when the Vedic era started. Just before the Mauryan era, the intervening period might have seen the change and soon we see the women, in general, taking to the initiation in a very large number, carrying the sermons from the Buddhistic and the Jaina literature of the ascetics and crossing the frontiers of the nation as a whole. Perhaps, it might have been the period when women, in the masses, resorted to greater liberty and kindness towards the subhuman beings, leave alone the human, and passed into the era of science awakening in which the world as a whole began to participate in full swing.

Now in India there are several minority groups made due to religious divisions. These groups are the Hindus, Muslims, Jainas, Budhists, Parsis, Sikhs, Tribal and so on. They live side by side without interfering one another. Their pattern of life is based on the Hindu pattern because of their largest majority. The doctrine of the Pancaśīla, the basis of the Indian foreign policy, is the result of the wonderful synthesis of the culture. There has been a great influence of the Buddhism, Jainism and Islam as well as the Christianity in the west on the life of an Indian woman. Due to the impact there were introduced new forms of art and architecture, of music, dancing, painting, literature, language, cooking, handicraft, sculpture and many other styles. There has been continuous invasion of the Greeks, Arabs, Turks, Mongols, the Moghuls and the Europeans in one form or the other.

Due to this impact the lot of women also took turns from one epoch to another as they were destined to adopt different religions. They were governed by their religious faiths, prescriptions and commands laid down by the society. Thus a Muslim woman could have only one husband but a Muslim man could be allowed to have four wives. A Hindu was also allowed polygamy, but a married woman or a widow was not allowed remarriage. "Simha gamana satpuruṣa vacana, kadalī phale ika bāra I Tiriyā tela Hamīra haṭha caḍhe na dūjī bāra". In this way, the woman although being the resident of the same nation had a different lot, but all the sufferings were coming from her economic condition in different laws of the same nation. The Christian woman could divorce, a right which was later on provided to a Hindu woman. A muslim woman got mehr from her husband at the time of her marriage and was to be equally treated when her husband married other woman. The Hindu woman, on the other hand was to depend on the joint family system rules according to their scriptural provisions alongwith other several bounds.

Thus in India, every average woman had to suffer due to lack of education and lead a life without freedom due to orthodox customs and tradition of the land in different religions. The same fate had to be endured by the woman abroad with some difference or the other due to her weakness simply as a woman created as such as the provision demanded. The theory of karma, however, makes her completely free to act her own way according to her wisdom, with the further freedom to destroy the karmas themslves for attaining freedom from the transmigration itself.

WOMEN IN THE ANCIENT TIMES IN INDIA

In India, however, in the ancient times, this was not the case. From the ancient holy texts or scriptures, the Vedas, the Upaniṣadas or the Śrutis and the Smṛtis, the Puraṇas and so on, we find that they have related the women at the highest status, holding them with great honour and reverence. Yet the women has always been kept as subordinate to the family in practically every aspect and respect from her childhood upto her last breath. The women were mostly attached to their family and society with rigid bonds of religion. As India was an agricultural country, with altogether different culture and traditions, in thousands of villages, with few cities, the lot of the village women represented the similar life without education, whether she was married to a farmer, businessman, officer, teacher or a priest. Once married,

they had to regard their husband as godly in spite of his all shortcoming. She regarded her in-laws as her own parents. She had to be completely absorbed in all the domestic affairs alongwith her cooperation in earning the livelihood as well as the bringing up of the progeny. Once a woman got widow, she could not remarry and remain servile to the family for her whole life as she was wholly dependent on the head for her livelihood. Women were sold and they had to remain as servant to the master for their whole life. There used to be many types of entertainment and the women were made the objects for their display, as dancing (Devadasī custom) even for temple festivals and they were also to live as Gaṇikās in the kingdom for entertaining the whole community.

However, although not in the masses, there were some great scholarly women whose names appear in the Vedic and the Upaniṣada literature: Brahmavādinī, Gārgī Vācakanavī and Maitreyī. Such Women were divided into two types: Brahmavādinī and Sadyovadhū. The former were eligible for upanayana, Veda study and other religious ceremonies. The Sdyovadhū had only to perform the upanayana before her marriage. Thus women were fully equals of the men as regards access to and capable for the highest knowledge, even the knowledge of the Absolute or Brahma. The Ṛigveda tells about the following riṣikas revealed by women seers also: Romasa, Lopamudra and so on. The Brahmavādinīs were products of the education given under the celebate discipline. The Ṛigvedic society was based on monogamy and was patriarchal. The Kauṣitaki Brahmin speaks of an Āryana lady, pathyasvastī, proceeding to the North for study to gain the title of vāk or the Sarasvatī goddess. Women were also bifurcated to be taught the fine arts, as singing and dancing. Similarly, women were taking part in religious ceremonies reciting chants along with their husbands. They also studied grammar and other literature.

When we pass on to the revolutionary period of the Buddhists and the Jainas, we find the literature in scriptural form in the period of the Mauryana Aśoka empire in edicts and other forms. The women got the freedom to study the scriptures which were in edicts and in prints in gradual development all over the nation. There was left now no difficulty in a self study or in groups even without a guru for going ahead of the general knowledge. Technology was definitely taking another shape in the manufacture of iron and the monuments were being built up with metallic knowledge not only in warfare, architecture but also in medicine and surgery. Although there were the same bonds of the society for the women but in the religious realms every woman was free to live of her own accord, even though she had adopted any type of profession or occupation. The relics at various archaeological survey sights reveal that women of various occupation had been donating for the religious structures and places their own property and material in worship and reverence of the Lords of their religions. Women began to make use of their potent powers of talents, intelligence and other social as well political activities. This lead to their social and economic uplift.

It was due to the inspirational execution of religio-political activity that thousands of monks and nuns, side by side, after initiation went around the whole nation and across its bundaries into the whole of Asia, Africa as well as Europe. They carried with them the most profound knowledge of the basic karma theory, "As you sow so you reap", the culture of non-violence, the intuition of logic, and above all, the lesson of non-possession. They were more conscious about their path of endless freedom, endless bliss, endless knowledge and endless vision. This gave a revolutionary change in the domestic and social life style of an average woman, leave alone a man, the political leaders regarding themselves as the real servant of the public and the society without selfishness and vested interest. Women came forward in every sphere of activity, from the religious, philosophical, logical, educational and preaching to the development of economic planning so that this nation was ultimately began to be regarded as a 'Bird of Gold' (Sone kī Ciḍiyā). There were plenty of animals and their vegetarian products, many business and commercial relations with several nations and the cultural activities surpassed all those in the past. There were several dynasties which were developing the Hindu, Buddhist and Jaina culture throughout the nation and across its

boundaries.

