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HISTORY OF HINDU CHEMISTRY
Messrs. WILLIAMS & NORGATE

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A STORY OF HINDU CHEMISTRY

FROM THE EARLIEST TIMES TO THE MIDDLE OF THE SIXTEENTH CENTURY A.D.

WITH SANSKRIT TEXTS, VARIANTS, TRANSLATION AND ILLUSTRATIONS

BY PRAPHULLA CHANDRA RAY, D. Sc., Ph. D.,
Professor of Chemistry, Presidency College, Calcutta

VOL. II

CALCUTTA

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CALCUTTA

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82, Maniktala Main Road.
To the Memory of

M. P. E. BERTHELOT

I dedicate this volume of the History of Hindu Chemistry.
PREFACE

The second and concluding volume of the History of Hindu Chemistry is now presented to the public.

When the first volume was under preparation, it was feared that many valuable works on Hindu Chemistry referred to in Rasārnava, Rasaratnasamuchchaya, etc., had been lost for ever. Pandit Navakānta Kavibhūshaya was deputed to Benares to make a searching enquiry and his labours have been rewarded by the discovery of several rare MSS., including one of Rasahridaya. This last-named work is of surpassing interest considering its comprehensiveness and antiquity. Two more transcripts of it have also been procured from the Libraries of the India Office, London, and of the Darbār, Nepal. A copy of Rasendra-chudāmanī obtained from the Library of the Deccan College, Poona, has also been of signal help. A critical study of the new materials throws a flood of light on the dark recesses of the history of Indian Chemistry. As a halo of literary and scientific activity including the pursuit of alchemy circles round the prominent figure of Nāgārjuna, considerable space has been devoted to a discussion of his age in the Historical Introduction.
It was with diffidence and hesitation that I placed the remotest limit of alchemical Tantras in the 12th century A.D. It now transpires that this date is to be pushed back by several centuries.

*A History of Hindu Chemistry* would be rightly regarded as incomplete which did not deal with the constitution of matter and the various hypotheses in regard to it. The European historian of chemistry has always turned his eyes to Greece as the perennial fountain of knowledge on this as on other subjects. And it is but natural that he should do so. * The Hindu atomistic school has not hitherto, I am afraid, found an interpreter who could do full justice to it. Colebrooke’s presentation of it with which I had to content myself in the first volume is masterly so far as it goes, but is fragmentary. Not feeling myself equal to the task I applied for help to Mr. Brajendra Náth Seal, Principal, Victoria College, Kuch Behar. Principal Seal has kindly responded to my appeal with alacrity. It is to be hoped that a long-felt desideratum has at last been supplied.

The frequent references which have been made to the first volume must be taken to mean the second edition of it. Those who happen to possess copies of the first edition will not, however, be put to any serious inconvenience.

* Vide Vol. 1, Intro, xiii.
I avail myself of this opportunity to express my cordial thanks to Pandit Harischandra Kavi-ratna, late Professor of Sanskrit, Presidency College, and my collaborator in the editing of the text of Rasárnava in the Bibliotheca Indica series.

In the preface to the first volume I presumed to narrate the circumstances under which I undertook the composition of my History. The great chemist and savant, whose inspiration has been my guiding principle throughout the arduous task and whose lengthy and appreciative review of the first instalment has been a stimulus in the continuation of it, is no more. Marcellin Berthelot breathed his last on March 18, 1907, leaving the world of science poor indeed. It was with the view of coming into personal contact with the illustrious scientist that the author made a pilgrimage to Paris in March, 1905. The long interview which he had with M. Berthelot and the reception which was accorded to him at a meeting of the Academy of Sciences by its late Perpetual Secretary, as also by its President, M. Troost, made a deep and lasting impression on his mind.

Alas, for the vanity of human wishes! These pages will no longer be greeted by the eager and indulgent eyes of M. Berthelot. All that now remains for me is to dedicate this volume to his sacred memory.
It is with mingled feelings that I mark the hour of my final deliverance from a self-imposed task which has occupied all my spare time during the last 15 years and more—feelings not unlike those which overpowered the Historian of the Roman Empire. The reader will, I hope, forgive me if I venture to give expression to them in the words of Edmund Gibbon himself. "I will not dissemble the first emotions of joy on the recovery of my freedom. * * * * But my pride was soon humbled, and a sober melancholy was spread over my mind, by the idea that I had taken an everlasting leave of an old and agreeable companion."

The Hindu nation with its glorious past and vast latent potentialities may yet look forward to a still more glorious future, and, if the perusal of these pages will have the effect of stimulating my countrymen to strive for regaining their old position in the intellectual hierarchy of nations, I shall not have laboured in vain.

Presidency College.
June 1, 1909.

P. C. RAY.
PRELIMINARY REMARKS ON THE MECHANICAL, PHYSICAL AND CHEMICAL THEORIES OF THE ANCIENT HINDUS.

My paper on the Mechanical, Physical and Chemical Theories of the Ancient Hindus is intended to be a synoptic view of the entire field of Hindu Physico-chemical Science, so far as this reached the stage of positive Science as distinguished from the prior mythological and empirical stages. As the work in which my paper appears relates to Hindu Chemistry, I have elaborated the chemical portions, including the Hindu account of the constitution of the fats and oils, and the organic tissues, in addition to Hindu inorganic chemistry. I have also briefly noticed the chief chemical industries of the Hindus which secured them an easy pre-eminence in manufactures for a thousand years, and, in the Addenda, given some interesting recipes relating to several matters of chemical technology. Of mechanico-physical theories, I have expounded the Hindu conception of Energy, potential as well as kinetic, and of molecular motion, so far as they are applied to the elucidation of problems of a physico-chemical nature, viz., the constitution of
matter, the genesis of atoms and their infra-atomic constituents, and the chain of mechanical causation in the system of Nature. I have also touched on the Hindu theories of light, heat and sound, as implying current or wave motion, leaving the elaborate exposition to my paper on Hindu Mechanics and Physics. In the Appendix, I have added a brief account of the Scientific Method of the Hindus, which shows that all this was not a mass of unverified and unverifiable speculation (the very antipodes of science),—the charge usually brought against Hindu thought and culture,—but professed to be the outcome of a Scientific Methodology which, in its formulation of the canons of the two fundamental Inductive Methods, is more comprehensive as well as more original and suggestive than Mill, and which, as regards its Applied Logic of the Sciences, (e.g., the Logic of Therapeutics, of Grammar etc.), is a standing testimony to the systematic completeness and rigour of the Hindu scientific mind. The difficulties of my task have been formidable, but I have not written one line which is not supported by the clearest and most authoritative texts. The ground trodden is, for the most part, absolutely new. I have gone back to the origines, and studied the authorities at first hand, being resolved to eschew all second-hand sources of information. Fortunately, the Sanskrit philosophico-scientific terminology.
however difficult from its technical character, is exceedingly precise, consistent and expressive. The materials also are full, and the sources of information corroborate one another. Another difficulty I have sought to guard myself against is the unscientific, unhistorical but very common and almost inevitable habit of reading modern ideas into old guesses or speculations of a happy-go-lucky or nebulous character. I do not think that the mere passion for Truth is a sufficient safeguard against this fatal facility of unconscious distortion or misrepresentation. A true historical perspective can only be acquired by historico-comparative studies, with the application of the correct historico-comparative method (vide the Introduction to my Comparative Studies in Vaishnavism and Christianity). I have also practised, or tried to practise, a habitual understatement, without consciously falling into that 'suppressio veri' which is so often a 'suggestio falsi.' How far I have succeeded in exhibiting the truth about Hindu science or the Hindu scientific mind is a question which I leave to competent judges to answer.

Before concluding, I must advert to my use of the terms "isomeric" and "polymeric" in senses different from the current ones, though suggested by the principle of analogous extension. Instead of coining new terms, I adopted (perhaps with a questionable freedom) these existing ones to ex-
press the Hindu idea of distinctions of chemical substances due merely to difference in spatial position or arrangement among the particles, without any implications whatever as to percentage composition or molecular weight. A study of the original sources has made it clear to me that a "Bhúta" in Hindu Chemistry represents a class of elements composed of similar atoms, and the different elementary substances comprised under one and the same "Bhúta" are 'isomers', in this limited sense, in reference to the atoms, being specifically constituted by differences of spatial position and arrangement among the latter. This is true of the Sáákhyá-Pátañjala and the Nyááya-Vaiseshika alike. But, in the Sáákhyá-Pátañjala, the atoms themselves are composed of Tanmátras; and in one view, the atoms that enter into the "isomeric" modes of the same "Bhúta" are themselves "stereo-isomers" in reference to the Tanmátras. A tri-Tanmátric atom, for example, may have different isomeric forms which would account for the diverse modes of the "Bhúta" originating with this class of atoms. Hence under the Sáákhyá-Pátañjala, I speak of "isomeric" atoms, while under the Nyááya-Vaiseshika I confine myself to the phrase "isomeric modes of the same Bhúta". It appears to me also that in the Sáákhyá-Pátañjala view, while an atom of a particular kind (say a tri-Tanmátric or a tetra-Tanmátric one) may have "isomeric" forms of its own, the
atoms of the different "Bhúta" classes (from the
mono-Taúmátric to the penta-Taúmátric) are what
may in a broad sense be termed polymers of the
Ākáśa Tanmátra and Bhutadi (matter-rudiment).
Under the Sáûkhyà-Páñjala, therefore, I have
spoken of "polymeric" atoms and "polymeric"
combinations of these, though I must confess that I
have done so with great diffidence and hesitation.

Victoria College,

Cooch Behar.

23rd May, 1909.

B. N. SEAL.
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Introduction

Chapter 1

On the age of Nagarjuna and the Buddhist Alchemical Tantras.

In the first Volume it has been incidentally mentioned that side by side with the Sivaite Tantras we have their Buddhist counterparts in which the salient features of the former appear. The question now arises: when did the votaries of the religion of Sákyamuni find themselves called upon to engraft upon their simple and pure creed the ensemble of the gross and grotesque superstitions, the hideous incantations, as also the speculative, the metaphysical and esoteric phases of spiritual aspirations of which the Tantras are the repositories? The answer cannot be given off hand

* Vol. i, Intro. lxx.
in a few words, for it will lead us to a discussion of the origin and development of Maháyánism. Under ordinary circumstances we should have considered it beside our purpose to devote much space to this subject in a work dealing with the history of chemistry. But it so happens that the most prominent figure in Indian alchemy, who is acknowledged on all hands to be the discoverer of the processes of distillation, sublimation etc., is no other than the reputed founder of the Mándhyamika system of philosophy, the renowned Nágájrjuna. A brief and rapid survey of the causes which led to the origin of Maháyánism and its intimate connection with the tenets of the Śivaitc cult will be of help to us.

It is one of the saddest episodes in the history of the great religions of the world that the purity of life, right conduct, right living,—in short, the moral code upon which their founders have always laid particular stress,—soon begin to occupy a subordinate position and a dogmatic theology springs up in time, which gives occupation to the subtlest intellect.
As for the masses of the people it is doubtful if ever they have remained contented with the mere ethical aspect of a religion. At any rate we find that immediately after the tidings of the death of Buddha had spread about there was a squabble among his followers for the possession of the master's corporeal relics and in course of time stūpas were raised over them, which no less than the three jewels (*Ratnatraya*)—the Buddha, the Dharma and the Samgha,—and the Bodhi-tree became objects of worship of the devotee. The Chaityas, Vihāras and other sanctuaries of divers sorts, with which Buddhistic India was dotted over in the first and second centuries after the decease of the great Teacher, afforded asylums for a vast multitude of monks, who, freed from all worldly cares, found ample leisure to formulate and draw up a code of spiritual and disciplinary exercises.

Although their high ideal was "to lead sweet lives of purest chastity" and induce their lay brethren to follow in their footsteps, rituals and ceremonials of an imposing and
elaborate character soon obscured the ray of light which shone forth from the founder. Thus we find that within 150 years after the passing away of Buddha tedious and circumstantial regulations as to the quality of robes to be worn by the Bhikshus, the mode of bathing and fasting, the taking of the midday meal, the drinking of unchurned milk, probation and penance, dwellings and furniture and so forth were amongst the weighty subjects for discussion in the Second General Council.* We need not pursue the subject further. The reader who is interested in the study of comparative religions will find striking parallels in the early history of the Christian Church. †


† The Sermon on the Mount was more or less forgotten. Idolatry disappeared, it is true, but only to re-appear in the shape of Mariolatry and the worship of Saints and relics. In the heat of the schismatic strifes, Christian Charity had to make shift for itself as best as it could. Theologians were busy with the interpretation of the writings of the fathers. In a word, the dogmatic to a large extent superseded the moral element of religion.
We are not concerned here with tracing the rise, progress or decline of Buddhism; if we have at all referred to its excrescences, it is only to prepare the mind of the reader for the proper understanding of the Mahāyānist development.

The India of Asoka and of the fourth and third centuries B.C. was in the main Buddhist, but it should not for a moment be supposed that the old faith was extinct. The triumph and ascendancy of the teachings of Śākyamuni and his followers were due in a large measure to the fact that they drew upon, and incorporated into, their creed much that was essentially of Hindu origin. * As Dr. Bhāndārkār observes:—

* Prof. Rhys Davids expresses the same views in several places:—"There is ample evidence even in the books of the orthodox body of Brahman teachers to show that when Buddhism arose there was not only much discussion of the ultimate problems of life, and a keen interest in the result, but also that there was a quite unusually open field for all sorts of speculations."—"Buddhism," American Lectures on the History of Religions (1896), p. 26. Again: "But Buddhism is essentially an Indian system. The Buddha himself was,
"But it was not the metaphysical doctrines of Buddhism that influenced the masses of the people. What proved attractive was its ethical side. The Buddhist preachers discoursed on Dharma or righteousness to the people. Such discourses on Dharma without the introduction of any theistic idea have their representatives in the Brahmanic literature. In many of the episodes of the Mahābhārata especially in the Śānti and Anuśāsanika books we have throughout his career, a characteristic Indian... he was the greatest and wisest and best of Hindus."—ibid, p. 117. The same high authority puts it more tersely when he says: "This is partly, no doubt, because we call them Buddhists, and imagine them, therefore, to belong to a separate class, quite distinct from other Indians of that stock. The Buddhists were, as a matter of fact, characteristically and distinctly Indian."—"Buddhist India," p. 165. Cf. "Buddhism, in fact, may be regarded as a reformed phase of Hindu religion and ethical activity. The Buddhistic doctrine of the vanity of the world had been thoroughly disseminated by Yājñavalkya (in the Satapatha Brāhmaṇa) and with it the practice of subsistence upon alms as Pravṛṣṭa or Bhikshu; and a fruitful soil had thereby been prepared for Buddhism." Weber's " Hist. Sans. Lit." trans. 3rd Ed. (1892) p. 285. Again "This teaching contains, in itself, absolutely nothing new; on the contrary, it is essentially identical with the corresponding Brahminical doctrine; only the fashion in which Buddha proclaimed and disseminated it was something altogether novel and unwonted."—ibid, p. 289.
simply ethical discourses without any reference to God, of the nature of those we find in the Buddhist
ic works; and sometimes the verses in the Mahá-
bhárata are the same as those occurring in the latter. There appears to be at one time a period
in which the thoughts of the Hindus were directed
to the delineation of the right conduct in itself
without any theistic learning. And Buddhism
on its ethical scale represents that phase. Right
conduct is the last of the four noble truths of Bud-
dhism."

* * * * *

"It was this phase of Buddhism that with the
strenuous efforts of the missionaries and of the Em-
peror Asoka enables it to achieve success amongst
the masses of the people; and what was wanting
on the theistic side was supplied by the perfection
and marvellous powers attributed to the founder of
the religion. Without this faith in the perfection
or, what we should call the divine nature of Bud-
dha, a mere ethical religion would probably not
have succeeded. Buddhism was not a social re-
volution as has been thought by some writers. It
was a religion established and propagated by per-
sons who had renounced the world and professed
not to care for it. From times of old there existed
in the Indian community such persons who were
called Sramaneras and belonged originally to all castes. These gave themselves to contemplation and sometimes propounded doctrines of salvation not in harmony with the prevalent creed. Buddhism was not even a revolt against caste, for though men from all castes were admitted to the monastic order, and though in the discourses of Buddha himself and others the distinction of caste is pronounced to be entirely worthless, still the object of those who elaborated the system was not to level caste distinctions. They even left the domestic ceremonies of their followers to be performed according to the Vedic ritual. This is one of the arguments brought against Buddhism by Udayanāchārya. "There does not exist," he says, "a sect, the followers of which do not perform the Vedic rites beginning with Garbhādhāna and ending with the funeral, even though they regard them as having relative or tentative truth."* Buddhism, however, was a revolt against the sacrificial system and denied the authority of the Vedas as calculated to point out the path to salvation. And

* नाम्भेव तद्भवं यत्र साध्वत्मवदिष्ठ्यापि गम्भृधानायच्यतिपत्यक्तसं बौद्धिको
कियो जना नातुत्सवनी। Atmatattvaviveka, Calc. Ed. of Samvat 1906, p. 19, साध्वत relating to संबंध, a Buddhist technical term.
this is the root of the hostility between itself and Brahmanism."**

The zealous missionaries of Buddhism captured the heart of the masses by appealing to their moral instincts. Persuasion and not persecution was the instrument they chose to wield. King Asoka proclaimed universal toleration; he inculcated respect for Brahmins as well as Sramanas or ascetics of all sects. It is a relief to find that the mighty monarch had never recourse to brute force for the propagation of his creed. We are spared all the scenes of blood, rapine and violence, which disfigure the pages of religious history in the West.

It has already been pointed out that Buddhism itself may be looked upon as an offspring of Hinduism; nay, it is a logical outcome of the principles enunciated in the

**"A peep into the Early History of India from the foundation of the Maurya Dynasty to the fall of the Imperial Gupta Dynasty" (B.C. 322—Circa 500 A.D.) pp. 362-363.

Śāṅkhyā system of philosophy. If India so readily responded to the teachings of the new faith, it is not because she renounced Hinduism but because she found that all that was highest and noblest in the latter was absorbed in the former. The great Teacher who now arose gave only a new shape and direction and a vigorous impetus to the germ of ideas already in existence and turned them to capital account. A good deal of confusion may be avoided by bearing in mind this aspect of the question. When speaking of Buddhist India one is apt to rush to the conclusion that every vestige of Hinduism had disappeared off the face of the vast continent. As a matter of fact even during the zenith of Buddhistic glory Brahminism was rearing its head and was professed by not a few among the cultured and intellectual classes and was ready to assert itself whenever a favourable occasion arose.

In the second century B.C., we find the Kābul valley, the Punjab and Mālava ac-
knowledging the sway of the Princes of the Turkish race. * Wema Kadiphses, the second of the Kushana Dynasty is spoken of as a devotee of Mahesvara; his coins bear the emblem of Nandin on the reverse, which is accompanied by a human figure which holds a trident in its right arm representing Siva. † The last three Kushanas— Kanishka, Huvishka and Vásudeva— have been noticed in the Rájataramgini, ‡ and the emblems on the reverse of their coins are figures of deities borrowed from the Greek, Persian and Brahminical pantheon and of Buddha. Thus the Gods of all these four religions shared the adoration of these Turkish Kings. But the figure of Buddha in the

† Ibid, pp. 808-811.
‡ See next page. Regarding the reliability of the account in the Rájataramgini, Dr. Stein observes:—“Kalhana’s account of the reign of these kings, who are supposed to have ruled simultaneously, is brief enough, but undoubtedly preserves data of genuine historical tradition. It clearly describes them as princes of Turuska, i.e., Turkish nationality, as powerful sovereigns and as faithful patrons of the Buddhist Church. On these points the statements of
sitting or meditative and the standing posture is to be found on the coins of Kanishka alone.*

In the Buddhist ecclesiastical history Kanishka occupies a prominent place. It was in his reign and under his patronage that the Third Council was held to settle the canon once again. The church was convulsed by internal dissensions and schisms, resulting in its being split up into as many as 18 sects. "The most significant trait of the Third Council is that it closed a period of old quarrels between the sects; it did not prevent the rise of new aspirations. Mahāyānism, which in an incipient stage was already existing ere long, boldly raised its head."†

the Chronicle are fully supported by the evidence of our most authentic records. The continued existence of the three places, Kanishkapura, Hushkapura, and Jushkapura, which are described as foundations of these kings and which still survive to the present day is likely to have assisted in preserving a recollection of their founders."

Cunningham: "Num. Chr," 1892, pp. 63 ff.
Hinduism was now very much alive. After the Third Council the distinction between the Hinayānists and the Mahāyānists became more and more accentuated. The apostles of the latter development became convinced that in order to draw into their folds the bulk of the people some sort of compromise was necessary, that orthodox Buddhism in all its rigidity must be given up. In other words, the neo-Buddhism which now sprang into existence began to absorb and assimilate the popular form of Brahminism and thus swell the ranks of its followers. A purely ethical creed has never secured a following except perhaps among a chosen few. To quote the eloquent words of the historian of "Rationalism in Europe":—

"There arise from time to time men who bear to the moral condition of their age much the same relations as men of genius bear to its intellectual condition. They anticipate the moral standard of a later age, cast abroad conceptions of disinterested virtue, of philanthropy, or of self-denial that seem to bear no relation to the spirit of their time, inculcate duties and suggest motives of action that
appear to most men altogether chimerical. Yet the magnetism of their perfection tells powerfully upon their contemporaries. An enthusiasm iskindled, a group of adherents is formed, and many are emancipated from the moral condition of their age. Yet the full effects of such a movement are but transient. The first enthusiasm dies away, surrounding circumstances resume their ascendancy, the pure faith is materialised, encrusted with conceptions that are alien to its nature, dislocated, and distorted till its first features have almost disappeared. The moral teaching being unsuited to the time becomes inoperative until its appropriate civilisation has dawned, or at most it faintly and imperfectly filters through an accumulation of dogmas, and thus accelerates in some measure the arrival of the condition it requires.” Vol. i, p. 305, Ed. 1900.

The same historian in explaining the rapid spread of Christianity in Europe observes in another place:—“It triumphed not so much by superseding rival faiths as by absorbing and transforming them. Old systems, old rites, old images were grafted into the new belief, retaining much of their ancient character, but assuming new names and a new complexion.”
Among the bold spirits who took a leading part in this renovation the name of Nāgārjuna stands conspicuous. The Mādhyamika system, with its axiom—*sarvam Sunyam*—a form of Pyrrhonism pushed to its extreme limits, which is an essential part of Mahāyānism is generally ascribed to him. Northern Buddhistic literature is replete with the marvels and miracles performed by him, and tradition has invested him with superhuman powers. Hiou-en 'Thsang calls him along with Deva, Asvaghosha and Kumāralabdha, "as the four suns which illumine the world."* As early as A.D. 401-409 we find a life of Nāgārjuna Bodhisattva translated into Chinese.† Tāranātha has committed to writing all the floating mass of legends connected with this venerable name, but as the Tibetan monk wrote so late as the beginning of the 17th century A.D., and as nothing was too astounding for his pious credulity, we have here only nuclei of facts round

*Nāgārjuna: a leading representative of Mahāyānism.

which have gathered accretions of vast proportions. It is now almost a hopeless task to separate the grain from the chaff. Nevertheless we can glean certain historical data from all that have been handed down. Before proceeding further we think it proper to treat the reader to a specimen of the materials with which one has to deal. We cull the following bits from the "Life and Legends of Nāgārjuna" gathered chiefly from Tibetan records including Tāranātha's "History of Buddhism."

"A rich Brahmin of the Vidarbha country to whom no son had been born for many years, once saw in a vision, that if he gave alms to, and entertained one hundred Brahmins, he could get a son. Accordingly he made offerings and prayers to the God and entertained one hundred Brahmins. After ten months his wife gave birth to a son. The rich man invited learned astrologers to predict the fortunes of his child; but they found that it could not live more than a week. In all other respects the child was calculated to be fortunate............. The astrologers assured them (his parents) that if they entertained one hundred Bhikshus, it would
live seven years, beyond which its life could not be prolonged by any means whatever. When the seventh year was about to expire the parents were overwhelmed with grief. To avoid the painful sight of their son's predicted death, they caused him to be removed to a certain solitary place in company with a few retainers.

"As the boy (Nāgārjuna) was passing his mournful days, one day the Mahābodhisattva Avalokiteswara Khasarpana visited him in disguise and advised him to go to the great monastery of Nālendrapa in Magadha as the surest means of escaping from the hands of death. He accordingly repaired to that famous Vihāra and arriving at the gate recited some gāthās. During that time the great sage Śrī Saraha Bhadrapa was the high priest of Nālendrapa, .......... who ordained Nāgārjuna a Bhikshu of the Vihāra. * * * * During the latter part of his office the country was visited by a famine in consequence of which the monks fell into great distress. The Manager became very thoughtful about the terrible effects of the natural calamity. Distress and scarcity compelled the congregation more keenly to feel the necessity of money. The monks now determined to devise some means of acquiring treasures for the support
of the famished congregation, and Nāgārjuna accordingly started on an expedition to visit an island in the great ocean where lived a great saint well versed in the art of alchemy. As the sea could not be crossed by any earthly means, he, by dint of his divine learning, got two leaves of an enchanted tree, by means of which he crossed the ocean and miraculously visited the island and presented himself before the sage who was greatly surprised to see a human being arrived at his abode deemed inaccessible to mortal beings. The sage earnestly inquired how he succeeded in achieving this wonder. Nāgārjuna replied respectfully stating to him the reasons of his visit and circumstances that brought him thither. He also showed him one of the enchanted leaves, concealing the other in his mendicant’s platter. He begged him to teach him the art of turning metals into gold. The sage consented to the proposal, but not liking to let the wonderful art be known in Jambudvīpa, he determined to detain him for ever in the island by depriving him of the enchanted leaf. To effect this, he said that he could not teach the art of alchemy unless Nāgārjuna consented to part with the leaf. Nāgārjuna consented, and was taught the art. When it was fully mastered,
he flew towards the Indian Continent by the help of the remaining leaf. Returning to Nālendendra, by means of his easily acquired wealth he supported the whole body of monks. By his religious practices he obtained Siddhi (perfection). He refuted the theories of Samkarāchārya * and imparted religious instruction to the monks of Nālendendra.

"Nāgārjuna returned to his country after a visit to Uttarakuru and erected many chaityas and temples, composed many works on science, medicine, astronomy and alchemy. After the death of Saraha Bhadra, the office of high priest fell upon Nāgārjuna, which he managed with great ability and indefatigable zeal. He matured the Mādhyamika philosophy which was only conceived by his illustrious teacher Saraha."

"Nāgārjuna is said to have been a great friend of king De-Chye (Sāmkara) of S. India, whom he converted to Buddhism."†

* An instance of glaring anachronism. Sāmkara flourished in the 8th—9th century A. D. See below, foot-note to p. xxii.
† S. C. Dās: Journ, As. Soc. li, Pt. i, pp. 115—120.
One thing seems to be clear from the above, namely, that Nagarjuna was born and brought up in the Brahminical faith but was afterwards converted to Buddhism and was celebrated as an alchemist.

Tāranātha, it is true, completed his History in 1608 A. D., * but he derived his materials from Tibetan sources and the analysis of Dulva by Csoma goes to confirm this account. We have already made use of the record left us by Hiouen 'Thsang. † It is thus clear that all the testimonies concur in ascertaining Nagarjuna not only as the originator of the Mādhyamika philosophy but also as an adept in magic, conjuration and alchemy, and that even so early as the 7th century A. D. The exact time during which he flourished is a matter of controversy. He is generally regarded as a contemporary of

*Nagarjuna as an adept in magic and alchemy.

† Vide Vol. i, Intro. xciii.
Kanishka. One cannot go far wrong in assigning *circa* 150 A. D. as the date of his succeeding to the Patriarchate.*

* According to Lassen Nāgārjuna lived about A. D. 23 during the reign of Kanishka. The Rājataramgini says:

"Then there were in this land three kings called Hushka, Jushka and Kanishka, who built three towns named after them (Hushkapura, Jushkapura and Kanishkapura).......

During the powerful reign of these [kings] the land of Kāśmir was, to a great extent, in the possession of the Buddhas. At that time 150 years had passed in this terrestrial world since the blessed Śākya Simha (Buddha) had obtained complete beatitude (Nirvāna)....... And a Bodhisattva lived (then) in this country as the lord of the land, namely, the glorious Nāgārjuna....... Stein’s trans. Vol. I, pp. 30—31. As the tradition of the Northern Buddhists as recorded by Hiouen Thsang (Si-yu-ki, 1. pp. 99, 151), the Tibetan Dulva (Csoma, As, Res. XX, pp. 92, 297) as also Schiefner (Tār. Gesch. d. Bud. p. 301) concur in placing the commencement of Kanishka’s rule 400 years after Buddha’s Nirvāna, the date assigned here to Nāgārjuna is rather curious. Lassen sums up his conclusion on this knotty point in these words:—"Wegen der grossen Anzahl seiner Münzen mus dem Kanishka eine ziemlich lange Regierung Zugeschrieben werden; ich glaube daher annehmen zu dürfen, das er etwa bis 40 nach Chr. G. regiert habe." Fleet maintains B. C. 57. V. Smith c. 120 A. D. While Messrs. Bhāndārkar c. 278 A. D. (Journ. Bombay Br. Roy. As. Soc. Vol. XX, No. lvi, pp. 269—396) as the date of Kanishka.
An important document has been preserved for us in its Tibetan and Chinese versions, which seems to have an historical basis. It is in the shape of a *Friendly Epistle of Nāgārjuna to king Udyana.*

The original in Sanskrit, entitled *Suhrillekha,* has not yet been recovered and probably been lost. Udyana in the Tibetan subscription is *Bdye-Spyod=Sadváhana.* This Sadváhana is a prominent figure in the history of S. India. In ancient Sanskrit literature he is frequently spoken of as a patron of learning and there are several literary reminiscences associated with this name.

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* Referring to a *new* MS. of *Harshacharita* in his possession Hall remarks—"for Sālivāhana I there find Sātavāhana"—Intro. to *Vásavadattá,* p. 54, This by implication would suggest that the other MS. had the reading Sālivāhana.
Now "the Andhrabhrityas or Śātavāhanas ruled over the Deccan from B. C. 73 to about A. D. 218, i.e. for about 3 centuries.

"The period during which they ruled over Mahārāṣṭra must have been a prosperous one in the history of the country. Hence several traditions with regard to different kings have been preserved. But that Śālīvāhana or Śātavāhana was a family name must have been forgotten and different princes of the dynasty have been confounded and identified. Thus Hemachandra in his Desikosha gives Śālīvāhana, Śālana, Hāla and Kuntala as the names of one individual."

The So-to-p’o-ho of the Chinese version of the "Friendly Epistle" has been identified with one of the Śātavāhanas or Andhra kings, possibly Yajna-Srī-Sātakarni, who seems to have reigned about 172—202 A. D. There is, therefore, nothing improbable in this particular, Śātavāhana being a contemporary of Nāgārjuna. In the alchemical Tantra, "Rasaratnākara," ascribed to Nāgārjuna,

there is a dialogue between this sage and Sālivāhana (p. 6). We shall revert to this subject later on.

Numerous works have been fathered on Nāgārjuna and it is an open question if any of them be genuine.* As is well known Vyāsa or more properly named Vedavyāsa has been taken to be the compiler of not only the four Vedas but also of all the Purāṇas put together. Piety and credulity go hand in hand and are seldom troubled with questions of anachronism. Plato, Democritus and Geber have been held responsible for writings which appeared several centuries later. Names, venerable and illustrious, have often been pressed into service to lend weight and dignity to productions which otherwise would not have commanded a respectful hearing. On the whole we are inclined to agree

Nāgārjuna as a comprehensive name of the activity of Mahāyānaism.

* In Bunyin Nanjio’s Catalogue of the Bud, Tripiṭaka there is a list of 24 works ascribed to Nāgārjuna. The Sūhrāllekha was translated into Chinese in 434 A. D. App. pt. I, p. 308.
with Kern when he says, "The figure of Nāgārjuna, so prominent in the history of the rise of Mahāyānism, shows a double character. It is, on the one side, the name of an influential person, the first eminent leader of a school imbued with Hinduism and the methods of Indian scholastic philosophy. On the other hand, Nāgārjuna is simply a comprehensive name of the activity of Mahāyānism in the first phase of its onward course."*

* In Vol. I of this work (Intro. xciii), we quoted Alberūnī as to the date of Nāgārjuna. This cultured Arab, ordinarily a very trustworthy guide, derived his information from the Brahmīns of that part of India from which every vestige of Buddhism had disappeared in the 11th century and he was evidently misled on this point as the traditions relating to Nāgārjuna had at that distance of time become very vague. This will be clearly seen from what Prof. Sachau says in the preface to the Arabic edition of Alberūnī.

"Its civilization was then essentially Brahminical as it had come to be in a protracted struggle with Buddhism. Alberūnī does not know Indian Buddhism from personal experience, though it had not yet entirely withdrawn from India and in some part was still a political power. (p. v.)

"The valley of the Kābul river and the Punjab are all that Alberūnī has seen of India. (p. xiii.)

"The high schools of Hindu science and learning, Kasmir and Benares, were in Alberūnī's time unapproachable for Muslems. (p. xiv.)"
From the time of Nāgārjuna onwards Mahāyānaism began to be tinged more and more with Brahmanical bias. A notable and decided step in this direction was taken by Asamga, a monk of Gāndhāra, who composed the Yogāchāra-bhūmīsāstra, in which by assimilating the doctrines of Patañjali he paved the way for the growth of the Tantras. He seems to have lived about 400 A. D.* Vasubandhu, Asamga’s younger brother, was another zea-


A life of Vasubandhu was translated into Chinese by Paramārtha. A. D. 557-569.—Bun. Nunj. Cata. p. 371. Osoma Korosi following the Tibetan Chronology says:—“I know that Arya Asamga lived in the sixth or seventh century after Jesus Christ.” As. Res. XX, p. 513. This date has been accepted by Lassen (Ind. Alt. ii, p. 460) as also by R. Davids (Buddhism, p. 207). But this chronology has now become untenable. The date of Asamga and his brother Vasubandhu should be put back by about two centuries, as some of their works were translated into Chinese in the beginning of the fifth century and perhaps earlier. (Bun. Nanj. Cata. App. i p. 371). It must have taken a century or two to have their works sufficiently recognised in India before they would deserve a place in the Chinese Tripiṭaka.
ious adherent of this school and is said to have been a teacher in the college attached to the monastery of Nálendra—the "Oxford of Indian Buddhism." From Tibetan sources we learn that the celebrated logician Dignāga was a disciple of Vasubandhu, a contemporary of Lha-tho-ri, king of Tibet, who lived up to 371 A. D. *

Mahāyānism now began to adapt itself to its environments. The absorption of the Yoga ideas made the transition into the Tantric cult easy and Northern Buddhism began to develop and expand by entering into an alliance with Saivaism, which favored the growth of Buddhist Tantras. The origin and development of this class of literature have been the subject of a masterly exposition by Burnouf. The Mahāyānists not only set up their own deities but borrowed copiously from the pantheon of the Hindus. Thus in the Sivaite Tantras while

the God Siva is the fountain of all knowledge and sciences, in their Buddhist counterparts we have the celestial, metaphysical and potential Buddhas * occupying the same position. The worship of the female energies (Sakti) which plays such an important part in the Tantras was encouraged in the person of Tárá. The Hindu Gods and Goddesses were also objects of adoration, only they were assigned a subordinate position. The question has often been asked: why did Buddhism seek alliance with Saivaism in preference to the Vishnouvite cult? The answer seems to lie in the fact that it was precisely in those parts of India where the worship of Siva, especially in its Tántric form, had struck root that Maháyánism asserted its sway; † and thus the apostles and propagators of the latter made most of the former. A few centuries later when Vaishnavism gained an ascendancy in Bengal the tables seem to have been turned. A gradual and imperceptible fusion

* i.e. the Bodhisattvas.
† Vide ante. p. xi, (under Wema kadiphses).
took place between the rival creeds. Thus in the celebrated adoration in the opening lines of Gintagovinda we find Buddha freely acknowledged as an incarnation of Vishnu and extolled for his abhorrence of sacrificial rites. *

From Fah-hian’s travels we gather that in the beginning of the 5th century A. D., the Mahayánists were gaining the upper hand, though their rivals, the Hínayánists, were still holding their own in several localities. Thus at Mathurá and Pá/áliputra he found the members of both the sects living side by side and having monasteries of their own.

* मन्दिरम् वर्णविवेकहर्ष मुसितालस् सदयहवदवर्धितप्पालस्। कैशव प्रतवद्युगरीर जय जगडीश श्रम।

It is scarcely correct to assert that Buddhism was exterminated in the land of its birth by cruel persecution. Cf. Vol. i. Intro. lxvii. The Bengali poet Ramchandra Kavibharati, author of Baudhá Sataka, though a devoted Buddha, belonged to the same class of thinkers as Jayadeva. Pandit S. P. Sástrí is inclined to place him in the latter end of the 13th century.—Journal of Buddhist Text Society, Vol. I, Pt. iii. So late as 1441 A. D. MSS. of Buddhist works used to be copied from in Magadha.—Bendall’s Camb. Cata. of Bud. Sans. MSS. (1883), Pref. iv.
From the fact, however, that the pious Chinese pilgrim repeats the Suramgama Sūtra for his protection, we may conclude, since he is by no means a pronounced Mahāyānīnist, that the predisposing causes for the origin of the Tantras were already in existence. "In this Sūtra is contained the most complete list of Dhāranīs (invocations) found in any Chinese compilation. There are 426 distinct sections containing the names of the different Buddhas and Hindu deities worshipped at the time of the composition of the Sūtra. Considering that Fah-hian in the early part of the 5th century regarded this book with reverence. . . . . . . . We may reasonably assign it to a period not later than the end of the 1st century. Now amongst the invocations we find distinct reference to Dhyānī Buddha, Vairochana, Akshobhya, Amitābha and others shewing that they were coming to be recognised and worshipped even at that early date."

* Intro. to Beal's "Fah-hian." (Lxxii).
These Dháraníś may be looked upon as the precursors of the Tantras and they fully support the views that when they were composed Buddhism had turned a new leaf. The repeating of certain magic formulas along with the names of Buddha Amitábha, etc., was to secure salvation, in other words, "instead of the old doctrine [of Karman]—as a man soweth, so he shall reap—a new and easier way of salvation is here preached, viz., as a man prayeth, so he shall be saved. It is what is known to us as salvation by faith rather than by works. . . . . . . It would almost seem as if this popular and easy doctrine had secured to itself the name of Maháyána, as meaning the Broad Way, in opposition to the Narrow Way, the Hínayána.*

The new class of literature which now arose in order to meet the demands of the Maháyánist revival is collectively known as

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the Vaipulya Sūtras or the Sūtras of the developed school, of which the Dhāranis are an integral part. It found expression in such works as the "Sādharmapurṇḍarīka," "Lalitavistara," "Tathāgataguhyaśākya," "Prajñāpāramitā," etc.,—all of which soon acquired almost canonical sanctity in the estimation of the N. Buddhists. Burnouf has tried hard to differentiate between the simple Sūtras as represented by the literature of the primitive orthodox Buddhism and the expanded Sūtras of which the distinguishing mark is the occurrence of Bodhisattvas.* This drawing of hard and fast

* "La présence des Bodhisattvas ou leur absence intéresse donc le fonds même des livres où on la remarque, et il est bien évident que ce seul point trace une ligne de démarcation profonde entre les Sūtras ordinaires et les Sūtras développés. —Burnouf, Intro. p. 112; ibid, p. 120. Ed. 1844. Vide Max Muller's remarks at the end of the Smaller Sukhāvatī-Vyūha, p. 102, S. B. E. Series, Vol. xlix.

_Cf. also_ Some Vaipulyas are, materially, much like the old Sūtras, whole passages _e.g._ of Lalita-Vistara recur almost word for word in the Pali Scriptures," Kern (Ind. Bud., p. 5). This eminent Buddhist scholar also very appositely re-
lines has been found to be well nigh untenable.

By the second century A. D, we find the leading beliefs and ideas as crystallised in the Mahāyāna literature fully in vogue. Thus we

marks elsewhere: "The results arrived at by Burnouf may be right so far as Mahāvaipulya Sūtra as a whole is concerned, they cannot be applied to all the component parts of such a work. Not to go further than the Saddh. and the L. Vistara, it can hardly be questioned that these works contain parts of very different dates, and from various sources." Kern—Intro. to Saddhar, pp. x-xi. Passages in L. V. are literally identical with those in Mahāvagga. Again:—"These few examples I have chosen will suffice to prove that the material of a Mahāvaipulya Sūtra is partly as old as that of any other sacred book of the Buddhists."—ibid, xiv.

* The truth seems to be that "the historical relation between the Hīnayāna and the Mahāyāna schools of Buddhism is to me as great a puzzle as ever."—Max Muller, Intro. to L. Sukh. Vyūha, ix. Even the very distinction between the N. and the S Buddhism has been taken strong exception to by R. Davids, who says:—"There is not now and never has been, any unity either of opinion or of language in what is called northern, or in what is called southern Buddhism. There is a distinct disadvantage in continually suggesting a unity which has no existence in fact. In a word the current division of Buddhist literature into northern and southern is entirely unscientific, and misleading."—Bud. India, p. 173.
come across in the "Buddhacharita" of Asvaghosha, who is admitted on all hands to be a contemporary of Kanishka, such a passage as this: "this, Sirs, is the Mahāyāna, the instrument of the law of the perfect Buddha, which is the establisher of the welfare of all beings, set forth by all the Buddhas."* The "Lotus of good Law" was translated into Chinese at the close of the second century A. D. †

Side by side with the growth of the scriptures another class of literature was called Buddhistic Tantras. into being by the exigencies of the times—we mean the Tantras, the necessity for which has been hinted at in the first volume. ‡ However esoteric may be the doctrines sought to be conveyed through the medium of these productions, it would be idle to deny that there

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† Edkin’s "Chinese Buddhism," p. 89. There were several versions of this sacred book.—Vide Kern’s Intro. p. xxiii (S. B. E. Series).
‡ Vol. i, Intro. lxx.
is much in them which is calculated to pander to the baser instincts of frail humanity. At what particular time these Tantras appeared on the scene is yet a matter of conjecture, but the views of Wilson which held the ground for more than 30 years have now been found to be erroneous. Evidence is now forthcoming from quite an unexpected source, which goes to prove that Buddhist Tantras existed as early as the fifth or sixth century A.D., if not earlier. * If Buddhist Tantras, again, pre-suppose the existence of Hindu Tantras, one need not be considered as rash in assigning an earlier age to the latter. †

* Vide the palm-leaf MSS. discovered in the monastery of Horiuizi in Japan and carried from Central India. One of these is in the handwriting of a famous Chinese priest, named Kanshin, who came to Japan in A.D. 753. The MS. contains besides a Dhārani, five Tantras. "Bud. Texts from Japan," ed. by Max Muller. Vol. i, pt. i. Intro. pp. 6-8. It is fair to conclude that these Tantras existed in the land of their birth at least two centuries earlier.

† Waddell says:—"No one has yet realised the vast extent to which Mahāyāna and Tāntric Buddhist remains cover India; nor sufficiently realised the leading part played by the Mahāyāna in Indian Buddhism during its popular period." Journal of the Roy. As. Soc. (1894).
The Tantras found a congenial home in China. Amoghavakra, a Sramana of northern India and a Brahmin by caste resided in the Celestial Empire for several years between 746 and 771 A.D., and under his influence the Tantric doctrines dealing with talismanic forms and professions of supernatural power first gained currency there. * Hence long before his time Tantras must have been popular in India. From the eighth to the eleventh century A.D. we are in possession of authentic records as regards the prevalence of Tantras in Northern India; as it was about this period that several of these were gradually imported into Tibet by Indian Pandits, but they must have been composed much earlier. †

Tantras imported into Tibet.


Cf.—Also "The existence of the Tantra Śāstras may thus apparently be traced at least as far back as the 6th century A. D."—Vide "Annual Report," As. Soc. Beng. 1906.

† In the first half of the eighth century two eminent
Atisa gave a fresh impetus to Tantrism in the land of snow. From the analysis of Mdo by Csoma we also come to know in detail the names with the dates of the Indian scholars who with the aid of the local interpreters (lochavas) rendered into Tibetan the various Sanskrit Tantras. The faithful accuracy with which these translations were made and their fidelity to the original enable us often to reproduce the Sanskrit Texts and thus we are in possession of valuable histori-

Pandits of Bengal visited Tibet at the invitation of its king and formally introduced there Buddhism; these Pandits were Sānti Rakshita, high priest of the monastery of Nālenda and his co-adjutor Padma Sambhava, a native of Udyana, who took charge of the Tantric part of the Buddhist liturgy. They were followed by the sage Dīpakara-Srījñāna (Atisa), b. A. D. 980, d. 1053. He acquired proficiency in the three pitakas of the four classes of the Hinayāna Srāvakas, in the Vaiseshika philosophy, in the three pitakas of the Mahāyāna doctrine, the metaphysics of the Mādhyamika and the Yogāchārya schools and the four classes of the Tantras. At the request of king Nāya Pāla he accepted the post of high priest of the monastery of Vikramastila.—Vide S. C. Dās,—Journal of the Buddhist Text Soc. Pt. i.
atical data.* Some of these Tantras deal with alchemy and their contents reveal to us the knowledge of chemical processes in India from about the 6th to the 8th century A. D. †

Fortunately we are not dependent upon the Tibetan Tantras alone for gaining an insight into this dark recess in the history of Hindu intellectual activity. In the course of our search

*Rasaratnākara.

*Speaking of the Tibetan translation of Asvaghosha's Buddha-Charita, Cowell remarks: "The Tibetan version appears to be much closer to the original Sanskrit than the Chinese; in fact from its verbal accuracy we can often reproduce the exact words of the original, since Sanskrit words are always represented by the same Tibetan equivalents, as for instance the prepositions prefixed to verbal roots."—l. c. Intro. p. x. Waddell is equally impressed with the "profoundly accurate and scholarly nature of the Lamaist translations of Sanskrit Buddhist books;" and he again observes: "It is clear that the Tantric and Mahāyāna features of Lamaism were imported en bloc from Indian Buddhism."—Journal of the Royal As. Soc. for 1894, p. 15.

† Analysis of the contents of the Mdo (Sūtra) by Csoma de Korosi—Asiatic Researches, XX (1836), p. 583. "A work on preparing quicksilver, the most powerful for subduing every sickness and for improving the vigor of the body."—"A work on turning base metals into gold." We are thus reminded of the contents of the Rasārṇava and the Rasaratnākara. Vide p. 2.
for MSS. of alchemical Tantras we have come upon a precious find, in the shape of a Buddhist Tantra, with Nāgārjuna as its reputed author. Of alchemical Tantras we have had enough and to spare; but there is great difficulty in assigning dates to them, as they one and all pretend to emanate from the mouth of the God Śiva himself. We are only left to internal evidences—evidences based upon the gradual evolution of chemical processes, which we have not been slow to take advantage of. The MS. in question is a mere fragment, but it is calculated to evoke all the zeal and enthusiasm of a Palæontologist—of an Owen or a Marsh—in his efforts to restore an animal and assign to it its proper place in the economy of the laws of evolution, when he luckily chances upon a fossil impression of its tooth or claws. From this point of view Rasaratnākara, for such is the name of our MS., is of uncommon interest. It is a Tantra of the Mahāyānist school and as such its invocations are
addressed to all the Buddhas; * and in one place there is a pointed reference to Prajñā-pāramitā † (perfection of wisdom) appearing before Nāgārjuna in a dream and revealing to him chemical knowledge.‡

A noteworthy feature of this work is that some chemical processes are discussed in the form of a dialogue between Śālivāhana and Nāgārjuna, and Ratnaghosha and Māndavya.§ These last two names are held equally in veneration with Nāgārjuna and grateful acknowledgments to their services occur in some later chemical treatises.¶ The bringing together of these four dramatis personae,

* प्रशिष्यति सचिवुद्रान्। Cf. The opening invocation in the Sukhāvatī Vyūha: अन्न नमः श्रीसचिवुद्रोविविष्यः। also नमः प्रेयकुद चार्यश्रवकाशाः नमो बाधिसचवानात् in Arya Manjusrīmūla Tantra.—Vide As. Res. xx, p. 512.

† Cf.—The invocation in Vagrachchhedikā: नमो भगवत्वा शाश्र्यप्रकाशरिमित्य।

‡ Vide Sans. Texts, p. 10, also Trans. p. 5.

§ Vide Sans. Texts, pp. 12-14, also Trans., pp. 6-8.

¶ Cf. Vol. i, p. 77.
especially of the first two has a significance of its own. We have already seen that references to Nāgārjuna and his contemporary king Śālivāhana are only to be met with in ancient classical literature (vide ante xxii). It seems probable that Rasaratnākara was written at a time when the memory of these personages was still fragrant. Judging from internal evidences also we come to the conclusion that it is one of the earliest works extant on the subject. In our attempt at throwing light on the text of Rasārnava, we had to quote several parallel passages from it, * and from a careful perusal of both we are of opinion that the latter is the inspirer rather than the borrower. Rasaratnākara, in short, seems to us to be a typical production representing the Mahāyānist period of intellectual activity and we may not be wide of the mark if we put down 7th. or 8th century A. D. as its latest date.

* Vide Vol. i, Sans. Texts, pp. 7, 12, 13 and 18.
From the 5th to the 11th century A. D. the colleges in connection with the monasteries of Pātaliputra, Nālandā, Vikramasīla, Udana-pura, etc., were the great seats of learning as the temples attached to the pyramids in ancient Egypt; and alchemy was included in the curricula of studies. *

The existence of a vast ancient Tantric literature with alchemy as a component part has now been placed beyond doubt, thanks to the searching examination of the Mahārājā's collection of valuable MSS. of Nepal by the eminent scholars Bendall, H. P. Sāstrī and S. Lévi. Of surpassing interest is the discovery of a Tantra belonging to the extinct school Kub-jikāmata, written in Gupta character and copied about the sixth century A. D. This

* Cf. "By the side of the tower of king Asoka is built a Samghāvāsa, belonging to the great vehicle, very imposing and elegant. There is also a temple belonging to the little vehicle......... In the college attached to the temple one may see eminent Sramanas from every quarter of the globe."—Beal's "Fah-hian," ed. 1869, p. 105.
school, though itself very ancient, presupposes the existence of other schools and we have distinct mention of the Mahāyāna. * We now learn that the gradual fusion and amalgamation of Sivaite and Buddhist Tantras had begun even anterior to the sixth century. The Kubjikā-tantra was evidently composed outside India proper, probably in Nepal. The Goddess Pārvatī encourages her consort to proceed to the continent for the spread of the tenets propounded by it. † In one place we come across a passage ‡ in which Siva himself speaks of pārada (mercury) as his generative prin-


For the passages cited here we are indebted to the industry and courtesy of Pandit H. P. Sāstrī, who has wended his way through the bulky MS.
ciple and eulogises its efficacy when it has been killed six times. * We also find allusions to the transmutation of copper into gold with the aid of mercury. In short, we have ample references to alchemical processes described in the very technical terms in which Rasaírnava, Rasaratnakara and other typical works of the Tantric period abound. †

It is now only necessary to wind up this chapter with an extract from the work of an eminent Buddhistologist with this reservation that the growing influence of Tantrism began as we have seen long before the 8th century.

"The decline of Buddhism in India from the 8th century downwards nearly coincides with the

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* Even at the present day mercury, which has been killed six times in succession, each time with an equal weight of sulphur, is reputed to be one of the most potent of remedies.

† e.g. पलिन विविषी वेद्यः किं व्यज्ञती ्न विधवनि।
रसाविज यथा तां न भूम्पक्षाधिनं वेद्यनि।

For the meaning of the word वेद्य (Vedha) see this Vol. p. 18, footnote, also Vol. i, p. 120.
growing influence of Tantrism and sorcery, which stand to each other in the relation of theory to practice. The development of Tantrism is a feature that Buddhism and Hinduism in their later phases have in common. The object of Hindu Tantrism is the acquisition of wealth, mundane enjoyments, rewards for moral actions, deliverance, by worshipping Durgā, the Sakti of Siva—Prajnā in the terminology of the Mahāyāna—through means of spells, muttered prayers, Samādhi, offerings, etc. Similarly the Buddhist Tantras purpose to teach the adepts how by a supernatural way to acquire desired objects, either of a material nature, as the elixir of longevity, invulnerability, invisibility, alchemy; or of a more spiritual character as the power of evoking a Buddha or a Bodhisattva to solve a doubt, or the power of achieving in this life the union with some divinity. There is an unmistakable affinity between Tantrism on one side, and the system of Yoga and Kammathāna on the other. Tantrism is, so to say, a popularised and, at the same time, degraded form of Yoga, because the objects are commonly of a coarser character, and the practices partly more childish partly more revolting.

"Tāranātha informs us that Tantrism existed and was transmitted in an occult manner in the period between Asaṅga and Dharmakīrti, but that after
Dharmakīrti's times the Anuttarayoga became more and more general and influential. Substantially his statement is certainly right. He adds that during the reign of the Pāla dynasty, there were many masters of magic, Mantra-Vajrāchāryas, who, being possessed of various Siddhis, performed the most prodigious feats.

"The kings of the Pāla dynasty, whose sway over Gauda and the adjacent regions lasted from about A. D. 800 to 1050, are known both from the annals and their inscriptions as protectors of the Faith. It was during that period that the monastery of Vikramasīla was a renowned centre of Tantrist learning.

"The Sena kings, who followed the Pālas in the dominion over Eastern India, though belonging to a Hindu persuasion, were not hostile to the Faith. Still Buddhism declined during their reign and more so after the invasion of the country by the Muhammedans in A.D. 1200. The monasteries of Udanaṇḍapura and Vikramasīla were destroyed; the monks were killed or fled to other countries. The learned Sākyasri went to Orissa, and afterwards to Tibet; Ratnarakshita to Nepāl; Buddhāmitra and others sought a refuge in S. India, whilst Saṅgama-Srijñāna with several of his followers betook themselves to Burma, Camboja, etc. And thus the Law of Buddha became extinct in Magadha."
"Many emigrants from Magadha rejoined their brethren in the South and founded colleges on a modest scale in Vijayanagara, Kalinga, and Konkan. The comparatively satisfactory condition of Buddhism in Dekkhan about that time is attested by the rich donations to the monastery at Dambal." *

It will be noted that the monks of the monasteries of Udana^rapura and Vikramasila on their dispersion carried with them their learning and arts in the same manner of the Spread of alchemy. Byzantine Greeks on their expulsion from Constantinople bore with them their intellectual treasuries to the Italian cities. In the kingdom of the Deccan and in Tibet the Buddhist refugees found hospitable asylums,† just as the Greek Philosophers did in the Florentine Republic under the Medicii.

Some eminent orientalists, whose opinions naturally carry weight, have hitherto taken

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† Cf.—"The Deccan, which from the eleventh century was the refuge and centre of literary activity generally. In Hindustan it had been substantially arrested by the inroads and ravages of the Muhammadans."—Weber. Hist. Ind. lit. p. 283.
for granted that the knowledge of chemistry such as we find reflected in the Tantras quoted by Mādhava in Rasesvaradarsana * was derived by intercourse with the Arabs. †

* Vol. i, Intro. lxxviii, et seq.

† E.g. Barth: "In regard to alchemy, anyhow in which the Sittars are zealous adepts, they were disciples of the Arabians, although other SVAites had preceded them in the pursuit of the philosopher's stone. Already, in his exposition of the different doctrines of the Saivas, SÁyana thought he ought to dedicate a special chapter to the Rasesvara-darsana or "system of mercury," a strange amalgamation of Vedantism and alchemy. The object contemplated in this system is the transmutation of the body into an incorruptible substance by means of rasapāna i.e., the absorption into it of elixirs compounded principally of mercury and mica, that is to say, of the very essential qualities of Siva and Gauri, with whom the subject of the operation is thus at length identified. This species of transubstantiation constitutes the jivanmukti, or state of deliverance commencing with this present life, the sole and indispensable condition of salvation. It is clear that the devotional formulæ of the Vedanta are here only a sort of jargon, under which there lies hid a radically impious doctrine; and it is not less clear that in this doctrine, which had from the fourteenth century produced a rather considerable literature, there is an infusion of Mohammedan ideas. . . . . . . . . The Arabs of the Khalifat had arrived on these shores in the character of travellers or merchants, and had established commercial relations and intercourse with these parts long before the Afghans, Turks, or Mongols, their coreligionists, came as conquerors."—"Religions of India," ed. 1891, pp. 210-211.
The attentive reader who has followed us all along could not have failed to notice that it was in the Universities of Nálanda, Udayapura and Vikramasíla, in Central India and Magadha, precisely the regions which were cut off from communication with the external world, that Tantric mysticism with alchemy as an integral part was cultivated and from thence spread to Bhot (Tibet) and the regions lying to the south-east of it, * and South India. †

* See under colophons to Rasahridaya and Rasasára respectively.

† The last rallying point of Hindu learning and sciences was the kingdom of Vijayanagara, which was in the heyday of its glory under Bukka I (A. D. 1354-1371) with Mádhava as his prime Minister. Wilson says:—"The history of Vijayanagara is a subject of considerable interest in the annals of India, as the last barrier that was opposed to Muhammedan invasions, and that preserved the southern part of the Peninsula from foreign rule until a very modern period."—As. Res. Vol. xx (1830), p. 1. See also Sewell's "A Forgotten Empire."—(Vijayanagara).
Chapter II.

Having thus far prepared the ground for believing that alchemy along with other cognate branches of learning was the outcome of Indian intellectual activity, we shall now proceed to follow it up with its further development. At the outset it is, however, necessary to remember that on the decline of Buddhism the vigorous impetus which its followers gave to literature and science was not lost to India. Nay, during and after the revival of Brahminism under the Gupta dynasty and its successions we have some mighty intellectual giants whose productions will continue to shed lustre as long as the Hindu nation exists. Kālidāsa and Bhavabhūti, Brahma Gupta and Aryabhātta, Samkara and Rāmānuja are names which may be regarded as the heritage not of India alone but of the entire civilized world. At the time of the Brahminic revival Buddhist works of acknowledged merit far from
being cast aside were held in veneration. Amarasimha in his Lexicon and Vāgbhata in his Ashtāmgahrīdaya* as also the psuedo-Vāgbhata* commence with an invocation to Buddha, which has never shocked the tolerant spirit of the Hindu. Charaka and Susruta also bear distinct impress of Buddhist retouching. The Buddhist Tantras became likewise a part and parcel of Hindu religio-philosophical literature, † the subject-matter of the former was incorporated into the latter, the names of Tārā, Prajñāpāramitā and Buddha being simply changed into those of Pārvatī and Śiva. In Rasaratnākara itself we have distinct indications that it is an admixture of both.

*Buddhist alchemical Tantras absorbed into Hindu Tantras.

† Speaking of a typical Buddhist production belonging to this category Burnouf observes: “Ce morceau est exclusivement spéculatif, et il nous offre une nouvelle preuve de l'alliance intime que le système des Tantras a contractée avec la philosophie buddhique la plus élevée.” (l. c. p. 543 ed. 1844).
It should thus be understood that the works under review in this chapter are based upon their Buddhist counterparts; in short, there is no disposition to ignore the debt of obligation the authors are under to Nāgārjuna, Ratnaghosha, Māndavya and others.

In the introduction to the first volume we stated: “It is to be regretted that of the several works quoted by Mādhava [on the science of mercury] Rasārnava alone seems to have survived to our days” (I. c. lxxxiii). Since then we have been fortunate enough to procure as many as three transcripts of MSS. of Rasahridaya by Govindabhagavat from different quarters. As Mādhava speaks of this author in terms of the deepest reverence and regards him as “ancient,” * we think we should not err on the wrong side if we place the author some three centuries before his time. If our surmise be

* Cf. Vol. i, Intro. lxxx.

The qualifying epithet समवत् is only applied to venerable Rishis of old.
correct, he should have lived about the eleventh century A. D. The only personal allusion which the author has condescended to offer for the edification of posterity is that he wrote his book at the request of the king of the Kirátaland, *i.e.*, the region adjoining modern Bhotan. Portions of this remarkable treatise after a careful collation of three MSS. have been reproduced in the proper place. The worm-eaten fragmentary MS. procured from Benares is 386 years old. Internal evidence equally goes to establish the antiquity of this work. The author was evidently a Buddhist as we learn from the colophon to the Benares MS. (*vide* trans. p. 12). It is, however, not to be found either in the India office or the Nepál MS. This important omission is easily accounted for. It is the reluctance of the latter day Hindus to acknowledge their obligations to a Buddhist author.

Rasárnava which has been noticed at length in the first volume and to which was assigned the 12th century A. D., as also Rasaratnasamuchchaya, (13th to 14th century), need not further arrest our attention.
The presentation of the various treatises of the Tantric and iatro-chemical periods under discussion in their exact chronological sequence is not an easy task; in the absence of more definite information, we are afraid, we shall now and then have to hazard a conjecture.

The introductory lines of Books viii and ix of Rasaratnasamuchchaya, in which Somadeva is mentioned as the author of the descriptive part, led us to suspect that they are merely reproductions from "a standard work on the subject by Somadeva, no longer extant."* Our surmise has proved to be partially correct. We have at last been able to recover the supposed lost work. A transcript of a MS. of Rasendrachudaman by Somadeva, preserved in the Library of the Deccan College, Poona, reveals to us the fact that practically all the important portions of this book have been woven into the text of Rasaratnasamuchchaya; and this gives us

* Vol. i, p. 118.
an additional opportunity of collating many doubtful passages in both. But the present work itself does not lay claim to originality. It makes a candid admission that it culls all its materials from pre-existing chemical treatises.* It further puts forward the alchemist Nandi as the inventor of the process of sublimation and of the Koshthi apparatus (Vol. i, pp. 69 and 89).† Nāgārjuna, Dandī, Sambhū and the sage Brahmajyoti are also spoken of as sources of his inspiration. We get very little inkling into the personal history of Somadeva, except that he was the ruler of a city named Karavālabhairava. The fact that R. R. S. lays Rasendrachudāmani so amply under contribution would suggest that the latter had become somewhat rare or that its contents had been well nigh forgotten when the former was compiled. Its date may therefore be put down between the 12th and 13th centuries A. D.

* अय यन्त्राणि वनाक्तेऽर्मलायुष्टिक मः समाधीय समाकिरिम सीम्विवं साम्वतम्।

† उद्रयातस्तन्तु वि निलिम परिकोलितम्। कौशिकायतम्बिद्ध गन्धिम गरिकोलितम्।
Another important work of this period is *Rasaprapkāsa-sudhākara* by Yasodhara. The author of *R. R. S.* in the opening lines mentions the names of 27 alchemists to whom he is beholden, among which occurs that of Yasodhana. We have little doubt the correct reading is Yasodhara. We now find that there is very little original matter in *R. R. S.*, it being made up of citations from *Rāṣārnava* and the works of Somadeva and Yasodhara. We should not, however, be understood to retract the high encomiums we thought fit to bestow upon *R. R. S.* for "its methodical and scientific arrangements of the subject-matter, which would do credit to any modern work."* Its author has never laid claims to originality, but on the contrary has freely acknowledged the sources he drew upon. The student of Hindu chemistry, however, like a weary but devout pilgrim, must wind his way through intricate and thorny paths and feel ineffable joy at being able to approach the original

* Vol. i, Intro. lxxxvi.
fountain undefiled. It now transpires that the credit for the accurate observations on the metallurgy of zinc (Vol. i, pp. 88 & 156) really belongs to Yasodhara. While the author of R. R. S. always scrupulously admits that his work is a mere compilation, Yasodhara, on the other hand, is anxious to let the world know that the processes he describes have been verified by experiments performed with his own hands. * Among the authorities he cites are Nāgārjuna, Devīśāstra (probably Rasārnava), Nandi, Somadeva, Svachchhandabhārava and Manthanabhārava. As Yasodhara quotes Somadeva, he must have been posterior to the latter by at least a hundred years and he should therefore be placed in the 13th century A. D. †

* Cf. स्वास्थ्यशिल्प न कर्तक ज्ञानेन न गृहित्यमया।
   स्वास्थ्यशिल्प भवयोगीन कर्तक सम्यक् दुःस्यम हि॥
   धरात्तिर्दत्तिरियाः सी स्वास्थ्यशिल्प कर्तो नया।
   हृष्ट्रक्षबाहद्वैदर्य कथितस नान वंशयः॥

† We are using a copy of the MS. preserved in the Runbîr Library, Kāśmîr. The readings are on the whole accurate.
Rasakalpa likewise seems to belong to this period. It is in the shape of a Tantra, but curiously enough it is not much troubled with consistency. In the opening salutation Siva, "the king of mercurial lore" and his consort Chandiká are reverentially bowed to—a procedure scarcely reconcilable with the position of a revealed document. The colophon at the end of each Chapter (ढ़ाँछ) claims the work to be a part and parcel of Rudrayámala Tantra; at the same time due acknowledgment is made to the contributions of Govinda, the author of Rasähriddaya, Svachchhandabhairava and other adepts. * Towards the end the author says: "The processes described have all been verified by me and not borrowed at second-hand from my teachers." Needless to add here that the God Siva would not have been at pains in justifying the necessity of his production with such a timorous apology. From internal evidence it is abundantly clear that it could not have been composed earlier than the 13th century A. D.

* E. g. सच्चाचार्येंश्चोरिता: ।
As the author has confined himself solely to a description of the metals, minerals and the processes of "killing" them with the agency of various apparatus and has not gone into the treatment of diseases with the aid of mineral preparations, he has been able to condense much important information within the narrow compass of a few short chapters.

Rasarájalakshmi also deserves some prominence here not because of its intrinsic worth but because of the references to previous Tantras and alchemists, amongst which are Rasárnavá, Kákachandísvara, Nágárjuna, Vyádi, Svachchhanda, Dúmodara, Vásudeva and Bhagabat Govinda. We have also categorical mention of the purely Ayurvedic works, such as Charaka, Susruta, Háríta and Vágbhata, to which our author is equally indebted.* From the colophon to the MS. procured from Benares we learn that the author Vishnudeva

* Vide Sanskrit Texts, pp. 80-81.
was Court Physician to king Bukka.* If this statement be accepted—and *prima facie* there is no reason to question it—this treatise must have been compiled in the latter part of the 14th century. Internal evidence equally supports this date.

* Vide ante., footnote, xlix.
Chapter III.
C. 1350 A. D.

We now proceed to examine the contents of another series of works belonging also to the Iatro-Chemical period; the one characteristic feature of which is that opium is recognised as an official drug in the materia medica portion. These may be taken to date from the middle of the 14th century A. D.

Rasanakshatramalikā by Mathanasimha, physician to the king of Malwa, should find a place in this chapter. For particulars as to the contents the reader may consult p. 22. The date given by the copyist of the MS. is Samvat 1557 i.e. 1500 A. D. The work itself is therefore older.

Rasaratanākara by Siddha Nityanātha, son of Pārvatī, comes under this category. * The author gives the sources of his information and explains the object of his compila-

* Two editions of this somewhat voluminous work have been published—one by Ganesa Chandra Ghose (Calcutta),
tion in the following words: "Whatever has been revealed by Śiva in Rasārṇava under the preparations of mercury; the Dīpikā of Basamamgala on mercury; all that has been said by Nāgārjuna for the benefit of people afflicted with diseases, as also by Siddha Charpaṭi, by Vāgbhaṭa and Su-

sruta,—all these and many other treatises on mercury and minerals being consulted, I have, after rejecting the drugs and medicaments which have become rare and difficult to procure, put together [in my work] the essential features thereof. * * * * All that I have learned from my teachers and have been in a position to subject to practical tests has been incorporated into my work for the benefit of mankind." In addition to the authorities cited above Nityanātha quotes from Chakrapāṇi and Rasendrachūḍāmāni (ante liv).

the other at the "Venkatesvara Press" (Bombay). We have compared the readings of these two editions with the MS. in the Library of the Sanskrit College, Calcutta. They agree fairly well.
Rasendrachintámaní will next claim our attention. We have before us the printed copy, edited by Umesa Chandra Sena Gupta, late librarian, Sanskrit College, Calcutta, in which the text has been adopted, as the editor informs us in the preface, after collation of 3 or 4 MSS. We have carefully gone over this edition and compared its readings with those of a MS. procured from Benares and another from the Runbír Library, Kásmír. All these agree in the main, but there happen to be certain omissions and additions, which form an interesting chapter in the history of interpolations in the literature of this description. To begin with: there is a dispute over its very authorship. Some MSS. ascribe it to Dhundhukanátha, disciple of Kálanátha, others to Rámachandra. After the customary salutation there occur two couplets in the Calcutta edition, which are not met with in the Benares and Kásmír exemplars. In these the author is made to justify his raison d'être for undertaking his task in these words: "I shall give publicity only to such processes
as I have been able to verify by my own experiments.” Such protestations have already been noticed more than once. * In another place we have: “Those mercurial operations alone have found a place in my book, which I have been able to put to tests. Those who teach without being able to perform experiments labour in vain.” This last couplet is quite out of place as it hangs like a tail to a long extract from Rasārnava and is in fact conspicuous by its absence in the Benares and Kāsmīr MSS. † For the second time we find calomel designated as Rasakarpūra (lit. camphor of mercury; vide vol. i, p. 250). This preparation no doubt occurs in the older

* Such pretentions put forth on behalf of the author, especially in the first person singular, lead one to suspect that they are later interpolations. In the Arabian alchemy Geber is often made to declare to the same effect: e.g. “J'ai expérimenté moi-même tout ce que je rapporte.”—Berthelot, “La Chimie au moyen Age,” t, i. p. 338. The well known egoistic couplet in Susruta, Ch. i, अर्थं हि धन्यनः रागद्विभिः is generally regarded as an interpolation.

† The extract commences with बेस माता सब्जंभुवानं.
works, e. g. Rasáruvava; but it is described there as the white "ash" of mercury (svetabháasma). The recipé for calomel as given in the Calcutta edition, however, is quite different from that in the Benares and Kásmír MSS. and it is altogether wanting in one of the MSS. in the Calcutta Sanskrit College Library. We are therefore not without suspicion that it has been foisted into the original composition. The author refers to Rasáruvava, Nágárjuna, Govinda, Nityanátha, Siddha Lakshmísvara, Trivikramabháatta and Chakrapáni. There is a lengthy colophon but no direct information can be derived from it as to the age of the author.

Rasasára: It is a comprehensive but purely chemical work dealing with 18 operations on mercury; various chemical processes are incidentally described, a good many of which, however, overlap each other. There does not seem to be any justification for coining a multiplicity of technical jargons to connote each of these. But prolixity was never regarded in the light of a vice by the
alchemical writers of the middle ages either in India or in Europe. The contents of Rasasára often remind us of a poem on alchemy by George Ripley, canon of Bridlington in Yorkshire (b. about 1460), of which Rodwell says:—

"But we cannot point to a new fact which he elucidated. He divided all chemical operations into twelve processes—calcination, dissolution, separation, conjunction, putrefaction, congelation, cibation, sublimation, fermentation, exaltation, multiplication and projection. Several MS. copies of his poem exist in the British Museum, bound up with copies of the works of Roger Bacon and earlier writers. Here is a specimen of his rugged rhymes:—

The first chapter shall be of natural Calcination;  
The second of Dyssolution, secret and phylosophycall;  
The third of our elementall Separation;  
The fourth of Conjunction matrimoniall;  
The fyfth of Putrefaction then followe shall:  
Of Congelation Albyficative shall be the Sixt,  
Then of Cybation, the seaventh shall follow next." *

* Vide "Birth of Chemistry."
The author, Govindáchárya, as a devout Hindu, begins with his adoration of Siva and Vishvú and tells us at the outset that his treatise is a compilation and epitome based upon standard works on the subject and the contributions of the adepts. We have every reason to be thankful to him for the many hints he throws on the sources of his information. Of surpassing interest is his declaration that for a knowledge of certain processes he is indebted to the Buddhists of Tibet.* This must be taken to mean that the cultivation of alchemy had become neglected and almost forgotten in India proper and the earnest searchers for this lore had to repair during the time of our author to Tibet. Confirmatory evidence to this effect is equally

* एवं बौद्ध बिज्ञानिनः भाट्यबुद्धिनिवासिनः।
Towards the close of his work the author again acknowledges his obligation to the Buddhists.

वेदावसानं तथा जातं रसमारं क्रतो समयं।
We have in our possession five transcripts of the MSS. of Rasasāra procured from the Libraries of Kashmir, Tanjore, Ulwar, Madras and the Temple of the Goddess Kāli, at Ramná, near Dacca, Bengal.
furnished in the colophon to Rasahvidaya (trans. p. 12). During the decadence of Buddhism and the corresponding ascendancy of Brahminism in Bengal, say about the 11th to 13th centuries A. D., this branch of science also found a safe retreat in the land of the Kirátas as we have already seen. Burnell, under the influence of his preconceived notion, namely that Indian alchemy owed its origin to the Arabs, very naively remarks: "By Bauddhas he (the author) probably means the Muhammedans (cf. the vernacular Malayálam use of the word), though studies of this nature were much pursued by the later Buddhists." *

Some idea of the date of Rasasára may be formed from the fact that there is mention of opium in it. But our author was evidently quite in the dark as to its origin; for, says he: "There are 4 different kinds of poisonous

* Catalogue of the Tanjore Palace MSS. pt. 1, p. 70. Burnell draws his conclusions from the reference to Buddhists in the colophon; but we have quoted above another passage in which distinct mention is made of the Buddhists of Tibet.
sea-fish, and it is from their foam that 4 different kinds of opium are derived, namely, white, red, black and yellow; while others maintain that it is derived from the foam of the snake and it is very properly used for chemical operations,” e.g.,—killing and fixation of mercury. From the context it is, however, doubtful if the narcotic drug is really alluded to here. But independently of the use of this term we may safely place this work in the 13th century A.D.

The Sanskrit word for opium, “ahiphena,” lit., foam of the snake, is of modern date. It is generally held that this word has been Sanskritised from the Arabic “aphiyun.”

These identical distichs also occur in the commentary on Sarngadhara by Vālāmalla with the additional line, प्रयासः (व्याक्षः) चीरविषयः, namely, it is the milky juice of poppy; proving that during the time of the latter its real origin was known, at the same time its supposed origin was not disbelieved.
Sārṅgadhara-samgraha—a compilation by Sārṅgadhara: its peculiarity is that it is based upon the Ayurvedas (Charaka, etc.) on the one hand and the Tantric chemical treatises on the other. In the chapter on the purification and incineration of metals, 7 of these are recognised, but strange to say there does not occur any mention of zinc. Later on, 9 metals are named including two alloys, brass and bell-metal, after the 9 planets, the significance of which will be discussed in the proper place.

The date of Sārṅgadhara can be ascertained with accuracy, as besides this medical compendium he is the author of the Paddhati, a voluminous miscellaney, containing, with other matters, a poetical anthology. The author dates his work in samvat 1420 or A. D. 1363. The name of the author's father is Dāmodara and that of the grandfather Rāghavadeva. The latter was highly considered by Rājā Hammīra, the Chauhan.*

* After the sack of Chitor by Alla-ud-din in A. D. 1303, Mewar was occupied by the garrisons of Delhi. Hammīra
There is a big commentary on this work by Xdhāmalla, whose ancestors settled in the city founded by Hammíra.*

Rasendrasárasamgraha: The author, Gopálakrishna, begins by admitting that his treatise is a mere compilation based upon many Tantras, though he mentions by name only two, namely, Rasamañjarí and Chandriká. Special stress is laid on the therapeu-

recovered his ancestral throne and during his prosperous rule of sixty-four years (1301-1365) and that of his successors arts and literature found liberal patrons (vide Tod’s “Annals of Rájastán.”) The court of Hammíra attracted another distinguished physician named Saugata Simha as we gather from the colophon to a noted recipé,

एता संगतमिन्हामभिस्वाग्नुकृता जोकि प्रकाशीक्रता

हम्रिघाय सहीभूजे * * मंभीजभाजे सृणस्।

Xdhāmalla gives an account of his family. His Grandfather was one Chakrapáni, not to be confounded with the celebrated medical author of Bengal (Vol. i, Intro. liv) and he himself was attached to the court of a ruler named, Jaitrasimha, whose capital Hástikántapuri was situated on the river Charmavatá. We reproduce in the next page the text which is somewhat corrupt from the copy preserved in the Library of the Sanskrit College, Benares.
tic efficacy of mineral preparations. * Like Rasendrachintámaní it assigns a minor place to the ancient Ayurvedic method of treatment by kasháyayoga, i.e., by herbs and simples; as far as the knowledge of chemical processes goes, it must be held inferior to the former. Numerous medicinal recipés

* For a description of some of these vide "Journal des Savants." April 1898.
I agree word for word with those in Rasendra-chintāmāni, which only proves that both have drawn on a common stock. There is no question of the one borrowing from the other, as internal evidence proves that both belong to the same period. Abhayānanda Gupta in the preface to his edition says:—"There is a tradition to the effect that Gopāla Kavibhū- shana of Dakshina Baiga is the compiler of this book; but this can scarcely be accepted as he lived not long ago." Again. "Its commentator, Rāmasena Kavindrāmani (author of Arthabodhikā) was court physician to Nawāb Jaffer Ali Khan of Bengal (Mir Jaffer) some 200 years ago." Rāmasena himself quotes from 3 commentaries of this book; hence it was recognised as of some degree of importance at that time and must have been composed long before. This work is very popular in Bengal and is a vade mecum of the local Kavirājas.

Rasendrakalpadruma is another work of this period. It deals chiefly with mineral preparations and is a mere compilation from
Rasarzzava, Rasamaṅgala, Ratnākara, Rasa-
mrita and Rasaratnasamuchchaya; the nu-
merous citations with which it is replete are
of some use in correcting many doubtful read-
ings in these latter. Our MS. is incomplete,
the first few couplets and the sequel being
lost; for the opening lines of the work see
Aufrecht’s Catalogue of the Bodleian Library,
MSS., pt. i., p. 321.

Dhāturatnamālā: This epitome is devot-
ed exclusively to short processes of *killing*
metals and minerals. Six metals are recog-
nised at the outset, namely, gold, silver, cop-
per, lead, tin and iron as in the ancient works;
but strange to say later on *kharpara,* which
is the mineral calamine, is taken as synony-
mous with jasada or zinc. We have before
us a MS. procured from Benares. It is full
of corrupt readings. The copy noticed in
the Bodleian Library Catalogue seems to be
more correct. From the colophon in the
latter we learn that the author is one Deva-
datta of Gujarāta, but in the Benares exemplar

* Vol. i, p. 158.
this portion has been coolly tampered with, so that this poor compilation may be palmed off as an integral part of a Samhitā of the Asviníkumáras, the divine physicians, and thus entitled to the respect due to revelation. This work cannot be placed earlier than in the 14th century. Here we have a serious side-light into the history of literary forgeries.
Chapter IV.

MODERN PERIOD.

1500—1600 A. D.

We have now arrived at what may be termed the modern period in Hindu chemistry and materia medica. The characteristic of this period is that over and above opium, we have some other foreign drugs incorporated into the materia medica. By the beginning of the 16th century A. D. the Portuguese had fairly established themselves at Goa and some other parts of India,* and as a result of intercourse with them, that dreadful scourge—the venereal disease—had made its appearance. Sanskrit medical treatises from the Charaka and Susruta downwards and ending with Sūrīgadhara are silent about this malady though they give fairly

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* The political influence of the Portuguese as early as 1533 A. D. is evident from the fact that Sultan Bahadur, king of Gujarát, entered into a treaty with them and through their assistance raised a force of 6,000 Abyssinians—"Memoirs of Humayun".
accurate descriptions of diseases of the genital organs (उपदर्म). But syphilis had now to be reckoned with and a new name had to be coined for it. Accordingly we find Rasaprāḍīpa, one of the standard works of this period given to Tantric method of treatment, prescribing calomel and chobchini (China root, Smilax China, Linn.) for what is now termed for the first time Phiraṅgaroga or the disease of the Portuguese. According to Flückiger and Hanbury "the use of this drug as a remedy for syphilis was made known to the Portuguese at Goa by Chinese traders about A. D. 1535." Thus from an independent source we can arrive at the approximate date of Rasaprāḍīpa. This work also gives us a detailed process for the preparation of mineral acids by distillation which is here termed samkhadrāvaka (lit. a solvent for conch shells) and is described as "endowed with the property of dissolving metals." It is thus evident that the use of mineral acids as a solvent for metals was unknown in India before this time.* A very

* Vide Note on mineral acids, vol. i. p. 185.
noteworthy circumstance in connection with this is that the Bhāvaprakāsa, which is posterior to Rasapradīpa, is silent about samkhadrāvaka, which had come to be prescribed by this time as a favorite remedy for indigestion and derangement of liver and spleen; the solvents being borax, treacle, etc.—(cf. vol. i, p. 130). In the Bhāvaprakāsa among the acids we have only the juices of acid fruits. This is only another instance of the danger one is liable to incur by drawing inferences from argumentum ex silentiio.

Rasakaumudī is another compilation belonging to this period and as far as its contents go it is comparable to Rasapradīpa in many respects; both opium and mineral acids are prescribed. From the colophon in the Calcutta Sanskrit College Library MS. we gather that the author is a physician named Mādhava. Curiously enough he is often confounded with the celebrated Mādhavakara, the author of the Nidānasamgraha, who preceded the former by some 8 or 9 hundred years.
The next work which should now claim our attention is the well known Bhávaprákása of Bhávamisra. It is a voluminous compilation in which the Ayurvedic method of treatment has been mainly adopted and as such ample citations are given from the Charaka, Susruta, Vágbháta, Háríta, Vrinda and Chakrapáni. But the Tantric remedies could not altogether be given a wide berth and accordingly one or two chapters have been devoted to mineral preparations; but these have been borrowed chiefly from Rasa-pradípa, Rasendrachintámani, Súrigadharā and other standard works. Bhávamisra has been scrupulously candid in his acknowledgments to the various authorities quoted by him. Phirangaroga is mentioned as also its treatment with the help of calomel and chob-chini. The author lived about the time of the Emperor Akbar and evidently in that part of India which is now known as the United Provinces and it is not to be wondered at that Mussulman influence is discernible in his book.

We conclude our survey of this period with the notice of a remarkable production
entitled Dhátukriya or "operations with metals"; it is in the shape of a dialogue between Siva and Párvatí; in short, it pretends to be a part and parcel of the Rudrayámal Tantra. * The work cannot be placed earlier than in the 16th century A. D., as it contains reference to the country of the Phirangas and to Rúma, the Arabic name for Constantinople. For the first time we come across the very appropriate term dāhajala (lit. burning water) coined to denote sulphuric acid. The information about the metals is of a very meagre and poor description and it has been needlessly spun into an inordinate length. The author evidently considers it a pious fraud to make such statements as follow emanate from the mouth of Siva himself:—

"By using coins made of imitation gold one can carry on exchange . . . and thus enrich oneself."

* We have in hand transcripts of two MSS.—one from the Library of the Mahárájá of Ulwar; the other named somewhat differently, Dhátuamanjari, from Benares. They agree very closely.
The curious reader who is referred to the translations of the selected portions of the text given elsewhere will not fail to recollect similar passages in the Leyden Parchment where the dishonest goldsmith gives numerous recipes for "augmenting gold." * Fraudulent attempts in the direction of palming off alloys of base metals, possessing bright, yellow lustre, for gold, have been made in all ages and in all climes (cf. extracts from Rasūrnava, Vol. i, p. 74).

Arkaprakāsa or a treatise on the preparation of medicinal tinctures and essences should also find a place here; † its authorship is ascribed to Bāvana, the mythical king of Ceylon. The contents of the work, however, reveal its date. For instance, mercury, treated with Sāmkhadrāvaka, is prescribed as the remedy for "Phiraṅgaroga" (syphilis).


† There is a Calcutta edition published by Gaṇesa Chandra Ghosha; we have compared it with a MS. procured from the Sanskrit College, Benares. They agree remarkably well.
Opium also is prescribed; while the term yasada is used to indicate zinc. As a distilling apparatus a tinned copper vessel is recommended. Mahommedan influence is distinctly discernible in this hybrid production. The very title of the book is no doubt Sanskritised from the Persian arrak (essence).

It is unnecessary to proceed further. We have before us the MSS. of Rasamañjarí by Sálinátha, of Rasarañjana, of Gandhaka-kalpa (a Tantra), of Rasárnava (quite distinct from the standard work bearing the same title,) of Rasaratnákara (altogether different from that of Nityanátha) and several others. As all of these repeat ad nauseam the processes already described, we refrain from examining their contents here.
Chapter V.

Indigenous Origin of Indian Alchemy.

The reader who has been able to follow us throughout with patience will not have been slow to recognise that alchemy in India has been developed all along on independent lines. Its origin and growth are interwoven with a phase of religious activity—the outcome of purely indigenous traits—which has been discussed at length in chapter i.

The only instance in which we find some allusion to adepts outside the pale of Hindu institutions occurs in Rasaratnasamuchchaya.* But the term Mlechchha used there is a generic one applied indiscriminately to the

* मेलक्षकाण्य, Vide Vol. i, Sans. texts, p. 56; a variant in the Poona edition has मेलक्षकाण्य, which must be rejected as both the Benares and Kásmir MSS. accept the former.
Sakas, the Yavanas (Greeks or Bactrians), the Chínas (Chinese), etc. The Hindus have never been shy of acknowledging their obligations to the Yavanas; Varáhamihira for instance expresses his admiration for the proficiency of the latter in the field of astronomy and would gladly learn at their feet.*

In the Mahábhárata again we find the services of the Yavana architect, Purochana, requisitioned. We have not, however, come across a single passage, which may be construed into implying a hint to alchemists in the West. That the term Mlechchha in R. R. S. really refers to the Kirátas is evident from the colophon to Rasahrídaya. †

Those scholars who have hitherto maintained that Indian alchemy is of exotic origin, have, we are afraid, done so on *a priori*

* ख्छच्छ हि यवनासेदु सस्यक् शास्मितं स्थितं।

कार्तिक्षेत्रिपि पूज्यले कि पुनर्दैवविद्याः।।

† Sans. texts, p. 39; there the four castes (चतुर्वेण) are distinctly mentioned and the kirátas evidently included under the Mlechchhas.
grounds. Indeed the frame of mind which they have brought to bear upon this subject is not calculated to lead to a judicial and dispassionate verdict. The fact that the Hindus are indebted to the Greeks for substantial improvements in their astronomy is too often urged whenever it is necessary to support such a view. * There is, however, very little affinity in the mode of growth of alchemy in India and of its *congener* in the West. The progress of magic, witchcraft and alchemy can be traced from the Atharva-

* Cf.—"It was, however, Greek influence that first infused a real life into Indian astronomy. This occupies a much more important position in relation to it than has hitherto been supposed; and the fact that this is so, *eo ipso* implies that Greek influence affected other branches of literature as well, even though we may be unable at present directly to trace it elsewhere." Weber: Hist. Sans. Lit. ed. 1892, p. 251. In justice to Weber, however, we should quote here his views on the independent origin of Hindu medicine; namely, "the weights and measures to be used by the physician are expressly enjoined to be either those employed in Magadha or those current in Kalinga; whence we may fairly presume that it was in those eastern provinces, which never come into close contact with the Greeks, that medicine received its special cultivation."—p. 269.
vedas onwards to the later Tantras according to the laws of evolution without any breach of continuity.

One of the most favourite doctrines of the neo-Platonists was that the metals were engendered in the womb of the earth under the influence of the planets. According to Olympiodorus (5th century A. D.) lead is begotten by Saturn, "electrum"* by Jupiter, iron by Mars, copper by Venus, tin by Hermes, gold by the Sun and silver by the Moon.† Now, such a fascinating astrological belief was pre-eminently calculated to appeal to the Hindu instinct, especially as there was a "commercial and lively intellectual intercourse," to quote Weber's own words, between Alexandria and the West Coast of India. Varāhamihira's *Vṛihatsam-

* An alloy of gold and silver was known by this name. Later on it disappeared from the list of metals, tin being assigned to Jupiter, and mercury to Hermes.

† The influence of the astral bodies on the production of the metals can be traced to Proclus' commentary on the Timæus.—Berthelot: "Les origines de l'Alchimie:" p. 49; also Coll. des. Alch. Grecs. trad. p. 100.
hitá, if anything, is a repertory of astrological notions. In vain do we look even there for any such chance and solitary reference.* The alchemical literature of India is equally silent about it. † True it is there are two metals which are often designated as the sun and the moon respectively, namely copper

«Chapter xvi of this work treats of "countries, people and things belonging to the domain of each planet." Among sundry other things "the Sun is the lord of gold and fire." Thousand and one articles are said to be presided over by the Moon, Mars, Mercury, Jupiter, Saturn, Venus, Ráhu and Ketu; but nowhere is there any connection between the planets and the metals. Vide Kern’s trans., pp. 97—101.

† The mythical origin of some metals is given in the Puránas; but no reference to the astral bodies is to be found. Thus silver originated from the tears of the God Siva, copper from the semen of the God Kártikeya, lead from the semen of the Snake God Vásuki, iron from the different parts of the body of the demons called Lomilas; and gold from the semen of the God of fire. Some vague and remote connection only can be established between this sort of nomenclature and that of the old Greco-Egyptian alchemists. According to the latter mercury is sometimes designated as the semen of Hermes; whilst in the Tantras it is the semen of Siva (हरवीज). Vide "Intro. a l'étude de la chimie des anciens," p. II.
and silver. * But this has nothing to do with the planetary generation of these metals. In the imagery of the Sanskrit poet the crimson tint of the rising sun and the pale white lustre of the moon are comparable to the colour of copper and silver respectively.

The old Greek writers repeatedly refer to the mystic relationship between the seven planets and the seven metals. In the Sanskrit literature, however, beginning with the Susruta and coming onwards to Rasaratna-samuchchaya, we invariably find six metals recognised, alloys being rigorously excluded from the list and regarded simply as "artificially made." † It is only in the Sārṅgadhara and other later works that we find seven metals enumerated; ‡ but this author

* रङ, चक्र and other synonyms are as a rule applied to copper but rarely to gold.
† Vide Vol. i, pp. 48, 72 and 127.
‡ (चार) brass being taken as the additional metal; zinc was evidently unknown to Sārṅgadhara.

क्रमशः ब्रह्माण्डपाणि नागवल्ली च तोत्तकम्।

थालवः सस्त्र विजेयः । । । ।
is guilty of a curious inconsistency, since in a subsequent part of his book he adds two more to the list and quietly lays down that there are nine metals, *which derive their names from the nine planets.* This may be read as a sort of vague and indistinct connection between the metals and the astral bodies.

The Arabs who adopted many of the Greek doctrines of alchemy also represented the seven metals by the seven planets. In fact it was through the medium of the Arabs

* "Kāmsya" (bell-metal) and "Vrittataloha" or "Vartaloha" (cf.—Vol. i. p. 114) make up the number. Rāhu and Ketu are the two mythical planets; they are in reality the ascending and descending nodes in the ecliptic. Rāhu is supposed to cause the eclipse of the sun and the moon by swallowing it up.

Sāṅgadāra stops here, but his prolix commentator, Adhavalla supplies the deficiency by making copper stand for the Sun, silver for the Moon, brass for Mars, iron for Saturn, gold for Jupiter, tin for Venus, lead for Mercury and bell-metal and vartaloha for Rāhu and Ketu respectively.

It will also be noticed that lead is here represented by Mercury; but in the Hindu alchemy mercury always stands as the visible manifestation of the God Śiva, it being generated from his semen, hence the name हरवीज given to it.
and the Jews that a knowledge of the Greek sciences including alchemy filtered to the European nations during the middle ages.* We have already seen that Rájputána had been overrun and even occupied for a brief period by the Mussulman conquerors shortly before the time of Sáríngadhará and it is reasonable to suppose that he had gleaned some astrological notions from that quarter.

We now advert for a moment to the main question of the connection of the comparatively modern and scientific phase of Hindu astronomy with the science of Alexandria. Although it is admitted by all those who are entitled to speak with authority on the subject that the Hindus borrowed from the Greeks and thus improved upon their older system, many points have yet to be cleared up. Professor Whitney who has

* "C'est par l'intermédiaire des écrits arabes et hébreux que la plupart des connaissances scientifiques des Grecs en mathématiques, en astronomie, en physique et en médecine, ont été transmises au moyen âge occidental; les écrits Grecs propres dits n'ayant guère été connus directement avant la Renaissance."—"La Chimie au Moyen Âge," T. i, p. 229.
carefully studied the subject is struck with the circumstance that the Sūryya and other Siddhántas bear resemblance to the system of Hipparchus rather than that in the Syntaxis.* In other words the transmittance of astronomical knowledge must have taken place before the time of Ptolemy. Now the period of lively intercourse is precisely that covered by the age of Ptolemy and that of his followers, and yet the Indian astronomers seem to be unaware of his teachings.†

* Intro. to "Sūryyasiddhānta". We find from Ptolemy that the observations of Hipparchus extended from B.C. 162 to B.C. 127. Ptolemy flourished at Alexandria in the second century A.D., under the reigns of Adrian and Marcus Aurelius.

This was also pointed out long ago by Colebrooke, e.g. "The whole cluster of astronomers mentioned by Brahma Gupta must be placed in the interval between the age of Hipparchus, and possibly that of Ptolemy."—Essays, pp. 411—412.

† Aryabhatta composed his treatise "Laghvāryabhattīyatam," in 496 A.D., and Varāhamihira his "Pañchasiddhāntikā" about 550 A.D. But these astronomers borrowed from the much older treatise entitled "Romakasiddhānta" ascribed to Srīsena, and Paulīsasiddhānta (vide Thibaut's Intro. to Pañchasiddhāntikā, xxvii—xxxvi).
This mystery has never been elucidated; Dr. Thibaut's arguments are ingenious, but, we are afraid, by no means convincing. Indeed in the purely mathematical sciences the Hindus far excelled the Greeks of the Alexandrian school. \textit{Aryabhatta}'s knowledge of algebra was superior to that of Diophantus and as for arithmetic it is generally acknowledged to be of Indian origin.†

The last word on the subject has yet to be said and it is doubtful if this dark recess will ever be illumined. In the meantime it would be better to hold our judgment in abeyance. At best we can only launch into hypotheses

* L. c., pp. li and liii.
† \textit{Cf.}—Colebrooke: "Admitting the Hindu and Alexandrian authors to be nearly equally ancient, it must be conceded in favour of the Indian algebraist, that he was more advanced in the same."—\textit{Essays}, ii, 429. Again, "in the whole science he [Diophantus] is very far behind the Hindu writers," \textit{ibid}, p. 438.

Kaye has recently questioned the priority of the claims of the Hindus: \textit{Vide} J. A. S. B. iii [N. S.], July, 1907.
or indulge in dogmatic assertions.

* One who approaches this subject should divest himself of prepossessions or the "bias of patriotism" as Herbert Spencer puts it. A very agreeable feature in this controversy is that those who are most competent to speak with authority are extremely modest, nay diffident in giving expression to their views. Woepcke in his masterly memoir "on the propagation of the Indian numerical symbols" says:—"La solution parfaite de ces problèmes ne résulterait que d'une connaissance tellement complète des événements et de leurs phases, qu'il faut à peu près renoncer à jamais l'obtenir. D'un autre côté, remplir les vides par des hypothèses arbitraires ou préconçues serait livrer l'histoire des sciences eux hasards et au dogmatisme des inspirations individuelles." "Journal Asiatique" (1863).

Lassen whose modesty is only equalled by his profound scholarship observes:—"Es wäre sehr wünschenswerth, dafs ein mit der gehörigen kenntnifs der Sanskritsprache ausgerüsteter Kenner der Mathematik und Astronomie es unternähme, aus diesen vorhandenen Hülfsmitteln die Lücken unserer Kenntnifs auf diesem Gebiet des Indischen Alterthums aузzufüllen; für jetzt müssen wir uns darauf beschränken, die hauptsächlichsten Ergebnisfe der bisherigen Untersuchungen zusammenzustellen." "Indische Alterthumskunde." Vol. ii. p. 1150; ed. 1874.
Chapter VI.

SOME NOTED INDIAN ALCHEMISTS AND THEIR WORKS.

Aufrechtt in his notice of the MS. of Rasaratnasamuchchaya, * evidently from a mistaken notion that the pursuit of chemistry was unknown in ancient India, goes somewhat out of his way in asserting that the names of the 27 alchemists, mentioned in the beginning of that work, † are mostly apocryphal. We have, however, positive proofs that these personages far from being evolved out of the imagination of the author existed in real flesh and blood and contributed not a little to the progress of chemical science. Thus we read in Rasaratnākara of “chemical operations performed by Māndavya” and also find Ratnaghosha taking part in a dialogue on certain processes, ‡ Yasodhara, again, is the author of the comprehensive work named Rasaprakāsasudhākara

* Catalogus Catalogorum, ii, p. 116.
† Vide Vol. i, p. 77.
‡ Eng. trans. pp. 6—8.
which we have noticed at some length in the present volume. Vyāḍī is a prominent name both as a grammarian as well as a chemist. The Garudapurāṇa quotes him as an authority on gems.* Nandī, as we have already seen, is distinctly referred to by Somadeva as the inventor of the kosh/hi apparatus and of the process of sublimation. †

There are, indeed, a great many names scattered throughout the mass of chemical and medical literature, some of which have been handed down to posterity, sometimes on account of the important processes they invented and sometimes, again, because of the efficacy of the metallic preparations which they introduced. Thus in Rasendracchintāmaṇi we come across the name of Siddha Lakshmīsvara. The names of the sage Brahmajyoti, Manthānabhairava, Svachchhandabhairava and Gahanānandanātha have in this manner been rescued from oblivion. Most of these were Buddhist monks.

* व्याढिःगाद जगतां हि महाप्रभावः सिद्धी विद्वन्नचितत्वपर्या द्यायतः।
† Intro., lv.
Sivadása in his commentary on Chakrapáni quotes besides Patañjali, Bhavyadattadeva as an expert on iron preparations. We give below the names of some of the authors and their works over and above those already noticed. It is scarcely possible to submit an exhaustive list.

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<tr>
<td>Ānandānubhava</td>
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<tr>
<td>Balabhadra</td>
<td>(Unknown).</td>
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<td>Bhojadeva</td>
<td>Rasarājamṛigāṅka.</td>
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<td>Chandrasena</td>
<td>Rasaśanthrodaya.</td>
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<td>Charpata</td>
<td>Charpatসiddhānta.</td>
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<td>Dhanapati</td>
<td>Divyarasendrasāra.</td>
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<td>Garudadattasiddha</td>
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<td>Harihara</td>
<td>Baudhasarvasva.</td>
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<td>Kapāli</td>
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CHAPTER I.

I shall now speak of the purification of the important rasas* (minerals).

What wonder is it that rājāvarta digested with the juice of Acacia sirisa converts silver of the weight of one guṇja into one hundred times its weight of gold of the lustre of the rising sun? ¹

* Regarding rasas see Vol. 1, p. 79.
What wonder is it that yellow sulphur, purified with the juice of Butea frondosa, converts silver into gold when roasted thrice over the fire of cowdung cakes? 2

What wonder is it that calamine ... ... roasted thrice with copper converts the latter into gold? * 3

* These laconic recipes all refer to the floating mass of traditions current at the time of the author on the transmutation of the base metals into gold. As they are of a fragmentary and disjointed character, the meaning is not always clear. Recipe 3 also occurs in Rasārnava; vide Vol. i, pp. 70-71. Various ingenious methods were resorted to for debasing gold or making an alloy, which would mimic the appearance of this metal. Silver, copper, lead, zinc and mercury were often made into an amalgam, and the latter rendered compact and coloured yellow with the aid of orpiment. No wonder that the law-books prescribe several penalties on the fraudulent debasers of the precious metals. Thus according to Manu "the king shall cause a goldsmith, who behaves dishonestly, the most noxious of all the thorns, to be cut to pieces with razors." IX, 292.

The reader who feels interest in this subject may consult Berthelot's "La Chimie au moyen âge," t. i. pp. 31 et seq., where will be found several recipes for augmenting gold aurum plurimum facere, or for the "fabrication of gold." One example may be cited here. Take gold, copper and mercury, make an amalgam of the whole, afterwards add sulphur, orpiment, "sandarac" (a kind of resin) and the bile of the vulture &c. The author of the recipe thus concludes:—"Thou wilt now discover a secret, which is sacred and worthy of praise" (l. c. p. 35).
What wonder is it that cinnabar digested several times with the milk of the ewe and the acids* imparts to silver the lustre of gold glowing as saffron? 4

Digestion [of minerals] is to be effected in the decoction of Dolichos uniflorus, Paspalum scrobiculatum, the urine of man and the acid juices of [the fruit of] ratan (Calamus rotang) and afterwards with the addition of the alkalies (soda, borax &c.) The operation of roasting is to be performed thrice.—Cf. the process of Rasaratnasamuchchaya (R. R. S.), Bk. ii, 67-68 in Vol. i, p. 83.

What wonder is it that the pyrites macerated in the juice of Musa sapientum and in castor oil and clarified butter, and placed inside the bulb of Arum campanulatum and roasted [in a closed crucible] undergoes perfect purification? 6

Chapala and other minerals, being macerated in the juice of the lemon for 3 days, become purified. Gold being smeared with the 5 earths, the ashes and salts ‡ and roasted, undergoes purification. 12

* Vegetable acids are meant here. Vide Vol. i, p. 128.
† Here extraction of copper from the pyrites is no doubt meant. Cf. R. R. S. Bk. ii, 89-90; vide Vol. i, p. 84.
‡ Cf. R. R. S. Bk. x, 71, 85; vide Vol. i, pp. 128-129.
Silver alloyed with lead and fused with ashes becomes purified.* 13

Lo! it is not to be wondered at that copper, melted with the alkali derived from the earth† and the milk of the ewe, clarified butter and one-sixteenth of its weight of oil, will become pure like the crescent of the moon. 14


Verses 25-30: Have reference to the extraction of copper from mākshika and tāpya (varieties of the pyrites). They agree in all essentials with Rasārnava, Ch. VII, 12-13. Vide Vol. i, p. 70.


Verse 37: Essence of darada, i.e. extraction of mercury from cinnabar by distillation. Cf. R. R. S. Bk. i, 89-90. Vide Vol. i, p. 78.

† प्राणवीििििि बांिि may refer to natron or to saltpetre.
Verses 50-51: Dissolution of gems (pearls &c.) by digestion in vegetable acids, e.g. sour gruel (impure vinegar) and the juice of certain acid plants.

Here ends Chapter Second of Rasaratnākara by Nāgārjuna on the killing of diamond and the metals, extraction of the essence of minerals and liquefaction of mica.

CHAPTER III.

I shall now explain [the process of] fixation of mercury. The king of rasas (mercury), rubbed with the juice of lime, sal-ammoniac, the acids, the alkalies, the 5 salts, Piper nigrum, P. longum, the dried root of ginger, the juice of Moringa pter., the tuber of Amorphophallus campanulatus, can readily amalgamate itself with the 8 metals.

Prajñāpāramitā (perfection of wisdom) appeared before Nāgārjuna at midnight in a dream and revealed to him the ingredients of a recipe (consisting of steel, copper, mica, pyrites, &c.)

Mercury is to be rubbed with its equal weight of gold and then [the amalgam] further admixed with
sulphur, borax &c. The mixture is then to be transferred to a crucible and its lid put on and then submitted to gentle roasting. By partaking of this elixir (i.e. the sublimate) the devotee acquires a body not liable to decay. 30-32

I shall now describe the Garbha yantram.*

Recipe for Kajjali or æthiops mineral. † 84-86

* * * * *

Having made salutation to all the Buddhas, free from the taint of sins, I shall now deliver the Kakshapûta tantram ‡ for the benefit of suffering humanity.

[ The most important part, from an historical point of view, is the dialogue between Nāgārjuna, King Śalivahana and Ratnaghosha.]

Nāgārjuna, whose end (salvation) had been attained, benevolent towards all living creatures, blessed with all favours, residing on mount Śrisaila, before him stood Ratnaghosha with folded arms,

* The same as in Rasārnava. Vide Vol. i, p. 66.
† The process is practically the same as in Chakrapâni; vide Vol. i, p. 58.
‡ There is extant a Tantra, which goes by this name, the reputed author of which is Nāgārjuna.
saying: "Be pleased to communicate to me knowledge on chemical operations."

Nāgārjuna said:—

Well done! well done! I am pleased with your devotion and shall convey to you all that you want to know, namely remedies for warding off wrinkles, grey hair and other signs of old age. Mineral preparations act with equal efficacy on the metals as on the body (human system).

For the benefit of living beings I went through all manner of penances for 12 tedious years and worshipped the goddess Yakshīṇī presiding over the Ficus religiosus. Then I heard an oracle.

Nāgārjuna said:—

O Goddess! if thou art propitiated, be pleased to communicate to me the rare knowledge of the fixation of mercury.

Śālivāhana said:—

I have dedicated to thee, O Goddess! treasures of gold and gems, now I await thy instructions.

* This was a favourite metaphor with the alchemists. Cf. Vol. i, Intro. lxxvi.
The Goddess said:—

Well done! well done! O wise ruler! I shall speak to you of chemical operations performed by Māndavya.* ... ... A disciple should be intelligent, devoted to work, sinless, and master of his passions. †

The apparatus known as koshthi, mouth blow-pipe, cow-dung, substantial wood (as fuel), a pair of bellows, iron plates, * * * having collected all these, chemical operations are to be performed.‡

* * * * *

Ratnaghosha said:—

Having prepared with great care "the powder of projection," which transforms a ten million times its weight of the base metal into gold, §  * * *

Nāgārjuna said:—

I shall convey to you what has been experimented upon by Sākānda. ¶

* * * * *

* A well-known alchemist; one of the 27 adepts mentioned in the opening lines of R. R. S. Vide Vol. i, p. 77.
† Cf. "Initiation into discipleship" in Vol. i, p. 115.
‡ Cf. Rasārnava in Vol. i, pp. 64-65.
§ को०थि मद्दारः—the term वघः has technical meaning. Cf. Vol. i, p. 120.
¶ We are unfamiliar with this name, probably the reading is corrupt.
Tests for killed mercury.

The first two couplets are almost the same as in Rasārnava. Cf. Vol. i, p. 74.

When the quicksilver, which has acquired the colour and the lustre of the rising sun, stands the test of fire (i.e. is not readily volatilised), then it is to be regarded as fixed.

Here follows a list of apparatus borrowed from Rasendramanianga. — Detailed account of most of these will be found in R. R. S. Bk. ix. Vide Vol. i, p. 67.

Chemistry in Rasahridaya of Bhikshu Govinda.

Quicksilver digested with sour gruel and then subjected to distillation is freed from [the impurities of] lead and tin. 1

Much the same as above. 2 * * * *

Description of the apparatus for purification of mercury by sublimation and distillation: it agrees almost literally with that given in R. R. S. Bk. ix, 68. Vide Vol. i, p. 121.

Preparation of mild alkali from the ashes of plants:—

The process must be considered as a poor one, compared to the elaborate description in Susruta. Cf. Vol. i, p. 32.

Experts [on the properties] of metals are of opinion that tin gives strength, tikshna colour, lead unctuousness, copper all these qualities to mercury.

Couplet (in p. 29, Sans. texts): The purport seems to be that when mercury is rubbed with certain sulphides, e.g. orpiment, pyrites &c., and sub-

* The text is not very intelligible. The other ingredients mentioned are tikshna and kanta, these being varieties of iron; but iron will not amalgamate with mercury. Tikshna may also mean a kind of saline earth. The old alchemists racked their brains in devising ingenious processes for robbing mercury of its fluidity and imparting to it various colours. Cf. Rasārṇava, IX, 2-3, XI, 197-198. Vide Vol. i, p. 74 and also "The Hindu method of manufacturing calomel."—Ibid. p. 250.
limed, it assumes the colour of lac or Coccinella insect (a poetical and figurative way of expression for red colour) in the shape of the red crystalline sulphide.

Patala ix.

Vaikrānta, kānta, sasyaka, mākshika, vimala, adri, darada, rasaka:—these are the 8 rasas* and their essences are well suited for chemical operations.

Sulphur, gairika, kshiti, khechara (mica), añjana, kaikushtha:—these are the uparasas. Cf. Vol. i, p. 89.

Gold and silver are the noble metals.

Copper, brass, tikshna and kānta (varieties of iron) are the essential or substantial metals; lead and tin emit foetid odours. Cf. Vol. i, p. 113, footnote (1).

The six salts are:—Sauvarchala, saindhava, chūlika (sal-ammoniac), sāmudra, romaka and vida. The alkalies are:—Sarjikākshāra, yavakshāra and borax. (Vide Vol. i, Index of subjects.)

Patala xi.

A cupel made of boneash (goat's) and lined internally with borax &c.

Colophon giving an account of the author:

Madanaratha, King of Kirāta, teacher of mercurial lore, in whom the Goddess of the science of mercury and minerals (Chemistry), the source of all good, has taken her abode for the benefit of mankind, who can restore to the disfigured patient, afflicted with leprosy, the healthy comeliness and lustre of youth:

Bhikshu Govinda, well versed in chemical operations and loaded with honours by the King of Kirāta, composed this tantra entitled "Rasahridaya."

This tantra is written by Govinda, the grandson of Maṅgalavishnu and son of Sumanovishnu:—May Tathāgata pronounce his blessings.

Chemistry in Kakachandesvari-mata Tantra.

Patala i.

The first patala gives the origin (mythical) of the tantra.

Patala ii.

Kākachandesvari said:—

* * * Please, give a brief account of the
Chemistry of the metals, the killing of mercury and minerals and the fusion of the gems.

Sri Bhairava said:—

* * * Mercury rubbed with the ingredients of the vida (see Vol. i, p. 72) and roasted in a closed crucible, is killed instantly. That mercury now acquires the power of converting a base metal into 1,000 times its weight of gold. 13-16

Copper, treated with the above preparation of mercury and rubbed with the acids, alkalies and the milky juice of Calotropis gig., and roasted in a crucible, turns into gold. 18-20

Earth for making crucibles. 21-22 Cf. Vol. i, pp. 67-68.

Transmutation of iron into gold:—process not clear. 25-32

Patala iii.

Liquefaction of mica:—

Thin plates of mica are to be smeared with the 3 alkalies and borax and strongly heated in a crucible. The whole mass fuses.* * * 29 30

* Refractory silicates are treated similarly at the present day with the "fusion mixture".
Chemistry in Rasendrachudamani of Somadeva.

_Sans. texts, p. 51._

Tests for killed iron (rouge).

As R. R. S. has borrowed these from the present work, it is unnecessary to repeat them here. _Vide_ Vol. i, pp. 118-119.

_Sans. texts, pp. 52-53._

Take lead of the weight of 30 palas and rub it with the milky juice of _Calotropis gig._ and calcine it till its weight is reduced to a karsha: this residue, even if it be calcined a thousand times, will not undergo further decay (_i.e._ diminution in weight). Metallurgists call this residue derived from lead Chapala.*

Tin also similarly treated will yield a chapala, which, on merely being touched with the hand, kills (fixes) mercury. This mercury is recommended for metallurgical and not for chemical purposes.

* Possibly it refers to lead derived from _argentiferous galena_. The lead, being cupelled off in the shape of litharge, will leave a button of silver, which will not undergo oxidation.
Sans. texts, pp. 53-54.

[A somewhat complex process described, which is not very clear. We shall try to give the purport thereof. The quantitative measurements are of particular interest.]

1 pala of tin should be taken and rubbed with 10 nishkas of mercury and made into a cake with the addition of zinc; * it is then to be digested with the decoction of certain herbs and plants and warm vinegar and once more rubbed with $\frac{1}{2}$ pala of blue vitriol † and the juice of Abrus precatorius. The mass is then to be divided into small pills; these should then be put into a crucible with the lid on and the fire to be urged by means of bellows. The essence is then to be taken out of the crucible. This essence of the weight of 10 Sānas is then to be enclosed in a mixture of ashes and salts and roasted. This essence of the weight of 2 nishkas is then to be fused with 80 times its weight of lead * * *. This (essence) is also termed chapala. Cf. "the gold-like alloy" in Vol. i, pp. 74-75.

* सनकाश संच्यन.
† पलाद्य गुर सुभ्यन.
Sans. texts, p. 55.
When quicksilver has been deprived of its physical properties (lustre, fluidity &c.) it is known as nashtapishta. Cf. Vol. i, p. 74.

Somadeva will now give a brief account of the apparatuses, after having consulted numerous chemical tantras. (Here follows the description, which has been reproduced verbatim in R. R. S. Vide Vol. i, pp. 121 et seq.)

* * * * *


Chemistry in Rasaprapakasa-
sudhakara of Yasodhara.

Sans. texts, p. 57.
Preparation of karpurarasa (lit. camphor of mercury, i.e. calomel): practically the same process as given in Vol. i, pp. 250-51.

[Note. Calomel is prescribed here only as an aphrodisiac and a specific for leprosy but not as a remedy for syphilis.]
Sans. texts, pp 59-61.

Rasaka (calamine): the author of R. R. S. has evidently borrowed his description of this mineral from the present work. Cf. Vol. i, p. 87.

Extraction of zinc from calamine:

[The process agrees almost word for word with what is given in R. R. S. The essence possessing the lustre of lead runs out of the crucible.*]

Sans. texts, pp. 61-62.

Saurāśṭrī or tuvari (alum-earth) almost identical with R. R. S. Cf. Vol. i, p. 91.

* * * The essence extracted from the alums (*i.e. oil of vitriol) is to be used for operations with metals and not as medicine.


[Descriptions of various kinds of pits for calcining and roasting purposes are given; as also their dimensions with the number of cowdung-cakes to be used as fuel &c. Cf. the typical roasting pit in Vol. i, p. 127.]

* * * * *

Here ends Chapter X of Rasaprakāsasudhākara by Yasodhara, son of Padmanābha.

* In R. R. S. we have "the essence possessing the lustre of tin."
Sans. texts, pp. 65-66.

Hemakriyā or process for the fabrication of gold: “I shall now speak of some curiosities of metals, partly from my own experience and partly from the classics on the subject. Calamine, cinnabar, copper pyrites and realgar are to be rubbed with the milky juice of Euphorbia neriifolia for 7 days together and then to be digested another 3 days. Melted copper or silver or lead, being alloyed with the aforesaid mixture, acquires the power of converting 100 times its weight of base metal into gold.”* Cf. ante, p. 2.

Chemistry in Rasachintamani of Madanantadeva.

Sans. texts, p. 68.

Svetabhasma: Cf. ante p. 16 and also Vol. i, pp. 250-51.

Sans. Texts, pp. 69-70.

Two processes for the fabrication of gold:—
much the same as already quoted from Yasodhara.

Process for the fabrication of silver:—
Take 1 part of bell-metal, 2 parts of silver, 4 parts of steel (?) * * these to be fused with

* शतवधि and सहसवधि are technical terms; for the meaning of वध vide Vol. i, p. 120.
tin and borax;—by this process will be made silver which will pass current for commercial purposes.

Sans. texts, p. 71.

Extraction of zinc from calamine:—

The process is much the same as given above (p. 17), with this difference that, whereas Yasodhara hits off the completion of reduction when the flame issuing from the pot ceases to be blue, the present author directs that the pot is to be taken out of the furnace as soon as white fumes begin to appear. The crucible is then to be held in an inclined position so that the lead-like essence of calamine drops on the ground.

Chemistry in Rasakalpa (Rudrâyamala Tantra.)

Bowing to Siva, the lord of mercury, and also the feet of Chandikā, I write this Rasakalpa, the depository of mercurial lore.

CHAPTER 1.

Tests for killed mercury:—

*Killed* mercury is that which is devoid of (metallic) lustre, not so ponderous, white,* des-

* The author previously refers to the red, black, white and even yellow ash (calx) of mercury; it is not clear why he should here
troyer of metals, divested of fluidity and non-volatile when stirred over a fire. 40 Cf. tests in Rasārnava in Vol. i, p. 74; as also in Rasaratnākara, ante, p. 9.

Purified mercury should be preserved in the hollow of a tooth or gem or bamboo. 42

CHAPTER II.

Gold, silver, copper, tin, lead and iron—these are the 6 metals; vartaloha, &c., (Vol. i, p. 114) are simply alloys. 1

Honest readers! I beseech you with folded arms to favour my book with your merciful glance.

The mahārasas are 8 in number; e.g. mercury, cinnabar, sasyaka, rasaka, &c. ... ... ... the rasas are mica, green vitriol and rājāvarta, &c. ... ... ... sulphur, orpiment and realgar, &c. are the uparasas as regarded by learned teachers. Cf. Vol. i, pp. 79 and 89.

There are 4 kinds of sulphur:—white, black, yellow and red. Cf. Vol. i, p. 90.

* * * * *

restrict himself to the white variety only. Chloride or sulphide of mercury, when treated with a metal and heated, kills (i.e. parts with its chlorine or sulphur to) the latter and in that sense it is a destroyer of metals विनाशक.
The saurāshṭris (alums) are of various kinds; the kāsīsas (vitriols) are of 3 kinds,—namely, kāsīsa proper, pushpa kāsīsa and hirakāsīsa.* Cf. Vol. i, p. 91.

Gairika is stated to be of 2 varieties,—the one of golden hue, the other red; Kaṅkushṭha and other rasas are also described by certain teachers; but these, however, are not referred to here, as we are treading in the footsteps of sages of old.†

_Sans. texts, pp. 75-78._

For the purification of mercury this process is recommended by Svachchhandabhairava and Govinda.

Chūlikalavana (Sal-ammoniac), sulphur and the ash of ginger, &c., digested one hundred times with cow's urine, ... ... ... make a _vida_ for killing gold. Cf. Vol. i, p. 72.

This process for killing [metals] was revealed by Śiva and has been transmitted by successive schools of adepts.

---

* Hīrākasa is the name by which green vitriol is known throughout India; Royle supposes that this word is derived from the Persian _kura_ green, and _Sansk._ kāsīsa. (Antiq. Hindu Med.) There is no necessity for looking upon hirākasa as a hybrid term, seeing that it occurs in the present work in which Mahomedan influence is nowhere traceable.

† Evidently Charaka and Susruta, who mention only a few commonly occurring minerals. _Vide_ Vol. i, pp. 29 and 44.
Extraction of the essence of copper pyrites. Cf. Vol. i, pp. 70 and 84.

Extraction of zinc from calamine:—

The process is practically the same as given in R. R. S. Cf. Vol. i, pp. 87-88.

I have performed the [aforesaid] experiments with my own hands and have seen them with my own eyes. They are not recorded from mere hearsay or from the dictation of a teacher. These are being promulgated for the benefit of mankind.

Chemistry in Rasarajalakshmi of Vishnudeva.

_Sans. texts, pp. 79-82._

Give an account of the common rasas and uparasas. Cf. Vol. i, p. 79.

Chemistry in Rasanakshatramalika of Mathanasimha, physician to the King of Malwa.

There are several prescriptions given in which mineral preparations play a conspicuous part. We have quoted only two; in the first, among other ingredients opium occurs; in the second, the
Svachchhandabhairavarasa, probably named after the celebrated alchemist, we have the *calces* of tin, iron and mercury along with other drugs.

**Chemistry in Rasaratnakara of Nityanatha.**

*Sans. texts, pp. 84-86.*

Test for *killed* mercury:—

When the substance, being heated over a fire of paddy husks, does not further decrease in weight, it should be considered as reduced to a calx.

Purified mercury should be stored in the hollow of a tooth or horn or bamboo.

Directions for making factitious cinnabar (*Makaradhvaja*). Cf. Vol. i, p. 132 (footnote).

**Chemistry in Dhaturatnamala.**

In the beginning the author after salutation says: "I shall speak of silver, gold, copper, lead, tin and iron as also of calamine, mica, pearls, coral, orpiment, realgar, the pyrites, mercury and diamond,—in fact, the properties of all the metals and minerals and the mode of their incineration."

Chemistry in Rasapradipa.

Description for preparing mineral acids by distillation:—"Sañkhadrēvarasa or liquid for dissolving conchshells,—practically the same as given under "mineral acids" in Vol. i, p. 186. The last line says: "Cowrie-shells and metals dropped into the liquid are at once dissolved."

Preparation of calomel and treatment of "phiraṅgaroga" (syphilis) with its application. Cf. Vol. i, p. 252.

Chemistry in Dhatukriya or Dhatumanjari (Rudrayamala tantra.)

Sans. texts, pp. 98 et seq.

Tin, iron, and copper are to be classed among the superior metals.

In general a metal being alloyed with silver is improved in quality. Sattvaja metal (i. e. an alloy of tin and copper, vide below couplet 15) is of middle quality. 12-14

Synonyms of the different metals. 39-49

Synonyms of zinc: Jāsatva, Yasadāyaka, rūpyabhrātā (lil. brother to silver), charmaka, kharpara, rasaka, &c. 50-51

* Yasada is the name commonly given to the metal extracted from calamine. Vide Vol. i, p. 156.
Pittala is an alloy of copper and zinc. 63

Kāmsyaka is an alloy of tin and copper. 65

Zinc being amalgamated with mercury gives rise to rasaka. 68

[N.B.—Rasaka and kharpara are the names generally applied to the mineral calamine (vide Vol. i, p. 158), but here they stand for the metal (zinc) or its amalgam.]

Lead being killed with the aid of gentle heat gives rise to minium (red lead). 69

Copper in combination with the “burning water” gives rise to tuttha (green vitriol).—Thus manifold operations are performed with the aid of mantras and apparatus: all these belong to the province of Chemistry. 70-71

Synonyms of haritāla (orpiment): Orpiment is a consumer of mercury and also a clipper of its wings.* 79

Synonyms of realgar, cinnabar, mica, &c. 81-89

Synonyms of pearls, coral, tortoise-shell, conch-

* The sulphide of arsenic on being rubbed with mercury and gently heated converts the latter itself into the sulphide. The mercury is thereby killed and fixed, i.e. deprived of its volatility (clipped of its wings—the Hindu alchemist’s favourite figure).
shell, tusk of elephants, the tail of the peacock.

90-108

Localities for different metals. 113-121

[ The information is very commonplace.]

Localities for copper specified: Nepāl, Kāmarūpa (the eastern portion of Assam), Baṅgala,† the country of the Mlechchhas, Rūma and the country of the Phiraigas, &c. 143-145

Localities for zinc: Kāmboja, Rūma, Balkh, &c. 146

Metals in combination with mercury and sulphur become fit for administration as medicine. 153

* * * * *

Process of roasting a substance in a stout glass-vessel using goat-and-cow-dung-cakes and husks of paddy grains as fuel. 9-10

One part of gold and four parts of zinc are to be melted together and the alloy roasted in a closed crucible . . . the process repeated with the addition of alkalies . . . gold of a reddish yellow colour will thus be generated. 11-17

* All these have been placed under the category of श्रीम inferior dhatu. Though the term dhatu generally means a metal, it is often applied to a mineral; here, however, it covers a much wider field.

† This isthe name given to Bengal in many Tantras.
A process for making factitious cinnabar by pouring mercury into its own weight of molten sulphur and then adding three-fourths its weight of orpiment . . . . The mass to be rubbed in a mortar and subjected to sublimation. 23-30

By using the augmented\(^*\) gold as a means of exchange one can amass wealth. 52

Tin is to be melted and one-hundredth part its weight of mercury to be amalgamated with it. This [fraudulent substitute for] silver can be used for purposes of exchange, and one can thus amass wealth. 85-86

Pure gold is to be alloyed with one hundred times its weight of copper and this [imitation] gold will resemble native gold. 88

Lead and copper being alloyed together will give rise to gold. 97-98

Colophon: Here ends the Chapter on the extolling of gold in Rudra-yāmala.

\(^*\) Cf. footnote, p. 2.
Chemistry in Suvarnatantra or Svarnatantra.

The origin of the tantra is explained in the opening lines. Parasurāma having given away his worldly possessions to Kasyapa is rendered destitute, and thus has to invoke the aid of the God Siva for his very maintenance.

Siva said: Listen! I shall now reveal to you the most wonderful mysteries of Svarnatantra.

A kind of oil is exuded from the bulbous root of a plant; all around it within a radius of ten cubits oily water is exuded and a venomous snake lives under it. If you want to test the properties of the bulb, you should thrust a needle into it, and the needle at once dissolves. Having procured this bulb, rub it with mercury in a mortar and add the oil and subject the mixture to heat in a crucible. The mercury is at once killed and acquires the property of converting one hundred thousand times its own weight of the base metal into gold.*

Pure orpiment is to be rubbed with this oil for 20 days, and the former is killed thereby and loses its volatility. The 8 metals in the molten state being treated with this prepared orpiment acquire

* वचवेदी सवेत्.
the power of transmutation. When the above oil is thrown into molten copper, it is turned into gold of beautiful lustre. Tin and bell-metal similarly treated are turned into silver, and copper, iron, brass and silver into gold. 19-24

Saṅkhadrāvaka (*aqua regia, see ante p. 24) is spoken of as an universal solvent . . . . This solvent with mercury is to be placed in a glazed crucible and subjected to heat; the mercury, thus killed, can convert the 8 metals into gold. By partaking of this mercury one becomes immortal; even his urine and faeces can convert copper into gold.* 1-10

* This sort of belief was prevalent also at the time of the composition of Rasārṇava.
Knowledge of Gems.

A few words on gems may not be considered beyond the scope of the present work especially as the subject has already drawn the attention of some European scholars.* We shall, however, limit ourselves, as far as possible, purely to the physical and chemical properties of the precious stones.

It has already been seen that among the 64 branches of arts and sciences recognised in the ancient 'Kāmasūtra' of Vātsyāyana occur the following:—(a) the testing [of the genuineness or otherwise] of gold and the gems; (b) knowledge of the colouring of gems, as also of mines and quarries.† Varūhamihira (d. 587 A. D.) in his "Vṛhat Samhitā" also conveys much useful information on this subject, but as he in his turn refers

* Garbe in his "Indischen Mineralien" (Leipzig, 1882) gives the text and the translation of Ch. xiii of Narahari's "Rājanighan/ṇu"; this work, however, is comparatively modern. Much useful information on the subject with bibliographical references will be found in Professor Yogesa Chandra Rāy's treatise in Bengali entitled "Ratnaparīkshā."

† Vide Vol. i, p. 191.
to experts who preceded him,* it may safely be concluded that long before this time it received adequate attention.

The Garudapurāṇa under the heading of Ratnaparikśā (examination of the gems) devotes several chapters to a detailed and fairly exhaustive description of the gems. This Purāṇa like so many of its class discusses on a variety of topics, mundane and spiritual; in short, it may be looked upon as a sort of multum in parvo.

From time immemorial the gems have been valued in India not only for purely decorative and ornamental purposes, but also as agents for warding off perils and the malignant influences of the planets and for securing luck and longevity. Hence it is that particular attention is paid to the testing of gems, as their virtue increases in proportion as they are faultless and flawless.

The typical characters which were most relied upon for differentiating one species of a gem from another were (1) the relative weight, (2) hardness, (3) lustre, transparency and colour, (4) fusibility, especially when heated in combination with the alkalies. It will be noticed that even the lapidaries

* गुरुवाचार्यः समुद्रित.
and the mineralogists of the present day have to depend largely upon these properties in the classification of the *stones*. We shall now proceed to say a few words under each of the above characters following in the main the authority of *Garuda-purāṇa*.

1. **Relative weight.** We have purposely used these terms as contradistinguished from "specific gravity"; as the latter connotes peculiar associations. The principle of Archimedes being evidently unknown among the Hindus, the measurement of volume could only be roughly approximate. To cite some illustrations. A stone may be of the same species as, and equal in volume to, a padmarāga (oriental ruby), but will differ in weight from the latter.*

Empirical and arbitrary scales of weight were adopted as standards. A ruby occupying the volume of a guṇja (*abrus precatorius*) may be equal in weight to 10, 7 and 3 guṇjas respectively. A ruby of the volume of a srīgālakola (a kind of jujube) should weigh 12, 8 and 7 guṇjas respectively. Again, a ruby of the volume of an āmalaki (*phyllanthus emblica*) should weigh 30, 20

* सुल्ख्यांश्यं विसुल्ख्यांश्यं वा सुल्ख्यां भविष्य सुल्ख्यः।

Garuda.
and 16 māshās respectively.* In each case the gem which is of greater weight is superior in quality and the value thereof is enhanced in proportion.†

In the case of precious metals, however, adulteration was detected by an ingenious device, which may be regarded as a near approach to the principle of Archemedes. Suppose it is intended to test the purity of a specimen of gold. All that one has to do is to draw a wire of this gold and another of the standard gold through the self-same orifice [of corundum]. As these wires are of equal

* We give below the standard weights as current at the time of Varahamihira.