Women were happy in this period as the economic condition had fulfilled the desires of every organ of the society.

THE MUSLIM AND THE BRITISH PERIOD

Then ushered the era of the Muslim rule when several customs were forced into the majority of the society. The purdah, the child marriage, the bandhuā system, the suttee system, the dowery system, leave apart the birth and death as well as other religious rituals came very heavy and disastrous upon the economy of an average family. The tyranny was to be suffered by the women society ultimately. History relates the invasion of the kindoms of Rani Durgavati, Rudrama devi, Tara Bai, Raziya Begum, Chand Bibi, Rani Avanti and so on, which were led to utter destruction during the battles. Then there were the Thugee and Piṇḍārī systems which played their own role apart from the tortures of the dacoits, thieves and so on. However, there were queens as Mangammal and Ahalya Bai Holkar who were famous for their administrative capacity. The Moghul princesses also played a notable part in the court life in Agra and Delhi.They were Jehanara, Roshanara, Zebunnisa. Their poems have come down to us with the representation of the culture of the era. Mention may also be made of Jija Bai, the great mother of Shivaji for her inspiration, strong will and autocracy. Kathāsaritasāgara also mentions about Ratnaprabha. Polygamy was legal and permissible. Thus the chains to which an Indian woman was gradually bound were rather atrocities to which she was inflicted.

The chasm between the Hindus and the Muslims was gradually opening wider and wider till the advent of the European traders who took advantage of this division and they adopted the very simple and unseen policy of 'Divide and Rule'. The British became the ruler of the whole India and they could, with its army power, establish the imperialism and colonialism all over the world. Christianity was patronized and the tribal areas, specifically, came into the fold of the European missionaries, and they were becoming Christian in large number. The British, however, were trying to establish schools, colleges and Universities and bringing all their empire to social service as well as putting an end to Piṇḍārī, Thugee and Suttee systems. During this period, the foreigners, as Anni Besant and Nivedita, came to establish the Congress and other social activities for emancipation of women. India also got leaders like Tilak, Gandhi, Rajaram Mohanroy, Ranadey, Cittranjan, Vivekanand, Abul Kalam Azad and several others under whom the nation gave full freedom to women to participate in political and social fields. The carakhā, the non-violent trades, khaāī, handicrafts, foreign material boycott, picketing for prohibition of wine, non-cooperation movement and so on, were promoted for improving the economy of the poor. Those who had left their occupation in their home villages and had come to the cities to join factories, began to return back to their villages. There was the struggle for freedom through non-violent and truthful means and side by side the struggle against poverty and social evil customs. This was the golden period for the women to come forward for the improvement of their lot. They became fearless and used to pour in the jails without any hesitation and obstacles. The freedom struggle of 1857 in which Rani Laxmi Bai and Tatya Tope and sevaral others took active part had remained unsuccessful. But when the united India struggled, forgeting all the religious differences, it could win the freedom from the foreign yoke. But, as soon as the nation was divided into two, the bright future came to a miserable consequence.

With all these visions, specifically the vision, that I have been able to get from the theory of karma, my life has taken up a path now that has suited me upto my capacity to work for the dissemination of the scriptural knowledge of the karma theory as envisaged by the ascetic seers in India, specifically.

For many a century, there has been a furtive search about what this world is and how the events go on taking palce in it, the stories of births and rebirths, union and separation, pleasure and pain, friendship and enemity and all of these as Yang and Yin predominating over our life. What has been our role in this short life span? After a great many philosophical approaches to this end one reaches some real understanding

that our own actions are responsible for our destiny, fate and capability for efforts in our life.

I feel that the story of my life may give or suggest some new ways which I have traversed all along upto this destination which I had never expected to reach. There are some circumstances and the befall of certain environment that the life is bound to take sudden turns like these. Whatsoever might have happened to the male in the human race, the fate of the women has been the less emancipated one in the centuries of the history of the world. It has been, in fact, painful and intensely painful as we turn the pages of their lives. They have still now been living the subdued life and have always been thought upon as slave to the male community, and never have been treated on equal terms with males. Although there are the provisions in law and constitutions of nations about their safety and treatment, yet as we all know, 'Samaratha ko nahiṁ dosa gusāīṁ | Ḍakarata phireṁ sāṇḍa kī nāīṁ'.

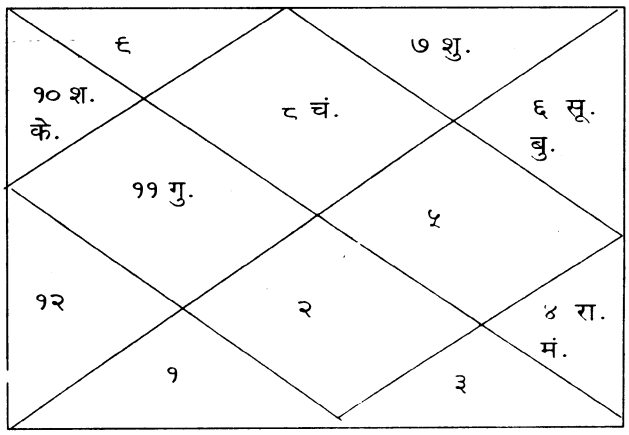
THE PATH TO REAL FREEDOM

This was the period when the Congress government brought forth a democratic constitution in which equality for all was in the preamble. Women were free to join colleges and universities and all the doors were open to them for improving their economy and status. The scheduled castes, the scheduled tribes and the backward communities were granted reservation of various types and the women all over the land got opportunity to get into whatever career they chose to excell in. They could go to foreign lands also for higher studies. They could join any job as in offices, military, technology, journalism, administration, executive, judiciary, education. Social service and political career was also now open for them with full freedom. For the women in the rural regions, more and more opprtunities were being given in domestic services, cooking, grinding, drawing water, dairy industry, flower and vegetables, tailoring, pottership, artisan, cleaning, dyeing, bangle selling, agriculture and non-agricultural jobs. In cities, women were given employment in tea plantation, textile, food factories, coal mining, jins and presses with full political and civil rights. Women began to become doctors, engineers, air hostesses, nurse, midwife, food officer, naval officer, welfare officer, journalist, ambassador, minister, governors and so on.