8 White mustards ... 1 tandula (a grain of paddy)
4 Tandulas ... 1 gunja (abrus precatorius)
5 Gunjas ... 1 Māshā
16 Māshās ... 1 Karsha or suvarna or tolaka
4 Karshas ... 1 pala

The standard of weight has always varied in different times in different parts of India. 10 gunjas weigh about 18 grains. The seeds often vary in size.

† Garuda lays special stress on the high specific gravity (=4·0) of a genuine ruby. लझुल विजातितिन्द्रं, अग्नि गुञ्वं मलोऽगं गुञ्ममेयः। While high specific gravity is indicative of the excellence of the gems in general, in the case of diamond it is just the reverse. गुञ्वतं सच्चरात्रागं गोर्वाधानकारणम्। वचं तन्तु वंपरीवं न मर्यं: परिच्छति। It is not easy to account for this qualifying clause, seeing that diamond has a sp. gr. of 3·5.
diameters, equal lengths will have equal weights, provided the sample is pure.*

2. Hardness. There are many stones which in external appearance resemble a ruby; the spurious substitute may easily be detected by its difference in softness (low degree of hardness), and low specific gravity: again in case of suspicion the gem is to be rubbed on a whetstone; if it simply gains in lustre but does not lose in weight (by abrasion), the specimen is to be regarded as genuine (test of a ruby). † Diamond and corundum alone will scratch ruby and sapphire. Skilful lapidaries often make imitation diamonds of zircon, ruby, cat's-eye, rock-crystal and glass; hence they are to be tested by calling in the aid of learned experts. All the gems occurring in this world as also the metals will be scratched by a diamond, but the latter will not be similarly affected by the former. .......... A diamond alone will scratch a diamond. ‡

* एकालिकं सम्बन्ध समवहं दृष्टिगतः।
भालो: नूः मानसम् निदुःस्य भविष्टं॥ Sukraniti.

† This is true in a qualified sense only. After the diamond corundum is the hardest of all known minerals.

‡ The ruby and the sapphire are only varieties of corundum. Varáha classes corundum as a species of ruby, the former being dotted over with black and white patches and feeble in lustre [i.e. the non-transparent or coarse kind]. It is scarcely necessary to
To the above tests Rājanighantu adds another, namely, when a diamond is struck with an iron hammer, it is not broken to pieces *

point out that the very word ' corundum' is derived from the Hindi kurand, a corrupt form of the Sanskrit kuruvinda. The statement "corundum will scratch ruby and sapphire" is not strictly accurate. There are degrees of hardness among the different varieties of corundum, the blue sapphire standing first in this respect.

We give here the original texts of which we have given above almost a literal translation.

"वर्षभमेंत्रि मुदंगा लघुवन विजातितिलेङ्खरु साध्वयवयम्।"

"अश्रणश्चाति सर्दंहे गिरायां परिपर्यव्यय।"

रुपय गोयधंबोभावान् परिमाणं न सुचवति।

स नैयायः रुपयातिस्य नैयायां विजातीयः।"

"वर्ष वा कुरुविष्टं वा विसुचचाँचेन केनचित्।"

न शक्यं लेखनं कष्टं अष्टरगिन्यन्नीविरोः।"

* The reading of the text is very corrupt. Garbe gives as many as 12 variants; that adopted by him seems to be on the whole reliable as also his rendering: "Wenn er mit anderen steinen oder eisernen Hammern geschlagen nicht zerspringt." On account of its brittleness a diamond will readily be shivered into splinters under the blow of a hammer. The following extract from Bauer and Spencer's "Precious stones" (pp. 129-130) may prove of interest.—

"The hardness of diamond has often been confused with its frangibility or brittleness. It has been supposed, especially in ancient and mediaeval times that hammer and anvil may be shattered but not the diamond which lies between. This statement was
3. Lustre, Transparency, Colour and other optical properties. Difference in lustre (विस्फोट) is often regarded as a diagnostic feature of the gems. According to Varāha gems of superior qualities should possess cool (lit. waxy) lustre, be limpid and emit rich rays. Classification according to colour is often enjoined. For instance, a diamond may be perfectly colourless, or it may be yellow,

made by Pliny, the great naturalist of ancient days, who was killed in 79 A.D. at the first historic eruption of Vesuvius. He proceeded to say further that the fragmentation of a diamond may be effected by subjecting it to a preliminary immersion in the warm blood of a goat, but that even under these circumstances the hammer and anvil will also be broken! According to Albertus Magnus (1205-1280) the blood is more efficacious if the goat has previously drunk wine or eaten parsley.

"Such being the views then held respecting the unbreakable and indestructible character of the diamond, it is easy to understand why the Greek word adamas, signifying unconquerable, should have been applied to this stone, although its application to the diamond is singularly inappropriate and inaccurate when its extreme frangibility is considered. Many a doubtful stone has been submitted to the test of the hammer, with the belief that the blow would be resisted only if the stone were a genuine diamond. Probably many beautiful stones have been sacrificed to this old belief. As a matter of fact, diamond is easily fractured, a very moderate blow from a hammer sufficing for the purpose; its perfect cleavage places it among the most brittle of minerals."
black, red or copper-tinted. Stones which are translucent, opaque and of dull colour are inferior in quality. In the case of diamond special stress is laid on its displaying the colours of the rainbow due to its high dispersive power. Some gems have only one shade of colour (एकचक्र), others again two (द्विचक्र).†

The changes in colour which the ruby and the sapphire undergo under the influence of heat had evidently been carefully observed. This test is to be applied with extreme caution as in case the pro-

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* रक्त प्रीति सितं शंगीयं (Varáha): अतामां (Garuda).

Yellow diamonds are unknown in India at the present day at any rate. “India can claim for its own all the finely coloured stones of blue, green and red, not however, yellow diamonds, which come mainly from South Africa.” (Bauer and Spencer). Crystals of black diamond should not be confounded with the black carbonado.

† Probably refers to dichroism. As has already been pointed out the red ruby and the blue sapphire are only varieties of corundum, which often occur in well-developed crystals belonging to the rhombohedral division of the hexagonal system. “The dichroism of the ruby affords a means whereby it may be distinguished with certainty from other red stones, such as spinel and the different varieties of garnet, which crystallise in the cubic system, and thus being singly refracting can show no dichroism.” (Bauer and Spencer). “The dichroism of the sapphires of Siam is specially well marked.” —Ibid.
per degree of temperature (चातुष्क्रोत) is exceeded, the stone may be materially injured.*

4. **Fusibility (Liquefication).** It was well-known that all the gems with the exception of diamond would undergo liquefaction when strongly heated with a mixture of the two alkaline carbonates [now familiar in the Laboratory as the "fusion mixture"]. The liquid principle of gems रत्रत्रा दृष्टि was a favourite remedy with the Hindu Iatro-Chemists (Cf. Vol. i, p 103). As most of the precious stones belong to the corundum and the spinel group, they easily yield to treatment with sodium and potassium carbonates. In the case of the pearls it is recommended that they should be enclosed inside lemons and placed in a mass of paddy grains [for the sake of the warmth].

* याद नं चाक्रान्त्य वेष्का पद्माश्रोपयोगता (?)।
इदन्नी न्यायमिष्ठान कमेत सुमद्दरस।
तथापि न परीचाय गुणाखामभिवर्तय।
मणिर्गृहाः समाधियः कष्टचित्रप्रय कष्ट।
रत्रत्रमाः (ि) परिचाने द्राहतिसैव दृष्टित।
सौन्दर्या भविस्तथः कथे नायतिताशा। Garuda.

Cf. "The red ruby, at a high temperature, is colourless: on cooling it first becomes green, after which it gradually assumes its original fine red colour." (Bauer and Spencer). "The blue colour of the sapphire disappears on heating."—Ibid.
GENERAL AND CONCLUDING REMARKS.

The crystalline character of the minerals is referred to in one or two places. All the old writers agree in describing the diamond as having 6 angles, 8 faces and 12 edges. * The octahedral form of the crystal is common in the diamond occurring in the neighbourhood of Panna in Bundel Khand. Rājanighantu further adds that the stone is often endowed with numerous faces and edges.† According to Rasaratnasamuchchaya the female diamond is flattened and rounded, whilst the neuter is rounded and obtuseangled. ‡ Vaikrānta is also

* कोणा पान्त्रानि धाराय यद्यप अदालित। Garuda.

† "In most cubes of diamond, however, each edge is replaced by two faces, ....... the twenty-four faces thus derived would, if produced or enlarged" sufficiently, give rise to the form known as the four-faced cube, or tetraakis-hexahedron. (Bauer and Spencer).

‡ The rendering of the description of diamond in R. R. S. (vide Vol. i, p. 100) is based upon a misreading. The correct reading is that adopted by the Poona edition, namely, श्रृंखालान्तरफलकं पञ्काणः "a diamond has 8 faces and 6 angles." The author evidently uses अस्त्र and फलक in the same sense; there cannot be any confusion here, as distinct mention is made of the 6 angles. As a rule अस्त्र and कोण are used synonymously. Thus in Varāha वज्र is described as वज्रति; the commentator Bhattotpala explains it वज्रधिर्निस्फलकं पञ्काणमिलयः। "Rounded" (वज्रति): Cf. Bauer and Spencer. "The faces of diamond crystals differ from those of most other crystallised minerals, in that they are, as a
(probably a mineral of the spinel group, vide Vol. i. p. 83) described as having 8 faces and 6 angles.

It is sometimes asserted that the phosphorescence of diamond was first observed in 1663 A.D. by the celebrated Robert Boyle. Bhoja, (11th century A.D.) however, mentions this property.* Faults in precious stones due to isolated grains of minute gravels etc., embedded in the mass (now technically called “enclosures”), are also referred to. †

It may be noted here that what is generally known as the Indian or Tavernier’s rule for determining the value of diamond can be traced back to a remote date. Sukraniti speaks of it as the “rule of squares,” ‡ while Varāha, himself a great

rule, much curved and rounded instead of being perfectly plane, as is usually the case.” p. 119. “Obtuse-angled” (कुत्तरकोणय) in the crystallographic terminology should be rendered as “with corners truncated off.”

* अस्सकार च दीप्यत (phosphoresces in the dark).
† कलुषा सत्ययतः लिखाकोणय: सदातव: सहर्ष:।
  दुवेंद्रा न मनीह: सशकरशनेति मविद्रोवि: ॥ Barāha.

Here सदातव: and सशकरशा: no doubt refer to the minute pebbles (gravels) enclosed in the body of the stones.

‡ यथा ग्रहतर वं तन्मय रणितभेट: i.e. if a diamond weighing 1 rati be worth x, one of the weight of 4 ratīs will be worth y × x.
mathematician, gives practically the same rule, though somewhat on an elaborate scale.*

It would be unfair to compare the progress made by the Hindus in this branch of knowledge in the 6th century A.D. and perhaps earlier with that of the present day. Reference to the crystalline forms of diamond can be found in the writings of Keppler, Steno and Robert Boyle in the seventeenth century. Scientific crystallography originated with Romé de l'Isle and the abbé Haüy at the end of the eighteenth century. The various physical and chemical properties of the minerals culled here bespeak considerable powers of keen observation.†

* सिमसङ्गपर्यायां तद्हि भवेत्चतुष्‌क्ति विषयः।
तुलित्वं देन लोकं मूलं दिडुर्गितं चैवत्॥
पाद्वंशाधरां विषयं विभागपंखां श्रोधिशं गंगाय॥
भागाय पञ्चविंशः श्रवितः साहसिकर्षित॥

i.e. if a diamond weighing 20 tandulas (p. 33 ante) be worth 2 lacs (2,00,000), one weighing 5 tandulas will be worth only \(\left(\frac{5^2 \times 4}{100}\right)\)th part of 2 lacs or 2,000.

† Concerning Ratnaparīkṣā cf. also "Les Lapidaires Indiens" by M. Finot in the "Bibliotheque de l'Ecole des Hautes Etudes."
NOTE ON THE METHOD OF PREPARING CAUSTIC ALKALI.

In the first Volume of our History the detailed description of preparing caustic alkali from the ashes of plants has been quoted at length from the Susruta and we referred to it "as a proof of the high degree of perfection in scientific pharmacy achieved by the Hindus at an early age."* M. Berthelot has no less been struck with the originality of this process; indeed, he goes so far as to suggest that this portion in the Susruta is evidently modern and in fact a later addition derived from contact with the European chemists. †

The process of rendering mild alkali caustic by the addition of lime is to be found also in Chakrapâni (c. 1050 A. D.) and Vāgbhata, who must have preceded the former by several centuries, and it is well known that both these authors are deeply indebted to the Susruta. There is not thus the remotest chance of inspiration from the European chemists.

* Vide Vol. i, Intro. c.
We have evidence from quite an unexpected and independent source that the cauterization of bad wounds by means of caustic alkali was an established custom in ancient India. Thus we read in "The Questions of king Milinda":—

"And when the inflammation had gone down, and the wound had become sweet, suppose he were then to cut into it with a lancet, and burn it with caustic. And when he had cauterized it, suppose he were to prescribe an alkaline wash. . . . Now tell me, O king! would it be out of cruelty that the surgeon . . . . thus cut with the lancet and cauterized with the stick of caustic."*

* "Sacred Books of the East," Vol. XXXV, p. 168. Although Milinda has been identified with the Bactrian Greek king Menander (c. 140—110 B.C.), it is not to be supposed that any Greek influence can be traced in it. In this ethical romance, king Milinda and the Buddhist Bhikshu Nāgasena have been put forward simply "as men of straw" to quote Rhys Davids. The work in reality conveys the teachings of the older Buddhists (Hinayānists) with the background of Sāmkhya and Vedaānta metaphysics.
The Tantrists, the Rosicrucians and the seekers after truth.

The East has not been always East and the West, West. Modern Europe is materialistic, but she has not disdained in the past to "plunge in thought." This reminds us of the truth of the poet's words: "one touch of nature makes the whole world kin." Ancient Greece had her orphic mysteries. They were developed into a religious and ethical system by Pythagoras. In the schools of Alexandria the neo-Pythagoreans and the neo-Platonists further added to it the Vedantic doctrine of a world-soul.

"With the dissolution of the neo-Platonic school in the sixth century, Greek philosophy disappears, it is true, as a distinct phenomenon from the theatre of history, but it continues to exist in combination with foreign elements in the service of a new form of culture in the Science of the Middle Ages and of modern times." (Zeller).

Says Waite:—

"The traditions of the neo-Platonic philosophy, with its elaborate theurgical system, were to some extent perpetuated through the whole period of the Middle Ages, for besides the orthodox theology of the great Latin Church and amidst the clamour of scholastic philosophy, we find the secret theosophy of the magician, the Kabbalist, and the alchemical adept borrowing, directly or indirectly, from this prolific
fountain of exalted mysticism. The traces of its influence are discoverable in Augustine, in Albertus Magnus, in St. Thomas, the angel of the schools, and in other shining lights of western Christendom, while the metaphysical principles of Johannes Scotus Erigena, even so early as the close of the ninth century, were an actual revival of this philosophy."

History repeats itself. In India the Yoga doctrines of Patañjali paved the way for the origin of Tantric mysticism and it associated itself with magic and alchemy. Some twelve centuries later, this phase in the stage of human progress found exponents in the soil of Europe. As Waite says:—

"In an age of progress, of doubt, and of great intellectual activity, it is singular to remark the almost invariable prevalence of mysticism in one or other of its manifold phases, and the close of the sixteenth century beheld spreading over the whole of Germany and passing thence into Denmark, France, England and Italy, a mighty school of mysticism in the great multitude of magicians, alchemists, &c., who directly or indirectly were followers of the renowned Paracelsus."†


† See also Kopp's "Die Alchemie in ält. u. neu. Zeit," ii, pp. 1—146, on the "Bekanntschaft mit Geheimnissen der Magie, Theosophie, Alchemie u. A."
Even the lower strata of society in England did not escape the contagion. Sir William Temple observes: "I have had several servants far gone in divinity, others in poetry, have known in the families of some friends, a keeper deep in the Rosicrucian mysteries."

There are those who sneer at the attempts of the alchemists to convert the baser metals into gold and are at the pains to insinuate that the motives of the adepts were sordid. It may be that there have been here and there men—vulgar charlatans—who have pursued the art merely from worldly considerations. The high priests of alchemy, however, have in every age and clime been honest seekers after truth. Had there been no desire implanted in the human breast to pry into the hidden and occult mysteries of nature there would have been no science. Whence come we and whither are we destined to go? What is this substance made up of, and what are its ultimate constituents, and what will its combination with this or that lead to? These are queries, the solution of which or rather the very attempts to solve which mark the birth of philosophy. Patañjali and Nāgārjuna in India and Paracelsus in Europe stand forth as the prominent representatives of
this spirit of inquiry. They have been dreamers, mystics and naturalists all combined in one. Such geniuses have always chafed at the restraints and limitations imposed on frail man and hence their fervid yearnings to peep into regions beyond the ken of our gross senses. As Emerson puts it:

"The privilege of this class is an access to the secrets and structure of nature, by some higher method than by experience. In common parlance, what one man is said to learn by experience, a man of extraordinary sagacity is said, without experience, to divine."

Plotinus heaved a sigh at the soul with its infinite possibilities being caged in a frail and corruptible body. The pursuit of alchemy by the esoteric Tántrist is easily explained. To him it was only a means to an end. "It (mercury) is alone that can make the body undecaying and immortal."† We find echoes of the same sentiment in the authoritative literature of the Rosicrucians.

Says Waite:

"Among the concourse of inquirers, and the clamour of supposed and pretended discoverers, there rose gradually into deserved prominence an advanced school of illuminati,

* "Swedenborg; or, the mystic."

† l'ide "History of Hindu Chemistry," Vol. i, Intro. lxxvii and xcvi—xcvi.
who, employing the terminology of the *turba philosophorum*, under the pretence of alchemical pursuits appear to have concealed a more exalted aim. . . . The student is directed by these writers from the pursuit of material gold to the discovery of incorruptible and purely spiritual treasures. . . Physical transmutation, the one and supreme end of the practical alchemist, sinks into complete insignificance; nevertheless, it is performed by the adept and is a landmark in his sublime progress.” l. c. p. 32.

The sage and seer of Hoenheim had his wrestlings. Should he pursue knowledge for its own sake or for what it bringeth? His evil genius holds out the bait thus:

"Know not for knowing's sake
But to become a star to men for ever;
Know for the gain it gets, the praise it brings,
The wonder it inspires, the love it breeds."*

The spiritual at last triumphs over the base in man. Paracelsus has his revelation, and he bursts forth:

"Truth is within ourselves: it takes no rise
From outward things, whate'er you may believe,
There is an inmost centre in us all
Where truth abides in fulness: and around
Wall upon wall, the gross flesh hems it in,
The perfect clear perception—which is truth."*

* Browning's "Paracelsus."
In the above delineation the poet has done no more than bare justice to the inward longings of an ideal alchemist, who is only an honest seeker after truth. The spiritual and thought-world has always transgressed all barriers of time and space. Kanada, Patañjali and Nāgārjuna of India and Heraclitus, Empedocles and Plato and the rest—they all form a holy fraternity; aye, these prophets and oracles of the intellect belong to a "lofty and sequestered class," "the high-priesthood of the pure reason, the Trismegisti, the expounders of the principles of thought from age to age. When at long intervals we turn over their abstruse pages, wonderful seems, the calm and grand air of these few, these great spiritual lords, who have walked in the world,—these of the old religion,—dwelling in a worship which makes the sanctities of Christianity look parvenues and popular; for 'persuasion is in soul, but necessity is in intellect.'"*

* Emerson: on "Intellect."
The metals and their loss in weight after calcination.

Very vague ideas prevailed among the Hindu philosophers on the constitutions of a metal and its fate after calcination. We are reminded of the diversity of opinion in Europe before the time of Lavoisier. A metal like every material substance was supposed to be formed of one or more of the five bhūtas; in fact the earthy or saline element was taken to be predominant in it,* and hence it lent itself so readily to calcination. † It should be noted here that by “bhūta” was understood not so much an element in the modern connotation of the term as certain qualities of individual substances. Even mercury was regarded as composed of the five bhūtas. ‡ When a metal was submitted to calcination some of its component bhūtas escaped, leaving the earthy or saline portion behind; hence the ash (calx) must weigh less than the original metal itself.

* पार्थिव्यां मूल्याधिकारिणीमूल्या सौधीमूल्याभिमुक्तागाशीलामूल्याभिमुक्तकपाल्यादयः। Ch. 1., 24. Again in Ch. XI.VI (Sūtra) 345 et seq. the metals are included among the saline ingredients.

† Cf. “For some maintain that gold is solid light, or, at least that the chief ingredient is light, which is rendered solid by mixture with some particles of earth. Were it mere earth it might be calcined by fire strongly urged.”—Vol. 1. p. 9.

‡ पञ्चभूताद्विक: मूल्याधिकारिणीव समासिद्धः। इति रमाण्यवे।
There is, however, no direct reference to be met with anywhere as regards the quantitative aspect of the question so clearly established by Lavoisier.

The proportion of loss which a metal undergoes on ignition was made the basis for determining its purity and we find in the law-books an arbitrary scale fixed. Thus according to Yājñavalkya "gold is unaffected by fire, while one hundred parts by weight of silver, tin and copper lose (lit. undergo decay to the extent of) two, eight and fifteen parts respectively." This is to be taken as referring not to the roasting (killing) of a metal but simply as allowance made to goldsmiths and other artisans for loss incurred in the shape of dross &c. when it is melted in a crucible.

That copper, lead, tin and other base metals (होनधात्रव:) when repeatedly calcined are completely reduced to their calces was well known as will be seen throughout the body of the texts. The passage from Rasendra-chūdāmani (p. 14) deserves some notice. Lead of the weight of 30 palas is to be calcined till its weight is reduced to a karsha (=\(\frac{1}{4}\) pala). Even if it be calcined now one thousand times, it will not undergo further reduction in weight. Our author evidently had his experience of lead derived from argentiferous galena which would leave

* अन्यहृ सुवर्षभूषण दिपलर रजते शते।
अष्टी चपुषिण सूमि च चाचे पचादशायमि॥
a residue in the shape of a 'button' of silver after the lead had been cupelled off.*

* Similar confusion prevailed in Europe up till the end of the 17th century. The following extract from Robert Boyle's "Concerning the Unsuccessfulness of Experiments" will make the point clear.

"Having, upon occasion, had the curiosity not long since to visit some mines of lead and other metals, I find that there is a great difference, and discernible even to the eye, betwixt the several ores; for instance, of lead, some of which I can show you so like steel, and so unlike common lead-ore, that the workmen upon that account are pleased to call it steel-ore, which being of more difficult fusion than ordinary, they are wont to mix it with other ore, which they call firm-ore, to facilitate the melting of it. And I likewise took notice of an ore, which for its aptness to vitrify, and serve the potters to glaze their earthen vessels, the miners call pattern-ore, and sell it (at least where I saw it digged up) dearer than other ore, from which it differs both visibly enough, and as the workmen affirm in divers other (and those less obvious) qualities; and yet all these ores, after fusion, do pass indiscriminately under the name and notion of lead. In which therefore it is no wonder, that severer inquiries find a great deal of disparity. I remember I did not long since cause some lead-ore to be tried, which being the most promising that ever I saw, made me suppose it might contain some considerable quantity of silver: but though it proved so rich in lead, as to yield after the rate of seventy pound to the hundred, yet one of the most expert artists in Europe could not extract one grain of silver out of it; whereas the lead of very many mines, being skilfully examined, will leave behind it, upon the test, a proportion of pure silver. And though this quantity of silver be not considerable enough to make such mines as yield it pass for silver mines
Antimony.

Although there is no direct recognition of antimony as a distinct metal, some sort of allusion to it as a variety of lead is not wanting. The reason why antimony was often confounded with lead is that at first sight stibnite may be mistaken for galena. The mineral sauvirāñjana or nilāñjana was thus indiscriminately applied both to the sulphides of antimony and of lead (cf. vol. 1., pp. 93-95.) That nilāñjana contained a new metal was often suspected though its nature was not properly understood. Thus in Rasendra-chudāmanī we have "nilāñjana, mined with tikshna (cast iron), and heated several times yields a superior kind of lead which is readily fusible and is of mild black colour."

(or, as we are wont to call them mines-royal) because the silver will not quit the cost of extracting it; yet such mines though they pass but for lead mines with the metalist, may appear to be mixt mines to the naturalist, who may meet with divers experiments, wherein the little silver that is in them, may make their lead operate differently from that of those ores, which are wholly destitute of silver."—Edition of 1772, p. 323.

* Vide Sans. texts, p. 52. The identical distich occurs also in R. R. S. Cf. vol. 1, p. 119. Cf also 'But to detain you no longer on this subject, give me only leave to strengthen the paradox I have proposed, by the authority of that great and candid chymist Basilius Valentinus, who speaking of antimony, after he hath told us, that there are several kinds of it, and especially two; the one more mercurial and of a golden property, witnessed by the shining streaks or beams it abounds with; the
The preparation known as Svarnasindura or makaradhvaja.

As the "law of definite proportion" was unknown to the ancients, tedious processes were resorted to for the complete conversion of mercury into its sulphide. "Makaradhvaja" even at the present day is a favourite remedy with the Hindu physicians of the Ayurvedic school.* Let us follow the recipe as given in Rasendra-chintamani: "when quicksilver is killed with an equal weight of purified sulphur, it becomes hundred times more efficacious; when it is killed with twice its weight of sulphur it cures leprosy; when it is killed with thrice its weight of sulphur it cures mental langour; when it is killed with four times its weight of sulphur it removes grey hair and wrinkles; when it is killed with five times its other more full of sulphur, but destitute of the golden nature that enriches the former; adds, that there is such a different goodness betwixt the several sorts of antimony, as there is betwixt the several sorts of flesh or fish, which, though agreeing in name and, if you please, in nature, do exceedingly differ in point of goodness, which brings into my mind the great difference which I have found, even visible to the eye, betwixt the several sorts of Antimony."—Boyle's work—l.c. p. 324.

* If we take the historical meaning of the term "A'ayurvedic," the above preparation cannot lay claim to this distinction, for it was unknown at the time of the Charaka and the Susruta and was introduced into the Materia Medica during the Tantric period.
weight of sulphur it cures consumption; and when it is killed with six times its weight of sulphur it is a panacea for all the ills that flesh is heir to. * Now 25 parts by weight of mercury can only take up (i.e. combine with) 4 parts by weight of sulphur; the excess of sulphur simply sublimes off unchanged. In the actual preparation of svarna-sindūra (Lit. vermilion with gold) the mercury is first made into an amalgam with thin gold leaves and then repeatedly rubbed in a mortar with sulphur. During the process of sublimation (अद्वात) the excess of sulphur volatilises off as we have already explained and the gold in fine particles remains behind as a residue. The lustrous, crystalline, reddish brown sublimate, which collects nearest the source of heat, † has the formula HgS. As there is an erroneous impression about the composition of this drug even among educated people in this country we give below the results

* तुल्य तु गम्भरी जीरों श्लष्टकद्रुणी रस:।
ब्रमुणी गम्भरी जीरों सल्वकुक्षर: पर:।
ब्रमुणी गम्भरी जीरों सल्वज़ादाविनाशन:।
चल्मुणी तत्र जीरों बलीपलितनागमन:।
गभे पद्रगुणी जीरों चये चयंहरिरूज:।
पद्रगुणी गम्भरी जीरों सल्वरोगहरी रस:। र. चि.

† Gopalakrishna very properly lays particular stress upon this point.

खोटबिला तु सुक्राभुमेश्वरे वालि व्यजी।
अधप्तर रमसिन्टर सल्वरेशिष्यो योजचित्। इति रमेन्द्रसारसंग्रहः।
of analysis of a sample of "mercury killed with six times its weight of sulphur along with gold."

Identification of metals by their colouration of flames.

Prominent attention should be drawn to the following extract from Rasārṇava (Vol. i. p. 68)

"Copper yields a blue flame * * * * that of the Tin is pigeon-coloured; that of the Lead is pale-tinted" * * * *

We are not aware of similar tests being applied anywhere at such an early period as a qualitative test for metals.

The age of Bhikshu Govinda the author of Rasahridaya.

There is a belief current in some parts of the Deccan that our Govinda is no other than the celebrated teacher of Saṅkarāchārya. If there be any historical foundation for the belief Govinda

* Percentage of sulphur found = 13.89; the calculated amount being 13.79; not a trace of gold could be detected.

† The following Slokas are cited from Saṅkaradigvijaya in support of the above:

तस्मीपदशिष्टवयस्माय गुहाया दारि नपुजयदुःखित स शंकरार्यः।
आचार लघुपदितेः स तन्त्र तस्मान सर्वविद्यासम स रुपस्यतीकृताः॥
should no doubt be placed in the 8th century A. D. Apart altogether from the question whether at such an early date the progress of chemical knowledge as revealed in Rasahrijdaya had been attained in India, the colophon at the end of the work would tell against such an hypothesis (Intro. hii). The author distinctly states that he wrote his book under the auspices of the king of the Kiratás and even throws out a hint that he was of the Buddhist persuasion. We have no valid reasons to believe that Saṅkara, the sturdy champion of Brahminal faith and the mighty dialectician, whose activity proved the ruin of Buddhism in India should have sat at the feet of a Guru of the opposite creed.

In the above Slokas Govindanātha Muśi is stated to be the preceptor of Saṅkara, the former being himself the pupil of Goudapāda, who in his turn was a pupil of Sūkadeva, son of Vyāsa, the well-known compiler of the Vedas. The Govinda nātha of the text has been confounded by the commentator, Dhanapati Sūri, with the Buddhist Govinda. It is scarcely necessary to take serious notice of the chronological perspective of the author of the Saṅkaradigvijaya.
I propose in this paper to give a synoptic view of the mechanical, physical and chemical theories of the ancient Hindus. A chronological survey, even if the materials for it were available, would be here of little account. The origins of Hindu natural philosophy in the speculations of the Brāhmaṇas and the Upanishads, or in the mythology of the Purāṇas, however interesting from the standpoint of *cultur-geschichte,* do not come within the scope of the present exposition, which relates to the results of systematic thought as directed to the phenomena and processes of Nature. I have therefore confined myself to an account of natural philosophy as expounded in the principal systems of Hindu thought. The Śāṅkhya-Pātañjala system accounts for the Universe on principles of cosmic evolution. The Vaiṣeshika-Nyāya lays down the methodology of science, and elaborates the concepts of mechanics, physics and chemistry. The Vedānta, the Pūrva-Mīmāṁsā, and in a less degree, the Baudhā, the Jaina and the Chārvāka systems, make incidental contributions on points of special interest, but their main value in this regard is critical and negative. The principal authorities followed in this account,—the Vyāsa Bhāṣya on
Patañjali's sútras, the Samhitá of Charaka the Bháshya of Prasastapáda, the Vártika of Udyotakara, and the Vrihat Samhitá of Varáhamihira,—all centre round the Hindu Renaissance, the beginnings of the anti-Buddhist reaction, in the fourth, fifth and sixth centuries of the Christian era. Whenever I have made use of later authors, e.g. Kumárila, Saíkara, Srídhara, Váchaspati, Udayana, Bháskara, Jayanta, Varavara, Raghunátha, Vijñánabhikshu &c., I have taken care to see (except where the opposite is expressly mentioned) that no idea is surreptitiously introduced which is not explicitly contained in the earlier authors.

The Sáûkhyá-Pátañjala System.—This system possesses a unique interest in the history of thought as embodying the earliest clear and comprehensive account of the process of cosmic evolution, viewed not as a mere metaphysical speculation but as a scientific principle based on the conservation, the transformation, and the dissipation of Energy.

**Prakriti—the ultimate ground**:—The manifested world is traced in the Sáûkhyá to an unmanifested ground, Prakriti, which is conceived as formless and undifferentiated, limitless and ubiquitous, indestructible and undecaying, ungrounded and uncontrolled, without beginning and without end. But the unity of Prakriti is
a mere abstraction; it is in reality an undifferentiated manifold, an indeterminate infinite continuum of infinitesimal Reals. These Reals, termed Gunas, may by another abstraction be classed under three heads, (1) Sattva, the Essence which manifests itself in a phenomenon, and which is characterised by this tendency to manifestation, the Essence, in other words, which serves as the medium for the reflection of Intelligence, (2) Rajas, Energy, that which is efficient in a phenomenon, and is characterised by a tendency to do work, or overcome resistance, and (3) Tamas, mass or inertia, which counteracts the tendency of Rajas to do work, and of Sattva to conscious manifestation.

The ultimate factors of the Universe, then, are (1) Essence, or intelligence-stuff, (2) Energy, and (3) Matter, characterised by mass or inertia.

These Gunas are conceived to be Reals, substantive entities,—not however as self-subsistent or independent entities (प्रधान ), but as interdependent moments in every Real or substantive Existence.

Even Energy is substantive in this sense. The infinitesimals of Energy do not possess inertia or gravity, and are not therefore material, but they possess quantum and extensity (परिमाण—परिमित्तद्रव ).

The very nature of Energy is to do work, to overcome resistance (रजत्रचलन सुपर्रभक ), to produce motion. All Energy is therefore ultimately kinetic. Even potential Energy (अनुभूतिभासित ) is only the Energy of motion in imperceptible forms.
The original constituents and their interaction. Every phenomenon, it has been explained, consists of a three-fold arché, intelligible Essence, Energy, and Mass. In intimate union these enter into things as essential constitutive factors. The essence of a thing (sattva) is that by which it manifests itself to intelligence, and nothing exists without such manifestation in the Universe of Consciousness (स्वरुप्तिः). But the Essence is only one of three moments. It does not possess mass or gravity, it neither offers resistance, nor does work. Next there is the element of Tamas, mass, inertia, matter-stuff, which offers resistance to motion as well as to conscious reflection. (तमः गुणः कर्मकामः).

But the intelligence-stuff and the matter-stuff cannot do any work, and are devoid of productive activity in themselves. All work comes from Rajas, the principle of Energy, which overcomes the resistance of matter, and supplies even Intelligence with the Energy which it requires for its own work of conscious regulation and adaptation. (चहान्याथमृ चहादायाम्यं सकायोपजगन्ति रजस्यहादारः सहकारी भवति \ लोकायते तत्तथाय-अदिताय करण।)

The Guṇas are always uniting, separating, uniting again. (यथायमावतान्यं सदान, नेत्रासादिश्चर्यायोव्रोणी विद्याय व उपलभ्ये।) Everything in the world results from their peculiar arrangement and combination. Varying quantities of Essence, Energy and Mass, in varied groupings, act on one another, and
through their mutual interaction and interdependence evolve from the indefinite or qualitatively indeterminate to the definite or qualitatively determinate. (एने गुणः परस्परपरकारणविभागः संयोजनविभागधारणः उतरितरीयश्रेणि उपार्जितमूलः—व्यासाभाय्) But though co-operating to produce the world of effects, these divers moments with divers tendencies never coalesce. In the phenomenal product whatever Energy there is is due to the element of Rajas, and Rajas alone; all matter, resistance, stability is due to Tamas, and all conscious manifestation to Sattva. (परस्पराश्रास्मिकेकल्प प्रश्रुतिश्राष्ट्राश्राष्ट्रविभागः—व्यासाभाय्। अन्योन्याश्रास्मिकावलिङ्ग उपार्जितविपण्यः प्रकाशणः सत्त्ववेश क्रियागुणः रजस्वेश विषितगुणंसमसमेव—विज्ञानाशिस्तं वंशात्तार्थिक on व्यासाभाय, ibid—नैन्यः श्राष्ट्रः संयोजनाशि—वाचस्पतिसिद्धः तत्त्वपशाद्वद्वी on व्यासभाय ibid).

The nature of the interaction is peculiar. In order that there may be evolution with transformation of Energy, there must be a disturbance of equilibrium, a preponderance of either Energy or Mass-resistance, or Essence over the other moments. The particular Guna which happens to be predominant in any phenomenon, becomes manifest in that phenomenon, and the others become latent, though their presence is inferred by their effect. For example, in any material system at rest, the Mass is patent, the Energy latent, and the conscious manifestation sub-latent. In a moving body, the Rajas, Energy, is predominant (kinetic), while the Mass or rather the Resistance
it offers is overcome. In the volitional consciousness accompanied with movement, the transformation of Energy (or work done by Rajas) goes hand in hand with the predominance of the conscious manifestation, while the matter-stuff or Mass, though latent, is to be inferred from the resistance overcome. (प्रधानवेविषयं उपस्थितिस्त्रधाना गृहेष्यपि च आपारमार्गेण प्रधानान्तरतानुसिधितचिता:—स्वास्त्यं).

The starting point. The starting point in the cosmic history is a condition of equilibrium or equipoise consisting in a uniform diffusion of the Reals. The tendencies to conscious manifestation as well the powers of doing work are exactly counterbalanced by the resistances of the inertia or Mass. The process of cosmic evolution (परिषाम) is under arrest. (स्तवरजस्यसं मायावस्या प्रकारं:—Pravachana-Sūtra. 61, Chap. I. मायावस्या अनया नितिनिरतावस्या अनुभूतिविविधात्मान: असंहतावस्या अकायावस्या इति निक्षेप:—विश्वानि,iíbd. )

Beginning of Evolution. The transcendental (non-mechanical) influence of the Purusha (the Absolute) puts an end to this arrest, and initiates the process of creation. Evolution begins with the disturbance of the original equilibrium. How this is mechanically brought about is not very clear. A modern expounder of the Sāṅkhya supposes that the particles of Sattva, Rajas, and Tamas possess a natural affinity for other particles of their own class, and that when the transcendental influence of the Purusha ends the state of arrest, the
affinity comes into play, breaks up the uniform diffusion, and leads to unequal aggregation, and therefore, to the relative preponderance of one or more of the three Guṇas over the others. Thus commences formative combination among the Reals, and consequent productive activity. (संहनम्म आरण्यकसंहौम्: नृगाधिकर्माविनि अध्योप मन्योगविश्विः। Chap. I Sutra 66, प्रवचनम्भं—विवर्णविभु। प्रविष्टिविपल्लितं वल्यक्षिकोग्नां एकजातिैव एकता। खजातीयैप्रपाधार्धिं ब्रह्मदासादिकं च बुकां। ibid. Sutra 128, Chap. I.)

Formation of wholes or systems—collocation of Reals:—Creative transformation accompanied with evolution of motion (परिष्क्रम) and work done by Energy (क्षेत्र) cannot take place without a peculiar collocation of the Reals (Guṇas.) To form wholes or systems (मुद्रत्व), it is essential that one Guṇa should for the moment be preponderant, and the others co-operant. And this cannot be without an unequal aggregation which overthrows the original equilibrium (गुणवैषयक, नृगाधिकर्मव),—in other words, without unequal forces or stresses coming into play in different parts of the system. (गुणविसंह—वाचस्पति।) अथ मक्खियं परिस्वरतं...मुद्रत्व: समनाय। स च गुणां गुणप्रधानभवन्तरं न सत्यायत। न गुणप्रधानभवो वैषयं विना। न च वैषय-मुपप्रधानमेंद्रभवता। वाचस्पति। कौमुदी on कृिकां 16.)

The Formula of Evolution—Differentiation in Integration.—Evolution (परिष्क्रम) in its formal aspect is defined as differentiation in the integrated (संह-
In other words, the process of Evolution consists in the development of the differentiated (विभेदः) within the undifferentiated (सामयिकः), of the determinate (विशिष्टः) within the indeterminate (अविशिष्टः), of the coherent (यृत्मिः) within the incoherent (अयृत्मिः). The evolutionary series is subject to a definite law which it cannot overstep (परिप्रेक्ष्यनमिः). The order of succession is not from the whole to parts, nor from parts to the whole,—but ever from a relatively less differentiated, less determinate, less coherent whole to a relatively more differentiated, more determinate, more coherent whole. That the process of differentiation evolves out of homogeneity separate or unrelated parts, which are then integrated into a whole, and that this whole again breaks up by fresh differentiation into isolated factors for a subsequent redintegration, and so on ad infinitum, is a fundamental misconception of the course of material Evolution. That the antithesis stands over against the thesis, and that the synthesis supervenes and imposes unity ab extra on these two independent and mutually hostile moments is the same radical misconception as regards the dialectical form of cosmic development. On the Sāṅkhya view, increasing differentiation proceeds pari passu with increasing integration within the evolving whole, so that by this two-fold process what was an incoherent indeterminate homogeneous whole
evolves into a coherent determinate heterogeneous whole.

The different stadia in the order of cosmic Evolution are characterised as follows:

(1) The inconceivable, the unknowable, the formless, of which no character can be predicated (अबिन्य), including Prakṛtī, or the Reals in a state of equilibrium.

(2) The knowable, the empirical universe, cosmic matter of Experience, things as matter or stuff of consciousness (विज्ञ),—comprising Mahat, the intelligible Essence of the cosmos, evolved by differentiation and integration within the formless, characterless, inconceivable Prakṛtī.

(3) Individuated but still indeterminate stuff bifurcating into two series—Subject-experience and Object-experience,—comprising on the one hand the indeterminate unity of apperception or the empirical Ego, as the co-ordinating principle of the Subject-series (अभिमान), and on the other hand, the indeterminate material potencies, the subtile vehicles of potential Energy (तब्रात्र, नृचम्वृत), the ultimate subtile constituents of the Object-series (the material world). The previous stadium, the cosmic matter of Experience (विज्ञ, महत) evolves within itself.
by differentiation and integration, an individuated but still indeterminate stuff in two co-ordinated series, Subject and Object.

(4) Determinate stuff (विदित) evolved within the indeterminate by further differentiation and integration, viz., in the series of Subject-experience, sensory and motor stuff; and in the Object series, a corresponding atomic matter-stuff actualising the material potencies in the form of specific sensible Energies. The latter includes the different classes of Paramāṇus, the different kinds of atomic constituents of different kinds of gross matter (स्नियत).

(5) Coherent and integrated matter-stuff, individual substances, characterised by generic and specific properties, which however are not rigidly fixed, but fluent being subject to a three-fold change and constantly evolving, (सन्यातिविद्यवेवदनुगत: समूहः दश्यमिति पनस्वलि:—वास्मभाष. Sutra 44, Chap. III. सामाजिकीविविधसमुदायी द्रव्यः—वास्मभाष, ibid. सामाजिकीविविधाया चन्द्री ध्रष्ट्री, ibid. धर्माणं धर्मचन्द्रगायस्यापरिणामः).

(6) And so the cosmic series moves on in ascending stages of unstable equilibrium (विस्तुढण्डपरिणाम) until the reverse course of equilibration and dissipation of Energy
which even now constantly accompanies the evolution and transformation of Energy, completes the disintegration of the universe into its original unmanifested ground, the unknowable Prakriti.

The order of Cosmic Evolution according to the यमकाथ (Sutra 19, Pada II) is shown below, in a tabular form:

<table>
<thead>
<tr>
<th>Prakriti, the unmanifested unknowable ground</th>
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<tr>
<td>Cosmic matter of experience</td>
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<table>
<thead>
<tr>
<th>Subject series (अविशिष्ट)</th>
<th>Object series (अविशिष्ट)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Individuated indeterminate mind-stuff (unity of apperception, empirical Ego, (अस्मिता))</td>
<td>Individuated but indeterminate matter-stuff (subtile material potencies, (लम्बव)</td>
</tr>
<tr>
<td>Determinate mind-stuff (विशिष्ट) sensory and motor psychoses, etc. (आनेन्द्रिय, कष्टैन्द्रिय और सन:))</td>
<td>Determinate matter-stuff (विशिष्ट) atomic and molecular constituents of gross matter (परमाणु—स्फूलभूत)</td>
</tr>
</tbody>
</table>
Coherent and integrated matter-stuff (चर्तमण्डयन्: समूहः सहात: द्रष्यः)

Individual substances, with generic and specific characters subject to constant change or evolution e.g. inorganic objects composed of atoms or molecules (प्रमणः), vegetable organisms (हतः), animal organisms (शरीरः)

N.B.—The usual order given in the Sāṅkhya compendiums is as follows:—Prakr티, Mahat, Ahaṅkāra,—and then the bifurcation, viz. 11 organs sensory, motor and common sensori-motor from Rājasic Ahaṅkāra, and Tamātras from Tāmasic Ahaṅkāra,—and finally the Paramāṇus of the Sthūla-Bhūtas.

The conservation of Energy (and of Mass)—the transformation of Energy:—

The Guṇas (Rcals), though assuming an infinite diversity of forms and powers, can neither be created
nor destroyed. The totality of the Mass (Tamas), as well as of Energy (Rajas) remains constant, if we take account both of the manifested and the unmanifested, the actual and the potential. But the individual products of the evolutionary process, the concrete phenomenal modes resulting from the combined action of the original Mass, Energy and Essence, are subject to addition and subtraction, growth and decay, which are only due to changes of collocation, and consequent changes of state from the potential to the actual, (in other words, from the future to the present and from the present to the past, in a time-series)—changes, which are illusorily ascribed to the Reals themselves. The different collocations of Mass and Energy give birth to the diverse powers of things, the various forms of Energy which may be classed as like and unlike; indeed the course of Evolution from the Reals conforms to a fixed law, not only as regards the order of succession, but also as regards the appearance (and mutual relations) of like and unlike Energies. And this transformation is constantly going on,—the course of Evolution is not arrested for a moment.

गुणान् सत्बिवधशास्वप्तितिः न प्रथममावनं नौपायम् अक्तिभिर्र
अतीतातिलात्यथयांत्रिवतीमि: गुणान्तिविन्यामि: उपोजनाव्यायामेव
d प्रथमाश्मां ( अयापाय, Sutra 19, Pada II.) परिवालनिवाका
गुणानां। सत्बिवधशाश्वप्तितिः (ibid. Sutra 13, Pada IV.) एवं गुणः: तुल्यातीतीयतृतुल्यातीतीयशक्तिभिद्वाचार्यात
(िबिः Sutra 19, Pada II.) परिवालनिवाका ( अयापाय,
Sutra 19, Pada II.) कसाबालं परिणामाकारं देतुः (Patanjali Sutra 15, Pada III.) प्रक्षिपः परिणामस्तोत्रा चक्रमयपरिवर्त्य नाबलिगः।

The doctrine of Causation, a corollary from the conservation and transformation of Energy:—the principle of collocation—the storing-up and the liberation of Energy:—

The Sāṅkhya view of causation follows at once as a corollary from this doctrine of the conservation and transformation of Energy. As the total Energy remains the same, while the world is constantly evolving, cause and effect are only more or less evolved forms of the same ultimate Energy. The sum of effects exists in the sum of causes in a potential (or un-evolved) form. The grouping or collocation alone changes, and this brings on the manifestation of the latent powers of the Guṇas but without creation of anything new. What is called the (material) cause or sum of material causes is only the power which is efficient in the production, or rather the vehicle of the power. This power is the unmanifested (or potential) form of the Energy set free (उद्वृत्तकक्षी) in the effect. But the concomitant conditions are necessary to call forth the so-called material cause into activity. When the favourable combination or co-operation of concomitants is wanting, there is no manifestation of the effect. The question is—what is the aid which the concomitant conditions render to the deter-
mination (and production) of the effect existing in potency in its material cause? First there is the merely mechanical view as illustrated by some commonplace examples, e.g., the manifestation of the figure of the statue in the marble block by the causal efficiency of the sculptor’s art, or of the oil in the linseed by pressing, or of the grain of rice out of the paddy by the process of husking. In these cases the manifestation of an effect is only its passage from potentiality to actuality, a stadium in the process of evolution from possible (future) existence to actual (present) existence; and the concomitant condition (सचकारणिक) or efficient cause (तिलिकारण), the sculptor’s chiselling, the pressing, the husking, is a sort of mechanical or instrumental help to this passage or transition. कायिभिन्मित्तमेव उपादान-कारणस्य | सा गुणक: कार्यम् अभावान एव | स एव विशेषः (उदाहरण: प्राक्कारणे विशेषे:) अभावास्: कार्यम् अभावान एव। इत्ययुग्ने। (विज्ञानभिच्छ-प्रवचनभाषा, Sutra 115, Chap. I.) अभिभिन्मित्त: वर्णसंज्ञावस्य | कारणस्यांपैदाय तत्त्वमात्रलक्षणपैरणांसैव जन्मति। यथा शिलामुख्यप्रतिसाय: वैद्यव्यपारिण अभिभिन्मित्त: तिलिकारणाः निर्माणाय व निर्माणोऽन्तः धान्यश्चतुष्टयम् च अत्यावत्ततेऽ। (विज्ञानभिच्छ-प्रवचनभाषा, Sutra 129, Chap. 1.)

These mechanical examples of the Kapila-Sāṅkhya have the merit of simplicity, but the Patañjali-Sāṅkhya brushes them aside, and explains causation on the basis of the conservation and transformation of Energy, advancing it as the liberation of potential Energy existing
stored up in a Guna collocation, (the sum of material causes) the liberation following on the action of the proximate efficient cause, or concomitant condition (निमित्तकारण).

The causal operation of concomitant conditions (efficient causes) lies only in this that they supply a physical stimulus which liberates the potential Energy stored-up in a given collocation. Everything in the phenomenal world is but a special collocation of the ultimate Reals (Energy, Mass and Essence). The sum of (material) causes potentially contains the Energy manifested in the sum of effects; and in the passage from potency to actualisation, the effectuating condition (the concomitant cause,) when it is itself accomplished, is only a step in the evolutionary series, which adds a specific stimulus, and renders determinate that which was previously indeterminate. When the effectuating condition is added to the sum of material conditions, in a given collocation, all that happens is that a stimulus is imparted, which removes the arrest, disturbs the relatively stable equilibrium, and brings on a liberation of Energy (उद्विक्तविशिष्टक) together with a fresh collocation (गुणसंविशिष्टिक). सबैमिर्द गुणान्तः सविशिष्टिक्षिप्साचः इति प्रसाधेतो गुणाविशिष्टः (वामभाध्य, Sutra 13, Pada IV.) सत्य फलस्य निमित्त वच्चमानोकारणे समथनं अपूर्वार्थज्ञन। सिंह निमित्त नैरैतिकः विश्वासुवहनं कुदर्तं नापूर्वाप्राप्तयतं। (वामभाध्य, Sutra 12, Pada IV.)
Describing the production of bodies ('organic vehicles') for individual souls, out of matter of Prakṛiti, under the influence of their merit and demerit, as concomitant conditions, Patañjali points out that non-material concomitants like merit and demerit do not supply any moving force or Energy to the sum of material conditions, but only remove the arrest (the state of relatively stable equilibrium) in a given collocation, even as the owner of a field removes the barrier in flooding his field from a reservoir of water. This description is intended to represent the super-physical influence of non-material concomitants (or causes) like volition, merit and demerit, etc., but the causal operation of a material concomitant condition is essentially the same;—there is the same reservoir of stored-up Energy in a given collocation,—the same condition of arrest or relatively stable equilibrium,—the same liberation of the stored-up potential Energy which flows along the line of least resistance;—the only difference being that in the case of material concomitants the stimulus which removes the arrest is physical, instead of being transcendental as in the case of non-material causes like will, merit and demerit, etc.

The Vyāsa-bhāshya helps us to a clear mental representation of the details of this process, being perhaps the finest example before Newton of the exercise of a Scientific Imagination, and as memori-
able as any in the whole history of thought containing as it does the theory of potentials as in a nutshell:—As the owner of many fields can irrigate, from a field which is already flooded, others of the same or a lower level, without forcing the waters thereto with his hands, and merely by making an opening in the barrier or dyke, on which the waters rush in by their own force;—or further, as the same person cannot force these waters, or the earthy matters held in solution therein, into the roots of the rice plants, but only removes the obstructive grasses and weeds, on which the fluids of their own power enter the roots;—such is the action of an effectuating condition (निमित्त) added to a sum of material causes or conditions.

(Patanjali Sutra 3, Pada IV.) न हि धर्मोदि निर्माति यथा चेतिकः केदारात चकां पूर्णात केदारं पिन्दावियिश्: समं निर्मात्वा निःस्वतं वा नापः पाणिनाय-कृष्टि च्यावरणं तु चासं भिन्नच्छ लक्षिणम् सिन्धु समन्वयापः केदागानरम्भु पिन्दावियिश्।

Chain of Causation—fixed order.—The order of Evolution with the transformation of the Energies follows a definite law. The unalterable chain of causes and effects in the phenomenal world illustrates this fixed order. But though the cosmic order is one and fixed, it comprehends divers series arising from different combinations of the original Gunas, which constitute subordinate or particular laws of cause and effect. (क्रमान्वल विपर्यायमालि चेति, Patanjali Sutra 15, Pada III.)
What we call the qualities of things are only modes of Energy acting in those collocations. (हृदयान् क्षत्रियान् स्थिरता वर्णमाणी—स च भावसमस्ताः संविशिष्टतमानः। (आदि, Sutra 14, Pada III.) तत्त्वात्मा स्वरूपमाणी वर्णमाणात् याज्ञवल्क्यः। (आदि, Pada III.) And these various Energies are sometimes actual (kinetic), sometimes potential, rising to actuality, and sometimes sublatent, subsiding from actuality into sublatency. In fact, the original Energy is one and ubiquitous, and everything therefore exists in everything else, potentialiter (क्षेत्रं संविशिष्टायमिति), without prejudice to the generic and specific differences of things (हृदयान् सूक्ष्मं संविशिष्टैः.) Inorganic matter, vegetable organisms, and animal organisms are essentially and ultimately one (जलमूद्रौः परिशिष्टिः सतान्तिविज्ञात्यं स्मरनेतृ इत्थ तथा स्मरनेतृ जंक्मेतृ जंक्माणं ज्ञात्रेतृ) so far as Mass and Energy are concerned, but the varied forms of Energy and the generic and specific qualities (or properties) of things, which are but modes of Energy, follow a definite unalterable law in the order of their appearance and succession, under conditions of space, time, mode and causality, and hence all effects do not manifest themselves at once (इदम् भक्तिर्मनो न खलु समानकल्पस आदिनासभियति। (ibid. Sutra 14, Pada III.) तत्त्वात्मानां सन्तीतं सतानं तथा सथानं सतानं। प्रन्तः प्रवज्जितं घट उपायवति इति धार्मिकार्णुकः। (वाणिज्यार्थिणानमः। घनस्थ सन्तीतं सन्तीतं वर्णमाणानां भावकः तथा प्रस्तुतं वर्णमाणानां भावकः। (आदि, Pada III.)
Time, Space, and the Causal Series:

A Tanmātra (infra-atomic particle of subtile matter) is conceived by our understanding to stand in three relations—(1) position in Space (देशाविचित्र), (2) position in the Time-series (कालाविचित्र) and (3) position in the causal series (निमित्ताविचित्र).

These three relations are the work of the intuitive stage of knowledge as opposed to the conceptual (निर्देशिकाविद्या as opposed to मार्गविद्या.) But this is not the pure relationless intuition of Reality (निर्देशिच्छाय निर्देशिकाविद्या) which may be termed intellectual intuition, but the intuition that imposes its forms on the Real substrate (सविचारा निर्देशिकाविद्या) or in other words empirical intuition. तत्र भूतमाण्यदेशाविचित्र तत्तद्वालीमितितनुमोक्षिता-विचित्रव्यूह ता समापति नाभिचारा इत्यचतित। ततापि एकधिनिःसमव विदिताविचित्र भूतमाण्यनिर्देशिकाविद्याव्यूहतित। (व्यासभाषा, Sutra. 44, Pada I.)

Infinite Time is a non-entity objectively considered, being only a construction of the Understanding (द्विनिर्देशिकाय) based on the relation of antecedence and sequence in which the members of the phenomenal series are intuited to stand to one another. These phenomenal changes as intuited by us in the empirical consciousness fall into a series, which the Understanding conceives, as order in Time. The Time-series, then, is a schema of the Understanding for
representing the course of Evolution. The \textit{schema} of the Understanding supervenes on the phenomenal world as order in time, and hence in the empirical consciousness the Time-series appears to have an objective reality, and to form a continuum. As there is an ultimate and irreducible unit of extensive quantity (परिप्रेक्ष्यृति) in the Gunas or infinitesimal Reals of Prakriti, which are without constituent parts, so the moment may be conceived as the ultimate and irreducible unit of this time-continuum as represented in the empirical consciousness. A moment therefore cannot be thought of as containing any parts standing in the relation of antecedence and sequence. If change is represented by the Time-series, a moment as the unit of time may be supposed to represent the unit of change. Now all physical change may be reduced to the motion of atoms in Space, and we may therefore define the moment as representing the ultimate unit of such change—\textit{viz.}, the (instantaneous) transit of an atom (or rather a Tanmátra) from one point in Space to the next succeeding point. Even an atom has constituent parts (the Tanmátras), and hence an atom must take more than one moment to change its position. The motion of that which is absolutely simple and without parts from one point in Space to the next must be instantaneous, and conceived as the absolute unit of change.
If this is held to be an irreducible absolute unit, it will follow that what we represent as the time-continuum is really discrete. Time is of one dimension. Two moments cannot co-exist. Neither does any series of moments exist in reality. Order in Time is nothing but the relation of antecedence and sequence, between the moment that is, and the moment that went just before. But only one moment, the present, exists. The future and the past have no meaning apart from potential and sublatent phenomena. One kind of transformation, to which a thing is subject, is that it changes from the potential to the actual, and from the actual to the sublatent. This may be called the change of mark (अवस्थापरिणाम) as opposed to change of quality (अवस्थापरिणाम), and the change due to duration or lapse of time (अवस्थापरिणाम). The present is the mark of actuality,—the future, the mark of potentiality,—and the past, of sublatency,—in a phenomenon. Only one single moment is actual, and the whole Universe evolves in that one single moment. The rest is but potential or sublatent.
Vijnāna-bhikshu points out that this does not amount to a denial of Time. It means that time has no real (or objective) existence apart from the ‘moment’. But the latter is real, being identical with the unit of change in phenomena (गुणपरिषासंय चरित्र-वचनात्). But even this is real only for our empirical (relative) consciousness (अज्ञितदर्शन), which intuities the relation of antecedence and sequence into the evolving Reals (Guzas), in the stage of ‘empirical intuition’ (सबिचारा निश्चिकप्रणा). The ‘intellectual intuition’ (निश्चिचारा निश्चिकप्रणा) on the other hand, apprehends the Reals as they are, without the empirical imported relations of Space, Time and Causality.

Space as extension and Space as position:

Space must be distinguished as Desa (locus, or rather extension) and Dik (relative position). Space (Dik), as the totality of position, or as an order of co-existent points, is wholly relative to the Understanding, like order in time, being constructed on the basis of relations of position intuited by our empirical (or relative) consciousness. But, there is this difference between Space-order and Time-order:—there is no unit of Space, as position (Dik),
though we may conceive a unit of Time, *viz., the moment* (चं) regarded as the unit of change in the phenomenal or causal series (परमार्थिकता or गुण्यपरिणामस्थ चंचलत्वनात्—योगवाचरिक, Sutra 51, Pada III.) Spatial position, (Dik results only from the different relations in which the all-pervasive आकाश stands to the various finite (or bounded) objects On the other hand, Space as extension or locus of a finite body, Desa, (देशः विवाताः.), has an ultimate unit, being analysable into the infinitesimal extensive quantity inherent in the Reals (Gunas) of Prakṛti. (गुणप्रकीकरणपरिसरः—योगवाचरिक। एतति निन्द्य्यदिगमिष्रित्य ऋणसामाजीवी आकाशात् सामाज्ञयो दिक्षयबङ्गाराभावत्। पुष्टिदिगमिष्रित्य दिक्षयविभिन्न सच्चारायं। सामाज्ञयो कालनिगमिष्रित्य सच्चारस्तैव चाकाशार्थूर् तदुपापत्तिः। कालनिगमिष्रित्य विशेषः यतः कालः चतुर्दशह इत्यति, तिर्क तु सम्पर्के वन्यति।)

The Causal series.—The relation of Cause and Effect has been already explained. It only remains to add that the category of causality is mediated through the *schema* of order in Time. The Empirical Intuition first superimposes relations of antecedence and sequence on changing phenomena (the evolving Gunas or Reals), and the Understanding out of these relations creates order in Time. The Empirical Intuition then intuities the phenomenal series of transformations of Energy in this Time-order and in so doing, imports the relation of cause and effect into the course of Nature. (कार्यकारणमािवादीनां चंचलस्थितिबालः—योगवाचरिक। Sutra 51, Pada III.)
The dissipation of Energy (and of Mass)—their dissolution into the formless Prakrti—Cosmic Evolution (परिशास्म) is a two-fold process, creative as well as destructive, dissimilative as well as assimilative, katabolic as well as anabolic (अनुवृद्धिसारस्य and विनोमसारस्य, विस्टस्यपरिशास्म and महापरिशास्म.) In one aspect, there is the aggregation (unequal aggregation) of Mass and Energy, with consequent transformation of Energy, resulting in the creation of inorganic as well as organic matter, and the genesis of worlds. The successive steps of this process may be described as (1) unequal aggregation with storing-up of Energy in a certain collocation, under a state of arrest (i.e. in a state of relatively stable equilibrium), (2) a stimulus removing the arrest, and disturbing the equilibrium, and (3) liberation of the Energy, moving on to a fresh collocation, fresh aggregation, arrest and equilibrium. The process of the world thus moves on from equilibrium to equilibrium, and the result of that process is the development of a coherent determinate heterogeneous whole (जिंक्त अविशिष्ट विशिष्ट, अनुवृद्धावतवस्यसूह, वृत्तस्यवाववस्यसूह) in what is essentially an incoherent indeterminate homogeneous whole (अविशिष्ट.)

But there is a second aspect of this evolutionary process. Unequal aggregations are unstable, there is a constant tendency in things to go back to the original stable equilibrium,
the state of uniform equal diffusion of Reals. This process is called the resolution of like to like (सङ्गपरिशाम), consisting in assimilation and dissipation, and being the exact opposite of the process of "differentiation in the integrated" which has evolved the Cosmos. The collocations of Mass, Energy, and Essence are always breaking up, and the Energy as well as the Mass, however slowly, however imperceptibly, are being dissipated i.e. dissolved into the original formless Prakṛiti a state of permanent equilibrium and arrest, from which there is and can be no return, except under the transcendental influence of the Absolute at the commencement of a new creative cycle. Not that there is a destruction of the Mass or Energy, but a dissipation or dissolution into a condition of equal uniform diffusion from which there is no return. This is not the phenomenon of kinetic Energy disappearing and becoming potential or sublatent, for in such cases there is restitution or reconversion by natural means. When this reverse current of assimilation (and dissipation) prevails over the current of dissimilation (and integration), the Universe will disintegrate more and more, until it disappears in the formless Prakṛiti, its unknowable source and ground. (तत्त्ववध and कौमुक्ति).

The Evolution of matter (ताम्यात्मिक सृष्टि) :-

The ultimate constitution of Matter is a question of the profoundest interest in the Śāṅkhya-Pātañ-
jala system. Three stages clearly stand out in the genesis of Matter:—(1) the original infinitesimal units of Mass or inertia, absolutely homogeneous and ubiquitous, on which Energy does work, when the original equilibrium comes to an end (भूतादि—तामसाइडार), (2) The infra-atomic unit potentials, charged with different kinds of Energy, which result from the action of Energy on the original units of Mass, (तन्मात्र), and (3) the five different classes of atoms, the minutest divisions of which gross matter is capable, but which are themselves complex Tanmātric systems (खूतमूतपरमाणु).

The first stadium Bhūtādī is absolutely homogeneous and absolutely inert, being devoid of all physical and chemical characters (खूजानिःसम्बन्धत्व) except quantum or mass (परिच्छेदाल, परिमाण); and this admits neither of addition nor of subtraction, can neither be created nor destroyed. The second stadium Tanmātra represents subtile matter, vibratory, impingent, radiant, etc., instinct with potential energy. These potentials arise from the unequal aggregation of the original mass-units in different proportions and collocations with an unequal distribution of the original Energy (Rajas). (तन्मात्र खूपाऴि: किं कारणम् प्रति चेत्ते स्वकारणि विभागम् भूमाधिकम्बविन अन्याइतर प्रति संयंत्रित एव—खजातीयपरस्माणि ब्रह्मज्ञानार्दिकं च वृत्ति).