Still then, the customs which had taken deeper roots, as dowery, corruption, illiteracy, child labour, crimes and so on could not be controlled so far. My life started in all such complexities of India which represented a mini-world in which one could see all the civilizations, cultures and life styles. I was the first daughter in my family after four elder brothers and I enjoyed full freedom as well as the affection from my parents and brothers.

The planetary positions at my birth was as shown in my horoscope :

Horoscope



Dr. Prabha Jain

CURRICULUM VITAE

1. NAME : KUMARI PRABHA JAIN

DESIGNATION : SECRETARY, PRAJÑĀ PRAKARṢA INSTITUTE.

21, KANCHAN VIHAR, VIJAYNAGAR COLONY,

JABALPUR , 482002 (M.P.), INDIA

OCCUPATION : Impartation of Religious sermons to scholars and others through workshops and seminars in form of Logic, Sanskrit, Prakrit, English and Jaina Culture and Practices

2. EDUCATIONAL QUALIFICATIONS :

EDUCATION	BOARD / UNIVERSITY	RESULT	YEAR
Higher Secondary School Certificate Board Examination	M.P. Bhopal,	First Division	1979
B.A.	Saugar University	First Division	1982
M.A.(Sanskrit)	Saugar University	Second Division	1984
M.Phil.(Sanskrit)	Rani Durgavati University Jabalpur	First Division (First Class First)	1993
Ph. D. (Sanskrit)	Rani Durgavati University Jabalpur		1997

THESIS : JAINISM IN SCIENTIFIC PERSPECTIVE (HINDI)

3. Status : Brahmacharini, Teacher, Lecturer, Preacher .

4. Date of Birth : 4th October 1962

5. Birth place : Pindrai (Mandla), M.P., India

6. Specialist : Teaching of Jainism in Scientific Perspective , Teaching of the Dīgambara Jaina Āgama (the Knowledge of the second and the fifth Pūrvas), the Gommaṭasāra, the Labdhisāra, the Trilokasāra and the Tiloyapaṇṇattī through mathematical aspects, Teaching of Yogas of various varieties, Mudrās and Āsanas, Meditations of various types, Prāṇāyāma of various degrees.

7. EXPERIENCE : Toured the whole of India and America for Preachings and Lectures, Attended several seminars and presented research papers, Impartation of the Practice in Worshipping, Yogas and Meditations, School and Collegiate Sports, Swimming and Driving, Managed several Workshops and seminars, Editing of Magazine, Well versed in computer techniques, served from time to time as adhoc lecturer in Sanskrit at the R.D. univercity Jabalpur.

8. PUBLICATIONS :

i. Illustrated Bhaktāmara Stotra (English and Hindi, with Yantra, Tantra and Mantra), Delhi, 1997.

ii. The Tao of Jaina Sciences (Coauthorship), Delhi, 1992.

iii. The Labdhisāra, INSA Project (1984-87)(Coauthorship), vol. 1, Katni, 1994.

iv. Kyā Samrāṭa Chandragupta Dakṣiṇa Bhārata meṁ Muni rūpa meṁ Brāhmi Lipi ke Āviṣkāra meṁ Sahayogī Hue ? Arhat Vacana, 4.4, 1992, pp.13-20; 5.3, 1993, pp.155-171.

v. Constant Set (Dhruva Rāśi) Technique in Jaina School of Astronomy, IJHS,28(4), 1993, 303-308. (Coauthorship)

vi) On certain Mathematical Contents of Prakrit Texts and their Role in Historical Linguistics and Palaeography, (Co. Ku. Prabha), Prakrit Bharati Smarika, Hyderabad, 1993, 37-42/(75).

vi. The Method of finding out the Number of Moons and their Families in the Tiloyapaṇṇattī, IJHS, 30(1), 1995, pp. 57-70. (Coauthorship)

vii. Certain Special Features of the Ancient Jaina Calendar, IJHS, 30(2-4), 1995,pp. 103-131, (Coauthorship).

viii. Exact Sciences in the Karma Antiquity, Vol. 1 (2003), vol. 2 (2004), vol. 3 (2005), vol. 4 (2005)



emitted by the accelerated particle and the hyperspace Φ_2 is the front of gravitational wave (Fig.1).

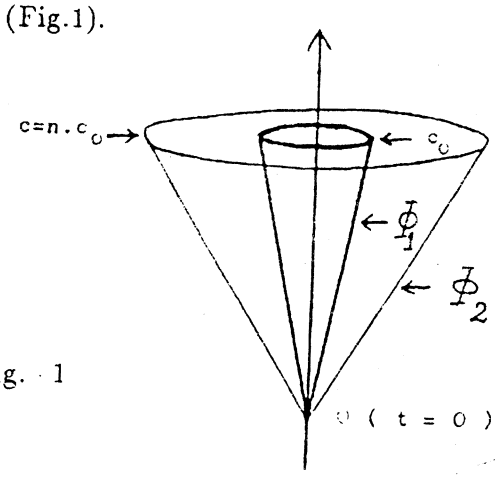


Fig. 1

Let the hyperspaces Φ_1 and Φ_2 be defined respectively by the equations –

$$Z(y^\alpha) = 0 \text{ or } Z^*(y^\alpha) = 0 \qquad (7)$$

where y^α are the functional coordinates.

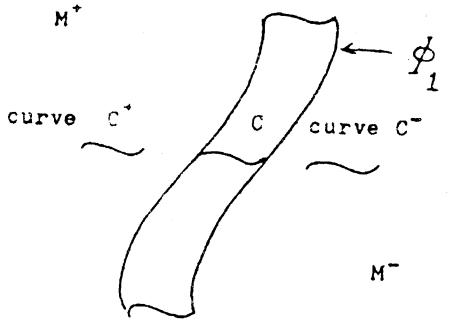


Fig. 2

Defining discontinuities across a hyperspace Φ_1.