The Tanmātras possess something more than quantum of Mass and Energy. They possess physical characters, some of them penetrability
(अंबकाष्ठान), others powers of impact or pressure, others radiant heat, others again capability of viscous and cohesive attraction. In intimate relation to these physical characters they also possess the potentials of the energies represented by sound, touch, colour, taste and smell, but being subtile matter they are devoid of the peculiar forms (विशेष) which these potentials assume in particles of gross matter like the atoms and their aggregates. In other words, the potentials lodged in subtile matter must undergo peculiar transformations by new groupings or collocations to be classed among sensory stimuli, — gross matter being supposed to be matter endowed with properties of the class of sensory stimuli, though in the minutest particles thereof the sensory stimuli may be infra-sensible, (अंतक्रिया but not अनुभव). (तदनुभाष्यन्त तन्मात्रः ते च अविशेषः.: ते च पदार्थः शास्त्रार्थमुद्धारेऽः. स्वभवगत-प्रत्ययिनिष्ठः: शूष्या एकपपलात्: तथाच शास्त्रार्थिीशिष्यशूष्यश्चादिस्त्वृतम् भूतान्त: श्वास्थितमात्रालम्।)

The Tanmátras, then, are infra-atomic particles charged with specific potential energies,—first, the potential of the sound stimulus is lodged in one class of particles, Tanmátras which possess the physical energy of vibration (परिस्थित), and serve to form the radicle of the ether atom (आकाशपरमाणु), then the potential of the tactile stimulus is lodged in another class of Tanmátras, particles which possess the physical
energy of impact or mechanical pressure in addition to that of vibration and serve to form the radicle of the gas atom (Vāyu Paramāṇu);—next, the potential of the colour stimulus is lodged in a third class of Tanmātras, particles which are charged with the energy of radiant heat and light in addition to those of impact and vibration and serve to form the nucleus of the light and heat corpuscle; then the potential of the taste-stimulus is lodged in other Tanmātras, particles which possess the energy of viscous attraction, in addition to those of heat, impact and vibration, and which afterwards develop into the atom of water, and lastly, the potential of the smell-stimulus is lodged in a further class of Tanmātras, particles which are charged with the energy of cohesive attraction, in addition to those of viscous attraction, heat, impact and vibration and which serve to form the radicle of the earth-atom.

शब्दातीना: तद्यथा शन्ततन्मात्रे स्पर्शतन्मात्रे रुपतन्मात्रे रसतन्मात्रे गंभरतन्मात्र इत्यादि समस्याः प्रवणःतन्मात्रे: शब्दात्य: पञ्चविशेषा: । यस्मात्यः सूत्र 19, पादा II. शब्दात्यः शन्ततन्मात्रे तत्तथात्वादारसांक्षेतात् शन्ततन्मात्र शन्ततन्मात्रे स्पर्शतन्मात्रे । पंबनकाशे एक कमुण्डलाम तन्मात्ताचे प्रयत्ने (श्रवणमात्र—सूत्र 62, चाप. I.)

शब्दातीना: सूर्यसमाग्रजातीयाणाम् एक: परिणाम: प्रविधवीरसाम्यः तन्मात्ताववः । भूतास्तमु प्रयो ग्रेहीश्चाकरणमित्वानिवार्त ऋषिनां उपास्त: सामाग्राम् एकविकारार्या: समावेशः । (यस्मात्यः, सूत्र 14, pada IV.) तद्यथा। गंभरतन्मात्रे संज्विला चतुर्धरतन्मात्रे ब्रह्मातीयाणाम्
Before explaining the genesis of atoms, it is necessary to say something about A’kása, which is the link between the infra-atomic particles (Tanmátras), and atoms (Paramárus). A’kása corresponds in some respects to the ether of the physicists, and in others to what may be called proto-atom (protyle). In one aspect A’kása is all-pervasive (विस्तृत्), and devoid of the property of impenetrability which characterises even the infra-atomic potential units (Tanmátras). In another aspect, A’kása is described as having originated out of the mass or inertia in Prakr̥ti (Bhútádi) when the latter became charged with the first potential vibration (the sound-potential). Vijñāna-bhikshu in the Yoga-Vártika boldly tackles the difficulty. A’kása, he explains, has two forms, original and derivative, non-atomic and atomic. The original A’kása is the undifferentiated formless Tamas (mass in Prakr̥ti, matter-rudiment—Bhútádi) which is devoid of all potentials, and is merely the all-pervasive seat or vehicle of the ubiquitous original Energy (Rajas). This A’kása
must not be confounded with vacuum, which is merely negative (अध्यक्षाभाव—un-occupiedness), though it must be conceived as all-pervasive, occupying the same space as the various forms of gross matter (समान्तरक्रम—अवकाशक्क्रम अयोग्यतिक), and therefore devoid of the property of impenetrability (मूच्छन्तरसमान्तरक्रम—योग्यतिक) which characterises atomic matter. But when the original equilibrium (साम्यत्व) comes to an end, unequal aggregations form collocations in different groups and proportions of the three Gunas. (सर्वाधिकाभिविन्यास संयोगसंस्थान; संयोग—विज्ञानमित्यु, प्रवचनभायु योग्यतिक). The transformation of Energy now begins,—working on a collocation of mass (with Essence), (समूहसंयोगसंस्थान—विज्ञानभित्ति, योग्यतिक); it first gives rise to the sound potential (शब्दसंयोगसंस्थापन परिप्रेक्ष्यति—विज्ञानभित्ति) and the atomic A'Kāsa (proto-atom, protyle) is but an integration of the original unit of mass charged with this vibration-potential. This vibratory (or rather rotary) ether-atom (अयोग्यता) is integrated, limited (परिरिक्ष्ट्र) and as such cannot occupy the same space with other (subsequently integrated) atoms. But this proto-atomic integration of A'Kāsa (कायकाश) is formed everywhere, and itself residing in the ubiquitous non-atomic A'Kāsa (कायकाश—अवकाशक्क्रम अयोग्यताकाश) forms the universal medium in which air or gas atoms, light and heat corpuscles, and other atoms move and float about. वायूग्रहणं। यदि हि अवकाशक्क्रम 'आकाश
The genesis of the infra-atomic unit-potentials (Tanmātras) and of the atoms.

The subject of the genesis and the structure of the Tanmātras and the Paramāṇus was a fascinating one to these ancient thinkers, and a wide divergence of views prevailed. I will here notice several typical views:—those of the Vishnu Purāṇa, Parásara, Patañjali and a certain School of Vedāntists reported in the तल्लोकिष्ठम.

I. A famous passage in the Vishnu Purāṇa explains the genesis and the structure of the Tanmātras and of the Bhūtas (Paramāṇus) in the following manner:—

The first Tanmātra originated from the rudiment-matter (Bhūtādi), the individuated but still indeterminate potential-less Mass in Prakṛiti, under the action of Energy (उपविधुत: परिश्रमयनिः—प्रवचनसाध, Sutra 62, Ch. I.) by a process of disintegration and emanation (विक्रियाः—विष्णुः राष—एकविकारार्थः—व्याससाध, Sutra 14, Pada IV. विकरणभाष: विशेषतासाधारम् व्याप्ताः इति
This first subtle matter, the first result of 'Mass-disintegration' and Energy-transformation, is charged with the sound-potential, the potential of vibration or oscillation (विभाजन). It is called the sound-potential (शब्द तन्मात्र).

This is typical of the genesis (and structure) of the other Tanmātras (kinds of subtle matter). In each of the remaining cases, an atomic Mass charged with actual specific energies (मूलपरमाणु) disintegrates and emanates, and thus evolves a form of subtle matter (a kind of Tanmātra) under the action of Energy, and always in the same menstruum or surrounding medium,—that of Bhūtādi, the super-subtle. Each kind of subtle matter becomes charged with a new potential in addition to the potentials already evolved. The genesis of an atom, a Bhūta-Paramānu, is a quite different process. Here the unit potential (Tanmātra) receives an accretion of Mass, and by a sort of condensation and collocation evolves an atom (Bhūta-Paramānu).

The genesis and structure of the Tanmātras and the Bhūta-Paramānus are worked out below:—

1. The super-subtle individuated Mass (rudiment-matter (Bhūtādi), under the action of the
original Energy (रज्:) disintegrates and emanates (विकृति:) in the menstruum or surrounding medium (समावरण:) of Mahat, cosmic super-subtile Mass, and evolves a form of subtle matter (तन्मात्), which becomes charged with the sound-potential (vibration-potential, परिष्कर्थः), and is called the unit of sound-potential (शब्दतन्मात्रा:).

2. This subtle matter, the Mass, charged with sound-potential, receives an accretion of Mass from the rudiment matter (Bhútádi) and by condensation and collocation evolves the A'kásā Bhúta, the atomic A'kása, the proto-atom charged with the specific energy of the sound stimulus (actual vibratory motion.) (स एव सुताद्व: शद्द-तन्मात्रान्त: खडितीयान् शद्दशुकः आकाशं सस्तं। तथाच शंस्तारशद्दतन्मायां भिविन्दा श्राकां चत्वरं—यागवाचिक or the Vishnu Purána's passage, Sutra 14, Pada IV).

3. This proto-atom, the atomic A'kása, charged with its actual specific energy, again disintegrates and emanates, under the action of the original Energy, and in the menstruum of the rudiment-matter (super-subtile Mass) and thus evolves another kind of subtle matter (Tanmátra) which becomes charged with the touch-potential (the potential of impact or mechanical pressure.
in addition to the sound-potential (vibration-potential—परिस्थिति) and is called the unit of touch-potential (क्षणिकात्मक).

4. Next, this subtile matter, the mass charged with touch (and sound) potential, i.e. with the potentials of vibration and impact, receives an accretion of mass again from the rudiment-matter (Bhūtādi) and by condensation and collocation, evolves the Vāyu Bhūta, a kind of gaseous matter or air of which the atoms are charged with the actual specific energy of the touch stimulus, i.e. with actual energy of impact in addition to the actual energy of vibratory motion.

5. Next, the atom of Vāyu, so charged with the actual specific energy of impact and vibration, again disintegrates and emanates, under the action of the original Energy, and in the same menstruum or surrounding medium of the rudiment matter (super-subtile Mass—Bhūtādi) and thus evolves another kind of subtile matter (Tanmātra), which becomes charged with the heat-potential (धीर्य—षोधन—heat-and-light-potential) in addition to the impact-potential and the vibration-potential, and is called the unit of colour-potential (रंगत्तल्लव).
6. Now this subtile matter, this radiant matter, charged with light-and-heat-potential, and also with impact and vibration potential, receives an accretion of Mass again from the rudiment-matter (Bhútádi), and by condensation and collocation evolves the Tejas Bhúta, the light-and-heat-corpuscle, which is charged with the specific Energy of the colour-stimulus, i.e. radiates actual heat and light (विकरण) in addition to manifesting the energy of impact (impingency) and of vibration (or oscillation).

7. Next, this atom or light-and-heat-corpuscle disintegrates, and emanates as before a form of subtile matter charged with the taste-potential (रसतन्मात्र), in addition to the three potentials already generated, and also with the physical potential of viscous attraction.

8. This subtile matter charged with the taste-potential and with the potential of viscous attraction condenses and collocates as before into the water-atom which manifests the actual specific energies of viscous attraction and the taste-stimulus.

9. The viscous water-atom charged with the actual specific Energy of the taste-stimulus disintegrates, and emanates as before a form of subtile matter charged with the
smell-potential in addition to the four potentials already generated and also with the potential of cohesive attraction.

10. This subtile matter charged with the smell-potential and with the potential of cohesive attraction condenses and collocates as before into the earth-atom, which manifests the actual specific Energies of cohesive attraction and the smell-stimulus.

Vījñāna-bhikshu in the Yoga-Vārtika briefly summarises the Vishnu Purāṇa process as follows:

Bhūtādi as radicle in conjunction with Mahat produces the sound potential, which as radicle in conjunction with Bhūtādi produces Ākāśa, which as radicle in conjunction with Bhūtādi produces the touch-potential, which as radicle in conjunction with Bhūtādi produces Vāyu, which as radicle in conjunction with Bhūtādi produces the colour-potential, which as radicle in conjunction with Bhūtādi produces Tejas and so on.

In this brief summary he does not bring out the force of विक्रृत्याथा: (the disintegrating process), and the distinction between the genesis of subtile and gross matter (Tanmātra and Bhūta).

यथा प्रधानेऽसदान् महत् स तथावतः ।
भूतादिनं विक्रृत्याथा: सर्वं तन्मात्रां कतः ॥
II. A famous passage in Parásara takes another view of the genesis and structure of the Tanmátras and the Bhúta-Paramánus. Krishnapúdá, in the तत्तत्त्वविवरण, represents the scheme as follows:—

The Tanmátras originate from one another in one linear series, and each Bhúta originates in a separate line from its own Tanmátra:—

| भूतादि (Bhútādi) |
|-----------------|-----------------|-----------------|-----------------|
| गुणतंत्राच | Sound-Tanmátra—as a radicle or centre surrounded or encircled by Bhútádi generates Ā'kása. |
| लक्षणतंत्राच | Touch-Tanmátra—as a radicle or centre encircled by Sound-Tanmátra with Ā'kása-atom as a help generates Váyu— |
| रंगतंत्राच | Colour-Tanmátra—as a radicle or centre encircled by Touch-Tanmátra with Váyu-atom as a help generates Tejas— |
| रसतंत्राच | Taste-Tanmátra—as a radicle or centre encircled by Colour-Tanmátra with Tejas-atom as a help generates Ap— |
| गमनतंत्राच | Smell-Tanmátra—as a radicle or centre encircled by Taste-Tanmátra with Ap-atom as a help generates Prithivi. |
The genesis of a Bhúta-Paramánú (atom) from the subtile matter of a Tanmátra is not here so simple as in the view of the Vishnu Purána. The latter speaks of condensation and collocation, but in the passage under reference a Tanmátra is supposed to act as a radicle, as the centre of a system, surrounded or encircled by Tanmátras of the immediately higher order in the medium of its own Bhúta.

Thus an atom of Ákása has the following structure:

An atom of Ákása

\[ Sb = Sábdha-Tanmátra \text{ (vibration-potential)} \]

\[ Bh = ( \text{ Bhútádi} ) \]
An atom of Váyu is constituted as follows—
This takes place within the surrounding medium of Ākāsa.

An atom of Váyu

Sp = Sparśa-Tanmátra (impact-potential)
Sb = S’abda-Tanmátra (vibration-potential)

An atom of Tejas—heat-and-light corpuscle—has the following structure:

Váyu
An atom of Tejas

$$Rp = Rupa-Tanmatra$$ (light-potential)

$$Sp = Sparsa-Tanmatra$$ (impact-potential)

and so on.

A Chemist will be disposed to push his chemical processes into the region of subtile matter. He may translate आवरण as a menstruum, and सहायक as a catalytic agent. In this case, an atom of Vāyu will be considered as generated from the impact-Tanmātra as a radicle, in the menstruum of vibration-Tanmātra, with Ākāśa-atoms as a catalytic agent.

A slight variation of the above view is ascribed to a certain school of Vedantists in the नाथनिधिपरम.

The scheme may be represented as follows:

A Bhūta-atom is evolved by integration (condensation and collocation, शृंख्लास्थारूप) from the corresponding Tanmātra (subtile matter). This is the same view as that of the Vishnu purāna.
The Tanmátras again evolve from one another in a lineal series as in Parásara's view. But the process of this generation is somewhat more complex. A Tanmátra first disintegrates and emanates in a surrounding medium (a menstruum) of the Tanmátra just preceding it in the order of genesis and with the help of its own Sthúla Bhúta as a sort of catalytic, generates the Tanmátra next in order; e.g., the infra-atomic impact particles (स्निःसन्नास्त्र) disintegrate or emanate, in a surrounding 'atmosphere' of the vibratory subtile matter (शून्यसन्नास्त्र) and then with the help of their own atomic integration Váyu, gas, generate the Tanmátra next in order, the subtile matter of radiant light-and-heat (तेजः).

III. Patañjali's view, as expounded in the व्यास-भाष्य and योगवाच्य is as follows:—

(a) The order of genesis of various forms of subtile matter (potentials):—

(1) Bhútádi, the rudiment-matter, original Mass, acted on by Rajas, Energy, produces the sound-potential (vibration-potential) व्यात्मायाम् चह्हारामृ स्मकायेर्जनने राजसाह्द्वारः स्मकायेर्मेविन्ति।

(2) This subtile vibration-potential, as a radicle, with accretion of rudiment-matter
(Bhútádi) condensing and collocating, and acted on by Rajas, generates the subtile touch-potential (impact-potential) which is impingent as well as vibratory (oscillating).

(3) This subtile impact-potential again, as a radicle, with accretion of rudiment-matter (Bhútádi) condensing and collocating, and acted on by Rajas, generates the subtile light-and-heat potential (क्षत्रियमात्र) which radiates light-and-heat, in addition to being impingent and vibratory.

(4) Next, the light-and-heat potential, as a radicle, with accretion of rudiment-matter, (Bhútádi) condensing and collocating as before, generates the subtile taste-potential, which is charged with the potential of the taste-energy, and of viscous attraction, in addition to being vibratory, impingent and radiant.

(5) Lastly, the subtile taste-potential as a radicle, with accretion of rudiment-matter as before, condensing and collocating, generates the subtile smell-potential, which is charged with the potential of the smell-energy, and also of cohesive attraction, in addition to being vibratory, impingent and radiant.
The order of genesis of the Bhūta Paramánum, (forms of atomic matter).

The five classes of atoms are generated as follows:

(1) The sound-potential, subtile matter, with accretion of rudiment-matter (Bhútádi) generates the Ākása-atom.

(2) The touch-potentials combine with the vibratory particles (sound-potential) to generate the Váyu-atom.

(3) The light-and-heat potentials combine with touch-potentials and sound-potentials (i.e. with impact particles and vibratory particles) to produce the Tejas-atom.

(4) The taste-potentials combine with light-and-heat potentials, touch-potentials and sound-potentials (i.e. with radiant, impingent and vibratory particles) to generate the Ap-atom and

(5) The smell-potentials combine with the preceding potentials (i.e. with particles of touch-energy and with radiant, impingent and vibratory particles) to generate the earth-atom.

The Ākása-atom possesses penetrability, the Váyu-atom impact or mechanical pressure, the Tejas-atom, radiant heat-and-light, the Ap-atom, viscous attraction, and the Earth-atom, cohesive attraction.
Vijñāna-bhikshu in one passage gives the following scheme of the genesis of the Bhūtas:


\[
\text{of Aʿkāsa} = \text{Bh}(\text{Sb}) \\
\text{of Vāyu} = \{ \text{Bh}(\text{Sb}) \} (\text{Sp}) \\
\text{of Tejas} = \{ \text{Bh}(\text{Sb}) \} (\text{Sp}) \text{ Rp}
\]

where Bh = भूतादि, Sb = श्रत्तन्मादि, Sp = स्फर्पतन्मादि, Rp = र्पपतन्मादि, and so on.

Bhūtas and Paramānus—Cosmo-genesis and its successive stages.

The ‘five Bhūtas’ stand for a classification of substances on the basis of their generic properties resulting, as the Sāṅkhya-s hold, from the structural type of their constituent atoms—a classification more physical than chemical, or properly speaking chemico-physical, unlike the purely chemical classification of the so-called elements of modern chemistry. A Paramānu, again, is a type of atoms corresponding to each Bhūta class, and indeed one and the same kind of Paramānu may
comprehend atoms of different masses, if only these should agree in their structural type.

Cosmo-genesis—a bird’s eye view:—Out of the all-pervasive rudiment-matter (Bhútádi) appeared A'kása (ether), first as a Tanmátra (subtile matter) charged with the potential energy of sound (vibration-potential), and then as an atomic integration of a mono-Tanmátric structure (the A'kása-atom —अक्षाकाशागु) also ubiquitous and all-enveloping. In the next stage we find a new kind of Tanmátras, systems of the infra-atomic vibratory particles, so arranged as to manifest a new form of energy, that of impact or mechanical pressure and these Tanmátras (खण्डनमात्रावाणि) combining with the vibration-potentials (A'kása Tanmátra) produced a new kind of atom, the di-Tanmátric Váyu-atom, which by aggregation formed a gaseous envelope composed of impinging (driving) vibratory particles (Váyu). Next appeared the third class of Tanmátras, infra-atomic systems of the impinging vibratory particles, which by their collocation developed a new form of Energy—the energy of radiant heat-and-light. These Tanmátras (रुप-नमात्रावाणि) combining with the potentials (Tanmátras) of vibration and impact, produced a new kind of atom—the tri-Tanmátric Tejas-atom, the light-and-heat corpuscle, which by aggregation enveloped the gaseous world in huge flames. In the next stage we have the fourth class of
Tanmátras, new and complex infra-atomic systems of the radiant impinging vibratory particles, which evolved the energy of viscous attraction as well as the potential Energy concerned in the taste-stimulus. These Tanmátras (रसतन्मात्राविशिष्ट) combining with the three previous ones, gave rise to another class of atoms, the tetra-Tanmátric Ap-atom, and the flaming gases were thus precipitated into cosmic masses of viscous fluid matters (Ap). Finally appeared the fifth class of Tanmátras infra-atomic systems of the viscous radiant impinging vibratory particles which developed new forms of Energy—the Energy of cohesive attraction, as well as the potential energy concerned in the stimulus of smell. These Tanmátras (गन्धरसतन्मात्राविशिष्ट) uniting with the other four kinds of infra-atomic subtile particles, formed another class of atoms, the penta-Tanmátric Earth-atom. Thus the viscous fluid matters were condensed and transformed into the Earth-Bhúta, comprising the majority of the so-called elements of chemistry.

The Puráñas, in their own fanciful way, conceive that, in the course of cosmic evolution, each succeeding Bhúta appeared within an outer envelope of its immediate predecessor, with a total mass (or volume?) a tenth less than that of the latter.
Examples of the different Bhūtas:

1. Ākāsa. This is ubiquitous.

2. Vāyu. Various substances composed of di-Tanmātric atoms,—kinds of Vāyu—must have been formed in the gaseous envelope in the second stage of cosmic evolution, out of the proto-atoms of Ākāsa. But they have either suffered a fresh transformation into substances of a more complex atomic structure, or have dissipated into the mono-Tanmātric Ākāsa, out of which they took their rise. The one familiar example now surviving is atmospheric air. Water-vapour (वाष्प) is but water (Ap), and smoke, fumes, etc. but earth-particles in gaseous diffusion.

3. Tejas:—Various classes of Tejas corpuscles,—substances with tri-Tanmātric atomic structure, *i.e.* two grades subtler
than the ordinary elements of chemistry (which are of a penta-Tanmátric structure),—are even now known. (तेजो भौमादि—भेदन ब्रह्मविध। भौमं दिव्यं चौद्यं चाकरणं—वर्णरासुरिन,—तत्त्वत्वभाष्य।)

First, there is fire, or the light-and-heat emitted by the burning log of wood or lamp (अग्नि—दीपः—भौमं तेजः). Now it is important to note that the flame of a burning log of wood (द्व्यन) or an oil-lamp is not pure Tejas, a pure mass of light-and-heat corpuscles. There is chemical union with Earth-particles (particles of the hard penta-Tanmátric substance) acted on by Energy; and then the Tejas corpuscles, light-and-heat particles which are latent (absorbed) therein, come forth as flame (पार्थि वैपस्य मन्न नद्युग्नातु तेजस: चायनमंतरिः—विज्ञानमिति—प्रत्यक्षभाष्य, Sūtra 110, Chap. V.)

Then there is the light of the sun and the stars (दिव्यं सौरं आदित्यादि) which are flaming masses of molten viscous matters (जलमालीक्ष्यनं तेज: दिव्यं सत्र सूयादि,—तत्त्वत्वभाष्य, चरितप्रकरण) or of molten earthy matters (सूयादि सत्र सत्र सूयादि, प्रत्यक्षभाष्य, Sūtra 13, Chap. III.) There is also the lightning, which liberates a kind of Tejas latent in the aqueous particles and vapours, under the action of
Energy, in the same way as an ordinary fire liberates the Tejas latent in the wood or other fuel. Next there are the stores of animal heat derived from the break-up of the nutritive material (धातु). Lastly there comes the peculiar form of the Tejas Energy (radiant Energy) stored up in the metalliferous ores and igneous rocks which have been formed in the subterranean heat. Here Earthy matters are mixed up, but the radiant Energy predominates in the composition of the metals (तेजसको नियोजित वृद्धिकोम्प्रमित, प्रवचनमाधय, Sūtra 19, Chap. III.) Aniruddha, a late Sānkhya commentator, notes in reference to ‘igneous bodies’ that the greater part of their mass is derived from the Earth-Bhūta, though the Tejas particles determine the peculiar chemical combination, which produces them; and this must also be his view of the composition of the metals.

4. Ap. This viscous fluid of a tetra-Tanmātric structure has but one pure example, viz, water, though the various organic acids, the juices of fruits and the saps of plants, are supposed to be transformations of watery radicles combined with different kinds of earthy accretions.
5. Lastly the Earth-Bhúta, the hard full-formed matter, with its penta-Tanmátric atoms, comprises by far the majority of the so-called chemical elements.

The question is,—how does one and the same Bhúta, of the same formal structure, comprise different kinds of elements, with different atomic masses, and different characteristic properties? And the answer is not far to seek. The properties of a thing are only the energies that are manifested in the particular collocations of the three Gúnas,—Mass, Energy and Essence; and a tri-Tanmátric, or a penta-Tanmátric atom, i.e. an atom composed of three or of five kinds of Tanmátras may differ from another of the same class, in respect of the number of constituent Tanmátras of any particular kind, as also of their collocation or grouping, and therefore in mass as well as in generic and specific characters.

The Sáńkhya-Pátañjala conceives the properties (or energies) of substances to result from the grouping or the quanta of the Tanmátras, or the Gúnas themselves, and hence any radical differences in substances of the same Bhúta class must characterise their atoms, though in an infra-sensible form. In the Nyáya-Vaiseshika, on the other hand, the atoms of the same Bhúta class are alike in themselves, homogeneous; and the variety of substances comprehended under the
same Bhúta, is ascribed merely to the different arrangements or groupings of the atoms (हूद्र) and not of their components, for components they have none.

As a typical and familiar instance of the variety of characteristic properties (or energies) that may result from variations in accompaniment or grouping, the Sánkhyā-Pātañjala points to the various kinds of fruit acids and juices, all originating from one and the same Bhúta (water) with different accretions of earthy matters (मूर्विकारा: ). In the same way, though we speak of only five classes of Tanmátras and atoms, the infinite variety of the world results from the infinitely varied collocations of the three original Guṇas, which underlie Tanmátra and atom alike (संत्वरजनकोऽस यापकत्यात्मक्तः: संघात: परमाणुरिति—ह्या०ह्यांति—ह्या०ह्या०ह्या०ह्या०ह्या०ह्या०ह्या०ह्या०ह्या०ह्या०ह्या०ह्या०ह्या०ह्या०ह्या०ह्या०ह्या०ह्या०ह्यांति—ह्या०ह्या०ह्या०ह्या०ह्या०ह्या०ह्यांति—ह्यांति—ह्यांति:—ह्यांт
If we take a unit of rudiment-matter (Bhūtādi) for the unit of mass (cf. the mass of an electron with a charge of motion etc.), and represent the first Tanmātra by t, such units, and if further, t₁, t₂, t₃, t₄, t₅ units of mass (Bhūtādi) be successively added at each accretion to form a fresh Tanmātra, then the second, third, fourth and fifth Tanmātras will respectively contain t₁ + t₂, t₁ + t₂ + t₃, t₁ + t₂ + t₃ + t₄, and t₁ + t₂ + t₃ + t₄ + t₅ units of mass.

Also the Vāyu atom (bi-Tanmātric system) will contain t₁ + (t₁ + t₂), i.e. 2t₁ + t₂ units of mass; the Tejas-atom (tri-Tanmātric system) will contain t₁ + (t₁ + t₂) + (t₁ + t₂ + t₃) i.e. 3t₁ + 2t₂ + t₃ units; the Ap-atom (tetra-Tanmātric system) t₁ + (t₁ + t₂) + (t₁ + t₂ + t₃) + (t₁ + t₂ + t₃ + t₄), i.e. 4t₁ + 3t₂ + 2t₃ + t₄ units; and the Earth-atom (penta-Tanmātric system), t₁ + (t₁ + t₂) + ... + (t₁ + t₂ + t₃ + t₄ + t₅), i.e. 5t₁ + 4t₂ + 3t₃ + 2t₄ + t₅ units.

If t units of mass be added to the first Tanmātra to form the atom of Aṅkāsa, the latter will contain t₁ + t units of mass.
In other words the numbers representing the mass-units (Tamas) in the different classes of atoms (gross matter) will form an ascending series, viz. 
\[ t_1 + t, \quad 2t_1 + t_2, \quad 3t_1 + 2t_2 + t_3, \quad 4t_1 + 3t_2 + 2t_3 + t_4, \quad \text{and} \quad 5t_1 + 4t_2 + 3t_3 + 2t_4 + t_5. \]

Now if a follower of the Sāïkhya-Pātañjala were asked to account for differences among Paramāṇus of the same Bhūta class, he would perhaps suppose 
\[ t_1 \text{ to vary from } \alpha_1 \text{ to } \beta_1, \quad t_2 \text{ from } \alpha_2 \text{ to } \beta_2, \quad t_3 \text{ from } \alpha_3 \text{ to } \beta_3, \quad t_4 \text{ from } \alpha_4 \text{ to } \beta_4 \text{ and } t_5 \text{ from } \alpha_5 \text{ to } \beta_5. \]

Therefore the mass-units contained in the Vāyu-atoms of the different possible Vāyu substances would be represented by 
\[ 2\alpha_1 + t, \quad 2\alpha_1 + t + t, \quad 2\alpha_1 + 2 + t, \quad \ldots \quad 2\beta_1 + t, \quad \text{in A. P. with unity as common difference, there being} \quad 2(\beta_1 - \alpha_1) + 1 \text{ possible Vāyu substances.} \]

The mass-units contained in the Tejas-atoms of the different possible Tejas substances would be represented by the series, 
\[ 3\alpha_1 + 2\alpha_2 + \alpha_3, \quad 3\alpha_1 + 2\alpha_2 + \alpha_3 + 1, \quad \ldots \quad 3\beta_1 + 2\beta_2 + \beta_3, \quad \text{increasing in A. P. by unity as common difference, then being} \quad 3(\beta_1 - \alpha_1) + 2(\beta_2 - \alpha_2) + (\beta_3 - \alpha_3) + 1, \text{ Tejas substances possible.} \]

The mass-units contained in the Ap-atoms of the different possible Ap-substances would form the series 
\[ 4\alpha_1 + 3\alpha_2 + 2\alpha_3 + \alpha_4, \quad 4\alpha_1 + 3\alpha_2 + 2\alpha_3 + \alpha_4 + 1, \quad \ldots \quad 4\beta_1 + 3\beta_2 + 2\beta_3 + \beta_4, \quad \text{there being} \quad 4(\beta_1 - \alpha_1) + 3(\beta_2 - \alpha_2) + 2(\beta_3 - \alpha_3) + (\beta_4 - \alpha_4) + 1 \text{ Ap-substances possible.} \]
The mass units contained in the Earth-atoms of the different possible Earth-substances would form the series in A. P.,

\[5\alpha_1 + 4\alpha_2 + 3\alpha_3 + 2\alpha_4 + \alpha_5,\]

\[5\alpha_1 + 4\alpha_2 + 3\alpha_3 + 2\alpha_4 + \alpha_5 + 1,\]

\[5\beta_1 + 4\beta_2 + 3\beta_3 + 2\beta_4 + \beta_5,\]

there being

\[5(\beta_1 - \alpha_1) + 4(\beta_2 - \alpha_2) + 3(\beta_3 - \alpha_3) + 2(\beta_4 - \alpha_4) + (\beta_5 - \alpha_5) + 1\]

Earth-substances possible.

Size (परिमाण).—As to size or volume, the Sāṅkhya accepts only two kinds,—the infinitesimal, which is also without parts (अणु—निरवयव) and the non-infinitesimal, which consists of parts (मक्त—साययव ). The latter varies from the excessively small (the so-called Anus, Tanmātras and Paramānus) to the indifinitely great (परससिह—विभृ—c.g.—Aṅkāsa ).

The Guṇas alone are infinitesimal, with the exception of those ubiquitous ones that evolve into Aṅkāsa-atoms and Mind-stuff (अनकाशाण , and अन्तकरण )—all the rest of the evolved products (whether subtle or gross matter) are non-infinitesimal.

Vijñānabhiphshu notes that all the Guṇas (Reals) cannot be ubiquitous. If this were the case, that disturbance of equilibrium, that unequal aggregation with unequal stress and strain, with which cosmic evolution begins, would be impossible. The Guṇas, which give rise to Aṅkāsa and Mind-stuff, must be held to be ubiquitous, and this will suffice for the ubiquity of Prakṛti.
Chemical analysis and Synthesis—Elements and Compounds.

What then is the equivalent in the Sāṅkhya-Pātañjala of the distinction between a chemical element and a chemical compound, or is there none? Did or did not this elaborate physical analysis and classification of things lead on to a classification based on chemical analysis and chemical synthesis? These are questions of singular interest, the answer to which will disclose some new points of view from which the ancient Hindu thinkers approached the problems of chemical physics and physical chemistry.

Aggregates (समूहा:) may, in regard to their structure, be divided into two classes, (1) those of which the parts are in intimate union and fusion, being lost in the whole (ययुतम्भस्वयम्: समूहा: ) ; and (2) mechanical aggregates, or collocations of distinct and independent parts (ययमस्यः: यन्तः समूहा: ).

A substance is an aggregate of the former kind, and may be divided into two classes, (1) the Bhūtas and their ‘isomeric’ modifications (मूम, मूतमेद and भूतविकार) ; and (2) chemical compounds (मिलितद्वच्य,
Chemical compounds again may be subdivided into two classes, (1) those composed of atoms of the same Bhūta class, i.e., of different isomeric modifications of the same Bhūta, and (2) those composed of atoms of different Bhūta classes. In the first case, there is contact between 'isomeric' atoms (सञ्जातीय-संयोग), in the second case between heterogeneous or 'polymeric' atoms (विजातीय-संयोग). The first contact leads to intimate union (संस्कृत:-सुक्र: य: संयोगविक्रितः: ततः द्वारा विकारो भवति—विजातनिन्विता, प्रवचनभावः): the isomeric atoms by a peculiar liberation of Energy (सञ्जातीयोपद्धं—the action of similars on similars) are attracted towards one another, and being riveted as it were, form the so-called material cause (उपादान कारण) of the compound product. The second kind of contact (that between unlike or 'polymeric' atoms of heterogeneous Bhūtas) begins with a liberation of Energy (उपद्धं), which breaks up each of the Bhūtas, and taking particles (or atoms) of one as nuclei or radicles groups particles of the rest round these radicles in a comparatively free or unattached condition. In this case, one Bhūta, that which serves to furnish the radicles, not necessarily that which is numerically or quantitatively predominant, gets the name of material cause (उपादान कारण), and the others, which by their collocation cause the liberation of Energy (उपद्धं, चद्धं or तद्धं).
are called efficient causes (निमित्त कारण)—एवं संयोजन—गुणमभवन प्रधान गुणं चार्थिल्य चप्रधानगुणाः परिपक्वम—भेदान्त प्रवृत्त यथा—वाच्यप्रति, कौशुदी on Kārikā 16. The illustrations given (viz. the Rasas as modifications of Ap, water, with Earth-accretions) show that this process applies not only to the Gunas, but also to the Bhūtas. यथा झाकाशादेकरम सालं प्रतिन नामाकृपात संशेखणात भिद्यते—(गौड़पाट on Kārikā 17).—तत्व लाप (तैजसे शरीरे लाप) वस्तुस्थिरार्थिकायायशावस्थानात् अण्वले च अण्तूभोगान (अविवर्तित on Sūtra 112, Chap. V). जातिसाधृष्ट्य स्वच्छावस्थानात् सामीसामायनाने चेंकैरण इन्द्रियेः एस्टा एकत्रातुतुष्ट्यात्मने बाध्यं नासी । (विज्ञानभिज्—प्रबन्धनाध्य).  

Aniruddha goes so far as to hold that both ‘isomeric’ and ‘polymeric’ (or ‘heterogenic’) combinations are real cases of constitutive contact. (चारस्र्वक संयोज, e.g. भौतिकवादोटेंहारस्मकलस्—स्वच्छाह on Sūtra 113, Chap. V.) But in the later Sāṅkhya-Pātañjala the current teaching denied this—बहानामुपादानायोगान (Sūtra 102, Chap V), when विज्ञानभिजु notes—बहाना भिन्नजानोगाना चोपादानर्त न देशमिति सजातीयभेदोपादानम् । इतराद्व भूतचतुष्णसुपप्प्रभाक्रम् ।  

But besides these transformations of substance—(द्वारादपरिपक्व) by ‘isomeric’ or ‘heterogenic’ process, ceaseless changes go on in the characters, the modality, and the states of substances—changes
which are due to the unequal distribution of force (or. of stress and strain,—pressure) among the Gunas, which are in themselves constant. (* दुःखस्वयंपरिशालयः न दुःखान्तरतः,-यथा एका रेखा मनोक्ष्याने न दुःखस्वयाने दश, एकाश्चक्ष्याने, यथा रूक्कुक्क्वयि मर्मान्त चोच्यते दशिना च स्माचेति,—गुणित्यवेशपि गुष्गानं विभेद्यै विविभाति—व्यासभाष्य, सूत्र 13, पादा III).

"Even as the same figure '1' stands for a hundred in the place of hundred, for ten in the place of ten, and for a unit in the place of unit."* 

* This conclusively proves that the decimal notation was familiar to the Hindus when the Vyāsa-Bhāṣya was written, i.e. centuries before the first appearance of the notation in the writings of the Arabs or the Greco-Syrian intermediaries. Vāchaspati, who comments on the Vyāsa-Bhāṣya, composed his Nyāya-Sūchī-Nibandha in वस्तुक्रेयसप्रभुः i.e. Samvat 898 or 842 A. D. This cannot be S’aka 898, for apart from the decisive use of वस्तुर्, which by this time had come to signify the Samvat era, Vāchaspati’s commentator, Udayana, wrote the Lakshanāvali in S’aka 906.

and Udayana, who wrote the Parisuddhi on the Tātparyyaitīkā of Vāchaspati, could not have been a contemporary of the latter, as will also appear from the invocation to Sarasvatī in the opening lines of the Parisuddhi. Vāchaspati then preceded Udayana by 142 years, and must have been himself preceded by the author of the Vyāsa-Bhāṣya by a
Now the question is—in these mixed substances does the fusion take place by Paramánus or by larger masses (or lumps)? Now a Paramánu is defined to be the smallest portion of any substance which exhibits the characteristic qualities of that substance,—in other words, it stands for the smallest homogeneous portion of any substance. It is not without parts and therefore not indivisible. It is subject to disintegration. In a Bhúta or its isomeric modification, the Paramánu, the smallest homogeneous component particle, is unmixed, and therefore corresponds to the atom of modern chemistry. In a mixed substance (मित्रनुत्वयं संहतशुद्धताधी) whether it is an ‘isomeric’ or a ‘polymeric’ compound, the qualities are due to the mixture, and therefore its Paramánu, the smallest homogeneous particle possessing its characteristic qualities, must result from the mixture of the Paramánus (in smaller or larger numbers as the case may be) of the component substances. The longer interval still, for Váchaspati ascribes the Bháshya to Veda-Vyása himself (वेदव्यासेन भाषिते भाष्येण व्यास्य विधास्यते). The internal evidence also points to the conclusion that the Bháshya cannot have been composed later than the sixth century,—cf. the quotations from Pañchasikha, Várshaganyya, and the Shashthi-Tantra-Sástra, without a single reference to l'svara-Krishna—which is decisive. I may add that I remember to have come across passages of a similar import in Buddhist and other writings of a still earlier date.
mánu of a mixed substance therefore corresponds to what we now call molecule. (अपकर्प पर्यः नः दुःख परमायुक्तिः—व्यासभाष्यः लोकः यः द्विप्रविधयमानस्य बभिः
प्रियवेऽयगतारतस्य अवतिष्ठते सः अपकर्प पर्यः नायुक्ति—
वाच्यस्थिः—तत्त्वेऽगार्दी—सूत्र 52, पदा III.—नायु
नियोग्या न निम्निग्यः। शैवोपरामायु जलपरामायु रिवार्दि—
अश्वयरस शैव्यादीनां अपकर्प कार्याभिलाषेण व । विज्ञान—
भिसः—प्रत्यक्षभाष्यः, सूत्र 88, चाप. V.)—That the
Paramánus form molecules (द्वगुक) in forming
substances, is acknowledged by the Súñkhyas as will
appear from Gaudápáda,—नया जन्योद्योगायथा दृष्टः
कवत्सुगा:। (गौड़पात्, on Káriká 12). Even the Vaiseshikas, with their prejudice against ‘polymeric’ or
‘heterogenic’ combination, acknowledge that in
‘polymeric’ compounds the different Bhúta
substances unite by their Paramánus (or atoms),
though they rigidly insist that in such cases only
one atom should be regarded as the ‘radicle’
(उपासन अर दुःखार्थक कार्यः) and the others as
co-efficient causes (निमित्त काराण—उपथम्भक्, e.g. प्रश्ल—
पाद—एवं समुद्धार्थयु चतुः महामूलेय महेस्वरसाध्याभिधानमा—
वान नेत्रमेधोद्यमभेः: पार्थिवपरामायु सहितेयो सहदस्मुत्
पद्यते (प्रश्लपादभाष्यः—where S'ridhara notes पार्थिवा
अन्यथा उपथम्भकः: and Udayana नेत्रास्यानं परमायु नां
पार्थिवायु सार्थ्यो न खर्म्यस्य हिरण्यायतुः विधिवत्।)
It is only in the mediæval Sānkhya-Pātañjala that under the influence of the Nyāya-Vaiśeshika doctrine a radical difference was conceived to exist between the structure (or constitution) of a molecule composed of 'isomeric' atoms, and that of one composed of heterogeneous (or "polymeric") atoms. In the former case, there was believed to take place intimate union (सङ्क), in the latter case, only a grouping of comparatively free or loosely attached atoms round a radicle atom (वृक्ष), with liberation of Energy (उपस्थत्व, —अवस्थ— or विद्यम्) and the setting up of unequal stress and strain (गुणवैम्यम् —द्रव्यरक्षण). At the same time, it was of course admitted that this distinction does not apply to the forms of subtile matter (Tanmātra—वृक्षभूत) which could unite in intimate fusion, whether homogeneous or heterogeneous. For example, the subtile body (सूच्य-गरीर) which is supposed to be the seat or vehicle of the conscious principle is acknowledged by Vijñāna-bhikshu to be penta-Bhautic (पञ्चभूतालक्ष): in other words, all the five Tanmātras serve as material causes, though the gross body (the animal organism) is stated to be only a "polymeric" compound with the Earth-Bhūta as radicle or base.
and 12, Chap. III.—सूनगरीर पार्श्वमेय भज्यानि च.
भूतानि उपद्धत्त्वानि (ibid. Sūtra 19, Chap. III.)

But in the original Sāṅkhya-Pātañjala it appears that the production of a new substance by mixture of unlike Bhūtas (विजातीयंशयोग) was conceded as freely as in the Vedānta, and was conceived as nowise differing from the formation of a compound of atoms of the same Bhūta class. The Sāṅkhya analysis of all change into transformations of Energy due to collocations of un-changing Guṇas, in other words the prevailing chemico-physical (or physical) point of view, naturally recognises no distinction between collocations of 'isomeric' and those of heterogeneous (or 'polymeric') atoms. At bottom they are all collocations of the Guṇas. Even Vijñāna-bhikshu who, as one of the latest expounders of the Sāṅkhya-Pātañjala, has been most affected by the Vaiseshika prejudice against ‘polymeric’ combination (विजातीयशयोग) urges that the qualities of a compound substance are not necessarily the result of similar qualities in the component elements. (सूजातीय कारणामृगाये व
कार्यं मुणार्श्वता दत्त तृणां (सार्वभौमायम) अधि न नियमः ।)

Elsewhere he explains that far from the vital activity being independent it is originated and maintained by the combined operation or fusion of the different sensory and motor reflexes of the living
organism, and notes that the united operation of mixed (or miscellaneous) causes, where there is a fit collocation of matter, offers no difficulty to a follower of the Sānkhya-Pātañjala:—

In the middle of the ninth century, we find Vāchaspati instancing some 'heterogenic' or 'polymeric' compositions as typical examples of evolutionary change (परिशालम) and unhesitatingly accepting the substantive character of the products. In the Kaumudi he describes the various acids and juices of fruits as modifications of the same original water in the presence of different kinds of earthy accretions. The process is peculiar. The water-particle (or atom) serves as a radicle or centre of a system, and the different kinds of the Earth-Bhūta centering round this as a nucleus become the seat of forces, which bring in the development of new energies (and new qualities, e.g. tastes) in the water. (यथा वारिद्रिविमुक्तं वदकं एकरसमयि न तदृ-भूमिविकारानं वास्तवं नारिकेच्च-लघु-विक-विपिन्यादिर-रसतया परिशालम् सदृशमृद्दवणातिकक्तुकपायतया विकल्पते। इति एककपुष्पसम्भवान प्रधानपुष्पं वास्तवं वास्तवानुषं परिशालमेदानं प्रवर्त्यति।) (कौशुद्धि on Kārikā 16). Vāchaspati also points out that different substances may be transformed into one and the same substance (c.g.
the production of salt by the cow, the horse, the buffalo and the elephant, thrown into the salt factory of Sambara in Rajputana or of the flame of a candle by the combination of wick, oil and fire.

(परिशासनस्तवं बहुनामयि एकः परिशासनं द्वादशः Tत्त्रयशानवाद्यमातङ्कानं स्मारितिनिर्मानानं एकलसंगल्हालोक-लच्छः परिशासनं, वसिस्तैलनानानं च प्रदीप् द्रिति।—तत्त्र-वेगारद्वी on व्यासभाष्या, Pada IV. Sūtra 14.)

Earlier still, i.e., not later than the sixth century, the Vyāsa-Bhāshya, noting that inorganic matter, vegetable substances and animal substances do not differ from one another essentially in respect of their potential energies and ultimate constituents, points out that various bi-Bhautic chemical compounds of water and earth substances, in the shape of saps, acids and juices, are found in plants in their different parts. (जवसूक्ष्मोऽपरिशासक्ष्मं प्रसारिते वे व्यक्त्यं स्थारंगे द्वादश। इति।) In other words, bi-Bhautic compounds are here placed in the same category as ‘isomeric’ compounds of substances of the same Bhūta class, for here the particles of both the Bhūtas are regarded as forming the matter (material cause—चपातानकारण) of the smallest homogeneous portions of the compound substances.

N.B.—Vāchaspati naturally interprets this to mean separate modifications of the two Bhūtas.
The view of the earlier Sāṅkhya that atoms of different Bhūtas may chemically combine to form molecules of compound substances as much as atoms of different modes of the same Bhūta comes out clearly in Utpala's brief reference to the Sāṅkhya system in his commentary on Varāhamihira's Vṛiḥat Samhitā. (एष्यः पञ्चभ्यः [तन्मालेभ्यः] पञ्चमहाभूतां सूतां भवलि। तेष्यः गर्हीराणां गर्हीरागिर्। यत् पञ्च-महामूलमयां गर्हीरागिरि (Utpala, Chap. I, S'loka 7).

Chemistry in the medical schools of ancient India:—As a matter of fact, long before the fifth century, probably as early as the first century A.D., the prevailing schools of medicine and surgery which were based on the Sāṅkhya teaching with a methodology derived from the Nyāya-Vaiseshika doctrine (cf. Charaka, Sārīrásthána, Chap. I, Vīmānasthána, Chap. VIII—also Susruta, Sárárāsthána, Chap. I) had founded an elaborate theory of inorganic and organic compounds, which equally admitted iso-Bhautic and hetero-Bhautic combinations. Like the Vedantists, Charaka and Susruta held that each of the gross Bhūtas (Mahábhūtas) is a peculiar ultra-chemical compound of five original subtile Bhūtas. In this sense, every substance is penta-Bhautic, but for purposes of chemical analysis and synthesis, i.e. considered with reference to the Mahábhūtas, all substances in their chemical constitution, belong to
one or other of the following classes: Mono-Bhautic, bi-Bhautic, tri-Bhautic, tetra-Bhautic, and penta-Bhautic. Compounds of different Bhūtas, again, may combine to form more complex substances, and these in their turn, higher compounds still, and so on in progressive transformation, as is more specially the case with organic substances and products.

Physical characters of the Bhūtas: The prevailing physical characters of the different Bhūtas and their isomeric modes are enumerated as follows.

Earth-substances—Heavy, rough, hard, inert, dense, opaque, exciting the sense of smell.

Ap-substances—Liquid, viscous, cold, soft, slippery, fluid, exciting the sense of taste.

Tejas-substances—Hot, penetrative, subtle, light, dry, clear, rarefied, and luminous.

Vāyu-substances—Light, cold, dry, transparent, rarefied, impinging.

Ākāśa-substances—imponderable (or light), rarefied, elastic, capable of sound (vibrations).

(युक्त खर कठिन मन्द स्यारातिपत्तःनूर-स्वस्त गत्युगुणवक्तुलानि पार्थिवानि।) दृव फ्लिंग्स शीश मन्द स्वद फिर्लिङ मरस्युगुणवक्तु-
Charaka points out that the primary qualities or specific physical characters of the five Bhūtas are tactile qualities, *i.e.* sensible to touch, *e.g.* hardness (or roughness) for Earth, liquidity (or yielding to pressure) for Ap, impelling or moving force (pressure) for Vāyu, heat for Tejas, and Vacuum (non-resistance, penetrability) for Ākāsa.

(Charaka-Sārīrasthāna, Chap. 1).

(cf. the elaborate enumeration of physical characters quoted in Vijñāna-bhikshu, Yoga-Vārtika, Sūtra 42, Pada I;—also Varavara's commentary on Tattva-traya, Achit-prakarana).

The Mahā-Bhūtas—mechanical mixtures:—Suṣruta notes that each of the gross Bhūtas (Mahā-bhūtas) is found mixed up with the other Bhūtas;—*e.g.,* the Mahābhūta Ākāsa is the receptacle (or vehicle) of air, heat-and-light, and water vapour: the Mahābhūta Vāyu, of water-vapour, light-and heat, and even fine particles of Earth held in
suspension; the Mahábhútá Tejas, of earth-particles in the shape of smoke, and also water-vapour.

(शास्मोद्यानुसारविधानां सम्बोध्येताराम निमूढः—Susruta Sárirasthána Chap. I.) अन्ये पुनः अन्यशयां व्यास्थति। अकाशेम पवन-दुधन-तोयानि। याति तेजोभुनि। सूरि प्रभु अशु ताविशेषेऽत्त। भूमिंपि धू माणिस्थेऽत्त। तेजोद्धृत्ये पानीयस्ति।—Dalvana on Susruta, loc. cit.)

Mono-Bhautic Earth-substances:—Charaka and Susruta regard the following as Earth-substances—Gold, the five Lohas (silver, copper, lead, iron and tin) and their 'rust', arsenic, orpiment, various mineral earths and salts, sand, precious stones. (Charaka, Sútrasthána, Chap. I. Cf. also Susruta, Sútrasthána, Chap. I पाण्डित्यः सुवान ्रजनमार्गस्यमहः:—गिताकृत्यापालाद्यः। सुवानाः इत्य पाण्डित्यवलम्बवाङ्कोऽक्षते। सुस्थितेऽस्मे याति दिष्टात्त। सुवाने चादि यथाशालू बोध्यम्ब-सिक्रताधुथा हरिवाच चवणा गैरिकसाराण्य प्रभृतिनां—Dalvana on Susruta, loc. cit.)

The salts include common salt, saltpetre etc. Susruta mentions the alkalis, borax, natron, Yavakshára (carbonate of potash) etc.

Of these Earth-substances, some were known to be compounds, e.g. the chemical salts of the metals, collyrium etc. Susruta describes the preparation of the metallic salts. The leaves of the metals were pasted over with the salts, and then
roasted (चयस्वानि) (Chikitsásthána, Chap. 10). These metallic salts are therefore mono-Bhautic Earth-compounds. Susruta also gives the preparation of mild and caustic alkalis. (Sútrasthána, Chap. 11).

Ap-substances, simple and compound:—

Susruta, following Charaka, enumerates various classes of Ap-substances (द्रव्य) as follows:—waters, acids, milks, curds, butters, oils (vegetable as well as animal), fats, honies, molasses, alcoholic liquors, urines etc.

Pure Ap (Mahábhúta) is tasteless and the six tastes are developed when the Mahábhúta Ap enters into combination, mechanical or chemical, with other Mahábhútas. Susruta notes that various kinds of Earths are dissolved in the waters of different localities. and where the particles so dissolved are predominantly Earthy, the water tastes acid or salt,—where predominantly watery, the resulting taste is sweet,—where the Earth particles are mixed up with Tejas, the water tastes pungent or bitter etc. Such is the case with mechanical mixtures. In the case of bi-Bhautic or tri-Bhautic compounds Charaka mentions that substances with Mahábhúta Ap predominating in their composition taste sweet; with Mahábhútas Earth and Tejas predominating, acid; with Mahábhútas Ap and Tejas predominating, salt; with Mahábhútas Váyu and Tejas predominating, pun-
gent; with Mahābhūtas Vāyu and Ākāsa predominating, bitter; and with Mahābhūtas Vāyu and Earth predominating, astringent. (Charaka, Sūtrasthāna, Chap. 26,—cf. Susruta, Sūtrasthāna, Chap. 42).

In fact with the exception of Susruta’s waters, which are mechanical mixtures, or rather solutions, all these Ap-substances are organic products and, as such, penta-Bhautic, i.e. compounded of all the five Mahābhūtas, and the particular ‘taste’ which is developed depends on the relative proportion of the Mahābhūtas, and the predominance of one or more of them in the penta-Bhautic compound in question.

Qualities of Compounds.—The isomeric modes of each Mahābhūta have specific colours, tastes etc. due to their structure, i.e. the arrangement of their atoms, and the physico-chemical characters of compounds whether of the same or of different Mahābhūtas result from the collocation in unequal proportion of the different forces latent in the atoms of the component substances. Charaka adds that the varied forms (textures) and colours of organic substances, whether vegetable or animal, are derived in the same way.
Susruta ignores Charaka’s distinction between Mahabhuta and subtile Bhuta, and views every substance as in reality penta-Bhautic, and it is only the relative predominance of a particular Bhuta or Bhutas in any substance that determines its class. (पृष्ठावम्रणाजीवाय वाकाशां समुदायात् द्रव्याभिनिर्देशः। उत्तमम् सु चर्विभ्राण्डको भवति इदं पार्शिवं इदं अयं इदं नैव इदं वायव्यं इदं आकारोद्धितं। Susruta, Sutrasthāna, Chap. 41).

The extant Charaka and Susruta—Succession of medical authorities:

The extant Charaka and Susruta, the sources of our present information regarding the progress of scientific knowledge in the medical schools of Ancient India, are both redactions of original authorities. The extant Charaka is a redaction by Drīdhabala of the genuine Charaka Samhita, which was itself a redaction by Charaka of the original work of Agnivesa, the disciple of A'treya Punarvasu as distinguished from Krishzatreyas and Bhikshu A'treya, also well-known medical authorities. The extant Susruta is a redaction by Nágárjuna of an original work (Vṛiddha Susruta) by Susruta, the disciple of Dhanvantari. That Charaka preceded Susruta is almost certain. Nágárjuna was probably earlier than Drīdhabala. This Nágárjuna is believed to have been the author of a commentary on Patañjali’s Mahabhāshya (vide
Bhojavṛitti and Chakrapāṇi), and was probably identical with the alchemist Nāgārjuna (Siddha Nāgārjuna), the metallurgist Nāgārjuna (author of a treatise on metallurgy, Lohasāstra), and the Buddhist Nāgārjuna, author of the Mādhyamika sūtravṛtti. Charaka and Susruta continued to receive additions after Dridhabala and Nāgārjuna, and even after Vāgbhata, but the whole of the extant Charaka is probably much earlier than the commentator Chakrapāṇi, and the whole of the extant Susruta earlier than Dalvana, the commentator, and Mādhava, the author of Rguvinischaya. The extracts in Vāgbhata make it certain that the passages I have quoted or shall quote from the Sūtrasthāna and Sārīrasthāna of Charaka and Susruta cannot be later than the sixth century of the Christian era.

Preparation of Chemical Compounds.—The knowledge of chemical compounds and of their preparation continued to make progress in the Charaka and Susruta Schools. The great metallurgist, Patañjali, in his treatise on Metallurgy (वशिष्ठशस्त्र) gave elaborate directions for many metallurgic and chemical processes specially the preparation of the metallic salts, alloys and amalgams, and the extraction, purification and assaying of metals. Probably it was Patañjali who discovered the use of the mixtures called Vidas, which contained aqua regia or other mineral acids
in potentia. Unfortunately Patañjali's *magnum opus* appears to have been lost, but extracts from it are frequently found in mediæval works on Medicine and Rasāyana, which leave no doubt as to its remarkable scientific value. The metallurgist Nāgárjuna, advanced the knowledge of chemical compounds by his preparations of mercury. The Harshacharīta, in the seventh century, relates a fable concerning this Nāgárjuna, and speaks of him as a friend and contemporary of Sātavāhana. The relative priority of Patañjali and Nāgárjuna is a vexed question in the history of metallurgy. That Nāgárjuna's Loha-sāstra was earlier than the final redaction of Patañjali will appear from the following circumstances:—

1. Chakradatta in his summary of Nāgárjuna mentions that the chemical process of testing pure iron must be repeated twice before it can be regarded as decisive, whereas Sīvadāsa Sen's extract from Patañjali shows that the latter directed the process to be repeated seven times; 
2. Patañjali in the Abhraka-vidhi (mica operation) adds mercury, which in this particular operation is wanting in Nāgárjuna's recipe (cf. Chakradatta, and Patañjali as reported in the Yogaratnākara-samuchchaya); and 
3. Nāgárjuna is quoted in the earlier compilations, Patañjali in the later.

Early in the sixth century, Varāhamihira in the *Vṛihat Samhitā* gives several preparations of
cements or powders called Vajra-lepa, "cements strong as the thunderbolt;" and there was ample use for these in the temple architecture of the Buddhist period, the remains of which bear testimony to the adamantine strength of these metal or rock cements. (Prāsādaḥlassesvāgabhīvaśāmedhāvānāmāśaḥ kīkeṣu vanaḥ yathā śanmahya śastraḥ) Chapter 56. Ibid ). Varāhamihira also alludes to the experts in machinery (yamādhi, yamāgam) and the professional experts in the composition of dyes and cosmetics (raagnārājakīvikīvid: Ch.16, also Ch.15). I would also refer to the interesting Chapter on cosmetics (Ch. 76) where Varāhamihira gives various recipes for artificial imitations of natural flower scents as of the essence of Vakula, Utpala, Champaka, Atimuktaka &c., arranges compound scents in a sort of scale according to the proportions of certain ground essences used in their preparation, and determines by the mathematical calculus of combination (loṣṭkaprāslar) the number of variations of the different notes in this scale. To these classes of professional experts were due three of the great Indian discoveries in the chemical arts and manufactures which enabled India to command for more than a thousand years the markets of the East as well as the West and secured to her an easy and universally recognised pre-eminence among the nations of the world in
manufactures and exports:—(1) the preparation of fast dyes for textile fabrics by the treatment of natural dyes like Manjishthá (तुबरी मांजिष्ठ रागबिन्नी) and other chemicals (e.g. sulphate of iron) also cow-dung, (cf. the "cowdung substitute", Roscoe); (2) the extraction of the principle of indigotin from the indigo plant by a process which however crude is essentially an anticipation of modern chemical methods; and (3) the tempering of steel in a manner worthy of advanced metallurgy, a process to which the mediaeval world owed its Damascus swords. It was this applied chemistry much more than handicraft skill which gave India her premier position in the middle ages and earlier (indeed from Pliny to Tavernier) in exports and manufactures; for in handicraft skill as in design and workmanship, great as were her merits, India came to be surpassed by her disciples China and Japan.

The Vásavadattá and the Dasakumára Charita in the sixth century allude to the preparation of a mass of fixed or coagulated mercury (पारस्तपशुड़ वालुलुबारित—वालुवारित); a chemical powder, the inhalation of which would bring on deep sleep or stupor (योगचूस्खायाद्रश्यमारचरित); a chemically prepared stick or wick for producing light without fire (योगचार्तिका—दशकमारचरित); and a powder which like anaesthetic drugs or curare, paralyses
sensory and motor organs (साधनचुक्तां सिव दिनित्रियांगां मृ—वास वद्दाता—धीन्त्रियक्षमेनित्रियांग दर्ष्यमा). Vrinda (circa 950 A.D.) notices the preparation of sulphide of mercury (रसाम्बन्धयुक्तां) composed of one part of sulphur, and half its weight of mercury; and also of cuprous sulphide (पण्डितात्म). Chakrapāṇi (circa 1050 A.D.) mentions the preparation of the black sulphide of mercury, "by taking equal parts of mercury and sulphur".

The Rasārṇava (circa 1200 A.D.) notices the colours of metallic flames, probably after Patañjali: e.g. copper gives blue flame; -tin, pigeon-coloured; lead, pale; iron, tawny; blue vitriol, red. It may be noted that the Rasārṇava regards mercury as a penta-Bhautic substance.

The Rasaratna-samuchchaya divides the mineral kingdom (Earth-substances, simple and compound) into the following classes:— (1) The eight Rasas, mica, pyrites, bitumen, blue vitriol, calamine, etc. (2) The eight Uparasas (useful in operations of mercury), sulphur, red ochre, green vitriol, alum, orpiment, realgar, collyrium, and medicinal earth, to which may be added the eight Sādhārana Rasas, sal-ammoniac, cowrie, cinnabar, rock vermilion, etc. (3) The gems, diamond, emerald, sapphire, cat's eye, sunstone, moon-stone, pearl, etc. (4) The metals,
gold, silver, iron, copper, lead, tin, and the alloys—brass and bell-metal. Other Earth-substances are six salts, three alkalis, mineral earths, and several poisons (cf. vol. I, pp. 32–98).

Chemical compositions and decompositions—metallurgical processes.—In these writings, we frequently come across instances of chemical composition and decomposition, by processes, more or less crude, of calcination, distillation, sublimation, steaming, fixation, etc. (भक्त्रिकरण. अध्यात्म, जम्व प्रति, स्वेत, स्वभान etc.) e.g. the preparation of perchloride of mercury by taking common salt and mercury (रसकूपर—पारदस्त्र वन-भक्त्रिकरणे चन्द्रकाकार;) of sulphide of mercury (हिझु) by taking sulphur and mercury; of Sindūra from lead (खिन्दूरं नागस्भावस्—Amarakosha);—of the medicinal compounds, Svarna-sindūra and Rasasindūra, with mercury, sulphur and gold, where gold may have been fancied to influence the resulting compound in some mysterious way, either as a 'dynamic' or as a catalytic;—also the extraction by chemical decomposition of mercury from sulphide of mercury (हिझु,—vide रसरतसभुजय;) of copper from sulphate of copper (तुल, सक्ख;) by heating this substance with one-fourth of its weight of borax (Rasaratna-samuchchaya,—cf. Bhāvaprakāsa, तत्त्व.)
The various metallurgic processes described are—extraction, purification, killing (formation of oxides, chlorides and oxy-chlorides for the most part), calcination, incineration, powdering, solution, distillation, precipitation, rinsing (or washing), drying, steaming, melting, casting, filing, etc. to all which each of the known minerals was successfully subjected by the use of apparatus and reagents and the application of heat in different measures (सिद्ध—मध्यसिद्ध—and मद्दतसिद्ध)—methods which, if often crude, especially from the absence of independent and isolated mineral acids, were yet in several instances remarkably simple and effective, and which, after all by the use of various Viḍās potentially containing mineral acids (aqua regia, sulphuric acid, hydrochloric acid, etc.) virtually accomplished the practical ends kept in view. To these were added several special processes for mercury (e.g. fixation), bringing up the number of mercurial operations to nineteen.
It may be noted that the mixtures called Vidās, which potentially contained dilute mineral acids, were regularly employed not only in killing the metals (forming their oxides and chlorides), but—what is of fundamental importance—for purposes of chemical decomposition of metallic salts, etc. and the extraction and purification of metals.

Organic Compounds.—Organic Compounds are either vegetable or animal substances. (स्वावर जड़म भूत). The molasses, the fermented liquors, the saps and juices of plants, fruit acids, vegetable ashes and alkalis together with the tissues of plants, are vegetable compounds (व्रोहित्र, स्वावर भूत). Honey, milk, curd, butter, fat, bile, urine, and other excreta, together with the organs and tissues of animals, are animal substances. Charaka notices vegetable as well as animal oils. The viscous (oily) substances are classed under four heads—butters, oils, fats, and marrows (स्विंस्लं वसा मच्छा स्नेहो दस्फलवथि: ). Salt may be either mineral or vegetable salt.

Susruta divides poisons into two classes—Vegetable and animal, but several poisons expressly termed mineral poisons (धातविव) are included in the first class.

All organic substances, whether animal or vegetable, are penta-Bhautic, being compounded
of greater or less proportions of the five Mahábhútás.

Taking the human body Charaka finds that the foetus is composed of sixteen organic substances, viz. four, composing the Sperm-cell which comes from the male; four composing the germ-cell which comes from the female; four added by the transformation of the nutritive material, and finally, four kinds of subtile matter, which together form the vehicle of the conscious principle. As to the four organic substances which compose the sperm-cell, or the other four which compose the germ-cell, it is not clear whether in Charaka's view they are also in their turn compounded of less complex organic substances, or whether their constituent elements are inorganic penta-Bhaútic compounds.

The tissues that appear in the course of development of the foetus are further transformations (higher compounds) of these foetal substances. All the component substances of the body are penta-Bhaútic compounds, though sometimes they are assigned to the particular Bhútás which predominate in their composition, e.g. bile to Tejas, lymph, chyle, blood, fat, urine, sweat and other secretions to Ap, and skin, flesh, bones, nails, hair, etc. to Earth. (शुच्रं वायुमभूत्यक्रमागतवत् —
गभूष चवितारं चविर्धानं भूतानं सातापितसङ्क्वानि चाकार-
Fœtal Development (after Susruta). The ovum fertilised by the sperm-cell and developing under the influence of animal heat forms successive layers and tissues, even as layers of cells and fibres are formed in wood. First are formed seven layers epithelial and dermal (स्प्रत्वचः), then follow the several tissues (कला:), the flesh, the vascular tissue, the fat and marrow, the lymphatic (and glandular) tissue, the intestinal tissues, the biliary and the seminal vessels. Tissues which are regarded by some as modifications of the original dermal layers of the ovum (cf. the layers of the blastoderm and their relation to the tissues in Embryology). The tissues are supposed to be developed successively, one out of another, by chemical action or metabolism (पाक), e.g. chyle is transformed into blood, blood into flesh, flesh into fat, fat into bone, bone into marrow, marrow into sperm-cell. The organs are next formed out of the tissues.
The liver, gall-bladder (होम), spleen and lungs are referred to the blood; the intestines to the blood, lymph and bile; the kidneys to the blood and fat; the testicles to the blood, lymph and fat; the heart to the blood and lymph; and the tongue to the lymph, blood and flesh. Vāyu, with the accompaniment of animal heat, impels the ‘currents’ (स्वतंत्र) in the system; Vāyu acting on the flesh gives rise to the muscles, and it is Vāyu again, which, with the essence of fat (or marrow), produces the nerves, arteries and tendons. (नस्य खल युक्तशोरोगतिस्य अभिपरिचानां च सैरन्त्रिव सन्तानिका: सम्प्रताचो भर्तन्ति) — कला: खल्विपि सप्र सम्भवन्ति। यथार्थ सारः काण्यु, किद्यमानेनु, द्वस्यं। तासां प्रथमा सांसधरा। द्वितीया रक्तधरा। तत्तीया चेतोधरा। चतुर्थी श्लेष्मधरा। पञ्चमी पुरीपधरा। षष्ठी विनान्या। षष्ठी मधुक्षधरा।—ग्रंथस्य यक्ष्मोध्रानां शोरीयंजो।—et seq Susruta, Sārīrasthāna, Chap. IV.—
रक्तादुःक्तं नतो मांसं मांसामेदः प्रजायते। चेतोतिच्छ्यतेन नतो मन्न्या मणः युक्तस्य नम्भवः। Sūtrasthāna, Chap. XIV).

The following parts (tissues and organs) in the foetus are in a special sense modifications of the four organic substances contributed by the sperm-cell of the male parent; hair, nails, teeth, bones, nerves, veins and arteries, tendons and ligaments, and the sperm-cell; the following, of the substances derived from the mother,—skin. blood,
Chemistry of Digestion—The food we eat contains five classes of penta-Bhautic organic compounds. From their radicles or predominant elements, the substances are named Earth-compounds, Ap-compounds, Tejas-compounds, Vāyu-compounds and Ākāsa-compounds. The Earth-compounds supply the hard formed matter of the body, the Tejas-compounds give the animal heat (or the metabolic heat), the Vāyu-compounds are the sources of the motor force in the organism, the Ap-compounds furnish the watery parts of the organic fluids, and the Ākāsa-compounds contribute to the finer etheric essence which is the vehicle of the conscious life. Roughly speaking, the Earth-compounds answer to the nitrogen compounds in the food, the Tejas-compounds to the hydro-carbons (heat-producing) and the Vāyu-compounds to the carbo-hydrates (dynamic). The Ap-compounds are the watery parts of food.
and drink. The flesh, for example, is a tissue composed principally of the Earth-compounds, the fat of the Earth and Ap compounds, the bones of Earth, Vāyu and Tejas compounds. For purposes of digestion it is stated that different operations of the metabolic heat (perhaps different digestive fluids are also meant) are required to digest the different substances in the food.

The course of metabolism is described as follows:—The entire alimentary canal is called Mahāsrotas (the great channel).

The food goes down the gullet by the action of the biomotor force, the Prāna-Vāyu.

In the stomach (चामाग्य) the food becomes mixed up first with a gelatinous mucus (फेषीमृत्तं कपं) which has a saccharine taste, and then gets acidulated by the further chemical action of a digestive juice (विद्धार्दमृत्तं गत:—evidently the gastric juice is meant). Then the biomotor force, the Samāna Vāyu, begins to act and drives down the chyle by means of the Grahani Nāḍī to the Pittāsaya (duodenum), into which bile comes down from the liver, and thence to the small intestines (the आमपक्षा). In these, the bile (or rather the digestive substance in the bile as opposed to the colouring element) acts on the chyme, and converts the latter into chyle (रस), which has at first
a katu taste (pungency). This chyle contains in a decomposed and metamorphosed condition all the penta-Bhautic organic compounds, viz. tissue-producing Earth-compounds, water parts or Ap-compounds, heat-producing Tejas-compounds, force-producing Vāyu-compounds, and lastly, finer etheric constituents which serve as the vehicle of consciousness. The essence of chyle (कृतभाग) from the small intestines is driven by the biomotor force, the Prāna Vāyu, along a Dhamanī trunk (cf. the thoracic duct) first to the heart (which is a great receptacle of chyle), and thence to the liver (and the spleen), and in the liver, the colouring substance in the bile acts on the essence of chyle, especially on the Tejas substance therein, and imparts to it a red pigment, transforming it into blood. But the grosser part of chyle (स्वयंभाग) proceeds along the Dhamanīs, being driven by the biomotor force, the Vyāna Vāyu, all over the body.

When the blood has been formed, the essence of chyle in the blood, acted on by Vāyu (biomotor force) and Māmsāgni (the flesh forming metabolic heat), forms the flesh-tissue, the Earth-compound of the food substance especially contributing to this tissue of the flesh tissue thus formed, the grosser part goes to feed or replenish the flesh tissue all over the body. The finer essence of flesh in the
blood in the chyle, acted on again by Vāyu (biomotor current) and the fat-forming metabolic heat (सेत्रांशित्व) in the menstruum of lymph (कम समारजित्व), receives viscosity and whiteness, and produces the fatty tissue, the Earth-compounds and Ap-compounds of the food especially contributing to the product. This fat in the chyle (or blood), or rather the grosser part of it replenishes the fatty tissue of the body, but the finer essence of fat in the flesh in the blood in the chyle, acted on by Vāyu (biomotor current) and the marrow-forming metabolic heat, in the menstruum of lymph (र्ग्प्रभाभत), becomes hard (or crystalline), and forms bone, the Earth, Vāyu and Tājas compounds contributing principally to the product. The essence of the fat fills the hollow channels of the bones, and acted on again by biomotor Vāyu and metabolic heat, becomes transformed into the marrow. The marrow is transformed into the semen, which is conveyed down by means of a pair of Dhāmanis (ducts) (दे गुआच्रन्त), lodged in its receptacles (गुआच्रत्रा—ढपणां) and discharged by means of another pair of ducts (दे विसगाय). The semen, or rather all the elements in their finer essence, give off Ojas, which returns to the heart, the receptacle of chyle and blood, and again floods the body, and sustains the tissues, thus completing the wheel (or self-return-
ing circle) of metabolism (चर्कायख्यं पित्त: Cf. Charaka and Vagbhata).

It is to be noted that, throughout, the fluid in the chyle (or blood) acts as the menstruum, though occasionally the lymph, which is itself a derivative from the chyle is added as in the case of the fatty tissue and the marrow; and that each preceding element or constituent of the body (धातु—गरीरायलञ्ज्ञाय), takes up the proper organic compounds from the food-chyle to form the next element or tissue. Throughout also, the chemical changes are due to the metabolic heat which breaks up the compounds and recombines, but the operations and even the vehicles perhaps of this heat are different. For example, these heat-corpuscles in the biliary ducts produce the bile, but the bile secretion is supposed to contain two distinct substances, (1) a digestive fluid in the duodenum (पिन्नायग्न्य) which acts on the chyme to produce the chyle, (चारखायख्यं पित्त); and (2) a colouring bile substance in the liver which adds a red pigment to the chyle and transforms it into blood (रक्तानिख्यं पिन्नम्). Besides, there are three other biles, of which the aqueous humour in the eye is supposed to be one (चानोखायख्यं पिन्नम्) helping in the formation of visual images (रक्तप्रायःकम्स). This is the view of Dhanvantari and his school, but Atreya holds there is no
evidence that the bile really performs the first (digestive) function, for this can be accounted for by the animal heat arising from the working of the whole bodily machine. There are three different hypotheses regarding the course of metabolism and the successive transformations of the chyle.

(Chāndogya-Upanishad—Kśetraphalitam—Bhrāṣṭāraṇya-Kūmara-Sūtraśāstra, 14.10, also his commentary on Charaka, Sūtraśāstra, 28), but my account is based upon the second hypothesis which has the preference of Chakrapāni (Sutrasthana). It may be added as a curiosity that each element of the body (धातु) under the metabolic heat is supposed to give off a finer essence (श्रवण) which serves as the material of the next succeeding element, and a dross (मद), which forms some of the excreta in the body, (including the nails, the hair, etc.), besides retaining its own substance (the gross or main part) which is driven along by the Vāyus (biomotor or vital currents) or by the Srotas to its destination in the body. Some idea of circulation appears to have been entertained, for the heart which receives and then sends down the chyle through the Dhamanis gets it back transformed into blood, and the Ojas also proceeds from the heart and returns to it along with the chyle and blood. (Cf. Vāgbhata—तत्व: लघुस्यः गिरिः रसालकं चोजः
Sutrasthana, Chap. 46. Cf. also वियनप्रवर्तनान्तर्भव्यं देखितमण्डलमिनिति विशुद्धमयितिः। सुस्रुताः, सूत्रास्त्रानां, Chap. 46. Cf. also वियनप्रवर्तनान्तर्भव्यं देखितमण्डलमिनिति विशुद्धमयितिः। सुस्रुताः, 

ibid., Chap. 41. भौमापामन्येत् वायुः पश्चायताम: शनाभसा: । पञ्चाहारमुगानाः ौऽ ुण श्राविवाौऽ ौऽ ौऽ । वयासः 

t. च पुष्णिन्त पञ्चाः शुद्धमुगानाः रथव्, पञ्चाहारै: पञ्चाहारणेश श्रेयः श्रेयां स देशमानृ। अनिरित्कशुणा रज्जने वहिर्भीमांसे त 

पञ्चाहारिकता । शेदङ्क्षं भुवंश्वरिक्षु योग्यीनिन्तवितजसम् । चारकाम, quoted by Dalvana. आदि यह क्षण नद्य तभु रोगुत- 

मौर्यवेत, पौन्योल्मण कृतं यां विटाक्षांस्त्यां सत: । वायुना 

समानायोऽने यह्निमिनशियत। पश्ची पिताधरा नाम या कला 

परिकोतिना, आमपायमः याः यह्नी सामिबिध्रोऽत। 

अभिविभाजनमध्यक्ष्य पञ्चाहारांमहाश्रीं मता । भु तमामास्ये शब्दा मां 

विपाच्य नयायः । बलवद्वरणा तन्त्रमामविव विमुः चति । ज्ञनस्मृ 

पत्रं पिताधरा पञ्चायां पुरातिमृ । दृष्टाधिबलांमहाश्रीमम्मृ सत्यवादीयांमम्मृ । तेजोरकानां सप्तचाम्मम्मृ यु चित्ते, पितोप्यक्र 

सरागेय रसो रक्तलक्ष्यति। वायुर्विनितजसा दृष्टं रक्तं सांसत- 

तुलक्ष्यति। श्रीपादां च समाहिताय मां । वायुर्विद्यायुतम्, 

स्यात्मां प्राय: शौैक्ष च मेतो देवेदीभिजायते । द्विविधाविनाल- 

रीनां सहायते। श्रीप भाग्यां, खरं प्रकोपवस्या जायते: शिय 

ततो नस्तम्। करोति तत शौैयमस्यां मध्ये समीरणः । मेट्। तत्र 

धारिततं पूर्ण ितः क्षोऽ हो महा तत्यं सनध्य। तत्त्वामः भौंचव
Charaka—Dridhabala Samhitá, quoted by Aruna in his commentary on Vágbhaṭa. Yadaśeṣṭārānirṇaṇāṃ kulājñānāṃ prabhāsādāṃ ksetsarrimāśāvijnāt, tadā rāṣṇa eva prathamaṃ rāṣṇaṃ jñāvijnāt. Tadā rāṣṇaśāyaṃ-sabjñātād rāṣṇaśāyasya rāṣṇaśāyasyaḥ vachārenāt varṇāvijnāt. Tadā rāṣṇaśāyaṃ mahāmanānāṃ ślokeṇaṃ jñātōḥ vāṇēḥ jñāvijnāt. Tadā rāṣṇaśāyasyaśāyasya jñāvijnāt, evamulāttarādhwānāḥ rasa eva jñāvijnāt (Chakradatta, Bhānumatī). This passage shows that the ‘venous blood’ was conceived to be chyle-essence mixed with blood, and that the circulation of the chyle so far as it was held to contribute its quota to the constituent elements and tissues of the body was really supposed to be identical with the circulation of the blood (नतो राष्त्रमाधा शाय मांसमाधा वय क्यों). This will be abundantly clear from the following account of the course of the chyle and the blood:—

तत: सार्यूमस्याधाररस्यं दौ भागाः भवत:। स्तूत: कृच्छर...तत: सूच्छो भाग: प्रायांमुयुनां प्रितो महानमाग्निः गर्दरागर्भ-कुल समस्याय स्थानं यकृतं हीच्छूतं गद्या तन सह मितिस्य भवित:।तत: प्रत्यायणः दौ अन्तो सा तिष्ठति।.....तत: सार्यूमस्याधाररस्यं दौ भागाः भवत:। स्तूत: कृच्छर। सूच्छो भाग: रायकाश्येन भित्तेन रथितं गर्दरागर्भकं राष्ट्रं पोषयन् यायायुनां प्रेरितता महानिविषं संचरनं सकलगर्दरागमानि सुषिकास्य युष्मासि। तत: सूच्छो भाग: यायायुनां प्रेरिता...
This finer essence of chyle which nourishes the flesh must also be carried in the blood, on the 'irrigation channel' hypothesis (केढारीक्ष्यामाय). (For diagrams of the central circulation and the sympathethico-spinal nervous system, vide Appendix. The mechanism of life and the inheritance of specific and other congenital characters are also dealt with in the Appendix.)

Formation of molecular qualities in chemical compounds:—The Charaka school, which, we have seen, was an offshoot of the Sāṅkhya (cf. Charaka, Vimānasthāna, Chap. 8, यथा वाटियः प्रकाशकः तथा सांख्यवचनं प्रकाशकमिति) supplemented the above account of inorganic and organic compounds with a characteristically Sāṅkhya explanation of the formation of molecular qualities by chemical combination. In Charaka's view, the colours, tastes, etc. of the molecules of chemical compounds result from the collocation in unequal proportion and unstable equilibrium of the different forces latent in the atoms (Paramāṇus) themselves. (एवंबलेनां रक्षानां षट्त्वणुपन्नं नूर्तानिरेऽरं वशीयात् महासूतानां। मृत्यानांविव स्थांरजातमाना नाना-वशीकरणिविशेषः। Charaka.)
Chemistry of colours.—As an interesting example of the way in which a follower of Charaka would account for the colours of chemical compounds, I may note the explanation given by the late Gaṅgādhara Kavirāja Kaviratna in the Jalpakalpātaru, a commentary on the Charaka-Samhitā, published at Calcutta in 1869, premising that the Kavirāja’s view is pure and genuine Charaka doctrine. Gaṅgādhara begins with a simple statement. The qualities of the atom, he writes, tend to produce similar qualities in the molecule. A molecular quality is therefore the result of the conjunction or opposition, as the case may be, of the atomic tendencies. When, for example, the five Bhūtas combine to produce an organic compound (the human body), Tejas, Ap and Earth tend to produce red, white and black respectively, but in the body (compound substance) the yellow colour may happen to be produced as the result of these tendencies in that particular proportion and collocation. The point to note here is that the molecule forms a fresh collocation, redistributes the Mass and Energy, and sets up new forces in the system which coming into play modify the potencies (or tendencies) in the component atoms, and thus determine the resultant. This is elaborated into a curious but complete theory of the colours of chemical compounds.
The colours (and other qualities) of a simple substance (an isomeric mode of any Bhúta) are the result of the potencies lodged in that particular collocation of Mass, Energy and Essence. Now when two such substances unite, their colours etc. tend to be produced, but the combination brings on a fresh distribution of Energy, Mass and Essence, and the forces thus set free may powerfully modify or even extinguish the separate tendencies or potencies of the component simple substances. For example, when we prepare a collyrium by mixing equal parts of sulphur and mercury (the black sulphide of mercury) we find the resulting compound black. To explain this, it has to be remembered that each of the substances (sulphur and mercury) contains Sattva (Essence), Rajas (Energy) and Tamas (Mass) in different proportions, and that predominant Tamas (Inertia, Mass) always produces black, predominant Sattva (Essence) white, and predominant Rajas (Energy) red. Now in the black sulphide of mercury, the white of the mercury tends to produce white, and the yellow of the sulphur yellow; and if these tendencies were not obstructed, the result would be a mixed colour. But, in the particular collocation in question, the Tamas of the mercury becomes intensive (निस्स्थू), and the black of the now intensive Tamas
extinguishes the white in the uncompounded mercury, which was due to prevailing Sattva, as well as the yellow of the uncompounded sulphur, which was due to the combined operation of white-producing Sattva and red-producing Rajas. Again, when, with proper apparatus and by the application of heat, we combine mercury and sulphur to produce the red sulphide of mercury, the resulting colour is explained by the fact that in this new collocation the Rajas (Energy)—probably of the mercury, though Gaṅgādhara does not specify—becomes intensive (चीङ्खा), and extinguishing both the white-producing Sattva of the mercury and the yellow-producing Sattva-Rajas of the sulphur, imparts a red colour to the compound. In these cases, as also in the formation of red by mixing powdered turmeric with lime, i.e., whenever a new colour is produced in the compound, it is to be explained by the dominance of Tamas, Rajas or Sattva, or their combinations, and the extinction of the uncompounded tendencies (or potencies) by the forces set free in the new collocation. But there are other cases where the colour of the compound is a mixed colour resulting from the colours of the combining substances, e.g., when sulphide of mercury and calcined tin are mixed, the resulting colour is evidently a mixed one (Pātala, pink), which is
easily explained by the colours of the component elements (the red of the sulphide of mercury and the white of the calcined tin). In the same way, in a mechanical aggregate, as in a piece of cloth, the colour is white, where the threads are white.

(तत्काल्यािर्भे ऋषीवार्त्तृद्वावशयागुणा गम्भरदयः)

खलु खलजातीयं गन्धविशेषाभिकं चारभमाणा: यदारब्धमाणं
स्तुमविकातीयं काय्य स्तास्रभ्रं कारग्राह्य भद्धवादांदिः
गुणां तमभयशा कुशंचित् हला कुशंचितं न हला। खलजातीयं
गुणाविशेषं चारभने। यथा पारदगन्धर्यको: संयोगे कक्षचि
हृदुर्वाहि पारदस्यः गुला: मुक्तविग्रेयं चारभमाणा: गन्धकस्यपीतः
पीतमारभमाणा: पारदस्यतो नृत्तयस्मारभमाणोऽनि विरोधिना
वधर्ते। सम्यावे शौकिन्तं सन्तुमगुणयोिनिकं तमोगुणयोिनिकेन
नल्क्षणे विरोधिना वधर्ते। गन्धकस्यपीतमस्योऽचलोकितशुक्रोऽ
रजः सन्तुमयोिनिकं वधर्ते। तयोऽऽुक्तलोकितवधे नृत्तस्मारभमाणोऽ
गोिनः क्रयः अभिव्यक्तते। दृष्टि पारदगन्धकोब्धमाणके कार्यः
शेतिनिमेलनेन सम्भाय्यं काय्यं यदूव्याः सतु तन्त्तुम्युगाः
वधर्ते, तत्कारणं शुक्लोलोक्ततं हला। एवं हिम्बुऽऽुपारद-
गन्धकाभ्यामारभमाणोऽण्विग्रेये बाहुर्माणे पर्यामाणे रजोविकल
योिनिकेन मील्त्तणे सन्तुमयोिनिकोऽऽुक्लक्षणोऽवधर्ते। पारदस्यः
शुक्लगन्धकस्यपीतमेलनेन सम्भाय्यं काय्यं वधर्ते। रजो
वामकलोकित्यं अभिव्यक्तते दृष्टि। एवं हिम्बुऽऽुपारद्वारस्यः
संयोगेष्यि शोहितं अभिव्यक्तते तुगा स्वतेन्त्रणेन हरिद्वारः...
Parināma-vāda versus Ārambha-vāda: Charaka's view of the formation of a new quality or a new substance is based on the Sāṅkhya teaching as to the conservation and transformation of Energy, and brings chemical synthesis in a line with evolutionary change (परिशा). On this view, a new substance may arise by spontaneous or isomeric change, i.e., by the inter-play of Energies within the system of any given substance, in the absence of any action from without. New qualities like new substances are only readjustments of the old, and continual changes are going on by spontaneous disintegration and recombination. Opposed to this evolutionary view of chemical synthesis is the Nyāya-Vaiseshika doctrine of Ārambha-vāda, according to which no change of substance or quality, no effect, in short, can take-
place except by the action of one component element (substance or quality) on another. A binary molecule, for example, cannot possess any ‘specific quality’ (विशेषात्मक) of a kind not represented in each of the two component atoms. In the cosmic process, no atom can exist free and uncombined with another atom, and every ‘specific quality’ in a substance can be ultimately analysed into the union of two ‘specific qualities’ of the same class in two ultimate particles which cannot be further divided. A single colour, smell or taste in a single particle, until it can link itself on to another specific quality of its own class in a second particle, cannot characterise any substance formed by the union of these particles as material causes. Hence an Earth-atom cannot unite with an Ap-atom, to form a new substance of which both the particles must be equally regarded as material causes. At any rate, such a compound, if effected, would be smell-less, as of the two constituent atoms, only one, viz., the Earth-atom, possesses smell. A compound of Earth and Vāyu would be smell-less, colourless and tasteless, and so on. The Nyāya-Vaiseshika does not deny that there may be compounds of different Bhūtas, nor does it deny the causal operation of specific qualities as efficient or energising (dynamic) causes (उपदेश, निर्मित्तारण), but it refuses to place
these compounds on the same footing as compounds of isomeric modes of the same Bhūta; and it accepts the 'material' causality, in such cases of only one of the Bhūtas, regarding the others as co-efficients' (निमित्तकारण).

The earlier Śāṅkhyaśas including the medical schools of ancient India brushed all this aside as a distinction without a difference. The Vedantists, as we shall presently see, flouted this doctrine of Ārambha-vāda. The Jainas, in opposing this Vaiseshika view of atomic combination, hit upon a solution of the problem of chemical affinity. Others again, found out a via media. They held, as we learn from the reports of Udyotakara in the Nyāya-vārtika, and of Vāchaspati Misra in the Tatparyyatikā, that a molecule of the structure EA (one atom of Earth and one of Ap) would exhibit some variety of colour and taste resulting from the joint action of the atoms and of their several colours and tastes. But as in the combination EA only the Earth-atom possesses smell, and the Ap-atom is smell-less, and as moreover no quality in a compound substance can result except from the joint action of the similar (potential) qualities of at least two component elements, it follows that a molecule of the structure EA would not manifest the energy of smell potentially contained in the Earth-atom.
Hence, admitting the combination EA for a smell-less compound, the upholders of this view would suppose a molecule of the type E₂A (i.e., two atoms of Earth and one of Ap) to explain any bi-Bhautic compound of Earth and Ap (like the plant saps and fruit juices) which exhibits smell in addition to the peculiarities of colour and taste. (Cf. Vāchaspati's comment on Udyotakara's refutation of this view:—

चयमबन्धनिति: | चतुर्व्याख्यपरमापि भावातं हुः तमार्क्षु-सम्बं: तयोः क्षयस्वर्णवच्चेन तदार्ब्रम्भसम्बं चापि गन्धवला-भावप्रसंज्ञाते। एवं पार्थिवाः समवेत्या गन्ध्या एकलेन चनार-रम्भक्लान्ति नापि पार्थिवपरमापि इत्यं एकादश पायशीयपरमापि: हृदि अणा नामार्ब्रम्भकले गम्भवोच्चोपपति: हृदि साम्प्रृतं। पर-मायाः नां बहुना चेनार्ब्रम्भक्लान्तु। तथापि लय: परमाणवः न काय्यं मारम्भलेः।)

Measures of Time and Space. Size of atoms.

The Siddhánta-Siromani gives the following measures of Time:—

30 Kshanas (क्षण) = 1 day, 2 Ghatikás = 1 Kshana,
30 Kalás = 1 Ghatiká, 30 Kāshthás = 1 Kalá,
18 Nimeshas = 1 Kāshthá, 30 Tatparas
1 Nimesha, and 100 Trūṭis = 1 Tatpara.

This makes a Trūti of time equal to \( \frac{1}{3050} \) of a second, which is nearly the measure of
the Paramánu of time, as given in the Vishnu-

puráva (vide Bháskara’s Siddhánta–Śírománi–

kaññamaññá(yá )).

The above measures were in use among the

astronomers, but the physicists computed according
to the following table given both in Udayana’s

Kiranávali and Śrídhara’s Nyáyakandali:—30

Muhúrtas = 1 day (24 hours), 30 Kalás = 1 Mu-
húrta, 30 Káshthas = 1 Kalá, 18 Nimeshas = 1

Káshthá, 2 Lavas = 1 Nimesha, 2 Kshanas = 1 Lava.

This makes 1 Kshana of the Nyáya-Vaiseshika
equal to \( \frac{3}{4} \) of a second. The Nyáya assumes

that the unit of physical change (or the time

occupied by any single antecedent step in a causal

series before the succeeding step is ushered in) is

equal to a Kshana (or \( \frac{3}{4} \) of a second). The

astronomers were familiar with far smaller mea-
sures of time. The astronomical Trúti of time

measures about the thirty-four-thousandth part of

a second. This is of special value in deter-

mining the exact character of Bháskara’s claim
to be regarded as the precursor of Newton in the
discovery of the principle of the Differential Cal-
culus, as well as in its application to astronomical problems and computations. This claim, as I proceed to show, is absolutely established; it is indeed far stronger than Archimedes's to the conception of a rudimentary process of Integration. Bhāskara in computing the "instantaneous motion" (तात्कालिकी गति) of a planet compares its successive positions, and regards its motion as constant during the interval (which of course cannot be greater than a Truṭi of time, though it may be indefinitely less). This tātkālika motion is no other than the differentia of the planet's longitude, and Bāpudeva Sāstrī claims that both the conception of the instantaneous motion and the method of determining it plainly show that Bhāskara was acquainted with the principle of the Differential Calculus. On the data before him, Mr. Spottiswoode remarks that Bāpudeva Sāstrī "overstates the case." Bhāskara "makes no allusion to one of the most essential features of the Differential Calculus, viz. the infinitesimal magnitude of the intervals of time and space therein employed. Nor indeed is anything specifically said about the fact that the method is an approximate one." "With all these reservations" Mr. Spottiswoode continues, "it must be admitted that the formula he establishes and the method of establishing it
bear a strong analogy to the corresponding process in modern mathematical astronomy" (viz., the determination of the differential of the planet’s longitude,—by no means the first step in transcendental analysis or in its application to astronomy). And Mr. Spottiswoode concludes by stating that mathematicians in Europe will be surprised to learn of the existence of such a process in the age of Bhāskara (circa 1150 A.D. —born 1114 A.D.) Mr. Spottiswoode’s second objection that Bhāskara does not specifically state that the method of the Calculus is only approximative cannot be taken seriously. The conception of limit and the computation of errors came late in the history of the Calculuses of Fluxions and Infinitesimals. For the rest, Bhāskara introduces his computation expressly as a “correction” of Brahmagupta’s rough simplification. The first objection (viz., that Bhāskara makes no allusion to the infinitesimal magnitude of the intervals of space and time employed) would be more to the point, if it were well founded. But it is not, and Mr. Spottiswoode’s error was due to the insufficiency of the data supplied to him. As a matter of fact, even Bhāskara’s unit, the Truṭi of time (or Paramānu), is exceedingly small as the very name implies, being about one thirty-four-thousandth of a second of time. And in the passage in which Bhāskara describes the process, he distinguishes
between Sthúla-gati and Súkshma-gati (velocity roughly measured, and measured accurately i.e., by reference to indefinitely small quantities, for Súkshma, as we have seen, has always a reference to the Anu, the indefinitely small). Indeed he expressly mentions that the Sthúla-gati takes only Sthúla-kála (finite time) into consideration, and that the determination of the Tátkálikí Gati (Súkshma-gati) must have reference to the moment (pratíjanam), which is an indefinitely small quantity of time being of course smaller than his unit, the Truti. (Cf. Dr̥va kín śālā gārta: ādi śālā tátkálikí kathet.............Yata áraśaśr̥taśya nātār̥tār̥kār̥tāk̄ya ār̥ta śālā śār̥taśya niśāśīmaśpaṃ katuṃ yuñjatē. Tatha samīpaścālānadhī. Yata dhur̥taraśr̥taśya: Dhur̥taraśr̥taśya ca chanḍ̄śya nātā aś̄aśya śālāha katuṃ yuñjate śālā kālākāntat̄. Yatādāntuḥgarāt: Mahācārt prati-jātaṃ samā na bhavaṃ atmahatzēṃ ār̥te viśeśaṁbhavat̄t;—nothing can be clearer than this conception of ‘momentary’ motion.—Bhāskara, Siddhánta-Sīromani, Ganitádhyaśya, Gatisphutiprakarana: cf. also prati-vyayār̥ta nā samā mahācārtat, ibid., cf. also Goládhyaśya, Tátkálikí-karana-vásaná-prakarana, where Bhāskara points out that the mode of computing adopted by the Ācháryya (Brahmagupta) is a rough simplification. The computation of relative motion and the idea of resolved components of motion were of course familiar to
the astronomers.—(Cf. एवे सत्याचार्यें गण लोपवाधीं रष्ट्रीसमविन्यों गणिकाला यहाँ प्रचितः:। ibid.) I may add en passant that Bhāskara's formula for the computation of a table of Sines also implies his use of the principle of the Differential Calculus.

Measures of weight and capacity. The Amarakosha mentions measures of three kinds—weight, length and capacity ( मान तुला कु चिऱ्रिस्थि: ).

The Krishnala (Guṇija, Raktiká, the black and red berry of the Shrub Abrus Precatorius) was employed as a natural measure of weight. 80 Krishnala berries on the average weigh 105 grains Troy, and this must be taken as the basis of our computation, though in current practice 80 Krishnulas are taken to be equivalent to 210 grains. One Krishnala was supposed to weigh as much as 3 medium-sized barley seeds ( मध्य यष ), one of the latter as much as 6 white mustard seeds ( गोरसपूर्ण ), one white mustard as much as 3 Ráji mustard seeds ( राजि सपूर्ण ), one of these seeds as much as 3 Likshas, and one Liksha as much as 8 Rajas or Trasarenu.s.

We now come to conventional measures. One gold Māshā was the weight of 5 Krishnala of gold, 1 Suvarna or Tolá weighed as much as 16 Māshás, and one Pala as much as 4 Suvarnas or Tolás. A Pala of gold therefore weighs 320 Krishnala ( Manu, Chap. VIII, Vishnu, Chap. IV, and Yājñavalkya, Chap. I ).
A Máshá of gold therefore would weigh $\frac{61}{13}$ grains; a Tolá, 105 grains, (in current practice it weighs nearly double as I have stated); and a Pala, 420 grains Troy.

The measures for silver were the following:—

1 Silver Másha = 2 Krishnalas, 1 Dharana = 16 Silver Máshás, and 1 Pala = 10 Dharanas. A Pala of silver would therefore weigh 320 Krishnalas. In other words, the Pala was a fixed measure of weight, and was equal to about 420 grains Troy, or double this, if we take the Krishnala of current practice.

A Pala, which equals 320 Krishnalas, was subdivided by 4, 16 and 5 successively for gold, and by 10, 16 and 2 successively for silver. A Suvarna (or Tolá) of gold corresponds roughly to a Dharana of silver, and a gold Máshá to a silver Máshá, but the sizes (or volumes) are not the same, and we must not therefore conclude that gold was supposed to be heavier than silver in the proportion of 5 to 2.

We find that 1296 Trasarezzus equal 1 Krishnala. A Trasareuzu, as a measure of weight, therefore, is the equivalent of $\frac{7}{9} \times \frac{7}{12}$ of a grain Troy, or double this according to current measures.

But the Trasareuzu of physics is a different conception. It stands for the minimum visible, i.e., as the physicists define it, that which is just discernible as a glancing particle in the slan-
tinting beams of the morning (or afternoon) sun, coming into a dark room through a chink or orifice of a window. This is a measure of size (or rather stimulus limen).

Measures of Capacity. Here the standard was furnished by the Kudava (कुदव), a vessel described as 3 Āṅgulis long, 3 Āṅgulis broad, and 1½ Āṅguli deep,—with a cubical capacity of $13\frac{1}{2}$ cubic Āṅgulis. 

4 Kudavas = 1 Prastha, 4 Prasthas = 1 Ā’dhaka, 4 Ā’dhakas = 1 Drona, and 4 Dronas = 1 Kháři or Bhára.

24 Āṅgulis make 1 Hasta, cubit, which may be taken to be 18 or 19 inches. A Kudava was divided into 4 Palas, and there can be no doubt that originally water of the weight of 4 Palas was found to be actually contained in a vessel of the cubical capacity of a Kudava. If we take the ancient cubit to have been 19 inches, the Kudava would contain nearly 4 Palas of distilled water at 30° Centigrade. On a cubit of 18 inches, the Kudava would contain about $3\frac{3}{4}$ Palas.

The Kudava in current medical practice is supposed to represent a cubical vessel, each side being 4 Āṅgulis. This would give a capacity of 27 cubic inches, if we take the modern cubit of 18 inches. The Kavirájas take a Kudava to contain 8 Palas of water, and as 1 Pala = 320 Krishnalis, and 80 Krishnalis are now taken to be equal to 210 grains Troy, a vessel of a capacity
of 27 cubic inches is accordingly supposed to contain about 6720 grains Troy,—which is not very wide of the mark, being about 1\(^\frac{3}{4}\) per cent. short for distilled water at 62° Fahrenheit.

Size of the minimum visible; size of an atom.

The supposed thickness of the just discernible mote in the sunbeam called a Paramanu in Technology, Silpa-sâstra, (and a Trasarenu in Natural Philosophy; follows directly from Varahamihira's table)—8 Paramánus make 1 Rajas (or Ratharenu,—cp. the Manasarâ), 8 Rajas make 1 Válágra (filament of hair), 8 Válágras make 1 Likshá, 8 Likshás make 1 Yúká, 8 Yúkás make 1 Yava, 8 Yavas (the Manasara has 4) make 1 Anguli (superior), 24 Angulis make 1 Hasta (cubit, lesser cubit, 18 inches). The thickness of the minimum visible (the finest perceptible mote in the slanting sunbeam) is therefore taken to be 3.2— or \(\frac{3.5}{2}\) of an inch. The volume of a spherical Trasarenu (or Paramánu of the Silpa-sastra) would therefore be \(\frac{4}{3} \times 3.2^3\) of a cubic inch. It may be here noted that such a Trasarenu is supposed in the medical schools to contain 30 chemical atoms (Paramanus of Natural Philosophy) according to one estimate, or 60 according to another. The size of an atom must then have been conceived to be less than \(\pi \times 3.5^3\) of a cubic inch.

Varahamihira, Vrihatsamhitâ, Chap. 57, Sōkâ 2—जालाननारगते
The magnitude of a Paramānu is called Pārimādualya (पारिमादूल्य) in the Nyāya-Vaisheshika, the name suggesting that the Paramānus were conceived to be spherical in shape. The Nyāya-Vaisheshika calls a Paramānu a mere point without any dimensions, but in the Sāṅkhya-Pātañjala, a Paramānu, though indefinitely small, had still dimensions, being divisible into Tanmātrasis, which were themselves integrations of Bhūtādi. The diameter of a spherical Paramānu must have been conceived to be less than $3.2^{-0}$ of an inch (i.e. less than the conventional Paramānu with which linear measures begin), and the volume of a Paramānu would therefore, in accordance with Bhāskara's formula, be smaller than $\frac{4}{3} \pi 3^{8.2^{-63}}$ or $\pi 3^{2.2^{-81}}$ of a cubic inch where $\pi = \frac{3\times8\times7}{12\times6\times0}$. The Tanmātras were conceived as smaller still.

That these were conventional measures arbitrarily assumed goes without question, for, of course, the Hindus had no physical data for a mathematical calculation of these minute quantities. A Vālāgra (hair-tip, or finest filament of hair), for example, is taken to be $3.2^{-14}$ of an inch thick; i.e. less than one five-thousandth fraction
of an inch in thickness; and a fibril of the networks of Dhamani or Nāḍī (nerve) that supply the pores of the skin (papillae? सूचानि रौमक्रूप-प्रतियढ़ानि, Susruta) was supposed to be about a thousandth part of the finest hair in thickness, or \( \frac{1}{1000} \) of the ‘minimum visible,’ and therefore about \( 3 \times 10^{-8} \) of an inch thick (cf. सूचानाधी-प्रभारत: रौमः सहस्रभागोत्तुल्याचु प्रचरति, Pañchadasāṅi), but it is evident that these measures were arbitrarily fixed upon, instead of being arrived at by calculation or actual measurement. Indeed, Charaka expressly states that the number of Sūrakṣas and Dhamanis in the body (three million fifty-six thousand and nine hundred) is only a conjectural estimate (अनिन्द्रेष्यमत: परं तक्षेमेव—Sūrārasthāna, Chap. VII).

My account of the chemistry of the Sānkhya-Pātañjala, and of the affiliated Yoga and medical schools, has anticipated in several points the views of the Vedānta and the Nyāya-Vaiśeshika. The chemical facts, processes and apparatus are indeed common to all the schools. In the following account of the chemistry of the schools other than the Sānkhya-Pātañjala, I will confine myself to the theory of the subject, and even of this I will attempt only the briefest outline.

The Vedāntic view:—

The Vedāntists believe Māyā to be the ‘material cause’ (उपादानकशार्य) of the world. The power
of Mâyá is the power to realise the unreal—to impart practical Reality or mediate existence to that which does not and cannot possess absolute Reality or self-existence. Mâyá is at once real and unreal, while the Brahma (Self) is absolute Reality, absolute Intelligence and absolute Bliss. The world evolves out of Mâyá (मायापरिब्रम्भ), so that Mâyá in the Vedánta replaces the Prakṛiti of the Súṅkhya. But Mâyá, and by implication the world, originate out of Brahma, not by a process of evolution (परिब्रम्भ), but of Vi-varta (self-alienation). The self-alienation of the Absolute, acting through Mâyá, produces in the beginning A’kāsa, one, infinite, ubiquitous, imponderable, inert and all-pervasive. The world thus begun goes on evolving, in increasing complexity. The other Súkhshma Bhūtas, classes of subtile matter, evolve from A’kāsa, in an ascending linear order,—A’kāsa giving off Vāyu, Vāyu giving off Tejas, Tejas giving off Ap, and Ap giving off Earth. A’kāsa, one, infinite, all-pervasive, has the capacity of sound. Vāyu, subtile gaseous matter, emanates from the universal A’kāsa, and is instinct with the potential of mechanical energy (impact, pressure). (ईरण, प्रकाशित, वहन, व्यक्त, —वायोब्रह्मचेताहेतुलोक सच्चिदिनाभूतात—Vidvanmanorañjini). Tejas, subtile radiant matter, emanates from Vāyu, and contains in potentia the energy of light and heat. Ap, subtile viscous matter, is the
transformation of Tejas, and is instinct with the energy that stimulates the nerve of taste, and lastly, Earth, subtile hard matter, which is the transformation of Ap, possesses the latent energy of smell.

But the subtile rudiments of matter must be compounded in various ways, to give rise to the gross constituent matter of the world. These forms of gross matter are called Mahábhútás. There are five kinds of Mahábhúta (gross matter corresponding to the five Súkshma Bhútás (subtile matter), and the process by which a Mahábhúta is produced from the Súkshma Bhútás is called Pañchí-karana (quintuplication). All the five Súkshma Bhútás are present as ingredients, though in different proportions, in each Mahábhúta.

The Mahábhúta Earth, gross earth-matter, is composed of four parts of subtile earth-matter, and one part each of the other forms of subtile matter. The Mahábhúta Váyu is composed of four parts of subtile gaseous matter and one part each of the other forms of subtile matter. And similarly with other Mahábhútás.

Hence if ak, v, t, ap, e, represent the five forms of subtile matter (A’kásá, Váyu, Tejas, Ap and Earth), and AK, V, T, AP, E, stand for the corresponding Mahábhútás, we may represent the constitution of the Mahábhútás as follows:—
AK = ak₄. (vᵣ, tᵢ, apᵣ, eᵢ), akᵣ being the radicle.
V = v₄. (akᵣ, tᵢ, apᵣ, eᵢ), vᵣ being the radicle.
T = t₄. (akᵣ, vᵣ, apᵣ, eᵢ), tᵣ being the radicle.
AP = ap₄. (akᵣ, vᵣ, tᵢ, eᵢ), apᵣ being the radicle.
E = e₄. (akᵣ, vᵣ, tᵢ, apᵣ), eᵣ being the radicle.

In forms of gross or compounded matter, the potential energies (or qualities) become actualised. The Mahābhūta A'kāsa manifests sound; Vāyu, sound and mechanical energy; Tejas, sound, mechanical energy and heat-light; Ap, the energy of the taste-stimulus in addition; and finally Earth, the energy of the smell-stimulus added to the foregoing.

The Pañchadasi characterises the different Mahābhūtas by their typical sounds; e.g., A'kāsa by the echo (hollow booming sound); Vāyu (air) by a sibilant sound, hissing, susurration (imitative symbol, Visi); Tejas (fire) by a puffing (or roaring) sound (imitative symbol, Bhugubhugu); Ap (water) by a liquid sound (imitative symbol Culu-Culu, gurgle, plash-plash, glut-glut); and finally Earth by a splitting or rattling sound, a crack or a thud (symbol, kad-kada)—Chap. II. Bhūtaviveka, S'loka 3, Pañchadasi).

Others hold that A'kāsa, Ether, never enters as a component part, and is always one and indivisible. In this view, the four Mahābhūtas—Vāyu, Tejas, Ap and Earth alone are supposed to be com-
pounded, and by a process which may be called quaternion (cf the Neo-Platonist quaternion):

\[ V = v_3 ( t_1 \cdot a_1 \cdot e_1 ) \]
\[ T = t_3 ( v_1 \cdot a_1 \cdot c_1 ) \]
\[ AP = a_3 ( v_1 \cdot t_1 \cdot e_1 ) \]
\[ E = e_3 ( v_1 \cdot t_1 \cdot a_1 ) \]

These compound forms, as before, are supposed to exercise their specific energies actively. Others again hold that the Mahábhútās—Tejas, Ap and Earth alone are compounded by a process named Trivrit-karana (triplication). Thus \( T = t_3 ( a_1 \cdot e_1 ) \), \( AP = a_3 ( t_1 \cdot e_1 ) \), \( E = e_3 ( t_1 \cdot a_1 ) \).

The Súkshma-bhútās are forms of homogeneous and continuous matter, without any atomicity of structure; the Mahábhútās are composite; but even these are regarded as continuous, and without any atomic structure. The Vedánta speaks of Anu (Paramánu) not as an ultimate indivisible discrete constituent of matter, but as the smallest conceivable quantum or measure of matter. In the Sáńkhya doctrine, the atomic structure is ordinarily accepted. The Gunas are supposed to be परिरिक्ष्ठ and अशु bounded and indefinitely small in size (except the Gunas giving rise to Jkása and Manas which are unlimited अपरिरिक्ष्ठ); and hence the Tanmátrās and Paramánuṣ must be conceived to have a discrete structure.

As I have already noted in my account of the genesis of Tanmátrās and Paramánuṣ, various
schools of Vedántists (e.g. the Rámánujists and the followers of Nimbárka) combined, in the orthodox fashion of the Smṛitis and the Puráṇas, the Vedántic theosophy with the Sāńkhyya cosmology especially as regards Prakṛti and the order of creation and dissolution. For example, the Vedánta kaustubhaprabhā, fortifying itself with texts from the Vishnu Puráṇa and the Subala and Gopała Upanishads, contends that, at the cosmic dissolution (Pralaya), each Mahábhúta merges into the one that preceded it in the order of creation by first disintegrating into its own proper Tanmátric form (तन्मात्रद्वारा), and that the Mahábhúta Akása merges into the original Tanmátras, which then lapse into Bhútádi, the supersubtile rudiment matter, proto-matter (Chap II, Pada 3, Sútra 14).

Parináma—Evolutionary Process:—When the Mahábhútas are once formed, the different kinds of substance are derived from them by the evolutionary process called Parináma (परिनाम, transformation). Matter is constantly undergoing change of state. The effect is only the cause in a new collocation (कार्यश्च य संस्कारामावं कार्यम्). Change is of two kinds:—

(1) Change by a spontaneous process, without external influence, including isomeric change (न्यायात्मिक परिनाम). The Vedántists believe in
spontaneous disintegration and reintegration. Action from without, impressed force *ab extra*, is not, *pace* the Naiyáyikas, always a condition of change of state (whether of rest or of motion); nor is it necessary that more than one substance should combine to generate another substance or variety of substance (*e.g.* the formation of curds from milk, of ice from water *etc.*.) All this is directed against the Nyáya doctrine (*Arambhaváda*).

(2) Change due to combination with other substances (*द्वान्तरसङ्ग्राम*). Such combination may produce (1) a compound substance possessing like qualities with the constituents (*ममान्तरोन्यात्पत्ति*), or (2) unlike compounds with new qualities, “heteropathic effects” (*वेजान्तरोन्यात्पत्ति*). Any new quality thus evolved through (chemical) combination is called Samhata-bhúta-dharma (*संहतभूतधर्मं*). *E.g.* the intoxicating power of the fermented rice and molasses, which does not exist in the ingredients taken separately. (*मद्याभासां प्रक्षेप चवर्त्तानांिः समुदायणः सङ्ग्रामः समुदायः: दश्यन्ति*). This Sambhúyakriyā (*सम्भूयक्रिया*, *समुद्याण*) corresponds to chemical combination, and the Vedántists, like the Sánkhyas, explain this only as the evolution of the latent energy (*गतिः, अनुसूचिकतः*) in a new collocation (*संख्यान, अवस्थव-सङ्ग्राम*). But, unlike the mediæval
Sāṅkhyya, the Vedānta freely recognises the combination of heterogeneous Bhūtas. Thus, Earth, Ap, Tejas and Vāyu freely combine in different proportions and groupings to produce the variety of substances in the world. For example, the animal organism is a compound of all the five Bhūtas (पञ्ज—भौतिक). It is not merely the concomitant or efficient causes that may be heterogeneous to the material cause, as the Naiyāyikas contend, but several heterogeneous substances (or Bhūtas) may unite as 'material causes' to produce a new substance.

The Vedāntists resolve all activity, physical, vital as well as psychical, into modes of motion, subtile cosmic motion (परिस्थित्त, सत्यभोक्ति—स्न्यान— Saṅkara; वासोः परिस्थितिविप्रस्तवतुः—प्राणश्च परिस्थित्तात्मक—व्यावहरण—यदृढः तं स्थूलं स्थूलम् च तकच्च भनः सत्यतमालम्—Saṅkara); but they give a separate substantive existence to the agents, the vital principle (प्राण) and the mind (मनः), though these are also evolutionary transformations of the Sūkshma Bhūtas (forms of subtile matter). What is common to the Nyāya, the Vedānta and the Sāṅkhya is that Consciousness or Intelligence (चक्ष्य) transcends Matter: but the Naiyāyikas as pluralists hold that vital and psychical activities are also immaterial and cannot be resolved into motion (परिस्थित्त);—the Vedāntists resolve these activities into subtile motion, but
ascribe them to a substantive quasi-material Life Principle and Mind, the all-mirroring Intelligence (चन्दन) alone being immaterial and transcendent; and the Sāṅkhyas accept the substantive existence of the Mind Principle (मन:) as derived co-ordinately with the Sūkshma Bhūtas or Tanmātras from individualised Prakṛiti (Ahaṅkāra), but resolve Life into a mere resultant activity of the bodily organs, viz., the organs of sense and movement, and the psychic principle (मन:).

प्रश्नोकर्षण : — द्वादित्र विधाय चैकैक चतुष्की प्रत्यय पुनः।
स्वतंतरदिविनीयाश्रेीसां जनात् पञ्ज पञ्ज तेऽः।

यथा विनंस्मुवै छटदान भूतानां स्फूटतरव्यक्तानाम-रूपस्य करणोपायनां नििष्टकर्षण युनः तद्वन्द्व शूलश्चकर्षण-शुनाभ अफळ तथा। तद्वन्द्वानि प्रश्नोकरणानां च चाकाश शव्दोब्धि-अन्यत्रे स्फूटतयोस्त मध्ये ये जनोयनम (विहनभूनामर्जीनी) —यङ्गसि विमी ग्रीैरेर सन्ध्यामिनी सन्ताना कायं संगतिवर्धिनि: चायकाश्चून्द-पवनलक्ष्मे नकाठिण्यां साध्ये जनातुभवसिहळ्ळात्। चाक्षस्तुतिकार्षणां प्रश्नोकर भूसानि एकदिस्मिन् दृष्टे सन्तीने संगते तत्तपत्योरित वच-वचावर्त्तमैवमैव पञ्ज्युद्वाहेयोर्युक्ता। न च सर्गशृणुस्वालात् एक-द्व्यालात् च चायकाश्च चारस्मकालातुपपत्तिविनिति वाच्य।
चारस्मकालात्स्य चन्द्रोक्तरात्। एकधारापी हरधारवायविनो द्व्याच-रस्मकालात्तुगानात्। वस्तुस्तुत पञ्जानम् भूतानां पञ्जाबलकार्य-दर्शिवलात् चारस्मकालात्स्य निराकारस्वालात्। लक्ष्मातु सिंहं ग्रीैरे पञ्जमानरितिमिनि। Vidvanmanorānjinī.
The atomic theory of the Buddhists:—The Vaibhāṣikas and the Sautrāntikas hold that the Vāyu-atoms are touch-sensibles, having impact or pressure for their characteristic property, and by aggregation form the element Vāyu; the Tejas-atoms are colour-and-touch-sensibles, having heat for their characteristic, and by aggregation form the Tejas Bhūta; the Ap-atoms are taste-colour-and-touch-sensibles with a characteristic viscosity, and form the Ap-element by aggregation; and finally the Earth-atoms are smell-taste-colour-and-touch-sensibles possessing a characteristic dryness or roughness (खर्च), and by their aggregation form the Earth-element. The Bhūtas
thus originated combine to form aggregates, which are classed as inorganic substances, organisms and organs. (कार्य स्वरूप कोश: Udyotakara's extract from the Buddhist Sūtras, Nyāya Vārtika. Chap. 1. अह्निक 1, Sūtra 14. cf. Vāchaspati's fuller extract:—कार्य स्वरूप कोश: रागस्य: कृपात्सरसपदाः: कामचात्तः:—also the Buddhist commentary:—कार्य कामचात्तौ वच्चा-च्या: चाः: कृपरसगमस्याः द्रवित वल्लारित द्रव्यारित ग्रंथिच्ययः तेजोयाः: द्रवित वल्लारित—Vāchaspati, Tātparyyatikā, loc.cit.—also खरस्तेषोग्रासभावानि भूतानि—vide Udyotakara, Chap. III, अह्निक 2, Sūtra 12,—Vide also Sṛṅivāsa's Vedānta-kaustubha, Chap. II. Pada 2, Sūtra 18).

The atomic theory of the Jainas:—Of the nine categories of the Jainas, that of Ajīva (the not-soul or non-Ego) consists of five entities, four of which are immaterial (चूत), viz., merit, demerit, space and Time, and the fifth, material (चूत, possessing figure). The last is called Pudgala (matter), and this alone is the vehicle of Energy, which is essentially kinetic, i.e. of the nature of motion. Everything in the world of not-soul (the non-Ego) is either an entity (द्रव्य), or a change of state in an entity (प्रत्याय). Pudgala (matter) and its changes of state (प्रत्याय), whether of the nature of subtile motion (परिस्थित्त) or of Evolution (परिप्रसाद), must furnish the physical as opposed to the metaphysical basis of all our explanations of Nature. Pud-
gala (Matter) exists in two forms,—Anu (atom) and Skandha (aggregate). The Jainas begin with an absolutely homogeneous mass of Pudgalas, which, by differentiation (भेट) breaks up into several kinds of atoms qualitatively determined, and by differentiation, integration, and differentiation in the integrated (सूचातां, भेटात, सूचाताभेटात—Uma-sāṭī, Chap. V, Sūtra 26), forms aggregates (Skandhas). An Anu has no parts, no beginning, middle or end. An Anu is not only infinitesimal, but also eternal and ultimate. A Skandha may vary from a binary aggregate (द्वागुक) to an infinitum (अन्नलागुक). A binary Skandha is an aggregate of two Anus (atoms), a tertiary Skandha is formed by the addition of an atom (Anu) to the binary (द्वागुक) and so on ad infinitum. The ascending grades are (1) what can be numbered (संख्येय), (2) indefinitely large (संख्येय), (3) infinity of the first order (अनन्त), (4) infinity of the second order (अनन्तानन्त), and so on.

General Properties of Matter:

The specific characters of the Pudgalas (Matter) are of two kinds, (1) those which are found in atoms as well as in aggregates, and (2) those which are found only in aggregates. Qualities of touch, taste, smell and colour come under the first head.
The original Pudgalas being homogeneous and indeterminate, all sensible qualities, including the infra-sensible qualities of atoms, are the result of evolution (परिप्रेक्ष्यन्य). Every atom thus evolved possesses an infra-sensible (or potential) taste, smell and colour, (one kind of each) and two infra-sensible tactile qualities, e.g. a certain degree of roughness or smoothness (or dryness and moistness?) and of heat or cold. Earth-atoms, Ap-atoms, etc. are but differentiations of the originally homogeneous Pudgalas. The tactile qualities (खर्च, स्फुरण, चक्षु, शोभ) appear first, but qualities of taste, smell and colour are involved in the possession of tactile qualities. An aggregate (Skandha), whether binary, tertiary or of a higher order, possesses (in addition to touch, taste, smell, and colour) the following physical characters:—1) sound, 2) atomic linking, or mutual attraction and repulsion of atoms, 3) dimension, small or great, 4) figure, 5) divisibility, 6) opacity and casting of shadows, and 7) radiant heat and light.

Sensible qualities. Tactile qualities are of the following kinds—hardness or softness, heaviness or lightness (degrees of pressure), heat or cold, and roughness or smoothness (or dryness and viscosity?). Of these, the atoms (Anus) possess only temperature and degrees of roughness
or smoothness, but all the four kinds of tactile qualities in different degrees and combinations characterise aggregates of matter from the binary molecule upwards. The Jainas appear to have thought that gravity was developed in molecules as the result of atomic linking. Simple tastes are of five kinds,—bitter, pungent, astringent, acid and sweet. Salt is supposed by some to be resolvable into sweet, while others consider it as a compound taste. Smells are either pleasant or unpleasant. Mallishena notes some elementary varieties of unpleasant smell, e.g. the smell of asafoetida, ordure, etc. The simple colours are five—black, blue, red, yellow and white. Sounds may be classed as loud or faint, bass (thick) or treble (hollow), clang or articulate speech.

The most remarkable contribution of the Jainas to the atomic theory relates to their analysis of atomic linking, or the mutual attraction (or repulsion) of atoms, in the formation of molecules. The question is raised in Umásváti's Jaina Sútras (circa A. D. 40)—what constitutes atomic linking? Is mere contact (or juxtaposition) of atoms sufficient to cause linking? No distinction is here made between the forces that bind together atoms of the same Bhúta, and the chemical affinity of one Bhúta to another. The Jainas hold that the different classes of elementary substances (Bhútas) are all evolved from the same primordial atoms.
The intra-atomic forces which lead to the formation of chemical compounds do not therefore differ in kind from those that explain the original linking of atoms to form molecules.

Mere juxtaposition (संयोग) is insufficient; linking of atoms or molecules must follow before a compound can be produced. The linking takes place under different conditions. Ordinarily speaking, one particle of matter (पदार्थ) must be negative, and the other positive (विपरितरूप); the two particles must have two peculiar opposite qualities, roughness and smoothness (कठिन and स्वाभाविक or dryness and viscosity?), to make the linking possible. But no linking takes place, where the qualities, though opposed, are very defective or feeble (जबन्धनुष). We have seen that, ordinarily speaking, two homogeneous particles, i.e. both positive, or both negative, do not unite. This is the case where the opposed qualities are equal in intensity. But if the strength or intensity of the one is twice as great as that of the other, or exceeds that proportion, then even similar particles may be attracted towards each other. In every case, change of state in both the particles is supposed to be the result of this linking, and the physical characters of the aggregate depend on the nature of this linking. When particles of equal intensity (negative and positive) modify each
other, there is mutual action; in cases of unequal intensity, the higher intensity transforms the lower, it being apparently thought that an influence proceeds from the higher to the lower. All changes in the qualities of atoms depend on this linking. A crude anticipation this, of the ionic theory of chemical combinations, very crude but immensely suggestive, and possibly based on the observed electrification of smooth and rough surfaces as the result of rubbing. The interpretation of क्षूर and स्निग्ध as dry and viscous (or as vitreous and resinous?) must be rejected in this connection as untenable. The Tattvārthaśāstra of Umāsvāti, which expounds the theory, most probably dates back to the first half of the first century A.D.

Cf. Umāsvāti-Tattvārthaśāstra, Chap. V.
व्याव: सक्षमास्तुः। द्वारं च। कारणामेव तदन्तः स्वतः निलक्ष्य
भवति परमाणुः। दक्षिणस्थलवर्णोऽद्वितीयः काय्य लिङ्गः
तदायोऽवबधः। सक्षमास्तुः बहुः एव। सक्षमाषतनि संघातभेदे धर्म उत्पदयाने। संघाताः द्वारति संघातभेदार्दित। द्वयः परमाणोः
संघाताः द्वारं प्रदेशः। हिस्र्यग्निस्यायोऽयं संघाताः द्विप्रेषः। एवं
संख्येयानासंख्येयानाभन्ननां अनन्यनन्यनां च प्रद्वेष्णां
संघाताः प्रदेशः। भेतादशः। भेतादशं परमाणुः कुतपद्यते
न संघातार्दितः। चालाः। किं संयोगमातार्दित संघाता भवति।
आहोत्तदिमति काव्यद्विशेषः दृशः। चालोच्चः। सति संयोगे
बहुः संघातो भवतोर्दितः। स्निःप्रथमतायाः। न जययज्जुः
समानाः। निःप्रथमाः। उपः वलोः स्यात्रां च भवतीस।
जच्चज्जुःस्मीतः संहुः जच्चज्जुःस्मीतः परम्यरेण वस्तोः न भवतीस।
एतां भवता जच्चज्जुःस्मीतो निःप्रथमाः सद्योः क्रयः
सान्याः च स्निःप्रथम सद्य वस्तो भवतीस। अय तुल्यग्नायोः
किमयन्त्रप्रसिद्ध दृशः। चालोच्चः। न गुणमात्राः सद्याः
गुणमात्राः सति सद्याः वस्तो न भवति। सद्योः। तुल्यग्नाः
स्निःप्रथम तुल्यग्नाःस्मीतः स्निःप्रथम तुल्यग्नाःस्मीतः दृशः।
चालाः सद्याःस्मीतः किमेच्चः दृशः। चालोच्चः। गुणमात्राः
सद्याः वस्तो भवती दृशः। चालाः किमेच्चः गुणमात्राः
सद्याः वस्तो भवतीस। चालोच्चः। दद्रधिकारितग्नाः तु
दद्रधिकारितग्नाः सद्याः वस्तो भवति। हिस्र्यग्निदद्रधिक-
स्मीरेण। हिस्र्यग्निदद्रधिकस्मीरे द्विप्रेषः। नुस्मायः
हिस्र्यग्निदद्रधिकस्मीरेः दृशः। एकार्दितग्निदद्रधिकरेः सद्योः
वस्तो न भवतिः। चालाः परमाणुः नक्षेत्रः च ये स्निःप्रथमाः
The Nyaya-Vaiseshika chemical theory: a brief summary.

I must content myself here with a brief and rapid sketch of the chemistry of the Nyaya Vaiseshika, which I shall elaborate in connection with the mechanics and physics of the ancient Hindus in a separate paper.

The relation of the specific characters of molecules (and higher aggregates) to the original atomic qualities is reduced in the Nyaya-Vaiseshika to the following canons:—

(a) काय्यमुग्छ कारणगुण-पूर्वकाम्।

(b) समानजातैऽस्य योगः: त्रिव्यार्स्मकः न विज्ञातौसमांयोगः। (Here त्रिव्य is used in a narrow technical sense, so as to exclude the quasi-compound substances).

(c) अपाक जन्यपरस्यन्यस्य परिमाणाः कत्र्ये कष्टव्य-गुणन्तः।

(d) क्यपरस्यम्यन्य-स्यस्य गुण-परिमाणाः कत्र्ये कष्टव्यात्तः हि: समानजात्यार्स्मकः।

No separate explanation is necessary, as the canons are embodied in the following exposition.
Theory of Atomic combination:—

The four kinds of Atoms are Earth, Ap, Tejas and Váyu atoms, possessed of characteristic mass, numerical unit, weight, fluidity (or its opposite), viscosity (or its opposite), velocity (or quantity of impressed motion—Vega); also characteristic potential colour, taste, smell or touch, not produced by the chemical operation of heat (हार्मज़-कुपरशगङ्ख्यार्मण्य काले क—पद्यो—गुम तद्वृत्तत्त्वो हवेगा: ).