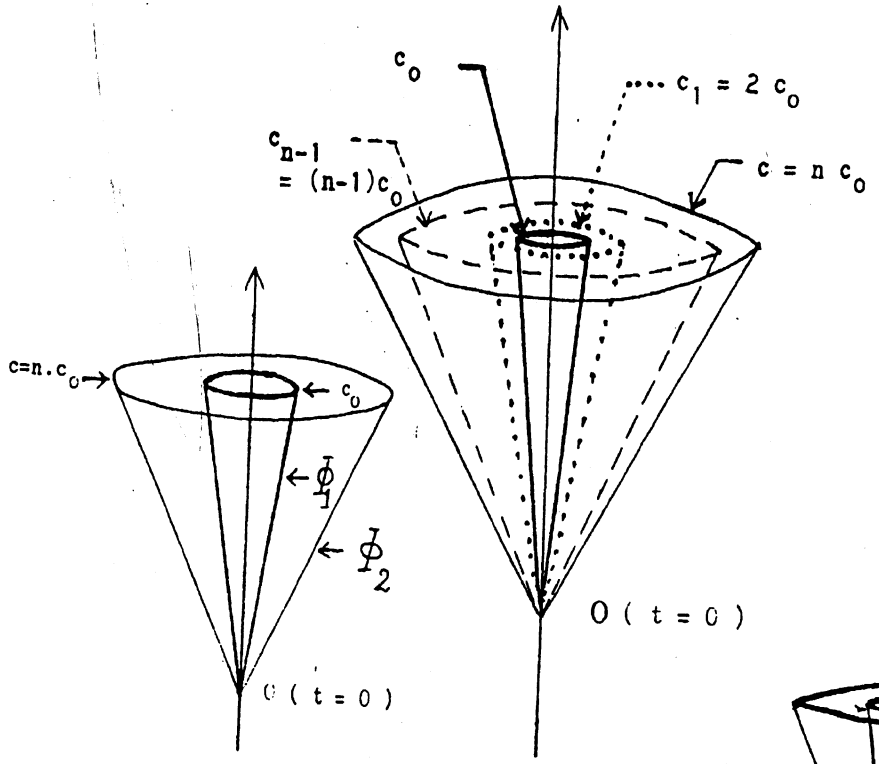
On the hyperspace Φ_1, we have half generalised spaces M^+ and M^-. consider a pair of curves $C^+$and C^-, both tending to a curve C on hyperspace? Φ_1 (Fig.2).

A metric in the functional non-symmetric field can be written as –

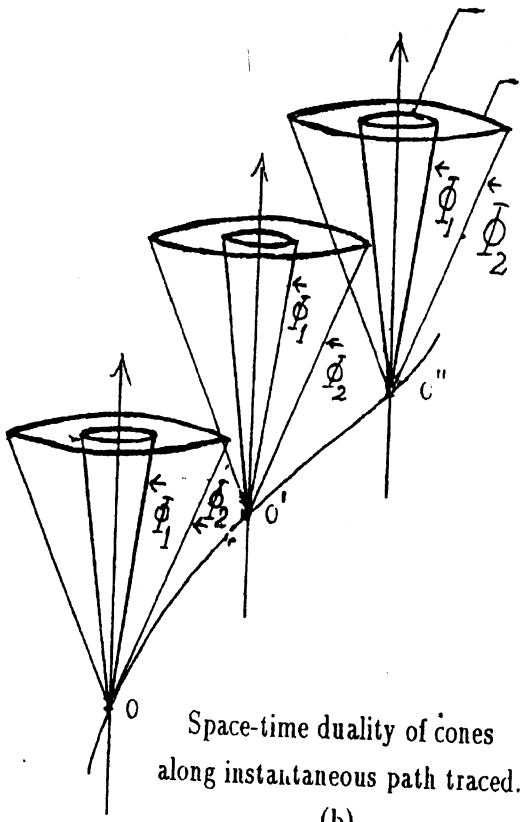
$$g_{\mu\nu} = h_{\mu\nu} + k_{\mu\nu} \qquad (8)$$

where

$$h_{\mu\nu} = g_{(\mu\nu)} \qquad \text{and} \qquad k_{\mu\nu} = g_{[\mu\nu]}.$$

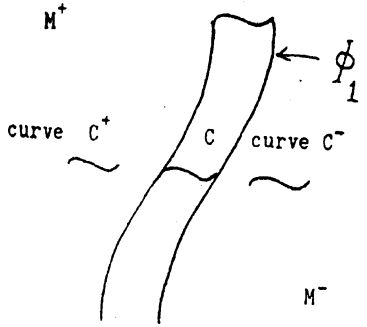


Space-time duality of cones
at an instant, at a stationary point.
(a)