A'kása has no atomic structure (निरबयः), and is absolutely inert (निधित्वः), being posited only as the substratum of sound, which is supposed to travel wave-like in the manifesting medium or vehicle of Váyu (air). Only the other four Bhūtas unite (or disunite) in atomic or molecular forms. The orthodox view is that, the presence of Earth-atoms is necessary whenever chemical transformation under the operation of heat (पाक्जात्पति) takes place.

Atoms cannot exist in an uncombined state in Creation (S’iváditya, Sapta-padārthi—rīde commentary, where, however, it is noted that still atmospheric air is believed to be monatomic in structure, i.e. to consist of masses of atoms in a loose uncombined state—(स्लिमित्राकु ल परमाणु समुह एव अनारस्थल-ट्वः: 1)

The atoms may combine in one or other of the following ways:—
I. One Earth-atom, by an original tendency, unites with another, to form a binary molecule (द्वारणक). In the same way, binary molecules of the other Bhūtas are formed. The atoms are possessed of an inherent Parispanda (rotary or vibratory motion), and when they unite in pairs, so long as there is no chemical operation under the action of heat corpuscles, the original qualities of the atoms produce homogeneous qualities in the binary molecules.

The question as to the existence of a triad, a tetrad, a pentad etc. of atoms is one of the moot points of the Nyāya-Vaiseshika. The orthodox view is that, the primordial infinitesimal particles (atoms) start with an incessant vibratory motion (अनवर्तपरिस्थितमानापरिमितिप्रतिप्रमाणः). Raghuñátha Siromani—गतिशोबद्धान प्रतिव्ययपदेशः प्रतिनीति, Udayana. Kusumānjali), and an inherent impulse that drives them to unite in pairs—a sort of ‘mono-valency’, as it were, exhausted with the formation of a binary molecule. The binary molecules now combine by threes, fours, fives, etc. to form larger aggregates as well as the variety of elementary substances, the particular collocation in any case being not only determined by physical causes, but also serving to satisfy the ends of the moral Law in creation (अद्वित, कम्प). (द्वारणकृपैंप्रभुराध्य इत्यिप नियमे, न द्वाभ्याम्। बहुथ तत्त्विनिमयः। कितीविरदा-
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A triad (Tryanuka), then, holds together three atoms (Anus), not three binary molecules (Dvyanukas) as on the orthodox hypothesis. Similarly with tetrads, pentads, etc. (चतुर्भुजः परमाणुः चतुर्भुजानि-वायूनाम्। द्वाभयं परमाणुः द्वाब्रणुः कमारभ्ये विभि)}
These binary molecules are grouped by threes, fours, lives, etc. (वर्ग के चतुर्गु के) to form different isomeric modifications. The variety of Earth-substances is due to differences in the arrangements of the molecules, (e.g. their greater or less density, and, above all, their grouping or collocation अङ्कृत, अयुग्मक्रमिश्न), which account for the specific characters (अपरजातिः) manifested by these isomeric substances. सा (श्रीयव) च स्वयं यथायग्न-मित्रेयशिर्यि चित्रजातिनिवक्तविमेशः। प्रसास्त्पादाः, श्रीयवविनःप्रमणः। स्थायिनः नियोऽनमः। चाडिग्राह्य श्री-प्राचीनादिपरिभाषः। परमाश्वादित्याः चाप्रजातिस्वाबेदिपि चाप-वा तथा तথा तथा तথा तथा तथा तथा तथा तथा तथा तथा तथा तथा तथा तथा तथा तथा तथा तथा तथा तथा तथा तथा तथा तथा तथा तथा तथा तथा तथा तथा तथा तथा तथा तथा तथा तथा तथा तथा तथा तथा तथा तथा तथा तथा तथा तथा तथा
These original differences in molecular grouping leading to distinctions of genera and species, however mechanically or physically explained, come also under the operation of moral and metaphysical causes (चक्रवातपन्न), i.e., of ideal ends in the moral government of the universe, which are superimposed upon the physical order, but which do not come within the scope of Natural philosophy. An elementary substance thus produced by primary atomic combination, may, however, suffer qualitative change under the influence of heat (प्रक्तितन्त्र) The process is as follows:—(1) the impact of heat corpuscles decomposes the binary (tertiary, or quaternary) molecules into homogeneous atoms possessing only the generic characters of the Bhūta concerned;—(2) the impacts of heat particles continue, and transform the characters of the atoms, determining them all in the same way;—(3) the heat particles continue to impinge, and reunite the atoms so transformed to form binary (or other) molecules, in different orders or arrangements, which account for the specific characters or qualities finally produced. The Vaiseshika holds that
there is decomposition into homogeneous atoms, transformation of atomic qualities, and finally recombination, all under the influence of heat. The Nyāya on the other hand thinks that the molecules and larger aggregates assume the new characters under the influence of heat without decomposition into homogeneous atoms, or change of atomic characters (पिन्यायक or पिटयायक).

The Nyāya view:—व विज्ञावयनाले पूर्वं चर्चारः...
Chemical combination (सम्बुधाःक्रिया, संहिताक्रिया). Chemical combination takes place either between two or more substances which are isomeric modifications of the same Bhūta, or between substances which are modes of different Bhūtas.

A. Mono-Bhautic compounds. The simplest compounds are Mono-Bhautic compounds, i.e. compounds of different substances which are isomeric modes of the same Bhūta.

(a) Mono-Bhautic compounds of the first order:—Under the impact or impulse (घमिद्धार अर लेटत) of heat corpuscles, the substances in chemical contact (आरस्वतः संयोग) break up into their atoms. These atoms are homogeneous, possessing only the original physical and chemical characters of the Bhūta concerned. As the speci-
fic differences between isomeric substances arise from the arrangement or collocation of the atoms, the substances lose their distinctive marks on decomposition into the latter.

(न च परमाणुः अपरजातिभेदः विद्यते न च यववीजालिखीजयपराणां काश्यद्रविशेषः ।
Udyotakara, Chap. III, A'hnika I, Sûtra 4. न च युक्तशोधितपराणां काश्यद्रविशेषः पार्यविनविशेषात् ।
Srîdhara, Nyâya-Kandali, यथविनिस्पस्यम्।) Under the continued impact (or, it may be, impulse) of heat particles (नेगवना वैष्णवक्ष्येण नोदनात् चमिषामात् वा—Jayanta), these atoms take on new characters. It is heat and heat alone that can cause this transformation of the colours, tastes, smells, etc., in these original Bhûta-atoms. What particular colours, tastes, smells or physical characters will be produced in the atoms depends (1) on the nature of the constituent substances in contact, (2) the intensity or degree of the heat (खर, मद्य or मध्यम पाक), and (3) the species of Tejas-corpuscles.
that impinge on the atoms, or the nature of the impact (विलेखणात्तुजःसंख्या).

Now when the atoms have all been determined in the same way, they begin to recombine again under the impact (or impulse) of the heat-particles in binary molecules, (or tertiary, etc.), and these in higher aggregates. It seems to be generally held that, at the final step one or more atoms of one constituent substance unite with one or more atoms of the other constituent substance or substances to form a molecule of the com-
pound; but the question is not of much significance for Mono-Bhautic compounds of the first order, as, in these cases, the atoms have before this all lost their distinctive characters and become homogeneously transformed. The compound so produced will possess the new characters of the transformed atoms, so far as taste, colour, smell, etc. are concerned, but as the molecular arrangement or structure (अय्यस्त्र, अवयवसिद्धिवे) may vary, different compound substances may result from the same components.

(b) Mono-Bhautic compounds of higher orders:—Again, Mono-Bhautic compounds of the first order may chemically combine to form higher compounds, and as the ultimate Bhúta substratum is the same, the process of decomposition and recomposition will be essentially the same as before. The only doubtful point is whether in this case the component compound substances are broken up only into their constituent molecules, or into the original homogeneous Bhúta atoms. Some of the later Vaiseshika Scho-
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Hindus hold that the latter happens in every case of chemical composition, however complex, but the earlier Vaiseshika conceived that in the case of compounds of compounds, the decomposition does not proceed so far as the original Bhūta atoms; but that it is the specifically determined atoms constituting the molecules of the component compounds that are transformed under the impact of the heat-corpuscles; and then one such transformed atom (one or more according to another version) from the molecule of one component unites with one similarly transformed atom (one or more according to the other version) from the molecule of the other component. Prasastapāda, the great Vaiseshika Doctor, holds this view. When, for example, in the fertilised ovum, the germ and the sperm substances, which, in the Vaiseshika view, are both isomeric modes of Earth (with accompaniments of other Bhūtas), unite, both are broken up into homogeneous Earth-atoms, and it is these that chemically combine under the animal heat (and bio-motor
Energy, वायु to form the germ-plasm (कलज). But, next, when the germ-plasm develops, deriving its nutrition from the chyle (blood) of the mother, the animal heat breaks up the molecules of the germ-plasm into its constituent atoms (कलारभ्यक्तरस्मारकारण:), i.e., into atoms specifically determined, which by their grouping formed the germ-plasm, and then these germ-plasm atoms as radicals chemically combine with the atoms of the food constituents, and thus produce cells and tissues. (समुत्पन्नप्राकणेः कलारभ्यक्तरस्मारकारण्युभिः: वहमवशातु उपजातसः आहारपरमार्थिभिः सः सम्भ्रू शरीरानन्यारः मातो रस्मार्थं रत्ने रस्माना। यिद्ध युक्त मात: शोषितं सत्योः सन्नियान्तः जटाराजः समस्वातं युक्तशोषितारभ्यक्तेऽयु सर्वायुऽयु पूर्वे सन्नियान्तिनाशी सति सामान्यायुऽयुरात्तौ द्वायुऽयु: प्रक्रियायेश कलारश्रीरोत्पाति:। ......

......तव मातुरा राजारश: सायो संभ्रामित वहमवशात् तत् पुनः जटाराजः समस्वात् कलारभ्यक्तरस्मारकारण्यु तियाविभागादिन्यायेश कलारश्रीरो न नु समुत्पन्नप्राकणेः कलारभ्यक्त-
In this hypothesis, it is assumed that the atoms are similarly transformed, i.e., become endowed with the colour, taste, smell, etc. of the product (the cell or tissue), the moment before the chemical combination takes place. Similarly, when milk is transformed into curd, one view is that the transformation takes place (under internal heat) in the constituent atoms of the milk molecules, atoms specifically determined as milk, and not in the original atoms of the Bhūta (or Bhūtas) entering into the composition of milk. (Cf. एवं सहात्साधारणभाष्यः परमाक्षुभिरेव द्वारा-रम्यते। एकमयिन्येव द्वाराभिषेकः पर-माणु भिन्नव्यतिभाष्यः तत् दिध्व। Nyāya-bodhinī, on Annam Bhatta's Tarkasaṅgraha.) Cf. Dinakarī, on the other hand—द्वाराभें सहात्साधारणभाष्यं जनवेदी श्रव तस्म (द्विः: )। In these cases, the atomic contact is called constituent contact.
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(चार्मक्षयस्ये), and all the atoms are equally regarded as material causes
(उपादानकारण or समवायकारण) of the compound.

B. Hetero-Bhautic ‘quasi-compounds’.—

The Nyāya-Vaiseshika maintains that in the case of bi-Bhautic (or poly-
Bhautic) compounds, which are only quasi-compounds, there is another
kind of contact between the heterogeneous atoms of the different Bhūtas,
which may be called dynamic contact and is distinguished in its operations as
Upashtambha, Vishambha or Avashambha (उपस्थांभ, विशांभ or अवशांभ). In some
cases, it so happens that the atoms of different isomeric modes of the same
Bhūta do not chemically combine under the mere application of heat;—
they require to be surrounded (and 'excited', 'energised') by atoms of
different Bhūtas. For example, in
the case of the oils and fats as well
as of plant saps and fruit juices the
Earth-atoms must be dissolved in water
(Ap), and it is only when the water-
atoms (Ap-atoms) congregate round
the former that dynamic intra-atomic
forces are set up, and the Earth-atoms (with the water atoms in dynamic contact) now take on peculiar infra-sensitive characters (colours, tastes, smells) under the impact of the heat corpuscles, and then, under further impact, fall into groupings or collocations (of a very peculiar nature, to be presently explained) which determine the nature of the composite substance thus produced. Here it is the water-atoms that are dynamic (उपपञ्चक), and excite the Earth-atoms, and these substances, oils and fats (तेरेर and ग्रहणं), as well as acids (खमलगं) are, because of the Earth radicles, regarded as Earth-compounds (or Earth-substances). (पाक्य-स्थाविधानभारसख्यापरमाण्य-मद्धिः परमंत्राधिकारार्धार्धण्यामिष्य ग्रहादितित्वमार्गते। तत् च उपपञ्चकतया निमित्तताभाष्मायम: पानीयायम्:। तेषां संबुक्तसमवायेन ख्येरसबोपपर्वते। तैलसीरादियु पार्षिवत-मिद्धिः। तैलस्य भौमानक्षेत्रस्तु ग्रहवरूपः। Udayana). In the above instances, Ap (water) acts as dynamic (Upash-tambhaka, (उपपञ्चक), but Tejas
and Vāyu can also act in the same way on Earth-particles. Conversely, Earth-particles may act dynamically on the atoms of the other Bhūtas. For example, in the case of mercury and the metals which are conceived in the Nyāya-Vaiseshika to be igneous bodies (in fact they are supposed to be formed under the subterranean heat खाकरण), the Tejas corpuscles are believed to form the radicles, and the Earth-particles are dynamic (उपष्मक). (सुख्योदिति निरत्तरं भायमानभिपि न पूर्वः रूपं जहापि। तेनैव दूष्प्रान्तेः प्रतिभविलात् उपष्मकोपिर पार्थिवभागः सद्ग्रुप्प एवानु-वत्ते, यतु पुष्पाकारिना रक्तसारता दश्यते तन्मिश्रीमूताभिभावकत्तुदूष्प्रोपणमात्। एवेन पार्दाति व्याष्ठात्मक। Udayana, Kiranávalí, सेज्जनिष्ठश्रमसू। Cf. also शारिपि तेजस्मिच्छिनि सुवर्णं तेनाध्यात्म पार्थिवोभाग उपष्म-करण एष्ट वरः।)

It may be here noted that Gaṅgesa, the author of the Tattvachintámani, conjectures that even gold can be evaporated or made to disappear by the application of intense heat;
But while every Bhūta can act dynamically as उपेक्षक, ‘energiser’, ‘exciter’, it is the Earth-Bhūta alone which is capable of exercising the power of arrest or inhibition of molecular motion or the motion of particles due to gravity as in fluids (Vishtambha, विन्ध्य), or the power of counteracting the tendency in a given set of atoms to fall into a peculiar order or group (धृतिविन्ध्यतत्त्व)।

But Mathuránātha notes here—भक्तिप्रकराभच्छदिकम्। (सन्धिकथितारत्रहस्त)।

Oils, fats, milks—Bi-bhautic quasi-compounds, with Ap as energiser:—Oleaginous substances
are divided by Udayana into (1) oils, derived from vegetables, (2) butters derived from milk, and (3) fats derived from animals. The medical schools, as we have seen, recognise animal oils as distinguished from vegetable oils. Vegetable fats (e.g. विड्डङ्खल) are also mentioned. Vāchaspati in the Tātparyyatikā contends that mustard oil has not the flavour and smell characteristic of the true oils (sesamum, linseed etc.), and is classed with the latter by convention. Judged by the flavour test, Aṁikshā (the casein substance formed by mixing milk-curd with hot boiled milk) is to be classed with milk substances. So also Takra, whey,—but Vājīna, the thin fluid that is left after the Aṁikshā (casein substance) is separated, cannot be classed as milk. It may be added that the milks and curds as well as oils and fats derived from different species of vegetables or animals are supposed to differ in their ultimate structural arrangement, and therefore in kind; but Vallabha thinks that the ghees (clarified butters) prepared from different kinds of milk are of the same kind; in other words, the milks and curds are ‘polymeric’, the ghees (clarified butters), ‘isomeric’, using these terms, as before, in a loose general sense.
II. Mixtures like soups, solutions etc:—A soup is a physical mixture. When meat is boiled in water, there is the application of heat, with chemical changes in the meat, but the combination of meat-particles and water-particles in the soup is only physical combination, and not a chemical one. It is of course not a true compound, neither is it a quasi-compound, like milk (in which the water-particles are ‘energisers’ of the Earth-particles). Milk, for example, retains its milky substance, when it coagulates or becomes solid, (this of course is also the case with mono-Bhautic substances whether elementary or compound, e.g. water, which becomes ice,) but the substance we call a soup or solution ceases to be a soup
or solution, the moment it solidifies. Udyotakara notices gruel, baths, and lyes (alkaline solutions) as mixtures of this class (एतेन पाककार्ष्ट्रकविवेकावचारार्थः प्रयुक्तः। Vārtika, Chap. I, A’hnika 1, Sūtra 14). यूदोतकर निम्न उत्पन्नपाकजानां द्रग्गां कालवियानुग्रहे सति द्रव्यालरस्यजानां पाकजातपनाः यः संयोगः स यूप हृति। एतेन पाककार्ष्ट्रकविवेकावचारार्थः प्रयुक्तः। Udyotakara, Vārtika, Chap. I. A’hnika 1, Sūtra 14. Vide also Vāchāspati’s comment: उत्पन्नपाकजानाः नै निम्न सापिष्ठ या पिन्त्रांधुपिश्नाकववाना द्रव्यालरस्य ग्रेलोन समुजानां पाकजातपनाः सलां न कामी सहसा द्रुतुं कालवियानुग्रहेः सतीसि। स च संयोगमेतः एव स्तोत्सांस्योन्ति अवयवेऽ बिजासीयोर्यार भक्तातू। नापि दृष्टानां नीयोसांस्यो द्रव्य चौरोजातीयािग्रेन सुभाम्। नीयोर्यारे काळिन्योर्यारे चौरुबृहिष्कयोर्यायार द्रव्यार्यार्। इह तु काळिन्यो न द्रुतुंकुहिष्कयोर्यार्यार् हृतिस सम्भवमेत एव स्तोत्सांस्योर्ण्यां हृति न्यायस्य। स च अनुभवविविधः संयोगियोपाधिकः। Vāchāspati, Tātparyatīkā, ibid. For salt and alkaline solutions, vide Kiranāvali—यत्तुपुनरस्विद्विभुते चारांदिर्प्रः पातिसे उपप्रभान्ते स द्रग्गुलकयास्त्रव पार्थिवविभोपाधिकः। कदमन्यथा सस्त्रव चन्द्रासक्षयस्य रक्षा सम्प्रय एव। Udayana, Kiranāvali, जवानिकृक्ष्यम्।

Chemical action and Heat:—The operation of heat is of course universally implied in chemical
combinations. Where the application of external heat is wanting, Vátsyáyana, the great Doctor of the Nyáya, points to the operation of internal heat.\footnote{Vátsyáyana-Bháshya, Chap. IV, Áhnika 1, Sútra 47.} In the case of combustion, we have seen Víjñána-bhikshu explain the heat as latent in the Earth-substance, the fuel, from which it breaks forth. Udayana points out that the solar heat is the source of all the stores of heat required for chemical change in the world. The change of colours in grasses, for example, is due to Tejas, in the form of latent (invisible) heat, not in the form of Agni; and the cold in winter cannot take away this store derived from the Sun. (Udayana, Kiránaválí 1) Similarly, it is under this solar heat that the unripe mango ripens, \textit{i.e.} changes
colour, taste, smell etc., showing that there is chemical transformation or subtile decomposition and recomposition going on; and this is also the case with the rusting of the metals, which is a combustion due to the solar heat (सूर्य पाखु) even as the conversion of food into chyles and of chyle into blood are instances of chemical action due to the internal animal heat (जागरान्त्व अर्चां तेजः).

But the kind of contact with heat-corpuscles, in other words, the kind of chemical action (पाखु) which transforms colours is supposed to differ from that which transforms flavour etc. (विन चागातिः संयोगः राखु नानाजातीयः रूपजनकः विजातीयतेजः संयोगः रसजनकः विजातीयः एवं स्मरणीद्रा अधिन नथा। एवं प्रकारेण भिन्नविनीतजः पाखः कार्यः लच्चविने कल्पनीयः। नथाः लगः पुढः निचित्रमादाय उक्तलक्षणाधिनस्तेजः संयोगः पूर्वणैहरितस्स्थनाष्ठ चुपालरसः पीताक्षरपनिः पूर्वण रमसय अस्मिनिवानुभवात्। कार्यः पूर्वणैहरितस्स्स्थनाष्ठ अर्धराष्ट्रां स्मरणीयतेजः संयोगः पूर्वण सनास्सुरसः भधुर प्रस्तानुभवात्। तस्मातः पजनकामिवयः रसजनको विलचणः एवं गन्धजनको विलचणः एतानेकाः। पूर्वसत्योरस्पराज्यम्प्रेय अधिन पूर्वण गन्धाणस्तेजः विजातीयस्स्मकुष्टाः सुरभिम्बोपलर्चः। एवं
Heat and light rays are supposed to consist of indefinitely small particles which dart forth or radiate in all directions rectilineally with a sort of conical dispersion and with inconceivable velocity. They may either (1) penetrate through inter-atomic (or inter-molecular) spaces as in cases of conduction of heat which when applied under the pot boils the water, or fries the paddy where there is no chemical action in the pot, no decomposition and recomposition of its atoms, no change in the molecular collocation; or, as with light rays in cases of translucency or transparency (खच्छता) penetrate through the inter-atomic spaces with Parispanda of the nature of deflection or refraction (तिथ ग्रगमन, Udyotakara), in the same way as when fluids penetrate through porous bodies (तत्त परिसन्धि: तिथि ग्रगमन परिस्फळ: पाल दृष्टि—Udyo-
takara, commenting on Vātsyāyana's *Sūtra 47, A'hnika 1, Chap. III.* or (2) impinge on the atoms, and rebound back—which explains reflection ( *वृक्षेण, विद्विघटन—Varāhamihira, रक्षमप्ररवत न—Vātsyāyana *) or otherwise be obstructed by the atoms in their path, which would explain degrees of opacity, the casting of shadows, *etc.*, all these operations being also physical, and unattended with decomposition and recombination or alteration of molecular grouping, or (3) lastly, strike the atoms in a peculiar way, so as to break up their grouping, transform the physico-chemical characters of the atoms, and again recombine them, all by means of continual impact with inconceivable velocity, an operation which explains all cases of chemical combination.

(अच्छभो हि तेजसो लावठालिगियेन बेगालियिय: यतु प्राचीना-
चकूड़िवालिगिन एव भगवति मण्यालिगिनि भवनोट्टेवुँ
अनोकरत्यालिगिनि लौकिकानाम् । (Udayana, Kiranāvalī,
तेजोनिलिगियुँ—taken from Vāchaspati, Tātparyya-
tīkā, प्रत्यज्ञनिलिगियुँ ।) Cf. also (चाँच्छ तेजः
मावालिगिते नातिसम्पति । Vāchaspati—
वत्तिशेष विभिन्नामाधि तेजः प्रसपृत् प्रायामोद्य व्यापोति ।
तत कस्त देनोः रूपायावलातः । क्षाभवतः प्रसर्थपि न रूपि-
मायातुविधायिन्यं प्रत्यज्ञाधित्वोऽथ ि तव विवघमेदानुविधायिनम् ।
ibid. Cf. स्पर्किकाद्यालिगिनिलिगित्वां प्रयायामाद्यतयः
Udayana, in reply to the objection—

\[ \text{उदयान, उत्तर-शास्त्रीय, उठान उपेक्षिता।} \]

Udayana, \emph{ibid.} Definition of सत्यस्य—

\[ \text{उदयान, \emph{ibid.}} \]

Udyotakara, Chap. III, A\'hnika 1, Sūtra 38. भोगितार्थम्:

\[ \text{उद्योगितार्थम्:} \]

Sūtra 47, where Udyotakara notes—कॉयः।

Vāchaspati explains वस्त्र दृश्यस्य भर्जनकपालदेः:

\[ \text{वाच्सपति व्याख्या।} \]

On the other hand in chemical combination, जनकपालदेः:

\[ \text{वाच्सपति व्याख्या।} \]

For opacity, shadows, etc., \emph{vide} काया तैुः

\[ \text{विषयै।} \]
For reflection, and its laws, I quote passages in my paper on Hindu Physics and Mechanics, to which the student of the history of Optics is referred.

Arrangement of atoms in Space:—The Nyāya conceives atomic magnitudes as Pārimāndalya, a term which indicates a spherical shape. (निल्प परि-भगुलम्—परिभगुलभेव पारिमाण्डलयाम्—Saṅkaramisra).

To conceive position in space, Vāchaspāti takes three axes, one proceeding from the point of sunrise in the horizon to that of sunset on any particular day (roughly speaking, from the East to the West);—a second bisecting this line at right angles on the horizontal plane, (roughly speaking, from the North to the South), and the third proceeding from the point of their section up to the meridian position of the sun on that day, (roughly speaking, up and down). The position of any point in Space, relatively to another point, may now be given by measuring distances along these three directions, *i.e.* by arranging in a numerical series the intervening points of contact, the less magnitude or distance being that which comes earlier in this series, and the greater that which comes later. The position of any single atom in Space with reference to another may be indicated in this
way with reference to the three axes. But this gives only a geometrical analysis of the conception of three-dimensioned Space, though it must be admitted in all fairness that by dint of clear thinking it anticipates in a rudimentary manner not only the foundations of solid (co-ordinate) geometry, but also of the geometry of position, and especially the conception of Space as a Manifold, which alone can serve as the basis of a generalisation comprehending all different possible kinds of geometry, Euclidean and non-Euclidean. (एकांतरण दिशा: चार्टिंगोदरंप्रद्यास्मयासम्बन्धसंबंधाय: व: स इतरस्त्रा विप्रक्ष्यप्रद्यासंस्थानाय: परमात्मा: पूर्व: एवं तत्त्वज्ञात्वयासमयासम्बन्धाय: व: स इतरस्त्रा विप्रक्ष्यप्रद्यासंस्थानाय: संयोगात: परमात्मा: पवित्रम: तथा च पूर्व: पवित्रमो: परमात्मा: चपेच्छ: व: सत्योद्यासमयासम्बन्धप्रक्ष्यप्रद्यासंस्थानाय: स मध्यवर्ती:। एवमेत्यति नित्यंग्रेष्यसविनिनां मध्यम चार्यवें मध्यविनितां वाणिज्यानुसार नानादेशानि च कृतिश्रेष्ठानि नो तत्त्वादि तत्त्र: परमात्मा:। एवं मध्यान्ति नवां तथा व्यवस्था मध्यविनितां वाणिज्यानुसार अपेक्षा उपपन्नोऽभावो दृष्ट:। संवृष्टिस्थानोऽुपस्थापनार्थविद्युतीय संवृष्टिकर्मिनिप्रकरणर्मणी पूर्व: संवृष्टिकर्मिनिनिप्रकरणर्मणी अपेक्षा उपपन्नोऽभावो दृष्ट:। संयोगसदिशा गृहस्थस्थापी मध्यविनितां वाणिज्यानुसार अपेक्षा उपपन्नोऽभावो दृष्ट:। वाचास्पति, तात्पर्ययात्तिका, Chap. IV. अङ्किका २, सूत्र २५।

The original physical arrangement of atoms is also given. Each atom is in contact with six other atoms, which gives a cubical arrangement. एवः
This is the typical primordial arrangement, and variations in the collocation of atoms and molecules (याँ, अवयवमिश्रिता), as we have seen, were conceived to account for the variety of isomeric modes of the same Bhūta, as well as of mono-Bhautic and poly-Bhautic compounds.

The molecular arrangement in the case of bi-Bhautic compounds is very peculiar. Two substances, say Earth and Ap (water), form a quasi-compound, first, and each substance breaks up into atoms, one atom of Earth comes into contact with one of Ap. But the two do not form a binary molecule. Instead, this contact of heterogeneous atoms leads to a curious result. The atom of Earth combines with a neighbouring atom of its own class, and forms a binary molecule. Simultaneously the atom of Ap combines with another Ap-atom, and forms a binary molecule. Now the first binary molecule links on to the atom of Ap, and similarly the second binary molecule links on to the atom of Earth. The moment after, the two binary molecules take on the physico-
chemical characters of Earth and Ap respectively, and simultaneously with the assumption of these physico-chemical characters, the binary molecules enter into complex contact (संयोगज्ञ संयोग). In all this process, work is done only in the first instant, in the contact of an atom of Earth with one of Ap—the resulting contacts, of atom with binary molecule and of the binary molecules with each other, involve no further expenditure of Energy. Thus we get a particle holding two binary molecules (of Earth and Ap respectively) in complex contact, and such particles continue to be formed. In this way the particles of the two substances arrange themselves, and the peculiarity of this molecular arrangement explains the resulting mixed or compound qualities of this class of quasi-compounds. (संयोगज्ञ)
The whole process may be graphically represented as follows:

\[ \text{E} = \text{an atom of Earth.} \]
\[ \text{W} = \text{an atom of water (Ap).} \]
\[ \text{E} - \text{a binary molecule of Earth.} \]
\[ \text{W} - \text{a binary molecule of water (Ap).} \]

Molecules of a bi-
Bhautic quasi-com-
 pound;—graphic for-
 mula of complex
 contact.

I will conclude this account of ancient (and mediæval) Hindu chemistry with a note on the conception of molecular (atomic) motion, Paraspanda, and the different varieties of such motion which were conceived to account for the physical phenomena of sound, light and heat. Any attempt to differentiate rigidly between Mechanics and
Physics on the one hand and Chemistry on the other at this primitive stage would be an idle affectation. My paper on Hindu Mechanics and Physics will give a detailed exposition in a separate treatise.

Parispanda:—Resolution of all physical action into motion:—

Parispanda sometimes stands for motion molar as well as molecular, but more often for the subtile motion of atoms or molecules. The radical meaning of the term is whirling or rotary motion, a circling motion, but it may also include simple harmonic motion (e.g. vibration). All action, operation, work (जिया, व्रायाय) is ultimately traced to this form of subtile motion lodged in the atoms or in the matter-stuff. The Vedánta, for example, speaks of a cosmic vibratory motion (सत्यनिस्तन्नम्—Saṅkara).—A’kása, in the Vedánta, as we have seen, is the first stadium in the evolution of Matter, which gives off Váyu, which gives off Tejas, and so on; but A’kása (Ether) itself passes through two stages before the emanation of the Súkshmahúta Váyu:—(1) the motionless ubiquitous primordial matter-stuff (answering to the Sánkhya Bhútádi) called Puránam kham (पुराणं खं): and (2) a subtile integration, the pure unquintuplicated Súkshmahúta called Váyuram Kham
(वायरे खं) (answering to the Sāṁkhyā Tanmātra stage). It is this subtle Ākāsa, in its Tanmātric integration, i.e. in the derivative form, which is subject to an incessant Paripanda. The gaseous stage of matter (the Vedāntic Vāyu) is indeed matter in a state of Paripandic motion (वायोः परिपन्द्रतात्कलान् — Saṅkara). So also the bio-motor and sensori-motor principles apart from the directive Intelligence of the Self (प्राकृतिः परिपन्द्रतादकलाट्यं — वद्धेतु नम् स्तूः सूनः सूचर्य तनस्यः मनः स्थितिभावः — Saṅkara). The Sāṁkhyā also conceives this Paripanda to characterise every process and phenomenon of cosmic evolution (वचस्पति, कामुदी). Bhūtas, organisms, mental organs, as modes of Prakṛiti (considered apart from the Intelligence of Purusha) are all subject to this Paripanda (वचस्पति कामुदीलिकोन्यो वेधान्त उपासनेत इति तेषां परिस्परं । श्रीश्रीमतः ग्रंथपालिनां च परिस्परः प्रसिद्ध एव । —Vāchaspati on Kārikā 10). On the other hand, Prakṛiti as the Avyakta, the a-cosmic, the un-manifest ground, with resolution only of like to like (सत्यतः रक्षः), is devoid of all Paripandic motion (यद्यपि अव्यक्तादपि परिश्रामलच्छः किया, मध्यपि परिश्राम्यो नामिल । ibid. on Kārikā 10). The Nyāya-Vaiseshika finds Paripanda in all
forms of matter, except A'kāsa which, in that system, is non-atomic and incapable of any change or activity (निविद्रिक्रय ). But all atoms from those of Vāyu downwards, are in incessant motion. The world at bottom is an infinitude of continually whirling (or vibratory) particles (नवरत्नपरिस्थित्व-मानापरिमितचन्द्रिपरम्नाथ:—Raghunātha;—compare also Udayana-Kusumānjali, Stavaka V.—परमेश्वर: हि गतिशीलतां वनतवायंद्रिम्: पतनोति।). All physical action consists in motion. The Nyāya-Vaiśeshika rejects force, power, operation (शक्ति) except as modes of motion. Jayanta indeed states: we do not acknowledge any mysterious power or operation, which the senses do not and cannot report to us. But this denial of Force (शक्ति) and of unperceived and unperceivable operation (नवीन्यवाय:पर) is put forward as a philosophical (epistemological and metaphysical) proposition to justify the Nyāya analysis of the causal nexus into mere invariable and unconditional antecedence among phenomena without productive power or efficiency (नव्यायक्षित्वेत्तर्म नियतपूज्व वर्तिता—Bhāshā-Parichchheda). It is not of course intended to question the existence of Parispanda, which is of the nature of motion, and which, though subtile and therefore infra-sensible (क्षुर्या and ज्ञेतूतरुप, not अलीन्द्रिय ), is the ultimate form of all physical
activity. (सर्पिलन्द्र एव भौतिको व्यापारः करोत्वर्थः। ज्ञाति-निर्यात्म्यकु व्यापारः नागरीतिः भूमिः।।।।।।तत्क्रात् कारक-चक्रेष्ठ चलना जन्यते फलस्। न पुनःप्रस्तादन्यो व्यापार-उपलब्धते। जयांत, न्याय-मान्जरि, अह्निका I )।

The effect (no less than the action) is, in all cases of material causation, the resultant of the combined motions of the various (material and efficient) causes involved (e.g. in the case of पाक-समुद्रात्मककारककिरकरसर्पिलन्द्र एव विगतकारकाविचित्रः पाक इत्यादि चलते। ... यथा व्यापार एवंः सर्बं संभूय साध्यं। किं फलेत्यापरां व: बज्जि संभूय साध्यं नाशः।—जयांत, न्याय-मान्जरि, अह्निका I )।

But, in the Nyāya-Vaiśeshika, though all action of matter on matter is thus resolved into motion, conscious activity is sharply distinguished from all forms of motion, as against the Sāṅkhya-Vedānta, which, as we have seen, considered every thing other than Intelligence, the Purusha or the transcendent Self, to arise in the course of cosmic Evolution, and therefore to be subject to Paripanci
dic motion. (किंगाविशेष एवायं व्यापारो ज्ञातुरात्मः। सन्तानकारकविचित्तू तत्क्रियालर्थात्मविकल्पः।—Quoted in Jayānta's Nyāya-māṇjari, A'hnika IV )。

Santāna, i.e. Gati-santāna (including wave motion and current motion or convection); Kampa santāna, Spandana, (vibration):—Charaka notes
three kinds of santánas, serial motions, viz., those of water, sound and light (जलसंतान, शब्दसंतान and चक्रपानि). Chakrapání points out that a wave of sound travels more rapidly than a wave of water, and much less rapidly than a ray of light. In Hindu Mechanics, a current of water (downward flow, शुद्ध) is conceived to consist of particles moving in an uninterrupted series under the action of gravity and fluidity (चक्रपानि). A ray of light implies the rectilinear propagation of indefinitely minute corpuscles, in all directions, with inconceivable velocity, and a sort of conical dispersion (चक्रपानि). A wave of water (चक्रपानि) implies the transmission of vibratory motion in the water particles. (Cf. Jayanta—पतंजलि जयंति योजितत्र—ञ्जोध्य-नक्कास, अध्य एक) A wave of sound is conceived by some on the analogy of a wave of water (चक्रपानि), only the air-waves (cf. the Mímámsá) or the sound-waves in and through the vehicle of air-waves (cf. the Nyáya-Vaiseshika) travel by concentric circles not in one but in all planes. (N.B. this assumes transverse waves). Others hold that the air-waves (cf. the Vákyapadíya) or the sound-and-air waves (cf. Udyotakara) are propagated by the transmission of the vibration in all directions, leading to conjunction and disjunction of air-particles, so that the wave may be said to expand by alternate concentric
spherical layers of rarefaction and condensation (प्रचय (N.B. this assumes longitudinal waves).—
(कदम्भोदकव्य—cf. संधोगविभागा नीरन्धरश्च क्रियामाणा: गुद्धभिम्भ्रव्यानो नादगद्वारब्य्या: (Savara-Bhāshya 1-1-17) 
अभिधानं क्ष प्रेतिता वात्र: सिंहितानि वायुतराशिः प्रति धातुमाणा: सच्च्य नौटिक्रान्त संधोगविभागान्त एन्यायानि 1—ibid. 1-1-13). The Vākya-padīya describes articulate sounds (Varnas) and indeed all sounds (sabdas) as only forms of air set in motion, with rarefaction and condensation (प्रचय), and capable of variations of velocity and configuration (स्नानिभिन्नो वाद्य: गद्यव 
प्रतियोगदात: तथाकाव्यमाच्छयों चेतयवथाश्चिम्या: | संधिपानि विभाज्यान्त 
and Physics). (For the Hindu doctrine of scientific Method, vide Appendix; for certain interesting 
recipes of chemical technology, vide Addenda).

I had intended to conclude this survey of Hindu Physico-chemical science with a comparative estimate of the evolution of scientific ideas in the culture-history (kultur-geschichte) of the Chinese, the Greeks and the Arabs, as an Essay in the historico-comparative method of investigation (vide the Preface to my Comparative studies in Vaishnavism and Christianity for a correction of this method), but space forbids, and the reader too, I fancy.
The Date of Rasaratnasamuchchaya.

While the present volume was about to issue from the press, Mr. T. G. Kála, Editor of the Marhattá Journal "Samálochaka", sent us a critical notice of R. R. S. As there are some important historical facts brought to light and as the date of this work arrived at from quite independent sources tallies with that assigned by us (Vol. 1. Intro. LXXXIX), we make no apology for reproducing its substance in a condensed form.

Charpásti or Charpaždnátha of the Nátha school is mentioned in the R. R. S., (see VI, 58, Poona edition), as also king Singhana.

The Navanátha Saktisára, a Marhattá work by Narahári Mála, gives some legendary information about this Charpaždnátha and speaks of him as a contemporary of Matsyendranátha. On the left has been given the genealogy of the pupils of मत्स्येन्द्रनाथ. The last, ज्ञानेश्वर or ज्ञानिश्वर, was the celebrated Marhattá Saint and author of a commentary on the मगव्रजीवत् called ज्ञानिश्वरी.* It was written in Saka 1212, i.e., A. D. 1290. So मत्स्येन्द्र and Charpaždnátha must have lived at the beginning of the thirteenth century A. D.

* See the concluding portion of ज्ञानिश्वरी, a Marhatta' work.
The R. R. S. which mentions the Siddha Char-pati must be therefore later than the first half of the thirteenth century A. D.

\[\text{सेत्वशचन्द्र II (A.D. 1069)}\]
\[\text{सिंघश I}\]
\[\text{मलुगि}\]
\[\text{भिल्हम (A. D. 1191)}\]
\[\text{जेमपाल (A. D. 1191-210)}\]
\[\text{सिंघश II (A.D. 1210-1247)}\]

Among the Yádava kings of Devagiri or Daulatábád, there were two kings by the name of Singhana. Taking the Singhana mentioned by R. R. S. to be the second, we are required to place the composition of the work in the latter half of the 13th century. On the whole, the R. R. S, may be safely taken to be a work written about 1300 A. D.

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**THE WEIGHT OF AIR.**

*(By Principal B. N. Seal).*

Experiments were of course conducted for purposes of chemical operations in relation to the arts and manufactures, e.g., metallurgy, dyeing, pharmacy, perfumery, cosmetics, horticulture, and the making of glass (lenses and mirrors of various kinds are mentioned, the spherical, oval —ढंत and चुंचुं, being well-known—Pliny indeed mentions that the best glass ever made was Indian glass). But of Experiment as a Scientific method of Proof or Discovery, the instances are rare. I may note one
interesting example in Udayana's Kiranávalí, relating to the weight of air. Udayana argues that air must be a distinct and independent Bhúta, for if air were made of the Earth-Bhúta, it would have weight, and it has none. To prove the absence of weight, he refers to an experiment. A small bladder made of a thin membrane, filled with air, will not cause a greater descent in the scale than the same bladder weighed empty. Hence the air possesses no weight. Then Udayana makes an interesting statement. It may be objected, he says by one who accepts the weight of air—that this argument is inconclusive. For a counter-experiment may be suggested. The balloon filled with smoke (or gas, धूम ) rises in the air, whereas air-filled balloon comes down. This would go to show that air has weight. Udayana replies that this would only show that both smoke (gas, धूम ) and air have no weight. The Hindus appear to have been ignorant of the principle of Archimedes, at least as applied to gases. Vallabhácháryya in the Lilávatí speaks of a peculiar resistance to sinking (or gravity) exercised by water, which explains the tendency in certain objects to float or to come up to the surface of the water but the description shows that he had no clear ideas on the subject. Cf. Udayana, Kiranávalí, वायुनिक्षप्यम्। Cf. also Vallabhácháryya, Lilávatí.
APPENDIX.

On the Scientific Method of the Hindus.

(By Principal Brajendranath Seal.)

The Doctrine of Scientific Method:—A study of the Hindu Methodology of Science is absolutely essential to a right understanding of Hindu positive Science, its strength and its weakness, its range and its limitations. Apart from this rigorous Scientific Method, Hindu Chemistry, such as it is, would be all practical recipe, or all unverified speculation. This, however, would be a very inadequate and indeed erroneous view of this early achievement of the human mind. That the whole movement was genuinely and positively scientific, though arrested at an early stage, will appear from the following brief synopsis of the Hindu Methodology of Science.

Criterion or Test of Truth:—The ultimate Criterion of Truth is found not in mere cognitive presentation, but in the correspondence between the cognitive and the practical activity of the self, which together are supposed to form the circuit of consciousness. That knowledge is valid which prompts an activity ending in fruition. (Cf. the distinction between सम्बन्धिज्ञान and विस्म्यादिज्ञान. Also, प्रामाण्ययात्रामवृत्ती प्रकृतियायात्मकसाध्यात्म यद्यवक्त प्रामाण्यम—Vātsyāyana).
Truth is not self-evidence, not the agreement between ideas, nor the agreement of the idea with the reality beyond, for this cannot be attained direct, but the harmony of experience (सब्बाद), which is implied when the volitional reaction, that is prompted by a cognition and that completes the circuit of consciousness, meets with fruition, i.e., realises its immediate end (cf. Śrīharsha, Khandana Khanda Khāḍya on the relation of प्रमा to लोकस्वपन्द्र). This is the material aspect of Truth. The formal aspect is given in a principle which governs all presentations in consciousness, and which combines the three moments of Identity, non-Contradiction and Excluded Middle in every individual cognitive operation [तद्कʿ तत् परिच्छन्नाति (identity) अन्यत्र व्यवचिन्नाति (non-contradiction) तत्तव-प्रकाराभावं च सूचयति (excluded middle) इति एकप्रमाण- आयार:—Jayanta, Nyāya-Manjarī, प्रमाणदैविकाभ्यासनम्].

Perception:—The conditions of perception, and its range and limits, were carefully studied. The minima sensibile (e.g., the minimum visible, the Trasarenu, the just perceptible mote in the slanting sunbeam), the infra-sensible (अनुप्रूढ़तपमं तुच्छ, sometimes termed अतीतन्ध्र), the obscured (अभिमू, e.g., a meteor in the mid-day blaze), and the potential (अनुप्रूढ़तपति), are distinguished; but finer instruments of measurement were wanting, and this was a principal cause of arrested progress. It may be noted that the measurement of the relative pitch of
musical tones was remarkably accurate and original (vide my Paper on Hindu Mechanics and Physics).

Observation (दशम—Váchaspati and Udayana):—
The entire apparatus of scientific method proceeded on the basis of observed instances carefully analysed and sifted. This was the source of the physico-chemical theories and classifications, but in Anatomy, the Hindus went one step further; they practised dissection on dead bodies for purposes of demonstration. Ingenious directions are given, e.g., the body must be first disembowelled and wrapped round with the kusa and other grasses, then kept immersed in still water for seven days, after which the medical student should proceed to remove the layers of the skin with a carefully prepared brush made of the fresh elastic fibres of green bamboos;—which will enable the tissues, vessels and ducts to be observed. Post-mortem operations as well as major operations in obstetric surgery (the extraction of the foetus, etc.) were availed of for embryological observations (e.g., it is stated as a result of observation that the rudiments of the head and the limbs begin to appear in the foetus in the third month, and are developed in the fourth; the bones, ligaments, nails, hair, etc. becoming distinct in the sixth);—and also embryological theories, e.g., the indication of sexual character in the second month by the shape of the foetus, the shape of a round joint indicating the male sex, and an
elongated shape as of a muscle the female sex (cf. Charaka, Sutrasthána, Chap. IV,—हिन्दू साहित्य धम: सम्बन्धत विभा पुर: भवर्षु हारं वा। तव धन: विभा रुपय: स्त्री धनं भवर्षु हारं नपुष्कमु) Chakrapáni notes: धन: क्षिणं। विभा रुपायार्घः। धन: दोहस्मपुष्करार्हं। राम्य वर्णलोगतम् loc. cit. ). In Phonetics (as in the Prátiśákhya, circa 600 B. C.), in Descriptive and Analytical Grammar (as in Pánini), and in some important respects in Comparative Grammar (as in Chanda's and Hemachandra's Grammars of the Prákrita Dialects), the observation was precise, minute and thoroughly scientific. This was also the case in Materia Medica, and in Therapeutics, especially the symptomology of diseases. In Meteorology, the Hindus used the rain-guage in their weather forecasts for the year, made careful observations of the different kinds of clouds and other atmospheric phenomena (e. g., they give the heights of the clouds, the distance from which lightning is ordinarily visible, or the thunder is heard, the area of disturbance of different earth-quakes, the height to which the terrestrial atmosphere extends, etc., vide Varáhamihira, Srípati, and the authorities quoted by Utpala). In Astronomy, the observation was, generally speaking, very defective as in the determination of the solar and the planetary elements, and this was probably due to the lack of practical interest, but the determination of the lunar constants entering into the calculation of lunar periods.
and eclipses, matters in which the Hindus had a practical ceremonial interest, reached a remarkable degree of approximation (much above Graeco-Arab computations) to the figures in Laplace's Tables, which can only be explained by the circumstance that in the case of these constants the Hindus carried out for more than a thousand years a systematic process of verification and correction by comparison of the computed with the observed results (like the navigator's correction of the course of the ship at sea), a process which was termed दृश्यमिश्रितक्रमः. In Zoology, the enumeration of the species of Vermes, Insecta, Reptilia, Batrachia, Aves, etc., makes a fair beginning, but the classification proceeds on external characters and habits of life, and not on an anatomical basis. In Botany, the observation was mainly in the interests of Materia Medica, and the classification was as superficial as possible. (Vide my paper on the Hindu Classification of Plants and Animals).

Experiments:—Experiments were of course conducted for purposes of chemical operations in relation to the arts and manufactures, e. g., Metallurgy, Pharmacy, Dyeing, Perfumery and Cosmetics, Horticulture, the making and polishing of glass lenses and mirrors of various kinds are mentioned, the spherical and oval चतुर्भुज and चतुर्भुज, being well-known—Pliny indeed mentions that the best glass ever made was Indian glass). And the
results of such experiments were freely drawn upon for building up scientific hypotheses and generalisations. But of experiment as an independent method of proof or discovery, the instances recorded in books are rare. I may note one interesting example in Udayana’s Kiranávali, relating to the weight of air. Udayana argues that air must be a distinct and independent Bhuta, for if air were a form of the Earth-Bhuta, it would have weight, and it has none. To prove the absence of weight, he refers to an experiment. A small bladder made of a thin membrane, filled with air, will not cause a greater descent in the scale than the same bladder weighed empty. Hence the air possesses no weight. Then Udayana makes an interesting statement. It may be objected, he says, by one who accepts the weight of air—that this argument is inconclusive. For a counter-experiment may be suggested. The balloon filled with smoke (or gas, घूम) rises in the air, whereas the air-filled balloon comes down. This would go to show that air has weight. Udayana replies that this would only show that both smoke (or gas, घूम) and air have no weight. The Hindus appear to have been ignorant of the principle of Archimedes. Vallabhácháryya in the Lilávati, it is true, speaks of a peculiar resistance to sinking (or gravity) exercised by water, which explains the tendency in certain objects to float.
or to come up to the surface of the water, but
the description shows that he had no clear ideas
on the subject.]

Mathuránátha, again, states that the determi-
nation of the degree of purity (the carat) of gold by
rubbing against the assaying stone and observing
the character of the yellowish streak against the
black smooth background, is only an indirect means
of ascertaining weight (रूपकल्पक लित. specific gravity)
—which seems to suggest that there was a more
direct means of arriving at the latter. Probably
this refers to the common Indian method of
comparing the lengths of wires of uniform thickness
that can be formed by drawing different pieces
of gold of equal weight through the same
diamond bore. I think it may be regarded as fairly
certain that the Hindus were ignorant of Archi-
medes’s discovery, an ignorance which, at any
rate, they could not have well borrowed from
the Greeks, no more than they could have thus
borrowed their knowledge of things unknown to the
Greeks themselves. [Cf. Udayana, Kiranávali:—

वासुकिपुस्म, किं च (वामी: ) गुरुलमर्गा स्थान्। न च
पत्रमापूर्तिवः चार्मुपुट्टकार्फः। गुरुवालमार्गात्: अर्थातः अवबन्धमस्।
चत्त्रोयः श्रीमापूर्तिवः देहमुष्टुष्मौ श्रावकालिकं इति चेतु। न। वर्षं धूमदशायां।
तवापि गरिमविधितोर्तोतवनिसिविशेष्यं भावतीतः। —Cf. Vallabha-
चार्य्य, Lilāvati—गुरुलविशेषं पापाधारात्। नमो-न्यायनिन्यमवतं भद्रहेतुकता साम्यचिं पतनोत्तपत्तन्-निव्यो भविष्यतीति।
Fallacies of Observation—Mal-observation and Non-observation:—These were carefully studied in relation to errors of observation, and Hallucination (Sam, Abhaya, Baririp)—which were ascribed to three causes:—(a) Dosha, दोष, defect of sense organ, as of the eye in jaundice, or of the skin in certain forms of leprosy (leading to tactile insensibility, cf. Susruta), or defect of necessary stimulus, e.g., too faint light, or undue distance or nearness, in vision; (b) Samprayoga, समप्रयोग, presentation of a part or an aspect instead of the whole; and (c) Sanskāra, संस्कार, the disturbing influence of mental predisposition, e.g. expectation, memory, habit, prejudice, etc.

The Doctrine of Inference:—Anumāna (Inference) is the process of ascertaining, not by perception or direct observation, but through the instrumentality or medium of a mark, that a thing possesses a certain character. Inference is therefore based on the establishment of an invariable concomitance (Vyápti, अव्यवस्था) between the mark, and the character inferred. The Hindu Inference (Anumāna) is therefore neither merely formal nor merely material, but a combined Formal-Material
Deductive-Inductive Process. It is neither the Aristotelian Syllogism (Formal-Deductive Process), nor Mill’s Induction (Material-Inductive Process), but the real inference which must combine formal validity with material truth, inductive generalisation with deductive particularisation.

An inference admits of a rigorous formal statement,—in the shape of five propositions, for dialectical purposes (i.e. in demonstrating to others),—or of three propositions when the inference is for oneself (सापेक्षितम्):—(1) the probandum, the statement of the proposition to be established (प्रतिष्ठा, सापेक्षितम्, e.g., yonder mountain is fiery (say, an active volcano); (2) the reason, the ascription of the mark (मात्र, विन्यास),—e.g., for it smokes; (3) now, the general proposition, stating the invariable concomitance which is the ground of the inference,—clenched by an example bringing home the responsibility of the reasoner to establish a real relation, e.g., whatever smokes is fiery, as an oven; (उपन्यय) ;—(4) next, the application, the ascertainment of the existence of the mark in the present case (उपन्यय) e.g., yonder mountain smokes;—(5) finally, the conclusion, the probandum proved (निगमन), e.g., yonder mountain is fiery.

1. Yonder mountain is fiery.
2. For it smokes.
3. Whatever smokes is fiery, as an oven.
4. Yonder mountain does smoke.
5. Therefore, yonder mountain is fiery.

For inference for oneself, only the first three or the last three propositions, are held to be sufficient.

The Hindu Anumána, it will be seen, anticipates J. S. Mill's analysis of the syllogism as a material inference, but is more comprehensive;—for the Hindu Udáharana, the third or general proposition with an example, combines and harmonises Mill's view of the major premise as a brief memorandum of like instances already observed, fortified by a recommendation to extend its application to unobserved cases, with the Aristotelian view of it as a universal proposition which is the formal ground of the inference. This Formal-Material Deductive-Inductive process thus turns on one thing—the establishment of the invariable concomitance (चार्णिः) between the mark and the character inferred,—in other words, an inductive generalisation. The question is—what is our warrant for taking the leap from the observed to unobserved cases? Under what conditions are we justified to assert a Universal Real Proposition on the basis of our necessarily limited observation?

The Chárváka view:—Among the Chárvákas there were two classes, the cruder school of materialists who accepted perception (प्रत्येक) as a valid source of knowledge, as well as the reality of
Natural Law (क्रमान्वय), and the finer school of sceptics, who impugned all kinds of knowledge, immediate as well as mediate, and all evidence, Perception as well as Inference, vide Jayanta's reference in the Nyāya-Manjari to सुभिरिचितवाच्येच्या; also चाँचोकसंस्थ 
व्यास तत्त्व व्याख्याय द्वित प्रतिवन्य प्रमाणमेतमयमः 
विचारमत्तथाकरणोमचेव व्याख्यात्वान्—अञ्जिक 1, मंजरी.

The Chārvákas hold that the principle of causality, which the Buddhists assume to be a ground of an induction (वापत्र) is itself an induction (a case of Vyápti), which amounts to reasoning in a circle (चक्र); that every inference is based on an unconditional invariable concomitance which itself must be inferred, as universal propositions cannot be established by our limited perceptions, and thus there is a regressus ad infinitum (अनादि परम्परा); and that the nexus between cause and effect, or between the sign and the thing signified (e.g., smoke and fire) is only a mental step or subjective association based on former perception, a mental step which by accident is found justified by the result in a number of cases.

The Buddhists—their Analysis and Vindication of Inference:—The Buddhists, however, take their stand on the principle of the Uniformity of Nature (प्रतिलोम, संघात्र प्रतिलोम, Nyaya-Vindu). This uniformity, for scientific purposes, has to be divided into two different relations,—(1) the uniformity of succession in the relation of cause and effect, e.g.,
of smoke to fire (कार्यकारणमात्र, तद्नुपर्य, Nyaya-Vindu); (2) the uniformity of co-existence (in the form of co-inherence in the same substrate) in the relation of genus and species, e.g., the relation of invariable concomitance expressed in the proposition,—all Sinsapās are trees,—which is not a relation of causality, but of co-existence or co-inherence in the same substrate (i.e., the co-inherence of the generic qualities of a tree with the specific characters of a Sisu tree, in this particular individual before me, a Sisu tree),—a relation which may be termed essential identity (互斥, अभिन्न न्यायाविद्या—Nyaya-Vindu). To these two, the Buddhists add a third ground of inference, non-perception of the perceptible (अभ्याय, अभ्यायानात्मा), which is employed in inferring the absence (अथवा) of a thing from the non-perception of something else. In all cases of inference based on the Uniformity of Nature, the relation is that of inseparableness or non-disjunction between the mark and the character inferred. The question is—how is this inseparableness (अभिन्नात्मा) ascertained, and what is the warrant of our belief in it, in these cases?

Ascertainment of Inseparableness or Non-disjunction: Buddhist Account:—First take the case of causation. The cause is the invariable antecedent of the effect. What is meant is that the specific effect (with all the distinctive and relevant accompaniments, कार्यविरियत्र) is invariably preceded by a
specific cause (कारणविशिष्ट). It is not that clouds always lead to rain, or that floods in the river valley always imply rain in the hills higher up. But this particular conjunction of antecedent circumstances (e.g. the appearance of a particular kind of clouds accompanied with flashes of lightning, the roll of thunder and flights of Valákás—driven by the wind from a particular quarter of the horizon, and ascending in black masses, etc.) is as a rule the precursor of a particular assemblage of rain effects (rain with particular accompaniments). Again, this particular kind of flood (overflowing of the river banks accompanied with muddy discoloration of the water, rapid currents, the bearing down of tree trunks, etc.) is always preceded by rain in the hills higher up (though, no doubt, other cases of floods in a river may be due to a breach in an embankment or the melting of the snows). In other words, the Buddhists (and the earlier Nyáya Schools) avoid the difficulty arising from the plurality of causes by taking into consideration the accompanying phenomena, which, if properly marked, would always point to a specific cause of a specific effect.

I quote Nyáya authorities, but this device to obviate the plurality of causes is common to the early Nyáya and the Buddhistic systems.
a single condition called a cause is not invariably succeeded by the effect, nor does the effect phenomenon in general point to any particular cause as antecedent, for there may be a plurality of causes of a general effect. The skilful observer will therefore select the full complement of causal conditions, which is invariably succeeded by the effect,—and also the specific effect (e.g., धूमविशिष्ट) which points to a specific causal antecedent. Compare also Jayanta:—we infer an effect from a specific assemblage of causes—न च कारणमात्र देतुलं नम्मी वेन्याय अभिवर्त: स्थात्। अपि च विशिष्ट सेव कारणं हेतुः। न च कारणविशिष्टो दुरोदभायः। गम्भोरग्रहितार्थमविभिन्नगिरिगढ़रः रोलभगत्व गवल्यानस्तमालविनिविष्कर: ...हृदं अभिवर्तलीकः नेत्र प्रायः प्रयोगुः। न समस्तविशिष्टावासमिः वीर्यमयात्। न स्मृति विशिष्टावासमिः वीर्यमयात्। Similarly we infer a specific cause from a specific assemblage of effects:—गीतविदितं यव कारणं
A specific assemblage of causes, therefore, has only one specific assemblage of effects, and *vice versa*. Of course, the observer is to find out the essential or relevant features (as distinguished from the irrelevant ones) which, being included, will enable him to specify the particular cause of the particular effect.

Now this being premised to be the exact meaning of the inseparableness or non-disjunction in the case of cause and effect, we come to the question with which we started—how is this relation to be ascertained or established between two phenomena or assemblages of phenomena? Obviously, mere observation of their agreement in presence (अस्तीत्व) and their agreement in absence (अभावित्व) is no help in the matter. Take a concrete example. The ass is customarily employed to bring the fuel with which fire is lighted. In a hundred cases you have observed the ass among the antecedents of smoke. In a hundred cases you may have observed that when there is no ass, there is no smoke. This is no
warrant for concluding a relation of cause and effect between an ass and smoke. It may be that you happen to have never observed smoke without an antecedent ass, or an ass without smoke following. Even this is of no avail. It is not agreement (unbroken and uniform though it be) in presence, or in absence, or in both, that can settle the matter. There is one and only one way of ascertaining the causal relation. Suppose $A$ with certain accompaniments is found to precede $B$ immediately. Now if $A$ disappearing, $B$ disappears, even though all other antecedents remain and there is no other change in the case, then and then only can the causal relation be ascertained. It is not a mere table of positive instances or negative instances ($अद्द्धर्मान् न दश्नात्$) ;—it is this method which we may term the Method of Subtraction (the Method of Difference in its negative aspect) that is the only exact and rigorous scientific Method. Such was the statement of the earlier Buddhists (cf. Udyotakara’s and Vāchaspāti’s report of the Buddhist Doctrine of Inference—$स देहं देहसमावर्जये।$)

तस्मात् तादांतदुपत्सविनवसनः एव प्रतिबन्धः। यदाहृ कार्यकरण भवान्ति तत्त्वाध्य निदास्मात्। भवनमानविनिधमौदश्त्वा नात्र न दर्शनात्।—a Buddhist Karika quoted in Vāchaspāti, Udayana, Srijārsha, Mādhava, etc.)—कार्यकर्ष्यमाध्य दद्म्—विख्याति भवति—सदृश भवित तद्यथे अध्यग्रहितं न भवति—एवमाकर्:।

न प्रत्यव्यवसितकायमतिर्द्वखः ।...

( एवं तादामितपि विख्याति वाकः)
But the canon in this form is not sufficiently safe-guarded against possible abuse. Two points have to be emphasised: (1) It must be carefully observed that no other condition is changed, (2) that the appearance and disappearance of $A$ must immediately precede the appearance and disappearance of $B$. The definition of a cause is based on two fundamental characters, (1) the unconditional invariableness of the antecedence, and (2) the immediateness of the antecedence. The canon of the Method of Difference must therefore be stated in such a form as to emphasise each of these aspects. And one main difficulty in the practical application of the canon is that along with the introduction or sublation of an antecedent, some other phenomenon may be introduced or sublated unobserved. As a safe-guard against this radical vitiation of the Method, the later Buddhists formulated the canon of a modified Method, termed the Panchakáráni, a Joint Method of Difference, which combines the positive and the negative Methods of Difference (the Method of Addition and the Method of Subtraction) in a series of five steps, and which equally emphasises the unconditionality and the immediateness of the antecedence as essential moments of the causal relation. This is
neither agreement in presence, nor agreement in presence as well as absence (the foundation of J. S. Mill's Joint Method of Agreement), but the Joint Method of Difference. The Panchakárani runs thus:—

The following changes being observed, everything else remaining constant, the relation of cause and effect is rigorously established:—

First step—The 'cause' and the 'effect' phenomena are both unperceived.
Second step—Then the 'cause' phenomenon is perceived.
Third step—Then in immediate succession, the 'effect' phenomenon is perceived.
Fourth step—Then the 'cause' phenomenon is sublated or disappears.
Fifth step—Then in immediate succession, the 'effect' phenomenon disappears.

Throughout, of course, it is assumed that the other circumstances remain the same (at least the relevant or material circumstances).

This Panchakárani, the Joint Method of Difference, has some advantages over J. S. Mill's Method of Difference, or what is identical therewith, the earlier Buddhist Method; and the form of the canon bringing out in prominent relief the unconditionality and the immediateness of the antecedence, is as superior from a theoretical point of view to J. S. Mill's canon,
and is as much more consonant than the latter to the practice of every experimenter, as the Hindu analysis of Anumána as a Formal-Material Deductive-Inductive Inference is more comprehensive and more scientific than Aristotle’s or Mill’s analysis of the Syllogism (or Mediate Inference).

But even the Panchakárani is no sufficient answer to the question with which we started. The Panchakárani is only a method; it shows only how in a particular case the relation of cause and effect is to be established (प्रतिबन्धण्य दौषषाय). But we want more than this—we require a warrant for the process. The Buddhists therefore supply the following proof of the Method:—Doubt is legitimate, but there is a limit to doubt. When doubt lands you in a contradiction of a fundamental ground of practice, and would thus annul all practical exercise of the will, the doubt must cease; else the doubt would be suicidal or sophistical. In this particular case, when the Panchakárani is satisfied, the antecedent in question must be the cause, for there is no other antecedent to serve as cause; the proof is indirect but rigid. If this be not the cause, there is no cause of the phenomenon. It was not, and it begins to be, without a cause; which would be a contradiction of the rational ground of all practice, for all volitional activity proceeds by implication on the principle of causality. If things could happen
without a cause, all our motives to action would be baffled. The link between a presentation and the instinctive volitional reaction would snap, and the circuit of consciousness would be left incomplete. In fact, the Buddhists go further; they hold causal efficiency (अर्थ्यत्व) to be of the essence of empirical (relative) Reality. The proof of the Joint Method of Difference, then, lies in a strict application of the principle of causality in its negative form (viz., there can be no phenomenon without a cause) and the truth of this last is guaranteed by the same ultimate criterion of empirical (relative) Reality as the truth of Perception itself, viz., the correspondence between the rational and the practical activity of the self.