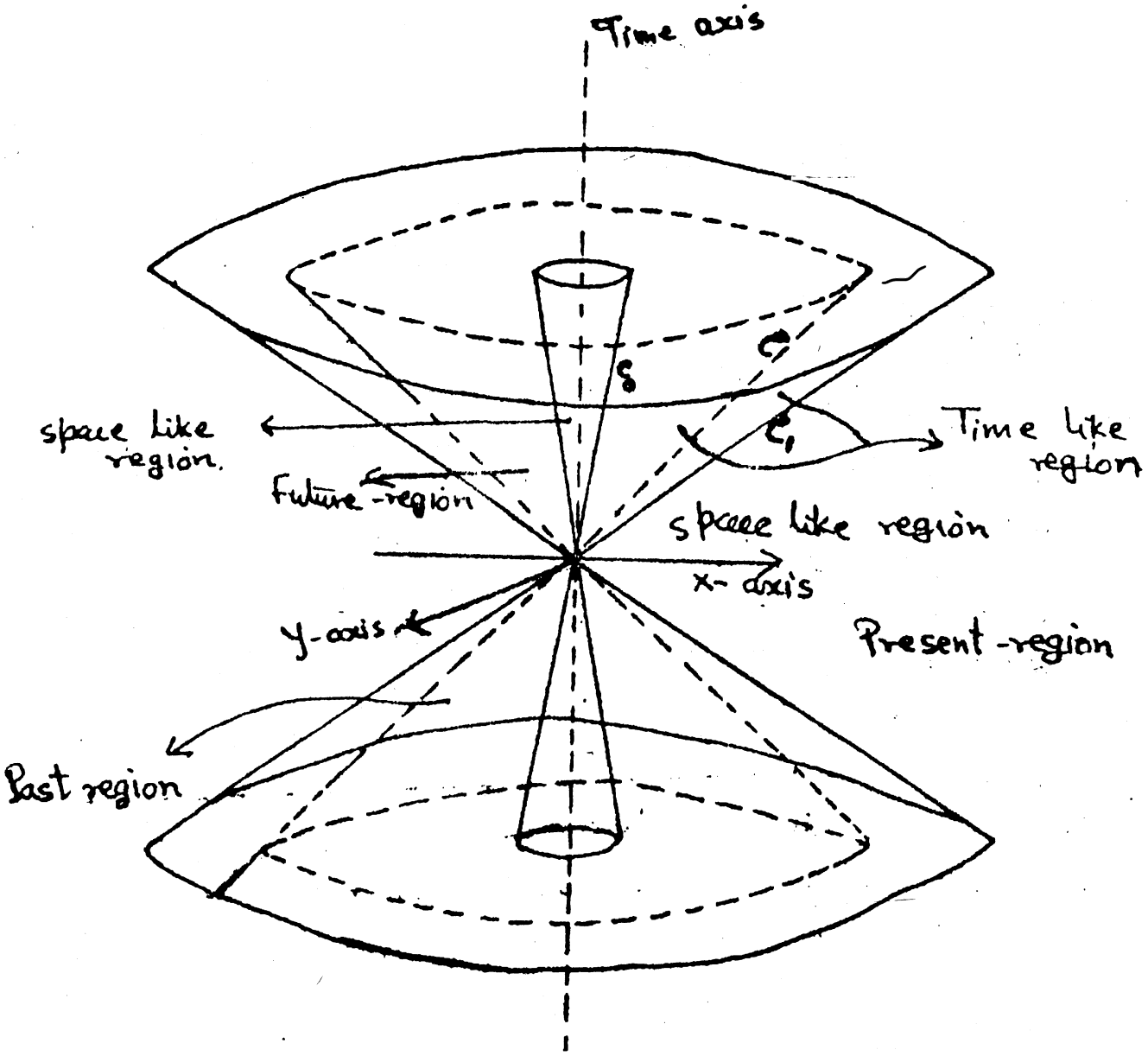


Space-time duality of cones
along instantaneous path traced.
(b)

Fig. 3



Defining discontinuities
across a hyperspace Φ_1.


Time axis
C
S
C1
space like region
Time like region
Future -region
space like region
x- axis
y-axis
Present -region
Past region