But invariable concomitance (or non-disjunction), the Buddhists argue, has another form, e.g., the relation of the genus to the species. We may have perceived a hundred instances of the association of certain characters with certain others; we may also have never perceived the former when the latter are absent; but this would not enable us to generalise and establish invariable and unconditional co-existence. We must be first satisfied that there is identity of essence (तादात्म्यवर्त्त्व). It is only when we perceive that the characters of a Sinsapá are co-inherent with the generic characters of a tree in the same individual object (a Sinsapá tree before me), and when we further-
perceive that the characters are held together by
the relation of identity of essence, that we can say
that all Sinsapás are trees. For as there is identity
of essence, a Sinsapá would not be a Sinsapá, if
it were not a tree. It would lose its self-identity
which is a contradiction. Hence the relation of
identity of essence (तद्याया समाव), as in the
relation of the species to the genus, is the sole
ground for establishing uniformity of co-existence
(प्रतिस्व, समावप्रतिस्व).

(For the Buddhist Method of Induction, in
its later form, the Panchakáráni, vide Sarvadarsana
Sangraha—Buddhist reply to the Chárváka attack
on Inference:—

ब्रह्मद्वार्ति ब्रह्मान्त: दुर्विध इति तदसाधीयः। तद्याया तद्याया
प्रतिस्वप्रतिस्व भूसत:।। तदुक्ते—काय्याकारणभावात् वा
समावात् वा नियमकात्। अवनियमनियमित्तद्यात् नाद्र
दुर्विध इति।

As for the Nyáyá view अयोध्यगति: की भविष्यानियममित्तद्यात्
दुर्विधारण: भवेत्।। भूत: भविष्यति वर्तमान: अनुपलब्धमानि च अभिविचार-
शास्त्र: अप्यार्थशास्त्र:— the Nyáyá retorts नन्त: तथाविधमानि
तावनीपि मते वर्धितामध्य: दुर्विधारणा इति।—the Buddhist
answers—सदावृति: निर्विवेकान्तार्ग्युष्मन्त: अस्वं
विधातां: शास्त्रां: अध्यात्मिकविवश्या निर्ज्ञलातु:। तद्व दिः
अड्चार्यात: अक्ष्यान्तां अध्यात्माद: नावितरः।। तदुक्ते अध्यात्मा-
विचाराश्च इति। तदात्मात् तदन्तप्रतिश्चायैं अविनायाः निर्ज्ञते।
तदन्तप्रतिश्चायैं काय्याद: प्रथाविधायः अनुपलब्धान्त: काय्याद:।
The Nyāya Doctrine of Inference:—The Nyāya easily demolishes the Buddhist contention about identity of essence. The Nyāya writers, being realists, do not impugn the reality of the genus (तत्त्व) like the nominalists or the nominalistic conceptualists in the Mimansa Schools (भावन; and वीरक:); but they point out that the inseparableness (or non-disjunction) in such cases can only be established by the experience of unbroken uniformity (क्षम्यचारित i.e., by क्षमयतिरिक्ती, दर्शनाद्यन्ते). Uniform agreement in presence with uniform agreement in absence, —not the mysterious identity of essence irresistibly perceived in any individual case or cases—is the only basis for constituting genera and species in Natural Classification. Indeed some of the later Nyāya writers point out that individuals do not always possess in Nature all the characters that go to form the definition of the class to which they are referred.
Similarly, as regards the relation of cause and effect, a *nexus* is sometimes fancied to be perceived, a power in the cause to produce the effect (शतिः), or an ultimate form (ज्ञति सौचा), which is supposed to be present, whenever the effect (quality or substance) is produced (cf. Bacon’s view of the ‘Forms’ of Simple Qualities). All this is neither a matter of observation nor of legitimate hypothesis. There is nothing except the invariable time-relation (antecedence and sequence) between the cause and the effect. But the mere invarableness of an antecedent does not suffice to constitute it the cause of what succeeds; it must be an unconditional antecedent as well (अन्यशास्त्रहीनत्वं नियमतूच्यथानिर्वितम्, being the definition of कारणार्थ). For example, the essential or adventitious accompaniments of an invariable antecedent, may also be invariable antecedents, but they are not unconditional but only collateral and indirect, in other words their antecedence is conditional on something else (न मात्रानि). The potter’s stick is an unconditional invariable antecedent of the jar, but the colour of a stick, or its texture or size or any other accompaniment or accident, which does not contribute to the work done (so far as we are considering it) is not an unconditional antecedent, and must not therefore be regarded as a cause. Similarly, the co-effects of the invariable antecedents, or what enters into the production of these
co-effects, may themselves be invariable antecedents but they are not unconditional, being themselves conditioned by those of the antecedents of which they are effects. For example, the sound produced by the stick, or by the potter's wheel, invariably precedes the jar, but it is a co-effect,—and A'kāśa (ether) as the substrate, and Vayu (air) as the vehicle, of the sound, enter into the production of this co-effect, but these are not 'unconditional' antecedents, and must therefore be rejected in an enumeration of conditions or causes of the jar. Again, the conditions of the conditions, the invariable antecedents of the invariable antecedents, are not unconditional. The potter's father is an invariable antecedent of the potter who is an invariable antecedent of the jar, but the potter's father does not stand in a causal relation to the potter's handiwork. In fact, the antecedence must not only be unconditionally invariable, but must also be immediate (प्रभवितपूर्वः कालाचार्चितं कायेचितं सत्तम्). Finally, all seemingly invariable antecedents which may be dispensed with or left out, are ipso facto not unconditional, and cannot therefore be regarded as causal conditions; in short, nothing that is unnecessary is unconditional; for this class, vide Visvanātha: —नियताश्यकपूर्वभावितः प्रभवेयप्रभवितपूर्वभन्नवित्ते एव कायेचितविवेचितम् तविविवेचितम् (अयातिति) पञ्चथायाःसिद्धां —Visvanātha, Siddhānta Muktāvali, on Sloka 20. For example, it is the custom to point to spatial position or direction with the
fingers, but finger-pointing, though invariably present, is not causally related to the perception of direction or spatial position, because we can imagine such perception without finger-pointing, (अन्यायासिद्धांतया प्रकृत्या निर्देश द्विक्रियायथानि सामान्यिकः सब्स्ति, Vāchaspati, Tātparyya-Tikā, Chap. I, A'hnika 1, Sutra 5,—this shows that the doctrine of अन्यायासिद्धांतया was long anterior to Gangesa).

[Visvanātha in the Bhāsha-Parichchheda mentions five kinds of अन्यायासिद्ध, conditional antecedents—(1) वृन सत्यसाधारणः, (2) श्रवण वा कारणसाधारणः (पूर्वभावः), (3) अन्यायसिद्ध पुरवश्रव्यावधिकृतविबाहानम्, (4) जनको प्रति पूर्वसाधिताम् अपरिभास यथा (पूर्वसाधिता) न गृहानि, and (5) धार्मिक यथा निर्देशार्थकपूर्वसाधितानि: प्रतिरिक्षितम् भवेत् (एतेव प्रवृत्तम् भावशकस्यमि—Slokas 19, and 20), यथा ब्रह्मादिः अन्यायसिद्धिर्कौ न स: किंतु सकारणसाधारणं अन्यायसिद्धिकौ स्वतः तदन्यात्मिकां, Siddhānta Muktāvali, loc. cit.—The Dīnakarī points out that the first two cases are comprehended under the formula इतरान्यायसिद्धिर्वक्रमान्यायसिद्धिकांशिलाभम्। There are several classifications of these irrelevant antecedents (अन्यायासिद्ध); I quote one of the best known].

The unconditional (अन्यायासिद्ध) as interpreted in this comprehensive sense is a far more fruitful conception than Mill's, and is well adapted to its work—the elimination of the irrelevant factors in the situation. In the end, the discrimination of what is necessary to complete the sum of causes, from what is de-
pendent, collateral, secondary, superfluous or inert, (i.e. of the relevant from the irrelevant factors) must depend on the test of expenditure of energy. This test the Nyáya would accept only in the sense of an operation analysable into molar or molecular motion (मर्यम्नः परं भोजितकी योधारः करीबयः—भतीमित्रायत्र योधारी नामस्, Jayanta, Manjari, A’hnika I); but would emphatically reject, if it is advanced in support of the notion of a mysterious causal power or efficiency (शक्ति). This is a peculiarity of the Nyáya—its insisting that the effect is only the sum or resultant of the operations of the different causal conditions—that these operations are kinetic, being of the nature of motion, in other words holding firmly to the view that causation is a case of expenditure of energy, in the kinetic form,—but at the same time absolutely repudiating the Sánkhya conception of power or productive efficiency as metaphysical or transcendental (भतीमित्र), and finding nothing in the cause other than an unconditional invariable complement of operative conditions (कार्यमयी) and nothing in the effect other than the consequent phenomenon which results from the joint operations of the antecedent conditions (समुद्रमकार्कायनिकर परिम्नतः एव—Jayanta—माम्यो कायं—साम्यीकायंते तु कायंमल्ले किमनरालब्धिनिगः शक्तिः—Jayanta, ibid, A’hnika, I, शक्तिनिर्राकार्ण्यम्—it may be noted that the Nyáya, while repudiating transcendental power (Sakti) in the mechanism of nature and natural causation,
does not deny the existence of metaphysical conditions like merit (धर्म) which constitute a system of moral ends that fulfill themselves in and through the mechanical system and order of Nature—vide Jayanta, बलोनिमश्र विभाजक कारण कल्पनामित धर्मादि—Ahnika I, शक्तिनिराकरणम्).

The causal relation, then, like the relation of genus to species, is a natural relation of concomitance (बाफः समाविकः स्वभावः—Váchaspati) which can be ascertained only by the uniform and uninterrupted experience of agreement in presence and agreement in absence, and not by deduction from a certain a priori principle like that of Causality or Identity of Essence.

Nyāya objection to the Buddhist Method of Difference as a means of ascertaining causality.

Take for example the Buddhist deduction of Causality in any particular conjunction by means of the negative Method of Difference, or of the Panchakārani. The ascertainment of the causal relation by these Methods is open to the following objections:—(1) The unconditionality of the antecedent cannot possibly be ascertained. As the Chārvāka rightly points out, the Methods enable you to eliminate irrelevant antecedents that are or can be perceived; but the introduction or sublation of latent or undetected antecedents can be imagined against which the Method of Difference is powerless. In the case of the production of smoke, for
example, by fire,—what if I say that an invisible demon intervenes in every case between the fire and the smoke, that this demon (विश्राच) is the immediate antecedent and real cause of the latter, and that the fire is an accident which, in every such case, is brought about by its own causal antecedents;—in saying this, I do not go counter to the principle of causality and am landed in no contradiction (आचार) such as strikes at the very roots of all practice, or baffles the completed circuit of consciousness, however much I may violate probability.

(2) In the second place, even supposing that the fire, in this particular case (which satisfies the Method of Difference rigidly) is ascertained to be the cause of the smoke, how can I know that fire is the cause in other cases, or that there is no other cause. You will perhaps argue that if there were an indefinite number of causes of the same specific phenomenal effect, it would violate the principle that phenomena are all conditioned, i.e., exist only under certain conditions (कारणिकहल),—which is more comprehensive than the principle of causality, and the contradiction of which equally overthrows all rational practical activity. Yes, I accept the conditionality of phenomena, but this is not violated by supposing that one specific assemblage of phenomena has more than one cause. It is true that if you suppose such plurality of causes, you cannot establish the invarableness of
the particular conjunction (green-wood fire and smoke) which your Method of Difference fixes upon as a case of cause and effect; in other words, with your special principle of Causality so restricted, and without any general principle of Uniformity of Nature to fall back upon, you cannot ascertain, from the present case, or from any number of similar cases that you may have observed, that all green-wood fires are followed by smoke; i.e., you are helpless in demonstrating with apodictic certainty (or ascertaining indubitably) the relation of cause and effect. But this is an objection against your own position, not mine. Why not admit at once that certain phenomena are naturally connected (as invariable concomitants or antecedents) with other phenomena, and take your stand on observed concomitance uniform and uninterrupted experience of agreement in presence as well as absence) without assuming causality as an a priori principle and making deductions therefrom, and without the trouble of ascertaining the relation of cause and effect in every individual case. I am free to admit that theoretical objections of irresistible force (like those of the Chārvāka Sceptics) can be urged against this ascertainment of universal invariable and unconditional concomitance (अनेकनर्विषय) on the basis of mere observation. Doubts of this kind can no more be laid by my view of the matter than by your canons of causality and essential
identity (तत्त्ववैदिकता और तात्त्विकता). Ultimately we all have to fall back on the rational practice of thinking persons (प्रेरणालयः), and such persons are always content to act on practical certitude instead of hankering after an unattainable apodictic certainty in the affairs of life (प्रामाणिककल्याणार्मतः पालयता यशादशं न प्रज्ञानीयम्). This same practical certitude is also the ultimate warrant of the Deductive-Inductive Inference by which we ascertain the characters of things without direct perception and through the medium or instrumentality of a mark.

[To the earlier Buddhist canon of the Method of Subtraction, i.e., the negative Method of Difference, Udyotakara and Vāchaspati of the Nyāya School pertinently and acutely object as follows:—

सबं यत् किषित् कःचित् हेतु तथा यव प्रतिवेशः, तविैः तम् तत् गमकं तव इति अनुजानोम्; स एव तु प्रतिवेशः न तात्त्विकः सन्धिष्ठः। का युनसाधिं तदुपवित्तिः। धृस्वम् किं बज्जानलं भाव्। स तात्त्वः भृणं रासमध्यापि। तत्प्रतिवेशवः प्रूसः यात्। एव तदभानुभवं भावः; न च रासभानलं भवन्निपि तदनन्तरस्मिन् भवति, तविन् सवति भविन् भवति वश्यो तदभावात्। भृणस्वम् भविन् सत्वां सवति सनवति बज्जो तदभावात्। भव यथविन् पूर्वययं विभवाणाविधिः तत्वोपमस्क, तथापि देशानलार्थिः तदभावोस्य कुत्ताः। तथा वि हि मूर्यो मूर्यो रासभं हेतु प्रूषोइश्वः, तदभावं च भज्जः; न स तत्तुकाः। तज्ञातीयस्यं पूर्वद्वारेयार्धमेव बिना सति वश्यो भावात्, एवं सधपि भर्ष्रां विशारंजनादुपं धृस्वम्; कांचनी शास्त्रो तज्ञातीयस्य एव रासभवेत्रविषयविपि विशारंजनादुप्यं समवापति, इति भवस्य शत्याः भात्येइ नियामक सत्यवादः। न च सति
Now the phenomenon that is contingent (कारणमेव) cannot be uncaused—अकारणविश्व हि कार्यस्थ नित्यं सत्काराश्च वा स्यात, अन्यं उपलब्ध न कार्यान्तकस्म। And with the limitation of a specific effect, there must be only one specific cause, for an unrestricted plurality of causes would amount to the denial of uniformity in causality (i.e., of the unconditional invariable antecedence)—

नापि अर्नेक कारणं, भकारणस्वप्रस्कार्यं। वज्ञानलक्षिणं भव दृष्टि वृम्मक विश्वायन्द्रं। स च इत्युच्छादेपि अन्लं, न एवकाराशं। खादु, इति न वज्जः कार्यस्म। एवमेव अपवस्थापि न कार्यं। न हि अच्छानलक्षिणं भवितं, वज्जः प्रस्कार्यं भावाशि, तत्तथ अच्छेतुको धृतं। खादु। तथा च कार्यान्तकल्यान्त:।

Nyāya rejoinder:—सत्त्वम्। यदापि विना वज्जः नोपलब्धी नूम। यदापि च पिशाचार्येऽनोपलब्ध्ये तथास्तत्स्वः। तथापि पिशाच-
The Nyāya proceeds to point out that what is contingent need not necessarily be produced by a cause. It is enough if there is natural connection with something else, a relation of antecedence and succession (or concomitance), without any element of productive efficiency or causation.

The Nyāya analysis of the causal relation continued:—Co-effects:—In the enumeration of dif-
ferent varieties of irrelevant antecedents (अनवधाितः), we have already noticed that co-effects of the same cause are apt to be confounded as cause and effect. In some cases, the co-effects may be simultaneous, e.g., the case of the ascending and the descending scale in a balance, which are co-effects of gravity (vide Pártha-sárathi Misra on Kumárila, Sloka-Várтика—तुषामनन्त्रमननदीस्तु न भिष्य: काय्यकारणाः, चभयीरेकार-जनात,—sloka 157, Súnya-Váda). In other cases, the co-effects may be successive effects of the same cause, and here the risk is great of mistaking the antecedent co-effect to be the cause of the succeeding co-effect; e.g., the case of ants moving in a line to carry their eggs upward, which is observed before the summer rains;—where the movement of ants and the rains are not cause and effect, but successive effects of the same cause, viz., the heat (उषा), which disturbs the elements, viz., the earth and the atmosphere (महाभूताभिः); the ants being affected by this heat earlier than the atmospheric movements which bring the clouds and the rain.

(Udyotakara, and Váchaspati—भच्च विपीलिकाष्ठ सूचरणः वर्ष्यम् कारणस्वप्नासामप्रगाति: अनवधायि तत्तमिन् वर्ष्यान्रतपि:। वर्ष्यमूलकारणस्य तु महाभूताभिभीक्ष विपीलिकाष्ठसूचरणः पूर्णकायम्। कथयमानः खलु विपीलिका भौमनीप्रणः स्वामृ अष्टादि भूभिषानि शपरिष्टात् नवन्ति—Tátparyya—Tiká II, 2, Sutra 37).
Synchronousness of Cause and Effect.—This is resolved into a case of simultaneous co-effects of the same ultimate cause, e.g., the ascent of one scale and the descent of the other in the balance, which are not related as cause and effect, but are simultaneous effects of gravity. In other cases, the synchronousness is only apparent, the interval between the antecedent and the consequent being too small (सूचकाल) to be apprehended (यौगपदाभिमान) e.g., in the case of the needle piercing a hundred soft lotus petals laid one upon another, where the steps are really successive; or the illumination of the whole room by the light of a lamp, where the succession is unperceived owing to the inconceivable velocity of light cf. Kumárilá, Sloka-Vartika,—हृदेहृदत्तां सिंह यौगपदाभिमान निदश नमू.—यदृ प्रदीपप्रभावादृक्क, सूचकावीर्यक्षिति तव न: । तुवंभतु यथा वैध: पद्मप्रणवन तथा । Sunyaváda, Sloka 156-157.—I quote Mimansa authorities, but the view is common to the Mimánsá and the Nyáya-Vaiseshika).

The time-relation in a chain of causes and effects:—A careful study of the time-relation in a chain of causes and effects is a peculiarity of the Vaiseshika system (and the later Nyáya). A moment (ultimate unit of time, Kshana, चम्क्ष) is defined to be the time-interval between the completion of the sum of conditions and the appearance of the effect. The Vaiseshika conceives the unit to be determined by reference to the division
of one atom from another. (सप्तपदार्थी साहित्यिक साक्ष्य: काल: च:—Sapta Padarthi, Sivâditya;—i.e., the ultimate unit of time is the time during which motion exists in an atom prior to its division from another atom, in a case of division due to motion). The Sánkhya, we have already seen, determines this ultimate unit by reference to the motion of a Tammátra.

The number of such units will determine the time-interval between a given set of physical conditions and a particular effect, for between a so-called sum of causes and a so-called sum of effects, there intervenes a series of atomic (or molecular) motions, with conjunctions and disjunctions which form the causal chain. However crude in the practical application, the fundamental idea is, in connection with the principle of work and energy (for which both the Sánkhya and the Nyáya-Vaiseshika furnish a rudimentary basis), immensely suggestive of a possible Time Calculus.

Plurality of Causes:—This will be discussed, when we consider the relation of Vyápti to the principle of Causality.

The Nyáya Ground of Inference—Vyápti (न्यायस्थिति—Váchaspati):—Inference, then, in the Nyáya, depends on the ascertainment, not of the causal relation, nor of the relation of genus to species, but of a natural relation, between two phenomena, of invariable and unconditional concomitance
Of the two phenomena so connected, one is called the Vyápya or Gamaka (the sign, mark or indicator), and the other Vyápaka or Garnya (the thing signified, marked, or indicated). In the relation of fire and smoke, for example, smoke is the Vyápya or Gamaka (sign or mark); and fire, the Vyápaka or Garnya (the thing signified or marked). Now the relation of Vyápti between A and B may be either unequal or equipollent (वियप्याहारित or समभावित). When A is the sign of B, but B is not the sign of A, the Vyápti is one-sided or unequal, and here a Vyapti is said to exist between A and B, but not between B and A. For example, smoke is a sign of fire, but fire is not universally a sign of smoke. When, therefore, the relation of Vyápti is an unequal one, as between smoke and fire, it is expressed in the proposition:—Wherever the Vyápya (sign or mark, e.g., smoke) exists, the Vyápaka (the thing signified or marked, e.g., fire) also exists. From this it follows by necessary implication (a sort of चर्चा) that whenever the Vyápaka (e.g., fire) is absent, the Vyápya (e.g., smoke) is also absent (वद्धकारिव वद्धकामावः). Again, the Vyápti may be a mutual or equipollent one, i.e., A and B may be signs of each other, e.g., green-wood fire and smoke. Here each in turn is Vyápya and Vyápaka, and this is expressed in
the two propositions:—(1) Wherever there is smoke, there is green-wood fire, and (2) wherever there is green-wood fire, there is smoke. By necessary implication it follows—(1) where there is no green-wood fire, there is no smoke; (2) where there is no smoke, there is no green-wood fire. We have seen that a Vyāpti exists between smoke and fire, for wherever there is smoke, there is fire. But we cannot say that a Vyāpti exists between fire and smoke, for we cannot say that wherever there is a fire, there is smoke. The combustion of an iron-ball (प्रामाणिलक), for example, is a case of fire without smoke. But it would be correct to say that a Vyāpti exists between green-wood fire and smoke, as well as between smoke and green-wood fire. The question, therefore, is—What is the relation between fire and smoke? The relation between fire and smoke is a conditional relation; i.e., on condition that the fire is green-wood fire, it would be a sign of smoke. In other words, a Vyāpti implies unconditional invariable concomitance, and the relation between fire and smoke is not therefore a Vyāpti (natural unconditional concomitance), for fire requires a 'condition,' Upādhi, viz., green-wood, to be followed by smoke. Smoke, on the other hand, requires no 'condition' to indicate fire. For the purposes of Inference, therefore, relations between phenomena may
be considered as of two kinds:—(1) Contingent conditional relations, holding good on the fulfillment of a certain condition or Upádhi, and (2) Vyáápti, or unconditional invariable relation, between a mark and that which it marks, a relation without any Upádhi or determining condition (व्याप्तिविविद्धः सचनाः). It is this latter kind of relation that serves as the ground of Inference. If we can ascertain that a Vyáápti exists between $A$ and $B$, then $A$ is a sign of $B$, and an inference of the presence of $B$ from the presence of $A$, and of the absence of $A$ from the absence of $B$, would be warranted. The question, therefore, is—how to ascertain the relation of Vyáápti between two phenomena.

Ascertainment of Vyáápti according to the early Nyááya (व्याप्तिविविद्धः).—Briefly speaking, the observation of agreement in presence (अवन्य) as well as agreement in absence (व्याप्तिरिक्त), between two phenomena, with the non-observance of the contrary (विचारद्रव्यम्), is the foundation of our knowledge of Vyáápti (दशोनादश नेवच्चसीन—Váchaspáti). This suggests a natural relation (व्यानाविविद्धः—Váchaspáti) of invariable concomitance (विन्यतसाहचर्य—Váchaspáti) between the phenomena, which is fortified by our non-observance (अद्यनन) of the contrary (विचारः). But this does not establish the unconditionality of the concomitance (उपायिविविद्धसचना), which is essential to a Vyáápti. We have therefore to examine the cases carefully.
to see if there is any determining condition (Upádhi—*i.e.*, some hidden or undetected but really operative or indispensable accompaniment) which conditions the relation between the supposed sign or mark (Gamaka) and the supposed signate (thing signified, Gamya). Now let us consider what constitutes an Upádhi. It is a circumstance which always accompanies, and is always accompanied by, the supposed signate (the thing signified, Gamya), but does not invariably accompany the supposed sign or mark (Gamaka). If, therefore, in the set of positive instances where both the sign and the signate are present, nothing else is constantly present, there can be no Upádhi. Or, again, if in the set of negative instances where both the sign and the signate are absent, no other material circumstance is constantly absent, there is no Upádhi. This follows from the very definition of an Upádhi. It is impracticable to fulfil these requirements rigorously. Still, every one of the accompanying circumstances (of course the likely ones) may be taken successively, and it may be shown that the concomitance continues even when the suspected Upádhi (शक्तिनापाधि) is absent, and therefore it cannot be the Upádhi. And this is to be fortified by the observance of uniform and uninterrupted agreement in absence (Vyatireka) between the two concomitant phenomena. In this way, when we have disproved all
suspected Upádhis, we conclude by establishing the Vyápti. It is true that we may still go on doubting. But doubt has a certain limit for the ‘experimenter’ and the thinking person (परीचक, प्रेचाबानु). When doubt overthrows the foundation of all rational practice (प्रामाण्यकोषकयाय), or leads to a stoppage or arrest of all practical activity (बाक्यवहंस), it stands ipso facto condemned, and must be abandoned (याचारविधारण), Sriharsha and Udayana—याचार is mentioned by Váchaspati). Thus it is that Vyápti is ascertained. In this way, we observe innumerable instances of Vyápti. Now by means of repeated observations of this kind (भूयोदश्न), we have established the principle of the Uniformity of Nature (समभाव-प्रतिद्वं), and also of Causality; and these two principles thus ascertained may be made use of in their turn as the basis of an argumentation or deduction (Tarka, U'ha, तर्क) to confirm a particular Vyápti in a particular case. Tarka or U'ha, then, is the verification and vindication of particular inductions by the application of the general principles of Uniformity of Nature and of Causality, principles which are themselves based on repeated observation (भूयोदश्न) and the ascertainment of innumerable particular inductions of uniformity or causality (भूयोदश्न ज्ञानितंस्यारसहितम् इत्स्यमेव स्मारितसंस्करणया—Váchaspati). Thus Tarka also helps in dispelling doubt (सन्देह). Sriharsha,
however, questions the validity of this verification,—cf. the well-known couplet ending तत्कः श्रावणचिकृतः।

It will be seen that the process of disproving all suspected Upādhis (उपाधिविनिराम), in the early Nyāya, answers exactly as a process to Mill's Method of Agreement. In fact, the disproof of a suspected Upādhi by pointing to instances of Agreement in presence (अन्तर्गत) even in the absence of the Upādhi, fortified as this is by the instances of agreement in absence (अतिरिक्त), virtually amounts to Mill's Joint Method of Agreement. But the fundamental difference is this:—Mill's Method of Agreement is formulated in view of the phenomena of causation (including co-effects, etc.) and, as usually enunciated, confessedly breaks down in dealing with cases of Uniformities of Co-existence unconnected with Causation; the Nyāya Method based on the disproof of suspected Upādhis is a more daring and original attempt, and is far more comprehensive in scope, being applicable to all Uniformities of Co-existence and of Causation alike. And this the Nyāya successfully accomplished, by introducing the mark of unconditionality (उपाधिविनिराम) into the relation of Vyāpti (Concomitance), even as the same mark of unconditionality (व्याप्तिकारणशृंगार) had been previously introduced into the definition of Causality (कारणवान्तर्गत). The difference between the early Nyāya and the Buddhist systems
may be briefly put thus:—The former relied on empirical induction based on uniform and uninterrupted agreement in Nature, and accordingly regarded the Method of Agreement as the fundamental Method of Scientific Induction, founding Inference on Vyápti to which they subordinated Causality in the doctrine of Method; the latter assumed two *a priori* principles, *viz.*, causality and identity of essence, deduced the canon of the Method of Difference by an indirect proof from the principle of causality, and made this Method the foundation of all scientific Induction of Causality, just as they based all natural classification of Genera and Species on their *a priori* principle of Identity of Essence.

[Texts from the early Nyáya:—

Method of Agreement and the Joint Method without the device of the Upádhi:—

Cf. Jayanta on साहच्यः—तत्त्त्वान् सच्येव भवने न विना
भवनं तत् । शयमेवाविनाभिस्वो नियमः सच्चारिता । 'तत्त्त्वान् सच्येव'
‘only this remaining throughout’, while others change—implying the Method of Agreement. The set of positive instances, in which this antecedent alone is constant, must be supplemented by a set of negative instances (agreement in absence):—

अतिरिक्तिनियमसत्तरं
प्रतितत्वस्थापातुपते । नियमस्वार्थ चच्चिे यत् तत्त्त्वान् सति भवन् ततो
विना न भवनं इति भूयोऽध्येनम् । तत् तत्त्त्वान् सति भवन् इत्यत्वमाः—
Doctrine of the Upādhi:—Unconditional concomitance distinguished from conditional:—

The Buddhist objects—In Nature, everything is connected with everything else. Hence if there were no nexus of causality between antecedent and consequent, everything might follow from everything else. The Nyāya replies—You admit uniformities (of co-existence, etc.) other than causal;—so you confess that a natural fixed order can exist without the causal nexus......

An Upādhi, how established and how disproved:—

The Nyāya then proceeds to show how an Upādhi
is established, or how disproved by observation:—

General Method of Induction by exhaustion of the Upádhi, more comprehensive than Mill's Joint Method:—

For the definition of an Upádhi, vide Sriharsha and Udayana: च्यास्मादायनी यः माध्यमम्बास्सि: चचते स उपाधिरितः।

Hence to avoid an Upádhi (which is माध्यमम्बास्सि:), the constant presence of anything relevant other than the sign and the signate in the positive instances (of agreement in presence, अन्वय), and the constant absence of any such thing in the negative instances (of agreement in absence, अतिरिक्) must be safe-guarded against. This amounts to Mill's Joint Method.

Suspicion of non-perceptible Upádhi—Limits of legitimate Doubt:—

न च भ्रामानदीपि दर्शनानि तथा साधकाधकाप्रमाणाभास्वेन संदिधामाम उपाधि: साधारिकल्य प्रतिवज्ञाति चति साम्यतमः। भेदाय श्रेयशं भविताय निधयमकामाभास्ति दशावकाशा खलु ईश्वर्म प्रमाणम्यादातिकमनेन श्रद्धा पश्चायो ज्ञाप्ता: न कचिन् नामोति नेत्रः
Tarka, U'ha,—Deductive verification of particular inductions by applying the two fundamental inductions of Uniformity of Nature, and Causality:—Doubt finally dispelled:—

Now innumerable particular uniformities of this kind (Vyáptis) are observed, and as a result of this repeated observation, a belief in the Uniformity of Nature (सम्भव प्रतिवेद्व), as well as in the principle of Causality (कार्यकारणमभाव) is generated in the mind, a belief which has evidential value and validity. It is not intuition (न सानक्षम) but a mental pre-disposition based on uniform and uninterrupted experience (सम्भोदशनंविनिः कार्यकारणमभाव इति दिव्यसे व 

9 व्यापकस्य स्थायुम, —भव सम्भोदशनंम् असाधारणम् इति प्रभावार्थ जातम्). Then armed with these new resources, the belief in uniformity and in causality as general principles, we proceed to fortify our particular inductions (Vyáptis), whether of uniformity of nature or of causality, by indirect deduction from these general principles:—We argue if, under these observed circumstances, A were not the mark of B, the principle of uniformity of nature would be violated,—Nature would not be uni-
form,—or, if under these observed circumstances $A$ were not the cause of $B$, the principle of causality would be violated, the phenomenon $B$ would be without a cause;—and such indirect proof (तर्क, ज्ञान) gives us the overwhelming probability which we call practical certitude, and on which every reasonable man (every thinking and judging person) proceeds to act in due natural course.—

 Instances of Vyāpti (uniformity) not comprehended under Causality, or the relation of Genus and Species:—The Nyāya points out that the relations of cause and effect and of genus and species do not exhaust the grounds of Inference. There are cases of Inference based on Vyāpti (i.e., on invariable and unconditional concomitance) which come neither under Causality (द्वैत प्रत्यक्ष) nor under Identity of Essence (तदात्मा). Vāchaspāti notes that today's sunrise and yesterday's sunrise, the rise of the moon and the tide in the ocean, the relative positions of the stellar constellations, are instances of Vyāpti (invariable concomitance) between phenomena which are neither related as cause and effect, nor as genus and species. Jayanta adds the conjunction of sun-set with the appearance of the stars,
of ants moving in procession (with their eggs) with the approach of the rains,—of the rising of the constellation Agastya (Canopus) above the horizon with the drying up of rivers; of the spring tide with the full moon; and dismisses as sophistical and far-fetched the Buddhist attempt to explain all these cases by means of causality. We have seen that the Nyāya and the Mimāṃsā reduce most of these conjunctions to cases of co-effects of the same cause, co-effects which may be either simultaneous or successive.

Vyāpti between Cause and Effect:—Relation of causality to Vyāpti:

On the Buddhist (and early Nyāya) view that one specific assemblage of ‘effect’ phenomena has one specific assemblage of causal conditions, there would be two aggregates, the sum of causal conditions (कारणसामग्री), and the sum of effects (कारणसामग्री). For example, fire requires green-wood to complete the sum of causal conditions to give rise to smoke with some particular marks (धूमविनिः,—
Here, between an effect and a single condition (termed a cause) there is a relation of Vyápti. The effect is Vyápaya or Gamaka (the sign or mark); the cause (or condition) is Vyápaka or Gamya (the thing signified). In other words, the presence of the effect indicates the presence of the causal condition, and the absence of the causal condition will by implication indicate the absence of the effect. Smoke of this particular kind is supposed to be an effect of which there is one and only one assemblage of causal conditions (fire and green-wood); hence where there is smoke, there is fire; and when there is no fire, there is no smoke.

Now introduce the complication of the plurality of causes:—Fire, for example, is the effect of several assemblages, e.g., (1) blowing on heated grass, (2) focussing rays through a lens on a combustible like paper or straw, (3) friction with the fire drill, etc. Here each assemblage is regarded as a sum of causes. But in this case there is no Vyápti between the effect 'fire' and any particular assemblage of causal conditions, say, of the lens or the fire drill. For the presence of fire does not indicate the presence of the lens or the fire drill assemblage, nor does the absence of either of the latter in particular, indicate the absence of fire.
Indeed in such a case, the effect 'fire' is not a mark or sign (Gamaka or Vyápya) of any one in particular of the different possible causal assemblages, though each of these particular assemblages of causal conditions is a mark or sign (Gamaka or Vyápya) of fire.

The plurality of causes requires a further consideration in the light of the definition of the causal relation. A cause is defined to be the unconditional invariable antecedent. From the unconditionality, it follows that the entire sum of conditions, and not one single condition, is, properly speaking, the cause. In view of the plurality of causes, an invariable antecedent must be taken to mean that any particular cause (i.e., assemblage of causal conditions) is invariably followed by the effect,—not that the effect is invariably preceded by any particular cause.

Popularly, a single condition, say the lens or the fire-drill, is said to be a cause of fire; but, in view of the plurality of causes, this is apt to be misleading, as there is no Vyápti in this case; the lens or the fire-drill is no more a mark of fire than fire is a mark of the lens or the fire-drill.

The plurality of causes strains the definition of a cause, and undermines the relation of Vyápti between an effect and a cause. Any particular cause (causal aggregate) still indicates the effect, but not vice versa. The earlier Nyáya (down to
Váchaspati and Jayanta obviated the plurality, as we have seen, by introducing distinctive marks in the effect such as would indicate a single specific cause (कारवैगच स्थितिः or कारवैगचायत्वक or कारवैगचायत्वक or कारवैगचायत्वक). Some indeed went further and held that when the antecedent causal assemblages differ in kind, the effect phenomena, though apparently the same, do really differ specifically (or in kind)—कारवैगचायत्वक कारवैगचायत्वक. But the Nyáya discards this hypothesis; the fire is the same, though the possible causes (or causal aggregates) differ, e.g., the lens, the drill, etc. But the effect phenomenon to which we attend is not the only effect;—in the case of plurality of causes, we must carefully examine the accompaniments of the effect, i.e., the sum of effects, and the examination will shew some distinctive or specific circumstance or accompaniment which will enable us to definitely determine the particular assemblage of causal conditions that must have preceded in the case under examination. This is the device of the earlier Nyáya as well as of the Buddhists, as we have seen; but the later Nyáya doubts the practicability as well as the theoretical validity of such a step on an unrestricted assumption of the plurality of causes, and feels troubled by the circumstance that no effect for which more than one cause (or causal aggregate) can be assigned, can be regarded as a mark or sign (Gamaka or Vyápya) of any one of
the causes in particular. Accordingly, some adherents of the later Nyāya advanced the proposition that when more than one causal aggregate can be supposed for any effect, the latter is a mark or sign (Gamaka or Vyāpya), not of any one of the causal aggregates in particular, but of one or other of them; and the absence, not of one such cause, but of each and every one of them, alone indicates the absence of the effect. A cause therefore should be defined to mean one or other of the possible alternative aggregates which, being given, the effect follows invariably and unconditionally. If we ask what is the defining mark (or quiddity) of the cause (कारणादृश्यदक्ष), we are told that it is one-or-otherness (व्यक्ततम), and nothing else: others cut the Gordian knot by assuming that the different possible causes of the same effect possess a common power or efficiency (शक्ति), or a common 'form' (आतिमका), which accounts for the production of a common effect. The latter is therefore a sign or mark of this power (शक्ति), or this form (आतिमका), which is manifested by each of the causal aggregates. This hypothesis (चलन.), they hold, is simpler and more plausible than the hypothesis of specific differences latent in the apparently identical effect of a plurality of causes (कारणतस्तत्तैत्कारियतद्विः).

(Cf. Dinakarī on the Siddhanta Muktavali—कृति विष्णुकृतकार-संबोधाकृतीनां विष्णुकृतकारसंबोधादिस्पष्टि।
The Scientific Methods already noticed, the Joint Method of Difference (the Panchakárani), and the Joint Method of Agreement (Vyáptigraha with Upádhisanká-nirasa and Tarka), are not the only methods of ascertaining causality or concomitance, or establishing a theory (सिद्धांत); nor are these Methods always practicable. Very often, we reach the explanation of a fact (उपपति) by means of a Hypothesis (कल्पना) properly tested and verified (निरस्त). A legitimate Hypothesis must satisfy the following conditions:—(1) the hypothesis must explain the facts (उपपति, or उपपति); (2) the
hypothesis must not be in conflict with any observed facts or established generalisations (ि भमक्षणं कल्पति, न कृतिविधाताय—Jayanta, Nyāya-Manjari, Ahnika 1); (3) no unobserved agent must be assumed, where it is possible to explain the facts satisfactorily by observed agencies (ि भमक्षणलरेपहं न सिद्धतं कामविण्ढतं कल्पताम, पवयाविवि तदुपयोज्यं किं तदुपकल्पनेन, ibid); (4) when two rival hypotheses are in the field, a crucial fact or test (विनिमयक, ratio sufficiens) is necessary; the absence of such a test (विनिमयनाविबर्त) is fatal to the establishment of either, (5) of two rival hypotheses, the simpler, i.e., that which assumes less, is to be preferred (celoris paribus) (कल्पनाराष्ट्र vers vs कल्पमायर्ष्ट्र); (6) of two rival hypotheses, that which is immediate or relevant to the subject-matter is to be preferred to that which is alien or remote (पथमीपश्यात्तल) ; (7) a hypothesis that satisfies the above conditions must be capable of verification (रिष्ण) before it can be established as a theory (सिद्धान्). The process of verification of a hypothesis consists in showing that it can be deduced as a corollary from (or is involved by implication in) some more general proposition which is already well-established (cf. Vatsyayana’s exposition and illustration of Verification, नियंच,—including both the Deductive Method and Colligation).

This doctrine of Scientific Method, in Hindu Logic, is only a subsidiary discipline, being com-
prehended under the wider conception of Methodology, which aims at the ascertainment of Truth, whether scientific (Vijnana) or philosophical (Jnana) (मील धीरजिनम् याम विज्ञान ज्ञिन शास्त्रायोऽ्, Amara-Kosha) — the latter being the ulterior aim. In the investigation of any subject, Hindu Methodology adopts the following procedure: (1) the proposition (or enumeration) of the subject-matter (Uddesa), (2) the ascertainment of the essential characters or marks, by Perception, Inference, the Inductive Methods, etc., — resulting in definitions (by लघु) or descriptions (by उपचर), and (3) Examination and Verification (पर्याला and निर्माण). Ordinarily the first step, Uddesa, is held to include not mere Enumeration of topics, but Classification or Division proper (विभागः उद्देशयनवार्ग्यायू भएभ्या एवामी। सामाज्याय विचारं मुद्रितं प्रकारसंदर्भाय विचार इति—Jayanta, Manjari); but a few recognise the latter as a separate procedure coming after Definition or Description. Any truth established by this three-fold (or four-fold) procedure is called a Siddhánta (an established theory). Now the various Pramánas Poofs, i.e., sources of valid knowledge) in Hindu Logic, viz., Perception, Inference, Testimony, Mathematical Reasoning (मन्त्रवाल, including Probability in one view) are only operations subsidiary to the ascertainment of Truth (तत्कार्यक्यं). And the Scientific Methods are merely ancillary to these Pramánas themselves.
I have explained the principles of the Hindu doctrine of Scientific Method, avoiding the technicalities of Logic as far as possible; and I cannot here enter upon the logical terminology or the logical apparatus and machinery, which would require a separate volume to themselves. For these, I would refer the reader to my paper on Hindu Logic,—as also for an account of the later Nyáya (न्याय), which, in spite of its arid dialectics, possesses a three-fold significance in the history of thought: (1) logical, in its conceptions of Avachchhedaka and Pratiyogi, being an attempt to introduce quantification on a connotative basis, in other words, to introduce quantitative notions of Universal and Particular, in both an affirmative and a negative aspect, into the Hindu theory of Inference and Proposition regarded connotatively as the establishment of relations among attributes or marks; (2) scientific, in its investigation of the varieties of Vyápti and Upádhi, (and of व्याप्तिविभक्ति) being an elaboration of Scientific Method, in the attempt to eliminate the irrelevant; and (3) ontological and epistemological, in its classification and precise determinations of the various relations of Knowledge and Being, with even greater rigidity and minuteness than in Hegel's Logic of Being and Essence. I will conclude with a few observations on Applied Logic, i.e., the logic of the special sciences, which is such a
characteristic feature of Hindu scientific investigation. What is characteristic of the Hindu scientific mind is that without being content with the general concepts of Science and a general Methodology, it elaborated the fundamental categories and concepts of such of the special sciences as it cultivated with assiduity, and systematically adapted the general principles of Scientific Method to the requirements of the subject-matter in each case. The most signal example of applied logic (or Scientific Method) worked out with systematic carefulness is the Logic of Therapeutics in Charaka, a Logic which adapts the general concepts of cause, effect, energy, operation, etc., and the general methodology of science, to the special problems presented in the study of diseases, their causes, symptoms and remedies (vide Charaka, Vimanasthána, Chap IV,—also Sutra Sthána,—vide my Paper on Hindu Logic). Here I will give an illustration of Applied Methodology from the Science of Analytical and Descriptive Grammar. Patanjali, in the Mahábháshya, is very careful as regards Methodology. I take no note now of the philosophical presuppositions of his philology (vide my Paper on the Hindu Science of Language), but will confine myself to his presentation of the Applied Logic of Descriptive and Analytical Grammar. The sentence is the unit of speech, as every Hindu philologer contends, but the first business of Analytical
Grammar is to analyse the sentence into its significant parts and their coherent relations to one another. Assuming that articulate sounds are significant, the question is:—how is the sentence, which is the unit of articulate speech, broken up into significant words and their mutual relations? Patanjali answers that this is done by an instinctive use (cf. Vāchaspati's ज्ञानविनिवृत्तिका द्वारा) of the Joint Method of Difference (combined Addition and Subtraction), fortified by the Joint Method of Agreement. Patanjali starts with a simple case. Take the two sentence-units:—Pathati (he reads) and Pachati (he cooks). Suppose you start with the assumption that these sounds are significant, and that separate elements have separate meanings. Then you hear Pathati, and, at the same time, a man reading is pointed at. Then the assemblage of sounds Pathati (i. e., Path + ati) stands for the assemblage—‘one reads,’ (i. e. the action reading + an individual agent). Similarly by finger-pointing or other indication, you find that the assemblage Pachati (i. e. Pach + ati) stands for the assemblage ‘one cooks’ (i. e. the action cooking + an individual agent, say, the same agent as before).

Now look at the groupings:—

Path + ati = reading + one agent.
Pach + ati = cooking + one agent.
From repeated observation of similar groupings, one is led to conclude that Path is the invariable concomitant of the action ‘reading’, because the disappearance of the former (the other element remaining) leads to the disappearance of the latter; a rough Method of Difference by subtraction — अंतराधिकृति; that Pach is the invariable concomitant of the action ‘cooking’ because the introduction of Pach (with nothing else added) leads to the introduction of the action ‘cooking,’ (a rough Method of Difference by addition, — अंतराधिकृति); and that Ati, which is the only ‘common antecedent’ (अनुगमी) is the invariable concomitant of ‘one agent’ which is the only common ‘consequent’ (अनुगमी). In fact, the last should come first by the Method of Agreement, then the other two either by Residue, or by Joint Agreement in presence and absence (अनुगमाविरोध). So far all is plain sailing, though only very simple and very rough applications of the Methods are given. But—and this is the point—throughout the argument, it is assumed that one sound is the concomitant of one idea, in other words, there is no plurality of causes to vitiate the application of the Method of Agreement in the above example. And now the objection is advanced that this basal assumption is untrue. The same sound is not the concomitant of the same idea. Different words (sounds) may have the same meaning, and the same word (sound) may have
different meanings. We cannot therefore by the Joint Method of Agreement (अनुयङ्गातिरिक्तः) determine the meanings of words, or the separate functions of roots (stems) and inflections,—at least not so simply as is pretended above. Patanjali states this difficulty in the way of applying the Scientific Methods to the problems presented by Analytical Grammar, a difficulty arising from the plurality of causes, but does not state the solution. The solution, however, depends on the Method of Subtraction and Addition (Patanjali's चौधरीनं and व्यवज्ञानं). For it will be found by extensive observation that the number of meanings of which a word (sound) may be capable is limited. So also is the number of words (sounds) expressive of a given meaning. Hence, by the Method of Difference, etc., the causal relations of words and meanings may be determined. Patanjali thus establishes the doctrine of Prakriti and Pratyaya 'roots and inflections', with their separate significance, which is of course a necessary postulate in the case of an inflectional language like Sanskrit. Isolating and Agglutinative languages offer less difficulty, whereas the difficulties are in some respects enhanced in the case of languages with a polysynthetic or incorporating 'incapsulating' morphological structure.

कथा पुनर्ज्ञानम् अनु प्रक्ष्यः। अनु प्रक्ष्याय ईति। अनुयङ्गातिरिक्ताभासः।
कृतस्मृ अनुयङ्गातिरिक्तः वा। इह पन्नोभ्यं कार्यितं शब्दः यूँयः,
Patanjali not only applies the Scientific Methods to the foundations of Grammatical Analysis, but also by their means establishes and elaborates the fundamental categories and concepts of Grammatical (and Philological) Science, e.g., the concepts of action (क्रिया), agent (कर्ता), instrumental cause (कारण साधकतमस्), end (निमित्त), origin (दैत्त), limit (भर्ति), substance (द्रव्य), quality (गुण), and genus (जाति);—also of the fundamental relations (at the bottom of all thought and speech)—the relations of Time (कालिकसम्बन्ध), of Space (दिर्गतिमस्मि), of Causality (कार्यकारणशास्त्र), of inherence (समवाय), of co-inherence (विशेषविशेष्यभाषा), of the sign and the signate (संज्ञासंज्ञाभाषा), of mutual dependence (संतरितमार्ग);—an entire grammatical (and philological) apparatus, which will serve as a ‘point d'appui’ for generations of philologists and grammarians to come.
ADDENDA.

(By Principal Brajendranath Seal.)

Empirical Recipes from Varāhamihira (circa 550 A.D.) relating to Chemical Technology.

A. Searing of hard rocks to enable them to be cut (or pulverised) ( shipment).

Sprinkle on the rock taken red-hot from the fire of Palasa and Tinduka wood (Butea Frondosa and Diospyros Embryopteris) :- (a) diluted milk, or (b) a solution of wood ashes (the ashes of the Mokshaka mixed with those of reeds), or (c) a decoction of (the fruit) of the jujube (Zizyphus Jujuba) kept standing for 7 nights in a mixture of whey, vinegar and spirits, in which Kulattha (Dolichos Uniflorus or Biflorus) has been steeped, or (d) a solution of the ashes of the Neema bark and leaves (Azadirachta Indica), the sesame pod, the resinous fruit of the Diospyros Embryopteris, and the Guduchi (Tinospora Cordifolia), with cow's whey. Repeat the process seven times (in the last case six times).

(Varāhamihira, Vrihat-sauhitá, Chap. 33, Slokas 112-117).
B. Hardening of steel (शस्त्रवाण).

(1) Plunge the steel red-hot into a solution of plantain-ashes in whey, kept standing for 24 hours;—then sharpen on the lathe.

(2) Make a paste with the juice of the Arka (Calotropis Gigantea), the gelatine from the horn of the sheep, and the dung of the pigeon and the mouse; apply it to the steel after rubbing the latter well with (sesame) oil. Plunge the steel, thus treated, into fire; and when it is red-hot, sprinkle on it water, or the milk of the horse (or the camel or the goat), or ghee (clarified butter), or blood, or fat or bile. Then, sharpen on the lathe.

(Varāhamihira, ख्रड्गलचापम्,
chap. 49, slokas 23-26.

C. Preparation of cements (for rocks, metals, etc.) (वज्रविप)

Varāhamihira gives the following recipes among others. (1) First, prepare a levigated powder with lac, the resinous exudation of the Pinus Devadara, the Balsamodendron Mukal, the Feronia Elephantum, the kernel of the fruit of the .Egle Marmelos (the bel), the Diospyros Embryopteris, the Neem (Azadirachta Indica), the Mhow (Bassia Latifolia), the Indian madder (Rubia Manjistha), the Phyllanthus Emblica, and the resin of the Sala tree (Shorea Robusta), then make a decoction of this in 256 Palas of water reduced
ADDENDA.

by boiling to 32 Palas, and apply the decoction hot.

(2) The horns of cows, buffalos and goats, asses' hair, buffalo's skin, with gavya (cow's urine etc.), the Neem (Azadirachta Indica) and the Feronia Elephantum, similarly treated.

(3) A mixture of eight parts of lead, two of 'bell-metal' and one of brass, melted and poured hot (Maya's cement).

The first, it will be seen, has lac, gum and turpentine as principal ingredients; the second makes use of gelatine; and the third is a metallic cement.

D. Nourishment of Plants:—(from Varāhamihiria, Chap. 54, on हेतुकृति).

The most suitable ground to plant in is soft soil that has been sown with the Sesamum Indicum, and dug up or trodden over with the sesame in flower. Grafts should be smeared with cowdung. For transplanting, the plants should be smeared with ghee (clarified butter), sesame oil, the honey of the Kshudra variety of the bee, the oil of the Usira (Andropogon Laniger or Andropogon Citrarum), the Vidanga (Embelia Ribes), milk and cowdung. Trees should be planted at intervals of 20 or 16 cubits.

As a sort of general prophylactic, mud kneaded with ghee (clarified butter) and Vidanga, (Embelia Ribes) should be applied to the roots, after which
milk diluted with water should be poured. As a remedy against barrenness, a hot decoction should be made of Kulattha (Dolichos Uniflorus or Biflorus), Masha (Phaseolus Roxburghii), Mudga (Phaseolus Mungo), Tila (Sesamum Indicum), and Yava (barley); which, when cooled, should be poured round the roots.

To promote inflorescence and fructification, a mixture of one A’dhaka (64 palas) of sesame, two A’dhakas (128 palas) of the excreta of a goat or sheep, one Prastha (16 palas) of barley powder, one Tula (100 palas) of beef, thrown into one Drona (256 palas) of water, and standing over for seven nights, should be poured round the roots of the plant. The measures given are for one plant.

To ensure inflorescence, etc., the seed before being sown should be treated as follows:—The seeds should be taken up in the palm greased with ghee (clarified butter), and thrown into milk;—on the day following, the seeds should be taken out of the milk with greased fingers, and the mass separated into single seeds. This process is to be repeated on ten successive days. Then the seeds are to be carefully rubbed with cowdung, and afterwards steamed in a vessel containing the flesh of hogs or deer. Then the seeds are to be sown with the flesh, with the fat of hogs added, in a soil previously prepared by being sown with sesame and dug up or trodden down.
To ensure the formation of Ballaris (i.e., sprouting and the growth of luxuriant stems and foliage), the seeds should be properly soaked in an infusion of powdered paddy, Masha (bean), sesame and barley mixed with decomposing flesh, and then steamed with Haridra (turmeric). This process will succeed even with the Tintidi (Tamarindus Indica). For the Kapittha (Feronia Elephantum), the seeds should be soaked for about two minutes (lit. such length of time as it would take one to make a hundred rhythmic claps with the palms—तालमंडू) in a decoction of eight roots (A'sphota, A'malaki, Dhaya, Vásika, Vetasa, Suryyavalli, Syáma and Atimukta, i.e., the Jasmine, the myrobalan, the Grislea Tomentosa, the Justicia Ganderussa, the Calamus Rotang, the Gymandropsis Pentaphylla, the Echites Frutescens, and the Dalbergia -Oujeinensis) boiled in milk. The seeds should then be dried in the sun. This process should be repeated for thirty days. A circular hole should be dug in the ground, a cubit in diameter and two cubits deep, and this should be filled with the milky decoction. When the hole dries up, it should be burnt with fire, and then pasted over with ashes mixed with ghee and honey. Three inches of soil should now be thrown in, then the powder of bean, sesame and barley, then again three inches of soil. Finally, washings of fish should be sprinkled, and the mud
ADDENDA.

Page. Line.

,, 127 ,, 21 after 'potash etc., add The Audbhida salt, an inflorescence of the soil, stands for reh

( चौङ्दे पाण्डवशः यथात् मृतत: कथवसः)

,, 128, ,, 5 after 1. 5, add Origin of precious stones:

— Some hazarded the guess that the precious stones are rocks (or earths) metamorphosed by natural process in the course of ages (Varahamihira—वैचित्त्व मृत: स्वभावात् वैचित्वं प्राहुपपालानम्—Utpala notes,—रक्षपरं प्राम्प: कालालरेन)

,, 143 ,, 4 after ‘Tejas compounds’ add

"The Tejas compounds predominate in the composition of the blood."

pp. 130-131 for the last 2 lines on p. 130, and the first line on p. 131, substitute the following 2—

At any rate, Dridhavala imported into Charaka much of the surgical knowledge which had till then been the traditional heritage of the Susruta school. And in the matter of the surgical treatment of certain diseases, the genuine Dridhavala is often as advanced as Susruta’s redacteur himself. The latter was probably......
ADDITIONAL ERRATA.

Page. Line.

73 for lineseed read sesamum

81 13 for intuites read intuit

92 18 or read on

101 20 for Purana's read Purana

128 10 honies read honeys

135 2 for Parshad read Parshandyt

136 17 after Amarakosa add sixteenth century, A. D.

137 8 is used read was wont

140 5 for Cakapan read Cakapan

148 22 for Cakapan read Cakapan

156 4 indeed read indeed

166 15 esser read lesser

167 7 Parimadunyalya read Parimadunyalya

171 24 after Panchadasi add cf. also Jayanta, Manjari

204 10 for Cakapan read of a peculiar kind, from which evaporation ordinarily sets the water free (cf. Udyana's Cakapan in Para).

205 21 for sand read sand

209 23 for Cakapan read Cakapan

209 24 for Cakapan read Cakapan

224 16 air-filled read the air-filled'

225 15 after Test of Truth add (after the Buddhists)

226 22 also read compare

226 25 Truth read the Buddhists contend

231 3 for subject read subject.

231 13 after lengths add and weights

240 21 for Vishak read Vishak

240 27 for Cakapan read Cakapan

242 1 for Cakapan read Cakapan

243 10 a contradiction read an unsettlement

246 9 after Buddhha Darsanam add vide also Sridhara, Kandah

253 25 for M. read M.

253 27 for M. read M.

262 20, 25 for non-observance read non-observance

264 18 for Cakapan read Cakapan

280 22 after Mahabhshya add cause and effect

284 24 for co-inherence read cow's urine

285 16 for cow's urine read cow's urine
SANSKRIT Texts.
Extracts from RASARATNAKARA.