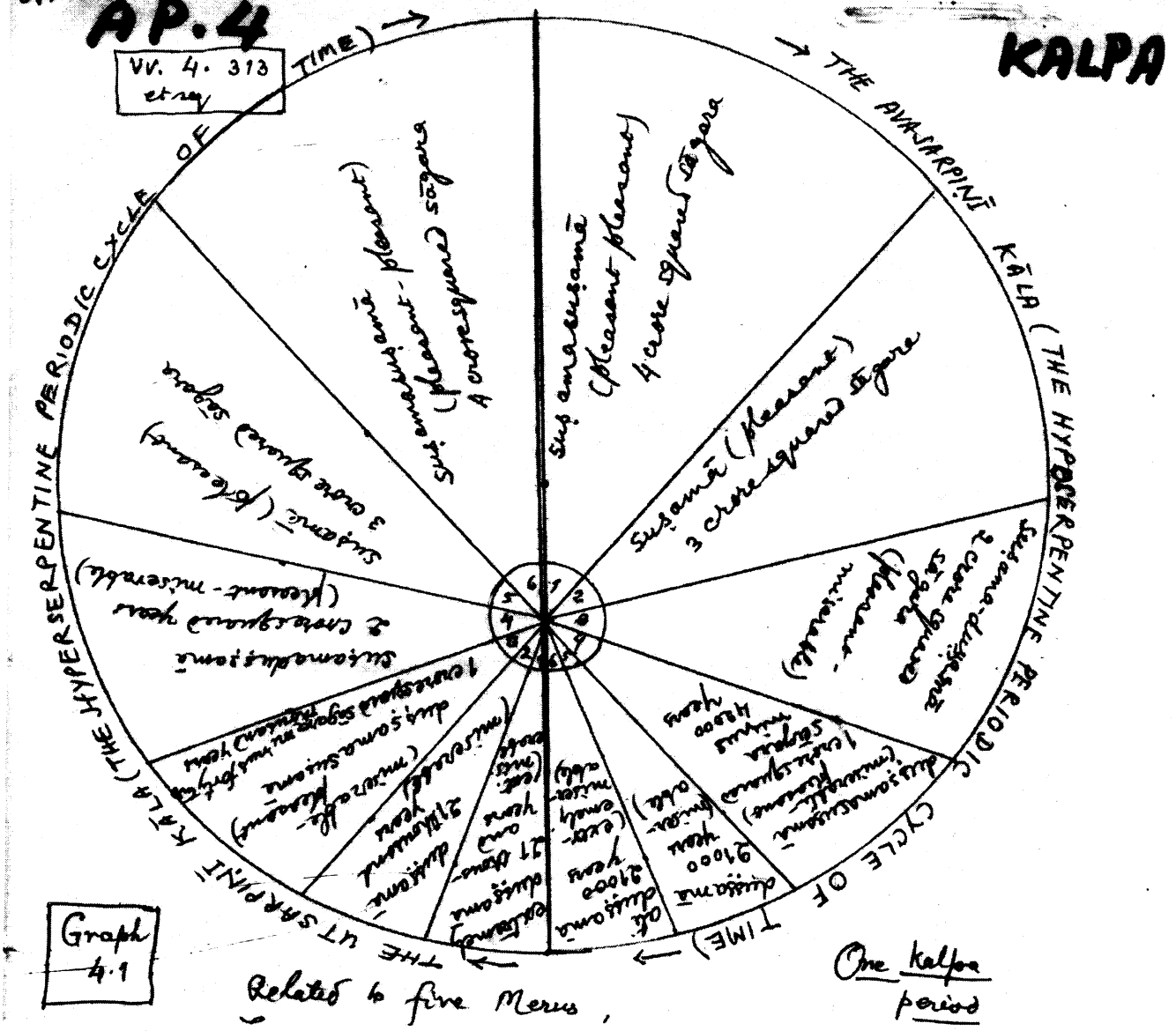
APPENDIX – 4.2

A.12

AP.4

KALPA

VV. 4. 313 et seq

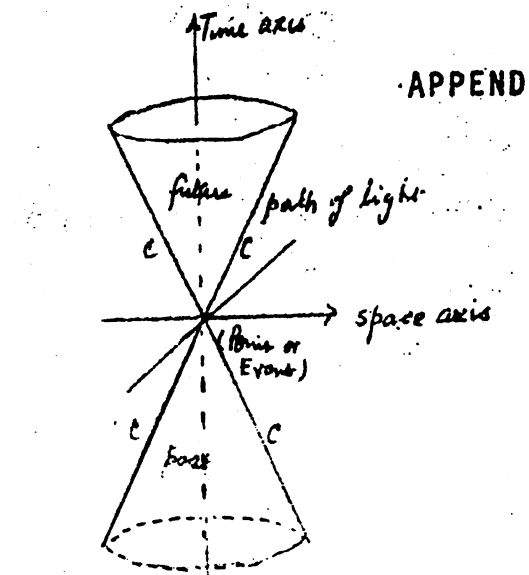


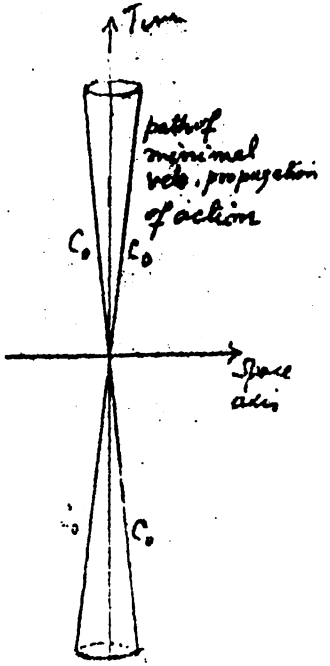
Graph 4.1

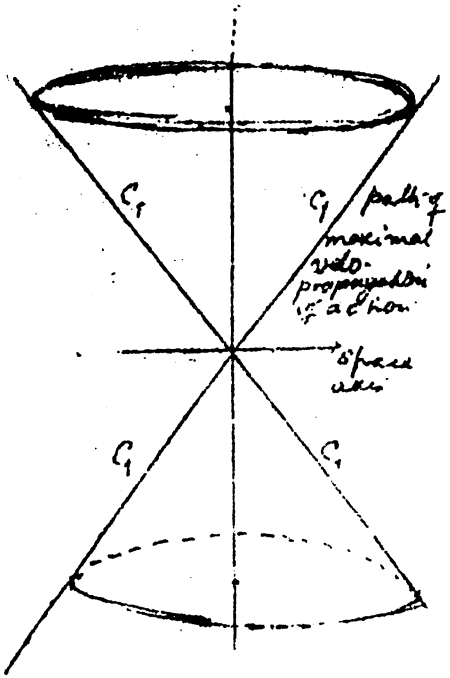
Related to five Meros.

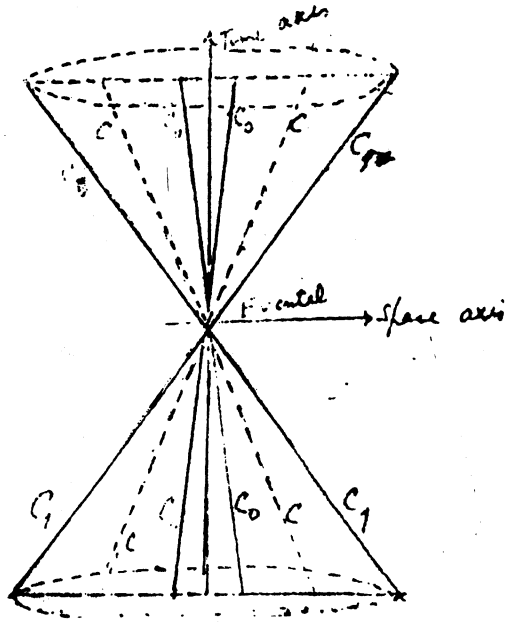
One kalpa period

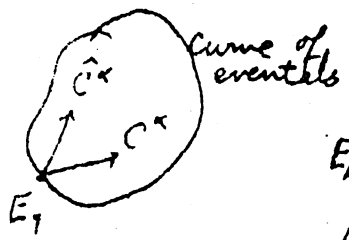
APPENDIX

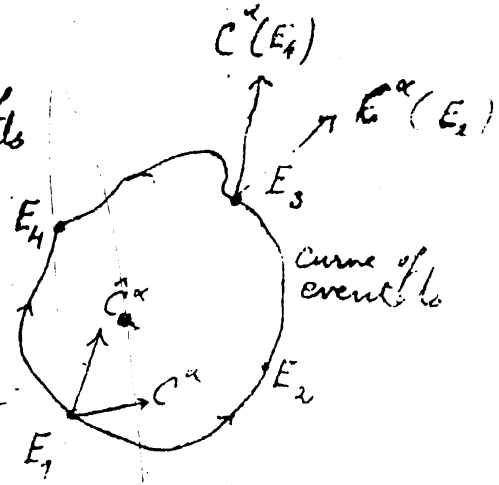

Time axis
future
path of light
c
c
space axis
(Point or Event)
c
c
past


Time
path of minimal velo. propagation of action
C_0
C_0
Space axis
C_0

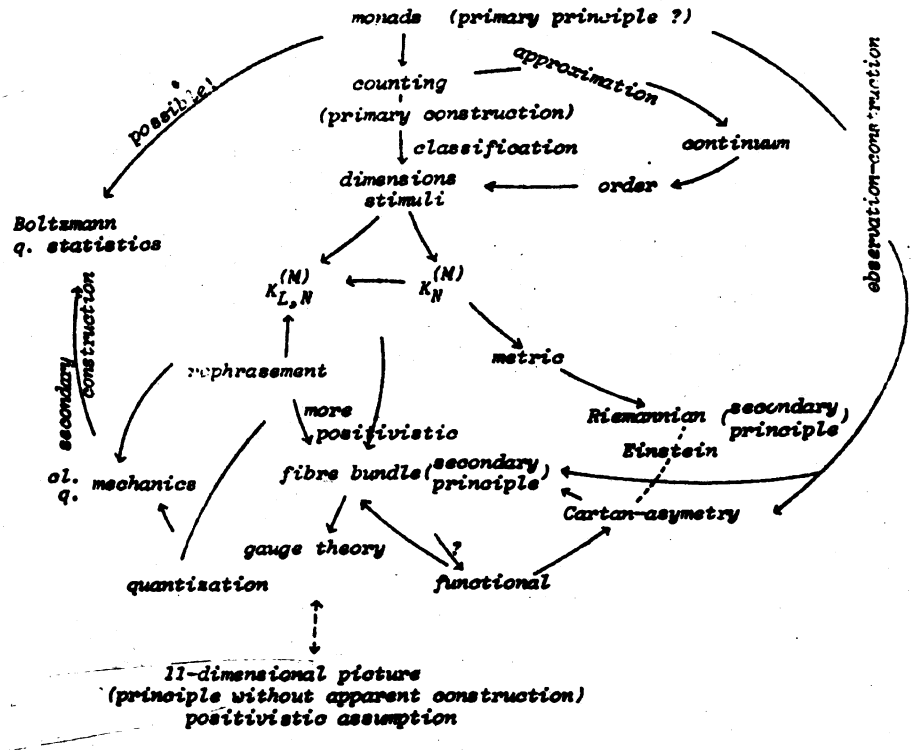

C_1
C_1
path of maximal velo. propagation of action
space axis
C_1
C_1


Time axis
c
C_0
c
C_1
Event
space axis
C_1
c
C_0
c
C_1


curve of events
$\vec{C}^\alpha$
C^α
E_1


$C^\alpha(E_4)$
$C^\alpha(E_2)$
E_3
E_4
curve of events
$\vec{C}^\alpha$
C^α
E_2
E_1

CONJECTURE OF KONDO TO SCHEMATIZE CHAOTIC
INTER-RELATIONS BETWEEN
PRINCIPLE-THEORETIC AND CONSTRUCTION THEORETIC WORKS *



* Private communication, March 31, 1984.



Back Cover page

The cover design gives the modern and the ancient scenirio of the three universes, what we eall today as the cosmos. The images of the great scientists appear at the centre, with the very known figures of Newton, Einstein, Raman and other Indian scientists, with that of Kalpana who sacrified her life for the cause of space research. The background boundaries are those of the ancient Jaina Universe explored explicitly by Vīrasenācārya (ninth century, A.D.) who is noted for his well known commentaries, the Dhavalā and the Jayadhavalā Prakrit texts of the Ṣaṭkhaṇḍāgama and the Kaṣāyaprābhṛta texts compiled by the preceptors Puṣpadanta and Bhūtabali (c. 2nd century A.D.), the disciples of Dharasenācārya, and by Guṇadharācārya (c.1st century B.C.), respectively. The image of Dr. A.P.J. Abdul Kalām, a missile-scientist, par excellence, rising to the supreme post of the Hon. President of India, will be able to inspire the little children to accomplish his dream of INDIA 2020. Mention may also be made of the third slogan, JAI VIJÑĀNA, given by the Hon. Indian Prime Minister, Shri Atal Behari Bajpai, which goes a long way to awaken the scientific spirit of ancient India, once again.

ERRATA

PAGE	LINE	INCORRECT	CORRECT
IV	first from top	reflection	reflections
IV	sixth from top	ANNOINTMENT	ANOINTMENT
XXXVI	third from top	inorder	in order
XXXVII	seventh from bottom	missing	$40^{90} \times 84^{31}$
XXXIX	nineteenth from top	vendiya	tendiya
XXXIX	twenty first from top	sensed four-sensed	sensed, four sensed
3	twenty first from top	Diagambara	Digambara
3	twenty third from top	had crushed	had been crushed
4	twelfth from top	vomitting	vomiting
10	twenty first from top	surprised	surmised
11	fourth from top	Riemanniam	Riemannian
12	twelfth from top	missing	add "see figures on cones pp. 140-142,144"
29	nineth from bottom	missing	add "see the resulting figures of cones on p. 142,"
30	twentieth from top	en pirical	empirical
33	third from top	$\log_2 p \div A$	$\log_2 p \div A$
38	fifteenth from top	cline	clue
38	seventh from bottom	tmastamahprabhā	tamastamaḥprabhā
39	footnotes	The foot notes refer to page 40 and page 42 respectively	
39	seventh from top	jambū	Jambū
39	twelfth from top	Bharat	Bharata
39	eleventh from top	HEIGHI	HEIGHT
52	first from top	HIS CONTRIBUTION	HIS POSSIBLE CONTRIBUTION
62	thirteenth from top	Asoka	Aśoka
62	eighth from bottom	lenthened	lengthened
103	heading	missing	THE SECOND SAMVATSARA (YEAR) OF YUGA
127	twelfth from bottom	europians	Europeans
128	twelfth from bottom	Apsaras	Apsarās
131	thirteenth from top	abstruce	abstruse
133	sixteenth from top	Aśama	Āśrama
133	21st from bottom	Baḍhiyā	Badhiyā
133	sixteenth from bottom	fevour	fervour
135	fifteenth from bottom	as well	as well as
135	fourth from bottom	Began	Begun
136	nineth from top	kindoms	kingdom
136	ninteenth from bottom	Cittranjan	Cittaranjan
136	17th from bottom	khaāi	khādī
136	third from bottom	palce	place



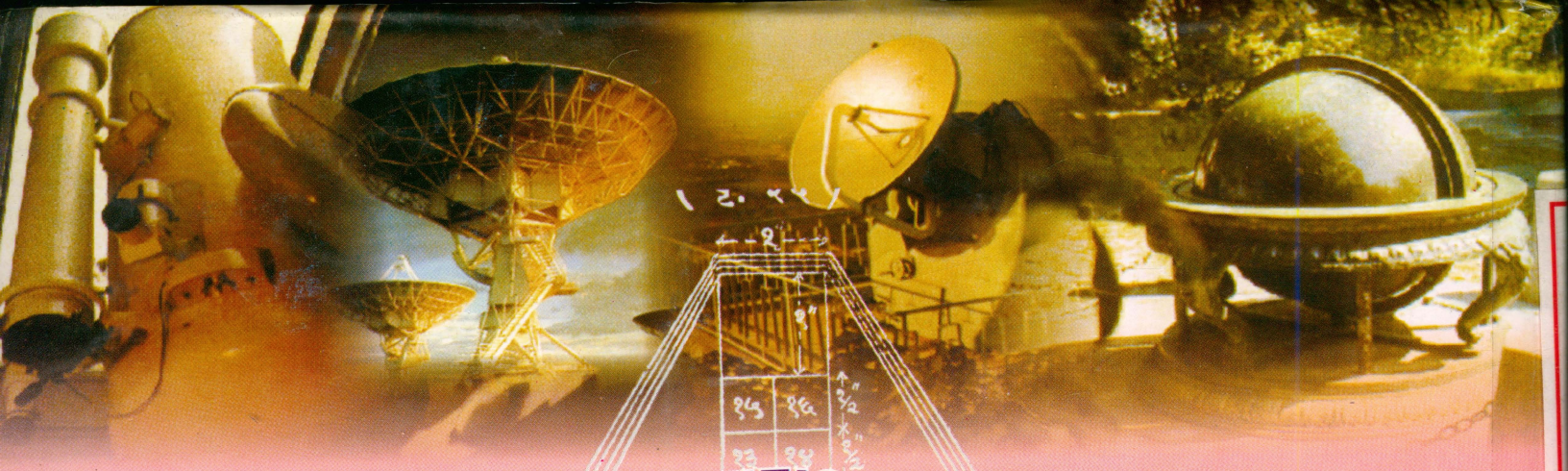
About the Co-author

She was born at Pindari Mandla (M.P.) on 4th Oct. 1962. She passed B.A. and M.A. (Sanskrit) from the Saugar University. Then she topped the list of M.Phil. in 1993, from the Rani Durgavati University in Sanskrit. She was then awarded the Ph.D. from the same University in 1998.

Soon after her M.A. in 1984, she chose the way to asceticism and devoted herself to studies in Logic and Jaina Philosophy, Religion and Culture. She went on Lecturing and preaching and visited the Jaina World Conference on invitation from the Jain Convention United States of America. Then she became the Director of the Brahmi Sundari Prasthashram, Jabalpur in May, 1999. She also took over the charge of administrating the Acharya Shri Vidyasagar Research Institute, Jabalpur, soon after it came under the management of the Prasthashram. Well versed in Computer Techniques she has been collaborating in publication works, like the INSA projects, of Professor L.C. Jain. She has to her credit, Joint authorship of the Tao of Jaina Sciences, the Labdhisara (vol.1) and a few research papers published in the IJHS and the Arhat Vachan.

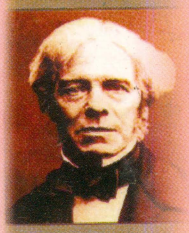
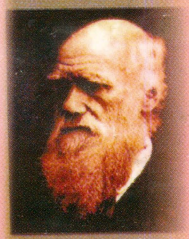
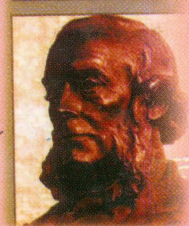
She is the Chief editor of the digest magazine, "Rishabh Bharti" devoted for topics on humanities, social sciences, science and technology and Karma theory.

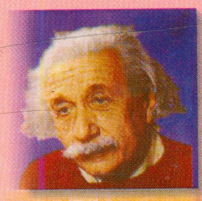
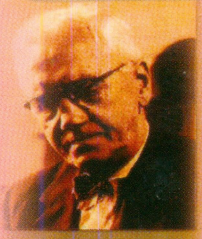
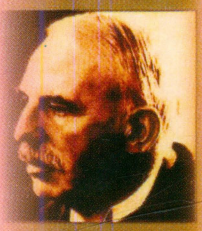
Recently, she has been engaged in organizing the publication of a series of volumes, on the Exact Sciences in the Karma Antiquity and the next series in the tradition of Shri Kundakundacarya (Mathematical Sciences in the Karma Antiquity). She is also serving as adhoc lecturer in R.D. University, Jabalpur.

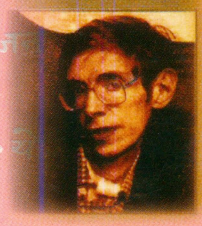


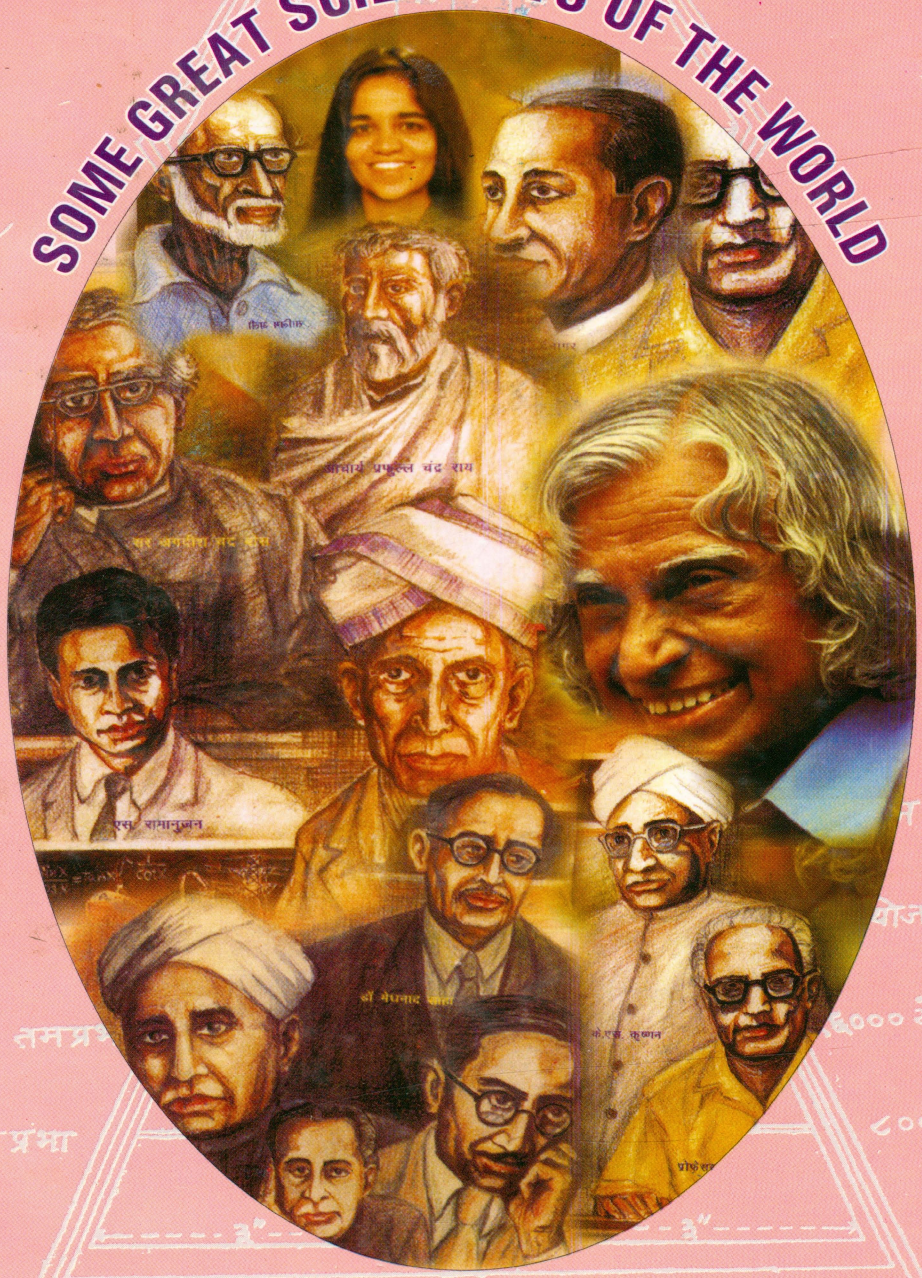
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