नागार्जुन-विरचितात्

रसरताकरादेवता: श्लोकाः

चथ महारसशेधनं व्याख्यायामः
किमत्र चिन्त यदि राजवर्तकोः
शिरोधपुष्पायससेन भावितम्।
सितं सुवर्णं तक्षार्कवसितं
करोति गुणाशतमिकायुख्या॥ १॥
राजावर्तशेधनम्।

किमत्र चिन्त यदि पीतगत्वः
पलामनित्यासससेन सौधितः।
वास्कैवत्त्वलक्ष्मीयु पाचितः
करोति तारं चिपुरेन काँचनम्॥ २॥
गन्धकशुद्धिः।
किम्रत चिन्त रसको रसिन

क्रमेण कबामुभरेण रचितः
करोति शुल्ल चिपुटेन कािचनम् ॥ २ ॥ *
रसकशोधनम् ।

किम्रत चिन्त द्वरः सुभावितः
प्रयेन्तः मेषा वहुधोक्षवर्गः ।
सितं सुवर्णं वहुधर्मभावितः
करोति साचाहरकुञ्जुमप्रभम् ॥ ४ ॥

द्वरःशुद्धः ।
कृत्याकोद्वकाथि नरसूचे धाश्येश्वरिु
वेतसायक्षवर्गः दच्चा चारं पुत्रवर्म् ॥ ५ ॥
किम्रत चिन्त ददलोरसिन
सुपारितं सुरसूक्तंसंस्कर्मम् ।


॥ पयस्न is the correct form.
वातारिति लौगिन पाण्यां वर्गशिंभिताः
पुत्रेण द्रुष्यं वर्गशिंभिताः।

मालिकाद्वितीयम्।

हिंदुशा विशली श्रीमतानं रश्चातित्येण संयुता।
लवणपद्ध तामृपद्धारिणी लिपयेत्।

चारणी संज्ञानं निर्गुणं दीर्घस्वातिकानि समधा।
मासान् वसुरस्नेन शूलशुद्धिर्भविष्यति।

परतः सम्बंधोपविष्यनम्।

चम्बेरतस्मथायास्मानमित्रतृतीयनि शूराः।

विशलशुद्धिः।

चपलाया धातवः सम्मेऽजम्बौरस्मभाविता।

श्रीतिस्त सम्प्रमुतिकामस्मालावणे।

संयुताः संस्थेष्यन्ति पुष्पाकरिन्त काश्यनम्।

हेमशार्धनम्।

नागे चाराजेन धार्यांत्य शुद्धिस्तुच्छिताः॥

* The text reads वष्णु, which is incorrect.
† This verse also occurs in Rasārṇava.
तारं निवारनिचित्रं पिशाचाचैतैलमध्यमम् ॥ १२॥
तारशुद्धि ॥

श्री नु चिन्तं यथिवीभवेन
चारेण समवृष्यसं घुतेन ॥
तैलेन शुद्धं दुतषोड़शांगं
भवेवं शुल्यं गणिश्यदृसविभम् ॥ १४॥

मोचसारोरपालाशं-चारगोमूँत्रभावितम् ॥
वज्रकन्द्यशिखाकल्क-फलमूलसमन्वितम् ॥ २२॥
तत्रकल्कं कगरकं साचाचूरीं वैक्तान्तसभ्रवम् ॥
सारवेन% समायुः सम्पृष्ट्यशीद्रवान्वितम् ॥ २४॥
पिणितं सूककूषात्सशं धारितेच्छ हठागिना ॥
तथैव पत्ते सत्वं वैक्तान्त्य न संशयः ॥ २५॥
वैक्तान्त्सचम् ॥

चौद्रं गम्बर्तैतैलं स्पष्टसंभिनवं
गी रसं मूँत्रक्षज

* These couplets also occur in R. R. S., with this difference that in the latter नवसार has been substituted for सारप.
भूयो वातारितिलिं कदलितसयुतं
भावितं कान्तिकसम् ।
मूषां कलाग्रिग्नकेशमलुणकारनिनं
प्राचिपीन्माचिकेन्द्रं
सत्यं नागेन्द्रतुल्यं पतति च सहसा
सूत्रं वैवानरामसंः || २५।। *

महााँचारोवतीरग्नं स्त्रोत्तानेन सुभावितम् ।
सूप्यायामग्रिग्नकेशमलुणकारनिनं द्रवीतायं न संशायः || २६।।
कदलितसयुतं भ्रान्तायं तायं स्त्रोत्तानेन महितम् ।
प्रशासमस्य निपतति सत्यं सूप्ययसु घ्रामिवत् ॥ २७॥
काल्लीकं बहुशुभोक्तिवं तायं चूलं काटुरिकम् ।
कलामुक्षिताम्वयं पलं वजःपायसभावितम् ॥ २८॥
ग्रहधूमं घृतं चौद्वं संयुतं पुनर्भवः ॥
धारितं सूक्ष्ममृणां शाेनिन्नानिभं भवेत् ॥ २९॥
कदलितसयुतं घृतमध्वेरेंरल्परिपक्षम् ।
तायं मृणुति सत्यं रसक्षेत्रविचित्रितानि ॥ ३०॥

माध्विकसत्त्वपातनविवधः ॥

चारस्थेहैं धान्यायें रसकं भावितं बहुः।
जणे लाचा तथा पथ्या भूलता धूमसंयुतम् ॥ ३१ ॥
सृकमृघांतं भातं टड़नेन समन्वितम्।
सत्तं कुटिलसंक्षणं पत्ति नान्च संग्रहं: ॥ ३२ ॥ *
रसकस्तथम्।

विमलं श्रियुतोयिनं कार्कीकामीस्त्वद्वः।
वज्रकन्दक्षमायुतं भावितं कशलीरसे: ॥ ३५ ॥
माधुर्कारस्थं धारितं सृकमृघोऽकै।
सत्तं चन्द्रार्कसंक्षणं पत्ति नान्च संग्रहं: ॥ ३६ ॥ †
विमलस्तथम्।

दर्दं पातनायण्यं पातितत्व जलायणे।
सत्तं सूतकसंक्षणं जायते नान्च संग्रहं: ॥ ३७ ॥

दर्दस्तथम्।

गन्धकश्च प्रभाविण्य सत्तमूयं स्वभावतः।

* Cf. Rasārṇava, Benares MS. V. 37—38.
तत: क्षातं महामच्छ रसेन्द्रस सम्य तत: || १४ ||

अभ्यकादित्मतथापत्तावधिः।

एक एव महाद्रावी पार्वतीनाथसम्भवः।

किं पुनस्विभि: संयुक्ती वेतसास्त्रास्त्रकाव्यिकौ: ||५.०||

सुम्भाफलाणि समाहं वेतसाम्यन भावेऽत्।

पुत्राकी ततत् तु द्रावति सलिं यथा।

कुरूति योगराजोऽय रक्तानं द्रावणं परम् || ५१ ||

अभ्यकादित्मतथापत्तावधिः।

तालोन बढः द्रावति तीच्छं

नागिन हृंमं शिलया च नागम्।

गन्धास्मना चैव निहलं शुकं

तारं भान्दीकरसेन हन्यात् || ५.२ ||

शुक्म्बु अजाचोरसुगम्यकेन

तारं खुचोरसुभाचिकेष।

यदृश्यं धातोविंहितं युं

निर्मयावतं कथितं तीच्छैः || ५.४ ||
मृतानि बोधानि प्रसीभणि
यशेन यूक्तामययनागनानि ।
चृत्याभयुक्ता पलितादिनानि
कुल्लानि तेषाः जराविनागम् ॥ ५५ ॥

इति नागाजुनविरचिति रसस्ताके वच्छाश्रम-
सच्यापतन-चर्मकारितिर्हत्रावण-वच्छनोऽह-
मारणाधिकार्यो नाम वितीयः ।

चतुर्दशी रसबन्धाधिकारं व्याख्यायामः ।
जखोरजीन नवसारघनास्ववरः
चारणिणि पद्ध लवणानि करुत्यध।
शिर्यूद्रकं सूरभिसूरणकं एभिस्-
संमदित्तो रसस्त्रशरतेष्ठोहान् ॥ १ ॥

चारणजारणविधि: ।

* * * * *
प्रजापारमिताः निशोभसंवैं सद्रे प्रसादोत्तरं
नामा तीक्ष्मसुवं रसेन्रसस्मासं नागाजुनप्रोदितम् ॥ ८ ॥

* * * * *
रसं हेमसमं मध्यं पोषित कार्यिरिगन्यकम्।
हिपदोरजन्यर्घः मद्येत् टक्कचाच्चिताम्॥३०॥
नष्टपिष्टच सुखच सन्मसुथा निधायेत्।
तुषारशुपुर्त दच्चा याविभ्रावसंगतः॥ ३१॥
भचण्डासाधकेन्द्रसु दिव्यदेहमवापुयात्॥ ३२॥

* * *

गर्भयनं प्रवचार्म पोठिकाभ्राकारकम्।
चतुर्गुलकदीर्घं विस्तारिणं च चालुक्लाम्॥ ६२॥
मूषा तु सच्चर्वं जला सुदहा वानुर सुधः।
विचारायणु लोकस्य भागमिकं तु गुमुली॥ ६३॥
सुज्ञाः पेययलः तु तोयं दच्चा पुनः पुनः।
मूलालेपं उर्ध बद्रि लोकांस्त्रलिका लुधः॥ ६४॥
कर्मं तुणामिना भूर्मी मदलेन्द्रिन ददयेत्॥ ६५॥
सुतकस्य पलं गह्यं तुषारां नासकुं विषम।
तकसंगम गन्धकं शुश्रुं चूर्णं जला विनिचिप्त॥ ६६॥
जला कलाजालिकामादी पलं दच्चा च गन्धकम्।
हुतपकश तद्धर्णं पविदायसमाजने॥ ६७॥

यावदववमायातित तत्त्वशास्त्र तं विनिचित्रित्।
पुटे वा कदलीपने सिंध पप्पिताकारसम्॥ १५॥
हितोपप्पितोरसः॥

प्राणिपलय सम्भवुङ्गान्
(सद्वोधानू) सकलदीघनिर्मुष्कान्॥

वच्चे सम्भवितार्थं
कच्छापुरं सम्भविसिद्धकरम्॥
श्रीशैलपञ्चतस्थायो सिंहो नागाजुनो महान्॥
सम्भवसतोपकारं च सम्भवभाग्यसमन्नितः॥

प्रार्थितो दद्रि सीघ्रं यष्ट प्रख्यति वाताव्रम्॥
दद्रि ल्यागच भोगच्च सूतकस्य प्रसाद्वतः॥
सम्भवसामायविषो स्नासन तथ्यव च॥
तेषां मध्ये प्रधाननाथ रक्षायोऽप्रचारकः॥
कताक्षलिप्टो भूल्या नागाजुनपुरः स्पितः॥
प्रृच्छ्दे रसकश्वाणि विवादाणं दद्रस्य मे॥
श्रीनागाजुन उवाच—

साधु साधु महाप्रभु तुषुहों भक्तवबसः॥
कथयामि न संदेहस्थ्लया परिप्रम्प्रथाताम्॥
बलोपलितनाश्च तथा काल्य धार्मनम्।
यथा लोके तथा रेखे चमते नाच संगमः॥

सत्वानां भोजनार्थः साधिता वटयनैशः।
हादशानिः च वर्षाणि महाकङ्कः; छतो मथा॥
तत्कालदेशवश्या दिव्या वाणो मथा स्वतः।
चृद्धप्रार्थिता प्रष्णहुः लं मव सामार्तम्॥

श्रीवत्तप्रशीयुवाच--
साधु साधु महामिद्ध
किंचिन्द्राहं ये सिन्न तत्सवं प्रदायम्यः॥

योनानाज्ञुन उवाच—
यदि तुष्टासि में देवि सचिवदा भक्तिवक्ते।
दुर्लभं चिषु लोकेषु रसवन्यं दुर्खं में॥

गाप्पवाहन उवाच—
सुवर्णेश्वरां णुमारी मदसुन्दरी।
निर्वेदतो मध्यबः में चार्टेइगो देवि दोषिताः॥
साधु साधु महाप्रान्त ममादिश्रीप्रमालकः।
साधयामिने सन्धेिहो युधक्तीयन साधकः॥
पुनर्ग्रं प्रवचनामि मार्गंकेन यथा किम्।
रसोपरसयोगी निव सूतं सुसाधितम्॥
विद्वत्तायानं नागं यथाथकाशनं किम्॥

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गाम्बं विशिष्टमार्गं गुरूपार्थं यथा शुतम्॥
तदां सम्प्रवचनामि साधनवेश यथा विधि॥

सहाययोवः प्राणा निरालभा द्वारता:॥
कुलोः पापहोपाय साधयङ्को जीतनित्रिया॥
कोष्ठिका वक्रनालच्छ गोमयं सारसिंहनम्॥
धमनं लोहप्रशाश्च चोपधं काल्लिकं विषम्॥
कोण्याश्री विधिचाश्री
स्थेरमिलवनं कला तत् कर्म समारभेत्॥

रत्नघोष उवाच—
साधयिला प्रयोगेन कोष्ठिवधी महारस:॥
शरोरिपिनीति सञ्चिं भवति निपंलम्॥

नागाजुन उवाच—
कथयामि न समेभ: साकांकेन यथा किम्॥
आद्वेलच्छ घनलच्छ चापलं गुरुशेजस:॥
यथैतानि न दश्यन्ति तं विद्याहुस्तकम्।
नानावशे भवेत् सूतं विहाय घनचापलम्।
लच्छिन्द्र दश्यते यस्य सूचितं तं वदन्ति नि।
गुरुसमर्पणं वा तेजो भामकरसत्रिभम्।
अभिमुक्ते यदा तिष्ठत् खोटवन्यस्य लच्छिन।

प्रयःशासी रसेन्द्रमझलानि यन्त्रविधि।।

गिलायनं, पापाशयनं, भूधरयनं, वंशयनं,
जलिकायनं, गजदलयनं, दोलायनं, अध्यातन-
यनं, भुवपातनयनं, पातनयनं, नियामकयनं,
गमन(?)यनं, तुलायनं, कच्चपयनं, वाकीयनं,
वालुकायनं, अभिसोमयनं, गन्धकारहिकयनं,
मृणायनं, हंसिकायनं, कम(?)भाजनयनं, घोषण-
यनं, गुड़ाभक्षयनं, नारायणयनं, जालिकायनं,
चारणयनं।

अथ प्रवचने सुगुरूपदेशानि
व: पाटलाख्यस्य रसस्य हुः।।

यस्य प्रभावात् चयमिहत्तक्रः
ज्ञरादिकुक्कासंयतिग्रहः स्वात् ॥
निदिष्य खले त्रिपुरान्तकस्य
वोजं हिशुद्धादीपलप्रमाणम् ॥
काथिन तथा त्रिपुरोजवेन
सम्प्रदेयेनु त्रिदिनानि यावत् ॥
कन्यारसेन चिदिनं तत्तथा
सम्पारिणा चाच दिनचयनं ।
चृण्डस्विकाया रजनीरजेन
सम्प्रदत्तं तस्म उपतीयधीतम् ॥
वीगिणि प्रमाणाण्यथ समसंघ
सम्पातपेत् पातनयन्त्योगात् ।
सम्पातितो निश्चलतामुपैति
सत्त्वप्रयोज्योपिवहितं प्रशस्तम् ॥
पलं समादाय रसस्य तस्य
शुल्क्ष्यो शुद्धस्य च कर्णभेदकम् ॥

* The text seems to be incorrect.
हिन्दू रसायनशास्त्र

हिन्दू रसायनशास्त्र

न्यायान्न्यायोज्य

गत्राग्र्यां दिगुणल देयम्

हृतप्रायोगिक विषाच्य प्रवान्

निचिद्र्य खल्ले परिमीर्दित्थ

निकवळ मात्रां लक्ष्मण्य दक्षा

गुज्जाप्रमाणा गुड्सिका च कान्या

श्रीलोकनाथस्य विभोऽः प्रसादात्

ज्ञातं स्वयं पोटलिकाविधानम्

* * * * *

दृति रसेन्द्रमझूलं समासम्
Excerpts from
RASAHRIDAYA.

भगवद्गीताद्विपादविरचितात्
रसाह्रिदयादुःख्त: छोकः।

A = MS. from Nepal.
B = MS. from India Office Library, with a commentary, named "Bālānvyabodhikā."
C = MS. from Benares.

दिनीयपटलादुःख्त: छोकः।

[टोका—मूच्छितरस्य उद्यापनसंस्कारमाह—]
चासुना विरंचिने हि सुविशेषो नागविधपरिमुक:।
सूत:१ पातनयने समुचित:२ कान्तिके कायातः३॥
[टोका—अथ मूच्छितरस्य प्रद्योगित्यमानसंस्कारं
सच्छयनाह—]

(1) A reads प्राय, which makes the sentence incomplete and the metre defective.
(2) A reads शुब्धिवृद्ध, which is a tautology as well as a grammatical error.
(3) कान्तिके कायात is the variant in B. This is a defective metre.
(1) A reads सुचिपिठम्.
(2) निपाखळे नागवङ्ग सद्रोय is the reading in A, which is incorrect as well as defective metre.
(3) A reads सुचिपिठम्.
(4) A reads गढ़, which is a tautology as well as a grammatical error.
(5) B reads अष्टाङ्गचविविपिठे, which destroys the metre.
(6) B reads देवेय तु, wherein तु is redundant.
(7) B reads सर्व सब्जळस्तुल ललाघार, which mars the metre.
(8) A reads अष्टाङ्गचविविपिठे, which is a defective metre.
(9) B reads ग्राहा, which is grammatically incorrect.
(10) A has उपविखिलिपुर्पिठ, which is senseless.
(1) A reads तस्मिन् द्रुप्तमाणे, which is incorrect.
(2) निपातितसकलद्रोपिनिमाणे, an incomplete variant in A.
(3) A has an incorrect reading—ग्रामजीर्षयपाल्यासी।
(4) This verse and the next two are not found in B.
(5) A reads रघुरंथःप्राप्ता, which has no sense.
(6) A has दौप्यवते.
(7) A reads कच्छपवत्रं चल्लगत, which is grammatically incorrect.
(8) The word तन्त्र is not found in A, thus making the metre defective.
(1) A reads कार्यविद्युतगुणान्, which is incorrect.

(2) B reads क्रजति.

(3) भुविद्युतमाहन्ति is the variant in A.

(4) A reads चुनिवतेलिपु, which seems to be incorrect.

मुनिविद्यु means by seven विद्व, mentioned below.

(5) A reads काँत्रि, which is incorrect.

(6) A has शिष्यरागतभावितम् सदा दनास्यि हि जार्यति, which is incorrect as well as defective in metre.
- सम्बाजः दश्मूलकाक्रमणगतिः सुरभिमूर्त्तिः ।
शतभावं वलिवम्यं नत्तुचन्तो जाध्यते हैम ॥

[टोका—चारविचारगौँवीचीराह—]
कदरोपलशिलस्निकुलकनसातालिवालसुकौशधा: ।
वर्षाभूतप्रसोंचकः सहिता: चारा यथालम्भम् ॥

[टोका—चारविद्यामाह—]
आनीय चारवचान् कुसुमफलशिवथान्—
लक्पलाशीपेतान् ।
खळवत्: खड़गमम्तान् विपुलदशिलवथान्—
पिशपाठावलिशक्षान् ॥

(1) सम्बाजः दश्मूलकासप्रतिगतिः सुरभिमूर्त्तिः, a variant in A, which has no metre at all.
(2) A reads शतभावितसरस्वत्या, which has no sense.
(3) तिक्ष is not found in B.
(4) A reads सारीक, which seems to be incorrect.
(5) कुसुमपलामापकर कुपेतान् is an incorrect text in A.
(6) A reads कुट्या तन्मूलससमन्, which is incorrect.
(7) A has विपुलदशिल्लापायक गाणितिस्यक्षान्.
द्रग्न्स काष्ठस्थितिज्य खरिस्वरभियोगः।
भोधिप्रजास्थाय वसे।
भज्ज तथासा जलं ततः ्मृदुगिसिनि पवित्र
हरंपांकेन ्भूयः॥

〔टीका—चारजलपाकलचणमाह—〕
तक्तेपभण्तिः नि सवासबुद्वुदान्
यदा विद्वते ्चणभजूरान् वहन्।
तदा चिपित् चूण्यण् ्हिदंगमवकं
चाररचभ् समवणानि ्भूखगम्॥

(1) A reads करिस्वरभियोग्राजकान् च मूः।
(2) A reads तं, which is incorrect.
(3) A reads चावर।
(4) A reads erroneously यथा वहिते।
(5) A reads चिपित् चूण्यण। B reads चिपित् चूण्यण। Both the readings are incorrect.
(6) A has चाररचच्च पदचवण् भूमिक्षण, which mars the metre.
र्वाणि संमिस्या निव्वल्य भूतले
व्यस्तिताविचमात्रकोटिरिकापुरे
संस्कारपियत् समस्तिनानि धान्यं
तत्र: प्रयोज्य रसजारणशालिकः

[टोका—जारणायं चारविधानमाह—]
जम्बीरवीजपूरकः चाष्मीविद्वारसंवाहसंयोगात्
चारा भवनि नितरां गंभीरतिजारणी शम्ता: ।

[टोका—रसे विडोजनमाह—]
विडम्बरोवीरमादी दल्वा सुत्वे चालमाशिनम्
कुश्माजारण्यवं क्रममाहेश्वर्यदग्निम्

(1) A reads व्यस्तिताविचमात्रकोटिरिकापुरे B reads व्यस्तिताविचमात्रकोटिरिकापुरे।

(2) A reads वीजपूरक, which is incorrect. The word वीजपूर is not found in B.

(3) गंभीरतिजारणा समा is an incorrect variant in A.

(4) A has दल्वा सुत्वे चालमाशिन, which is not correct as it destroys the metre as well as the sense.

(5) A reads वीडेर्द्याय, which is grammatically incorrect.
(1) A reads जीणाभक, which mars the metre.

(2) A reads दुहरयंति, which is incorrect.

(3) घनानुकम्पिनी काय ा is the variant in A. घनानुकम्पिनी कायां कायां is the variant in B. Both the readings seem to be incorrect.

(4) कणा रक्ता पीतं शितं is the reading in A, which is incorrect.

(5) A reads टदा मंकरधिम्नाः, which is incorrect.
(1) अनामकेण बलवान् is the variant in A, which is incorrect.

(2) A reads मिलायभः, पृथ्वः.

(3) A has नविन्यंति चेत, which has no clear sense. B has नविन्यंति चेत, which mars the metre.

(4) B reads दय निन-निम्पण, which is not correct.

(5) A reads चचा रसपीयंति, which is grammatically incorrect.

(6) A reads भवमाण, which is incorrect. B reads कर्मण। वचमाण, which is also incorrect.

(7) A reads नाराको.
(1) A reads erroneously प्रतिविधिता तीर्था.
(2) A reads सारणिक, which is incorrect.
(3) A reads क्रमणस्थ.
(4) B reads नागव्रजतम.
(5) A reads तीर्थम्.
(6) A reads यात्रि, which is incorrect.
(7) A reads वैदिताकङ्क्ष, which has a defective metre.
(8) B has omitted हुँ भाचोकेन रवि.
(1) काशीवः व वचस्यकाठीणां, a variant in B.

(2) रस्मीपि द्हि रसायनी विवाहः, a variant in A.

(3) This is not found in B.

(4) A reads erroneously पत्रस्यचिह्नः.

(5) A reads धातुविच, which is incorrect.

(6) This sloka is not found in B.

(7) A reads तारकः.
(1) विवरीतेन्द्रः जग्यवानसू, a variant in A, which has a defective metre.

(2) B reads शय.

(3) A reads शिम्भु, which is incorrect.

(4) B reads erroneously शय.

(5) चिरुगुण्य हि चीरकृती, a variant in B.

(6) The word बहु is omitted in B, which renders the metre defective.

(7) A reads गमयकः शिलानम्.
एकैन वापितम्भतः
कमलं रञ्जयति रसराजम्॥

[टीका—रागाधिकारि-गन्धकादिनाह—]
वाल्लो गन्धकरागोऽवलुलितरागोऽ मनःशिलातालि।
माचीकःसत्तरसकी दावेती ॥ रञ्जने शस्ति॥

[टीका—प्रधानयों: ताम्मक्षपंरयों: ऋष्माह—]
कम्बट्टे: रविरसके: ॥ संश्वो स्रूक्षमूषिकाभासात:॥

(1) A reads वापितम्भतः, which seems to be incorrect.
(2) A reads गन्धकराग, which is incorrect.
(3) A reads शिलातालि. B reads विलुलितरागेऽ. Both the readings are grammatically incorrect.
(4) B reads माचिक, which mars the metre.
(5) B reads द्राच्ची हि, which seems to be incorrect.
(6) A reads कम्बट्टेरविरसके:. B reads कम्बट्टी रविरसकी.

We have adopted the above reading after collating the texts.

(7) सूक्षमूषिकाभासात:, a variant in A, which mars the metre. सूक्षमूषिकाभासात:, a variant in B.
(1) A reads चोळ्य जीर्णि। B reads चोळ्य जीर्णि।

(2) A reads प्रतिहितसनिभ भवित, (प्रति = देत्) B reads हितसनिभ जायते, which mars the metre.

(3) A reads अघोऽ, which destroys the metre.

(4) A omits तथा.

(5) A reads चीर्णि जीर्णि, which seems to be incorrect. B reads चीर्णि जीर्णि.

(6) हितभित(?)सनिभं सच्चं मुतं, a variant in A.

(7) कनकं च रसतालयुतं, a variant in A, which is a defective metre. The reading of B, which we have adopted, is also a defective metre. The word चन्त्र or चान्त्र should be added after the word युतं.
[टोका—एतद्रभ्रजोभिणि्सुध्वस्य लच्चमाह—]

तबूणि स्तववरे चिरुणि जोणि हि ।
दुतहिमनिम्भः सूतोऽ रज्यति लोहानि सम्भाणि

[टोका—सम्बों धातुः रसानामुतरोतरविशेषबलमाह—]

पञ्चादस्त्रश्च सचं सच्चाददश्त्रश्च दुर्दशः।
दुतरश्त्रश्च वोजं तम्बाद्वीजं तु जार्येत्॥

(1) A reads जोणि । B reads चोणि हि।

(2) दुतहिमनिम्भः, a variant in A, which seems to be incorrect.

(3) A has जरति लोहानि सवानि। B has रज्यति लोहानि सवानि। Both the readings have defective metre.

(4) This verse is found in A after the verse तारक-द्रश्चिनामि: &c. (vide ante pp. 28—29) and runs thus:—

पञ्चादस्त्रश्च दला सच्चाददश्रश्च दुर्दशः।
दुतरश्त्रश्च वोजं तम्बाद्वीजं तु जार्येत्॥
HINDU CHEMISTRY

[টীকা—বোজপ্রশ্নসনমাহ—]
চিত রক্তোপি রসেন্দ্রে বোজন বিনা ন কঠিনাতমভবতি।
হিংসিং তত্‌ পীতসিং। নিযুজ্যতি সিদ্ধিচ্ছ রসমূ।

[টীকা—রসোপরসধাতুর্ণাং বধিবিধচ্ছাত্ত শোধন-মাহ—]
তস্য বিশ্বদিবিবহৃতা গণনরসোপরসলোছুরূণে।
হিংসিং বোজন তরপি নাশদ। শুচ্যতি কদাচিত্তপি।

[টীকা—বোজপ্রশ্নসবাবমাহ—]
য়: পুনরুং কৰুতি কঠিনাশ্বেনৈবেদ্রস্তব্য।

(1) B reads পীতং সিং, which destroys the metre.
(2) নিযুজ্যতি সিদ্ধিচ্ছ রসঃ, an incorrect variant in A. নিযুজ্যতি সিদ্ধিচ্ছ তত্‌, a variant in B. Both texts are collated in our adopted reading.
(3) রসতি শুচ্যং, a variant in A, wherein the first term seems to be incorrect.
(4) B reads নেতত্ত্ব instead of কদাচিত্তপি. This is incorrect; since it contains two negatives.
हथैयापकः पतल्लोः न रशि न रसायने योगः।

[टीका—रससंप्रकाशकानाह—]

वैकल्पिकानां सख्माचिकां विमलाद्रिदरादरसकाश।

ऋषिः रसायनशास्त्रां सत्तानिः रसायनानि श्रुः।

[टीका—उपरसंप्रकाशकानाह—]

गन्धकागैरिकसुरिलिः जितिर्विचरस्मन्तन्त्रजनमृ।

उपरसंप्रकाशकानाहृत्य मिश्रितशिरी सारलोहाक्षः।

(1) हथैयापकपतमि, a variant in A, which is incorrect.
(2) A reads योगः. B reads रसायनानि योगः. Both the readings are incorrect.
(3) A omits कान्त.
(4) A reads माचीक, which mars the metre.
(5) A reads दल्द्रस्मकः.
(6) A reads चलारि, which is not accurate.
(7) B reads शिखलाक, which destroys the metre.
(8) B reads संजकमिन्द्र, which mars the metre.
[टोका—पूर्तिसंज्ञी भाषा—]

ताम्भारतोल्लोकन्ताभ्ववधलोहानि¹ नागवङ्गः च²।

कथितीि च पूर्तिसंज्ञी³ तिष्यं संगीयतनं काय्यम्॥

[टोका—लवणचारसंज्ञी भाषा—]

स्वर्चंलस्मृतवं चूलिकसामुद्रोमकविष्टानि।

पड़ुलवणण्येतानि तु सजीयवटमणः; चारा:॥⁴

[टोका—शोधकद्वारकगणमाह—]

सूय्यावर्तः⁵ कदली कन्या⁶ कोशातकी च सुरदाली।

शैयुऽ⁷ वचकन्त्री नौरकण्ण काचमाची च॥

आसामिकर्मणे तु लवणचाराभास्माविता बहुः।

शृवद्धानि रसोपरसा भाता मुद्धानि सत्वानि॥⁸

(1) B reads मलवाननि।
(2) B reads वज्नानी च।
(3) B reads कथिती कृष्णमत्ती, which is incorrect.
(4) This verse is not found in A.
(5) A reads सूय्यावर्तक।
(6) B reads कङ्गा।
(7) A reads शियुऽ।
(8) This verse is found in A only.
(1) A reads सचाराम्रेषि.
(2) A reads हटाधविति, which is incorrect.
(3) A reads तद्दुलमाचे, which is incorrect.
(4) B reads रमुग्वीः, which seems to be incorrect.
(5) सावनत: चेहरागगोसिन्ह, a variant in A.
(6) A reads रायः.
(7) सत्सिद्धित: परं योषितत् कार्ये, a variant in A, which mars the metre. B reads सत्सिद्धित: परं, wherein अभिरत: is incorrect as well as a defective metre.
(8) B reads पशालु चन्द्रे न. 
(1) द्रद्धाचिकोमथ्यं तथा गुज्जानि, a variant in A, where-in the last two words are superfluous and incorrect.

(2) B reads तनुरिपति पत्रलिंग, which has no sense.

(3) A reads खुष्टि. B reads खुष्टि. Both the readings destroy the metre.

(4) A reads बहुशि वहीद्रावल्लभ. B reads बहुशि द्रवल्लभ. Both the readings are defective.

(5) धीभो रविरिधापि च सुनिमिय, a variant in A. B reads रविशि च वारसुनिमि. Both the readings are incorrect.

(6) B reads सिङ्के, which is not correct.
रक्षागणगतिपशुजलभावितप्रितिन्ति च रक्षति¹ लोच्चम्।
शुद्धति कद्विलोकिकरसभावितप्रितिन्ति² चिंभिषरे:।

[टीका—मारणमाह—]

सङ्ख्या: शुद्धति लोको रक्षति³ सुरगोपसत्वभो वायात।
माचिकसत्वे श्रेष्ठ⁴ शुल्लं वा गंधकेन छतम्⁵।

एकादश: पदम्।

छागाष्टिक्ष्मस्थिनिनिर्मितमूषं कल्वामलकावारं।
दलयोगी घनरस्था टंकणाविपुष्टकलिपां।

(1) A reads रक्षति, which is incorrect.

(2) शुद्धति कद्विलोकिकरसभावितप्रितिन्ति, an incorrect variant in B.

(3) A and B read रक्षति, which is grammatically incorrect.

(4) A reads सुष्मं. B reads दर्पं शः. Both are unintelligible.

(5) A reads शुल्लेन वा गंधकेन छतम्. B reads मृतं.
(1) कुल is not found in B.

(2) स जयति श्रीमदनर, a variant in B.

(3) C reads सकलमझलाधारा.

(4) Of the latter half C has only पर सहिष्णुः.

(5) C reads चतुर्वंशीयदयादिवराहवसलभम्, which seems to be incorrect. Cf. Patala I., in which the following verse is given:—किरातगीपिण्डिकंपाथविवेदियादिवराहवसलभम्।

(6) द्वचिस्मुरस गङ्गीता is the incorrect reading in C. [In the case of किरातगीपिण्डिकंपाथ: गङ्गीता: i.e. collected पाथ—mercury, minerals &c. and द्वचिस्म is favorable; and in the case of आदिवराह पाथ: गङ्गीता: i.e. lifted up the earth.]

(7) This verse and the next are not found in B.
नष्टश्रीरविवर्णिः हीनामाः कृष्णो गुणादयस्य।
श्रविन्नकेषभरतामयारुपी पुनर्रविवर्जनः॥

[टीका—कर्तवी खनाममहं सूचयनाह—]
तम्मा त् किरातपतिः: बहुमानमवायु रससुक्ष्मरतः।
रसढ़द्याख्यं तन्त्वं विरचितवान् भिन्नोऽविन्दः॥
नम्न सम्भविषेण: सम्भवोऽविरितः सुतेन तन्त्रोऽध्यमः।
श्रीगौविन्दने जन्तः तथागतः: येसे सूचयातः॥
प्रत्यादशसंख्यां रसिन्द्रेयस्य दिश्यतति दृष्टा।
लिखितमिदं पुर्खतमं रसढ़द्यात्मवायते सकालम्॥

(1) C reads रसकमित्रसदेशवो दृष्टा, which destroys the metre.

(2) C reads रसढ़द्यात्मचं, which seems to be incorrect.

(3) C reads विरचितायां भगवद्गौविन्दः, which is incorrect.

(4) C has रसढ़द्यात्म तन्त्रोऽध्यम, which is incorrect.

(5) C has श्रीमद्भगवद्गौविन्दने जन्त, which mars the metre.

(6) This verse and the next are not found in B.
(1) MS. A ends abruptly with the colophon, which runs thus: —इति श्रीमदभगवद्गोऽविन्दविवर्चितं रसहद्वयं समासम्।
शुभमलु।
संवत् १६०४ समये ज्येष्ठ वादि १२ भीमे
जगन्नायभद्द लेखि॥
श्रीराम आल संवत् १५८० पीष वादि १ भीमे।

The author's account of himself is altogether wanting in it. B has "इति श्रीमदभगवद्गोऽविन्दविवर्चितं रसहद्वयं समासम्। इति श्रीमदवद्गोऽविन्दविवर्चितं
रसहद्वयं समासम्। इति श्रीमदवद्गोऽविन्दविवर्चितं रसहद्वयं समासम्। इति श्रीमदवद्गोऽविन्दविवर्चितं
रसहद्वयं समासम्। इति श्रीमदवद्गोऽविन्दविवर्चितं रसहद्वयं समासम्। इति श्रीमदवद्गोऽविन्दविवर्चितं
रसहद्वयं समासम्। इति श्रीमदवद्गोऽविन्दविवर्चितं रसहद्वयं समासम्। इति श्रीमदवद्गोऽविन्दविवर्चितं
रसहद्वयं समासम्। इति श्रीमदवद्गोऽविन्दविवर्चितं रसहद्वयं समासम्। इति श्रीमदवद्गोऽविन्दविवर्चितं
रसहद्वयं समासम्। इति श्रीमदवद्गोऽविन्दविवर्चितं रसहद्वयं समासम्। इति श्रीमदवद्गोऽविन्दविवर्चितं
रसहद्वयं समासम्। इति श्रीमदवद्गोऽविन्दविवर्चितं रसहद्वयं समासम्। इति श्रीमदवद्गोऽविन्दविवर्चितं
रसहद्वयं समासम्। इति श्रीमदवद्गोऽविन्दविवर्चितं रसहद्वयं समासम्। इति श्रीमदवद्गोऽविन्दविवर्चितं
रसहद्वयं समासम्। इति श्रीमदवद्गोऽविन्दविवर्चितं रसहद्वयं समासम्।
Extracts from
KAKACHANDESVARIMATA.

काकचण्डेश्वरीमतञ्चतः
समुद्रातः: श्रोका: ।

ॐ नमः सदाशिवाय ।
कैलासशिरासीनसुमा रुद्रं जगद्गुरुम् ।
ऋद्वंद्रिमहाकाली भृंगचण्डीविनायको || 1 ||
योगिनीमायष्ठ तच्च गुष्ठादुगुष्ठतरं परम् ।
कपाली कालरात्रि च कालचंद्रकलामिका¹ || 2 ||
काराली कालकण्ठिः च काकचण्डेश्वरी तथा ।
एवमादिस्मिः चान्या योगिनीगणगुष्ठकौः² || 3 ||

(1) The text reads कालचंद्रकलामिका, which is incorrect.
(2) The text reads गुष्ठकौः, which is incorrect.
हिन्दू रसायनकौशिकी: सान्या जैन स्वरूप चित्तमसी।
तत्संग्रह बैरवं त्वं योगनाग्रविज्ञितम् इ ॥ ४ ॥
कैदित् मूर्वति संहक्ष्या: कैदित्रायण्यि युक्तुक्तका:।
कैदित्रायण्यि गुह्या ये कैदित्रायण्यि न कुर्वे।। ॥ ५ ॥
कृषितं। बैरवं त्वं पंचवंम चिनोचनम्।
तं हः भैरवी हः हः जगतां चिद्रेकरिः।। ॥ ६ ॥
क्षताश्चलिपता भूत्वा क्षणतारकलोचना।
काकच्छेश्वरे त्वा उवाचित तु भैरवी।। ॥ ७ ॥
काकच्छेश्वरे उवाच।
भगवन् त्वेद्विशष सर्वं सर्वविच्छिव॥
सर्वप्रकाशीवाग रज्जु प्रक्षापमि शंकर।।। ॥ ८ ॥
कथं कायस्ति तो जीवो जीवको जीवको सी प्रकौळित।।।।
कायस्य। कम्भणं केन स्यित: संसारपंजरे।। ॥ ८ ॥
जराव्याधिदाताद्विव यस्त: संसारवंधनाः।।।।
एको ब्रजति यानेन एक: स्मधिव वहैव तम्।। ॥ १० ॥

(1) The text reads छप्रभ, which is not correct.
(2) The text reads सर्वच्छविव, which is not correct.
जयजयमयं सांगल्यमेकाभावं च जंतवः।
किं कुर्वणः प्रकुर्वणः कस्मासि ब्रूहि श्रंकर॥१२॥

श्रीसर्वेण उवाच॥

श्रुतं लं काकचामुङ्दे साधकानां हितं प्रिये॥
गुह्यादृश्यन्तरं वाकं प्रश्नों लं वराननि॥१२॥
कथयामि समाशेन श्रुतं लं काकचंद्रकेः॥
यथार्थं परी नित्यं: ब्रह्माणिनिधनेशि।॥१३॥
सुरुपं निगुः: शांतो विम्ब्यापी परात्यर।॥
ब्रह्माणिसंप्रसंवंधः कायश्चो भवते तु सः॥१४॥
जीवे व्याधिभयं करं चतुरानात् संप्रकोपितं।
तस्मात् कर्मभवान् लक्ष्यं संसारं संसर्तिसः॥१५॥
करोति विविधं करं संसारं काममोहित।
द्रव्योपायं न जानाति कामभोगार्थेनुषु।॥१६॥
कायंस्य शेषम् मानव्यो द्रव्योपायं करोति सः॥
हितवालाज्ञेयसेवायं म्याविक्रियविक्रियेः॥१७॥

(1) The text reads काकचंते, which is incorrect.
(2) The text reads करोत, which is not accurate.
(3) The text reads कालकेशिन, which is not correct.
वश्निम काष्ठभारांच दण्डभारसङ्ककः।
यान्त् यवनाच्छत्रं१ च किं करोति२ करोति सः।।१५॥
कामासांकरः श्रीमान् कृष्टि कर्म नैकः।
कुबाब्यां नरः केचित् कामासांकार्थ्यचिन्तकः।।१८॥
जायते मल्लोकेश्वरन् दारिद्रोपहतचिताः।
जायते नाथ संदिहो कुञ्जखंजा नपुण्यकः।।२०॥
महासंसारबलिन्यान्न चिहुण्यन सुखचिता।।
चतुर्यां घोससंघचवाहिकां तु नयति ततु।।२१॥
पतने कथितं भद्रे यथं मां परिप्रस्थसः।
किमन्यन्त् पुछ्चि में भद्रे तथा ति कथयायहम्।।२२॥
इति काकचंढेस्वरीमिति प्रथमः पटलः।।
श्रीकाकचंढी उवाच।
कथयान्न महादेिव कामभोगप्रसाधनः।
चन्तः संपद्यते चेत्य चलोम्याल्प परमेश्वर॥१॥

(1) The text reads यवनाच्छत्र, which has no sense.
(2) The text reads किं कुर्वित, which is incorrect.
(3) The text reads कुर्ल कर्मनैकः, which is incorrect.
तद्धृं श्रीतुमिक्षामि कथयमि प्रसादतः।
आकाशगमनं दैव क्विचर्लं यथा भवितः॥ २॥
पादुकाया दले पंचदिव्यस्त्रोकासाधनम्।
रोचनं श्रंजनं चैव धातुवादरसायनम्॥ ३॥
जलूकावंबधिमित्राहु: रसस्य मारणं कथम्।
जारणं रत्नकृत्यं वचेभध्रावणं कथम्॥ ४॥
एतत् सर्वं समासेन ब्रुहि से चिपुरांतक।

श्रीभैरवं उवाच।

शृणु लं काकचामुंडे साधकानां हितं प्रिये॥ ५॥
कथयामि समासेन पृथक् सिद्धार्थसाधनम्।
न द्रव्येश विना सिद्धिः भोगा: काम एव च॥ ६॥
द्रव्यहिना नरा मल्ये प्रेतस्तूष्ण संस्थिता:।
अर्नति मल्यस्त्रोक्षिनं पयंपद्रवकारणम्॥ ७॥

** ** विवेष (?) तेषां जायतोपि श्रुतयुते:।
कुलं सीभाग्यरूपं च पांडित्यं ज्ञानसंशितम्॥ ८॥
द्रव्यहिना न शोभमति ग्राणहिना नरा यथा।
कुमितो ग्राणहिनोपि केनापि वधिरः स्थिताः॥ ९॥
पद्धति मर्यादीकिर्मिन् द्रव्यम् सकरार्धान्तं ।
तथातु संसाधनयोद्विति रसैन्द्र साधकोत्तमं ॥ १० ॥
अर्थात् संग्रहच्यामि रसैन्द्रसाधनं तव ।
मारणं जारणायं च द्रव्यसाधनसुतमम् ॥ ११ ॥
वज्रदंडः सुर्दंडः लोहदंडस्तवियचि ।
चयो विना चोरधिये रसम् मारणि हिताः ॥ १२ ॥
तात्त्विवध समासिन यथा जानन्ति साधकः ।
वज्रदंडकेतु वज्री स्वातः लोहदंडं पुरं विडः ॥ १३ ॥
सुर्दंडः ब्रजदंडः च समासात् कीर्तितं तव ।
प्राह्येतं समासिन साधकः हष्ठमानसः ॥ १४ ॥
तद्रसं रससंयुतं एकोऽचि तु मद्यितू ।
श्रद्धमूःपागतं म्हातं रसं स्मियतेन तत्चातात् ॥ १५ ॥
सहस्रविधि कर्त्ता च ज्ञायते स महारसः ।
सूत्तां संलेपितर्त् तेन पुरायुष्म महौषधिः ॥ १६ ॥
श्रद्धविलामिदेये तु रतिवंधः अर्थ विधिः ।
पदात् पलसहस्त्रं शुल्कम् याह्येद्वुधः ॥ १७ ॥
महम्मवगृहें सुखम् चारवगृहें म्हम् ।
वज्रीराणार्थीरेन मद्यितू श्रत्वा नरः ॥ १८ ॥
पुरं द्वात् समानिन कालिकारहितं भवितु।
मुषागमीद्रे चिंत्रा धामयेत् खंडिरानले। ॥ १८ ॥
रसेन्द्र: चिधिते तत्र तारं संज्ञायते चक्षु।
चक्षु: संप्रवच्चारम् मुषाबंधं यथा भवितु। ॥ २० ॥
छत्रिका: ग्राहयेत् प्राज्ञृणपाणाश्रविजीता।
तुषाद्भास्यो ग्राहा सदभागासु चयस्यथा। ॥ २१ ॥
एकीक्षा तु संबंधे मूषा तद् कार्येद्‌वधः।
गोस्तनाकारसदश्रीमथवालकं कुरु। ॥ २२ ॥
मूषाबंधविदिते ध्यानं साधकानां हिताय वै।
चक्षुव्यत् संप्रवच्चारम् रसस्य मारणं यथा। ॥ २३ ॥
ग्राहयेत् पूर्ववद्भूयः चोषिधोस्तिः साधकः।
मूषां संलिप्येत् तेन धाम्य कर्म समाचरेत्। ॥ २४ ॥
रसेन्द्री चिष्यते चिंत्रं कुरु कर्म यदिच्छया।
वीतोदकृते कामिनन हृंकामीचि वा श्रुते। ॥ २५ ॥
कार्येत्रोस्मयं पारं तस्योऽः मूषमश्च शुभे।
वन्योन्यपूषसंलग्नं कार्येत् साधकोक्तमः। ॥ २६ ॥
वधीयन्विता तं धाम्य ारसं तत्र जार्येत्।
तस्मारकोद् तिसं जरते नाच संग्रह:। ॥ २७ ॥
तद्गुणं चायस्य तत्र हिमं चायस्य दृश्यत् ।
चीरकवं तथा चारी पट्टारो उदिग्रहात् ॥ (?)

हिमं संजायते तत्र धमकामाथ्यार्थन ।
ग्रंथ खल्वोदरे तसे हिमं घड्यूर्णतां मलजत् ॥ २८ ॥
पुरा महाकृष्णेऽतनं जरते नात्र संशयः ।
जारिति सारितं द्वारात् पुनस्य जारितंज्जनिन् दि ॥ २० ॥
कुर्वति कर्मसंपायां कर्म सिद्धार्थसाधनं ॥ २१ ॥
जारिण मारणं चैव समासात् कोरितं मया ।

किमन्तृत् प्रश्चवे भद्रे तथा ते कथयायमहम् ॥ २२ ॥

हाच चौकाकचंडश्रेष्ठमति द्वितीयं: पठलः ।
हथानं संप्रवच्यामि चभक्ष्य यथाक्रमम् ॥ २० ॥
ह्रावणं चभक्ष्यावं समासेन विधीयते ।
चीरकवं चुकिंचुरा तद्गुणेनाभिमावितं ॥ २१ ॥
निगुणंचेतहस्तं तु तदस्य भावितं कुरु ।
एकेकं समवारेऽतु भावितं साधकोन्चम् ॥ २२ ॥
(भावानं) चभक्ष्य चग्ने चिन्हिन्चन्यां ।
हह्याम समारातं तु चिन्हेदस्य नरोत्मम् ॥ २३ ॥
तेन कल्कीन प्रतापिणि लेपयेद्वंद्वकस्य च।
कांस्यपाचेना ॥ ॥ स्वाधिकोाः साधकोाः स्वाधिकोाः ॥ ॥
स्वद्धायिनि ततो घायिनि। समां साधकोाः ॥ ॥
द्रवति नाट्र संद्रेहः प्रियं हद्दा यथा स्वियः ॥ ॥
द्रवति नाट्र संद्रेहः प्रियं हद्दा यथा स्वियः ॥ ॥
रसस्य भागेमिकं तु दुतभागसमं कुरु।
एकौक्षेत्तु तदाम्यं स्वियति नाट्र संशयः ॥ ॥
लहंशवंद्विवधिकोमस्मि हि जायति नाट्र संशयः।
चथान्यं संप्रवच्यामि यथा संजायति दुर्दति: ॥ ॥
ग्राहयेद्वस्य प्रात्शै: पीतं वा प्रशामिव वा।
पुरासङ्कारयुक्तं तु कर्तव्यं साधकेन तु ॥ ॥
यवासा चित्रकं धारे: कंलुकीवज्जवंडदयोऽः।
वज्जलार्ककंविरं च भजानं संकरणं तथा ॥ ॥
चारार्जसमायुक्तं प्रतुपंचसमविन्तं।
एकौक्षेत्तु तु कल्कैन सम्प्रतापिणि लेपयेद्वः ॥ ॥
सूलागभोंदरे चिप्पा धाम्येत् खंडिरानले:।
द्रवति नाट्र संद्रेहो ॥ ॥ ॥ ॥ ॥
द्रवति काकुवंडवरीमति पथ: पतल:।
Extracts from RASENDRACHUDAMANI.

सोमेन्द्रविरचितात् रसेन्द्रचूड़ामणि:

उद्वर्त: शोका:।

रूप्येण सह संयुतं भातं रूप्येण विभक्तैः।
तदा निष्कर्मसमिस्त्र सोमेन्द्रचूड़ामणि।
एवं रूप्यं सनागं चेत् भातं नामे लगितश्च।

निष्कर्मात्रे तु नागेष्विनिर् लोहखायां हति सति।
स्वतः लज्जां हैति गलाकं चतुरि ध्रुवम्।
कुमुद्भतैलसं तस्मि स्वर्णमुहिरिति ध्रुवम्।
गुणानागीर्यसुहिर्षहं वक्ति: 3 स्वर्णमुहिरिति।

(1) The text reads लघु. But रसेन्द्रचूड़ामणि reads लगित।
    which seems to be correct.

(2) The text reads स्वर्ण स्मितिः, which is incorrect.

(3) The text reads स्मितिर्गंधिः, which has no sense.
The text has दुत्रावी, which is incorrect. We have adopted the text of रसग्रन्थसूचय.

(2) The text reads साधोऽक्षयापाख्या, which seems to be erroneous.

(3) The text has चयमायानि सच्चेन, which is grammatically incorrect.

(4) The text reads मार्गसंधवः, which is incorrect.

(5) The text reads इत्य चीरपलः, which is senseless.
स रसी धातुवादिरु प्रस्थते न रसायनेः।

तयं हि खर्प्याश्चेन लोकनाथेन कौन्तित: ॥

भ्रामकाख्यरः सघ्न पञ्चमांगरसानिचितम् ॥

कुमारिमूलतोयेन महत्येकवासरम् ॥

चाङ्रेयसेवेशभि दिनमेकमनारतम् ॥

एवं भूनागशालिन महं येद्विसदयम् ॥

अर्धेकपलमानिन तावता चपुणापि च।

दुःधिमेकसेन्द्रण श्रेष्ठपिठी समाचरेत् ॥

योजयिताय कल्लेन यथापूर्ब्ब विमाइयेत् ॥

ततः सारसेन्द्रण सल्लेन रसकुख्य च।

पिठों कल्ला तु पूर्वेन पूर्वेन कल्लेन योजयेत् ॥

(1) The text has रसायनम्.

(2) खर्प्याश्चेन is the reading in रसायनमुच्य.

(3) The text reads दिनमेकमनारसम्, which has no clear sense.

(4) The text reads मोठेन, which is unintelligible.
पलादेश्वरस्येन मृत्युग्रजारस्येन च।
विवर्तं काल्पिक कुर्यात् मरिचप्रसिद्धिः युद्धोऽ। ॥
विनिंद्यं वञ्चमूलायं संयंवल्यं विधायं च।
शुपिर्देवविभिःः सम्यंग्नम्भाईयं च धभित्तं खलु ॥
ततो सूयागतं सचं समारंतं सम्मलतः ॥
धभित्तं प्रकटंमूलायं वञ्चनालेन श्रेये ॥
दशशास्त्रं हि तत्सचं भृस्मन नवणेन च।
सकालिकेन संवेष्यं पुष्टोगिनेन शीर्षयेत् ॥
हिनिच्चप्रसिद्धि नस्विन् पूर्वप्रश्नेन भृस्मन ।
चशोतिगुणितं नागं भालवा निवर्ष्येत् खलु ॥
इयताःः पूर्वसुतोस्यो जोयते न कथवचन ॥
चपलस्यं ससुविष्ट्यो लोकनाथेन शश्चुना ॥
चन्द्रानाधि रसंः शीत्त्रं वध्यते पूर्ववत् खलु ॥
कार्तव्येज्जात्वरूपेणं शास्त्रा मूर्तितो हि सः ॥
भवेन्द्रगविनिश्च्युतो यासं ग्रहदाल्यश्रीतः ॥

(1) The text reads मरिचप्रसिद्धि युद्धोऽ, which is incorrect.
(2) The text reads शुपिर्देवविभिः, which has no sense.
(3) The text reads इयता, which is incorrect.
The text reads विगुण्णार्ग, which is incorrect.

(2) The text reads तथा, which is not accurate.

(3) The text has अपभ्रंशं, which is not accurate.

(4) The text reads धीतास्य, which is not correct.

(5) But रसग्रहमुद्धव reads विभिन्निनिर्गितः.

(6) But रसग्रहमुद्धव reads अभिव्यक्तः.
जड्डपातनयन्त्र हि नन्दिना परिकौरितितम् ॥

कोष्ठि(ष्ठ)कायन्त्मेतदि नन्दिना परिकौरितितम् ॥

विम्याद्री विम्याद्री विषमप्रते च मलये गोमलकी चोगिरी चोगिरी सहाद्रावध पारियानकंगिरी चिंकिंधिनामालये।
माहेन्द्रवथ चाषयवत्तिधः तद्वपनामाधिकं गोपाभूरकसिदवैवसुखतो वैयः समाविषताम् ॥

इति श्रीकरवालभूरवपुरवपतियशीसोमदेवविरचिते
रविन्द्रचूड़ामणी रससूचनानि रससहिमज
नित्यः नाम प्रथमार्थः
समासः।
Extracts from
RASAPRAKASASASUDHAKARA.

वशोधरविरचितात् रसप्रकाशसुधाकरान्
उद्वृत्ता: श्रोका: ।

विमलसूतवरो हि पलाष्टकं
तदनु धातुघटीपरकांचिका: ।
प्रशणगमाश चतुःपलभागिका:
स्नाकश्रुतीपलाष्टसमन्विता: ।
सह जलेन विसर्य च यासकं
लवणकार्कजलेन विमिश्रितम् ।
उदितधातुगणस्य च भूषिकां
कुरु रसं विनिवेशय तच्च वै ।
डमगकाभिध्यन्वरिण तं
हिंदश्यामसाृजायवलिना ।
प्रवनपितकफच्यकारकं
सकलरोगहरं परसं सदा ।
गजपतिर्वलब्रवलद्रो नृत्यं
हिजपतीचप्पववनवनप्रदः ।
युवतिकामविलासविधायको
भवति सुनवरं सुखदं सदा ।
संघमसारसः किंल कान्तिदः
स्वविलकुलकः कवितो मया ॥

इति कपूरसः ॥

उद्यभास्करनामरसी द्वायं
भवति रोगविधानकरः खयम् ।
मणिकामधुनासह सुद्द्रिका
चतुर्मित्र सदा परिभ्रमितः ॥
ललितकामविलासविधायकः
खर्कोशिपि रती तरुणायति ॥
गदधरी वलदोषिपि हि लघुद्वी
भवति कम्भिरविपकजरोगणः ।
सकसूतकशास्त्रविम्बमयो
हिजवरेण मया प्रकटिद्वः ॥

इति उद्यभास्करसः ॥
(1) The text reads कानी बलवदुः, which appears to be incorrect.

(2) The text reads सं, which seems to be incorrect.

(3) The second hemistich is wanting in the text. We have adopted the reading of रसरसमुचय.
(1) The text reads मिक्षी राजिता, which is not accurate.

(2) The text reads निमलित, which is incorrect.

(3) The text has only मृ, which mars the metre.

(4) द्राविन्द काशिन्द is the reading of the text, which is evidently an error.
वचाहरित्रातिरिक्तग्रन्थधृत्मः सर्वभवे।
भक्तातकेतस्तथेषां चार्यात्रीतिय महितम्।
पादांसंयुतरूपां हन्ताकफलसन्निधाम्।
निस्त्रव्य शोभयितवा च मूर्गायुमङ्गोपरि न्येष्ट्।
प्रभाते खेपिरे ध्वजः सिता नीला भवविद्यदि।
लोहसंदर्भके मूर्गाः ध्वजः कला द्यायोसुखीम्।
भूम्यामादलयेत् सच्चं यथा नानं न महते।
तदा सौसोपम् सच्चं पतलेव न संग्रह:।
भृजनेव प्रकारिणे वार्तव्यङ्कते सति।
विनःसरित् सत्यसत्य सहिंगु(?) गुरुपदेशितम्।
चर्य सौराश्रीगुणः।
सौराश्रध्वेश मञ्जाता खविनजा3 तुवरी मतः।
या लेपिता शेतवमः रक्षणवच्यकरी हि सा।।

(1) The text reads वचाहरित्रा, which seems to be incorrect.

(2) रसरक्षसुधय says वचाहरित्रा. See Chap. II. Verse 161.

(3) The text reads खविनजा, which is incorrect.
फुशिका खटिकाः तदन्त हिम्मकारा प्रशस्यते।
किच्छित् पोता च सुनिश्चिता गर्दिप्विनाशिणि।
खेतवर्णी परा सास्त्रा फुशिका लोहमार्गी।
कपाया मधुरा काळी कटुका विषनाशिणि।
ब्रजपी कक्षा चैव मेवयापचित्रोद्धरा।
कष्टरोगमहा सा तु पारिं वोजजारणि।
धान्यामें तुव्री चिह्न शुद्धित विदिमिन वै।
चारंरक्षक सृद्दिता भ्राता सच्चं विसंवचित।
तत् सच्चं धातुवादार्थं चीष्मि नोपपयते।
ब्रह्म पुषानि लिख्यते।
भूम्यां वै खन्यते गर्भं चिह्नसं चतुर्स्त्रकम।
कामिन सहस्रं पूर्यायत्तनतरम्।
श्रीपरं धारणेः तदाच्छाद्य वनोपलैः।
सहस्तां वै सम्भवविं प्रज्ञालयंति।
महापुत्रमीतं प्रोक्तं ग्रन्थकारणं निर्मितम्।
इति महापुत्रं।

(1) रसरससुद्धेय says फुशिका।
एकहस्तप्रभावाणि धि चतुर्रतं च गर्तकम् ॥
वनोपलसहस्रं स्नायुं च पूर्वितम् ॥
प्रूषिकां चैववेनाथ पूरितं तां तु सुद्रेयेत् ॥
गर्तक्षेर निधायाय गरिष्ठानि च निविष्टः ॥
धृतीपिन्तं ज्ञात्येत् सम्बुकः सोरयं गजपुटो भवेत् ॥
\( \text{इति गजपुटः} \) ॥

उपलं पिष्टकं क्राश्मुत्यलच्छ गरिष्ठकम् ॥
क्राशीपलमारी च तचरा\(^2\) क्राश्माभिधा: ॥
\( \text{अरविमाने कुंडे च वाराहपुटसुच्यते} \)\(^3\) ॥
\( \text{इति वाराहपुटः} \) ॥

वितस्तिहयमानिन गति चतुर्रतस्त्रकम्\(^4\) ॥
कुकुटाख्यं पुरं विद्याद्विधानां त्य साधनम् ॥
\( \text{इति कुकुटपुटः} \) ॥

(1) रसरसमुच्यः reads गरिष्ठानि.
(2) रसरसमुच्यः reads वराही.
(3) The text reads अभिमानिष्ठूं च वाराहपुटसुच्यते; which seems to be incorrect.
(4) The text reads गति कुकुटाख्या, which mars the metre.
चरणऽर्थिन: सम्यक्क कपोतपुटसुचयते ॥

इति कपोतपुटः ॥

तुषैवं गौररावापि रसभास्प्रसाधनम् ।
माणिकायमाननि गौरं पुत्रसुचयते ॥

इति गौरपुटः ॥

मद्धाभेशे तु प्रथूप्तेव मध्ये द्रव्यं तु विन्यतेत् ।
अधस्ताज्ञालीयेद्रामिनि मद्धाभेशपुटसुचयते ॥

इति (मद्ध)भेशपुटः ॥

gर्गं तु बालुकापूर्णं मध्ये द्रव्यं तु विन्यतेत् ।
उपरिखात्त्वभाष्यं बल्स्य उैष्यात् प्रयम्बन: ।
नद्वालुकापुटं सम्युच्यते शास्त्रवकीविदि: ॥

इति बालुकापुटः ॥

सूष्कां मूमिनमध्ये तु स्खापितं हाङ्गुलादध: ।
उपरिखात् पुरं द्वयात्¹ तत् पुरं मूढाराभिधम् ॥

इति मूढारापुटः ॥

(1) The text reads द्वया, which is incorrect.
गोवरेवीं तुषैवापि मात्राकर्षिते पुष्टम्।
यत्र तत्त्वावकाख्यं स्थानूमुदत्रयायं साधने॥

इति लावकामुपतः॥

इति श्रीपञ्चनामध्येनुभूमीयशोधरविरचितं
रसप्रकाशसूधाकरं दशमीस्थायः॥

चयानं साम्रध्यामिम धातूनां कौतुकं परम्।
स्नानभूतं सया किल्लबं श्रुतं यज्ञास्ततं: खलु॥
तदहं कथविचार्यामि यत् कला ना सुखी भवेत्॥
रसकं दर्दं ताथं गगनं कुन्तोसमम्।
रक्षारम्भोभिभिः महीण्ड्रितसमस्यकम्॥
जलवन्नेशं वेपाचं चतुर्विंशतियामकम्।
तेन वेद्यं दुःतं तामं तारं वा नागमेव वा॥
सह(शतं)वेद्वो तु तकल्को जायते नान्त्र संग्राय:॥
एकभागःस्थाया सूतो वज्जव्यायं महितः॥
खंसे तिन्निश्चाच रसे पञ्चभागसमाविते।
वेदायद्या च रागिन्या पीतकल्कं प्रजायत॥
षोड़शांशेन दातव्यं दृवत्त ताम्रे सुगोभने ॥
जायते प्रवरं हेम शुद्धं वर्णेच्वतुहंगम् ॥

द्रव्य हेमक्रिया ॥

वर्णमाचिकं संस्कं कालिके दिवसतयम् ॥
चर्मंग्राया(गा)रसेनैव मदमेदिनसामकम् ॥
जलेन धीतं नावच यावदेमनिभं भवेत् ॥
दर्दं रसदेशोयं गोसूचनेन खेदयेत् ॥
दोलायलेक्ति² चलारि पदाच्चुकतमी भवेत् ॥
मनःशिला पदरनिभा रत्ना चैव सुगोभना ॥
खेदिता सुनिपुष्यस्य रसेनैव तु दोलयः ॥
याममद्रमिता शुद्धा सबन्धकायेषु योजयेत् ॥
नवसारःथः सूतः शोधितोप्रमात्माति स्थले ॥
समभागान्ति सर्वाणि मदमेदिनमुकारसेः ॥
मातुलुजरसेनैव कुमारोसुरसेन वा ॥
सुर्यात्मेव विमर्देसो पाचितो जलयन्ति ॥
द्रिनानि चीणि तीव्रानि कुर्यांत्वतारंगेत् ॥

(1) The text reads रसदेशो, which is incorrect.
(2) शब्द [श्रास्ति] is grammatically incorrect.
ग्रापां वेध्येण्यारं शुद्धिम प्रजायते ।
जलभंदी यदा न स्थाि्म काय्यी विचारणा ||
गिलयान मारितं नांग कुमारायीः स्वरसिन तु ।
पुरुषाधिगारोगिन नागभस्म प्रजायते ॥
शतसंख्यानि वै कन्यातु पुराणेवं श्रावकः ।
कुमारायीः स्वरसिनैव भाविद्यनिमसमकः ॥
पूर्वेवतु पुरं काय्यं शतसंख्यामितं तथा ।
सूतगन्यागिलाददृशं वेद्गामभस्मकः ॥
तिंशिना भृतेन्द्रायातु पुरं वाराहसंक्षकः ॥
ग्रन्थन विद्यना सम्यकं शतसंख्यानि द्रापयेत् ।
पुराणेवं छती चीरि शतानि हास्माधिकाः ॥
पयाहुः काचभये कृपे हातिष्ठायामकाः ॥
वालुकार्मिन प्रद्यािचु स्थाि्म ग्रीतं समुद्रशित् ॥
तलभस्म यद्वृत्तयां वेध्येण्यारशुद्धिकेः ।
शुद्धिम भविषयन नाव काय्यी विचारणा ॥
पत्रग्रहयोगोयं कथितो नाव संवशयः ॥
Extracts from
RASACHINTAMANI.

सदनान्ति देवसूतिविविधचितात् रसचिन्तामणि:
उद्धृता: ऋक्षा: ।

सैव तौरिकां स्नूत कामीसं लक्षणार्द्वे: ।
विभव खल्वागाध्वं सवंस्च सं दिनचयम् ॥ ६६ ॥
हस्तकायं तदारोप्य काथविकीर्णीयते ।
दिनचयंध्यानीकर्णे मस्मे भेदतरं मन्दवेत् ॥ ७७ ॥

* * * * * *

इति चयोद्ग मस्मस्नूतः ।
खर्पैरो दाद्गाण्डः स्वात् शिनिवं च लुकं ।
षड्गुर्गन्त्त मात्रिकं निवत्तां ग्राह्यं मनं शिला। ।
भागाएण्ज्यमिलं ग्राह्यं शोभनागतकारे।: ॥ १८ ॥

(1) चाप निवत्तां मनं शिलाः is the correct reading as stated in the margin of the text.

(2) चयो भाग अधि ग्राह्यं: शोभनागतकारे: is the correct reading as stated in the margin of the text.
एकाधिका भवेल्य भावनाद्वार विषंति।
विगीयावसित्तं तारं भवेल्याचक कांचनं || ११० ||
द्वितीय चिन्तामणी हेमीकरणप्रयोगः ||

हेमभागहरं तारं तथा नामं चतुष्ठयं।
एकतः क्रियते प्रचमतिसूच्यं निरामयं || १११ ||
जंग्रारनोरसंपिदं खंपरख्यांटलंकरं।
नन तानथ प्रताणि लेपनीयाणि वै बहु || ११२ ||
श्रावकंतेन पुनंकर्त्या मूणकी गलिताणि च।
तदा तानि भवेल्यं हेमहृपाणि नान्याया || ११३ ||
द्विती हेमीकरणप्रयोगः ||

एकभागी भवेद्वारः तारं भागहरं भवेल्।
ब्रंदभागं भवेल्योऽखं सवं सलवाचं वै दश।
बंगभागं भवेल्यं सवंमेकं कार्येत् || १०८ ||
रंगक्षणीन पुनः भातं चतं कलास्य वक्रं।
विलात्ययमिदं भातं तक्रमं वे निवेशीयेत् || ११० ||
एवं तारं भवेदृः परीचार्यममापणी।
द्विती तारोत्पाद्यं ||
तुषकं पिपते खले विफलाहिंगुटकण्डोः।
मध्यायमित्रितं भांतं सतं पातयं धुवं॥ ६८॥

इति तुषकसत्वापातनं॥

खण्डः खेथ्यं पूज्यं कौलत्येन जलेन च।
वटारोहजलेनापि पर्षुचुर्गणं शोभनं॥ ७५॥

गुड़ंगकणसमिश्रस्विफलाकामयमदिनं।
मृच्छेपं कृपकं कत्वा धाम्यमानो भृशं च स॥ ७६॥

शेतधर्मोदुगमि जाति तत् द्रव्यायं कृपकं।
सावधानं करेणेव भूमीं तं चाध आनयित॥ ७७॥

पुनं धाम्यं कृपं तथाजातं च तं पुनः।
कृपकं च पुनस्मिमं तथा तं नामयित् पुनः॥ ७८॥

सलं खपरकशेतूत् नागरूपं पत्त्वध॥ ७८॥

इति खपरसत्वापातनं॥
Extracts from
RASAKALPA.

शिवं नवं रसाधीशं चिह्निकाचरणं तथा।
कियति ्रसकल्पोत्यं रसप्रानविशारदः॥ १ ॥

॥ चय परिचय॥
चतुः चचरुः शुभो लोहहा(५)चचलो रसः॥ ३ ॥
यदा नवर्जितद्विः नोईं गच्छेतद्यूतः॥ ४ ॥

(1) The text reads कर्मि, which is grammatically incorrect.
(2) The reading in the text is विशारदस्, which is incorrect.
(3) The text reads रस, which is incorrect.
(4) The text reads यद्रामार्गिण, which is not correct.


(1) The text reads वद्यार्शि:, which is grammatically incorrect.

(2) लोहेज़ाङ्गः is the reading of the text, which seems to be incorrect.

(3) The text reads रेवतःवायस्तकृतिम, which is palpably an error.
ग्रहणं तु यथं कान्तं राजावर्षमथाण्डनम्।
वजं वैकान्तं च च रसं शु। (रसः)

grahaka talaakshile chitibibhargirika:।
dhvaadhyaparas: sabhaavarchkulddrita:॥
(उपरसा:)

सितासिताः पौतं ग्रहकं तत्ततुर्भिंधम्॥
तालकं हिप्रकारं स्यात् गोदन: पाटलच्छिवः।
रक्ता पौता शिला हेपा पूव्या चेटोत्तराधमा॥
वहुप्रकारास तीराध्री कासीसं तिविचं मतम्॥
कासीसं पुष्कासीसं हीरकासीसमितिय॥
गैरिको तिविचः प्रीतः सीवर्णी लोहितस्तखः॥

(1) The text reads पटलच्छि, which seems to be incorrect.
(2) पूव्यं हीरसमाधमा is the reading of the text, which is incorrect.
(3) The text reads कासीसिविधि मत:, which is incorrect, as it is mentioned neuter in the next line.
कहुँढादृश् । रसायन कृतिदाचार्य वर्णयन्ति वै ।
चन्द्राभिरिक्त तब्रोक्तं सुनिमार्गानुसारिभः ॥

इत्येव प्रोक्तिः मार्गी रसश्रोधनक्रिया ॥
सच्च न्द्रभैरवायुक्रो मोक्षदीमिहितः ॥

लवण चूलिकोशृं गद्धकृं समम्बितम् ॥
स्वाइभुवनं चित्राद्रि खूलभमिस्रापाग्रितम् ॥
गोमूर्धने शत मात्रं नद्रमे जार्येित् शनीः ॥
तत्त्व संपर्कात् सूतो राचसो भवति ध्रुवम् ॥

(1) The text reads कहुँढादृश्, which is an error of the scribe.
(2) The text reads समाधितः, which is incorrect.
(3) The text reads स्वाभुवनं, which seems to be incorrect.
(4) शनीः, as given in the text, is grammatically incorrect.
एतदेव विद्येद कथात्त सद्वेद इंजारणि।
सुखं संजायते तन जीयते च विनिद्वितम्।
इति श्रीसिद्धागमले रसकल्ये उमामहेश्वरसंवादे
रसाधिकरणोऽन्तः नाम दित्योक्षासः।

(1) The text reads हंजारणि, which is not correct.
(2) The text reads न, which appears to be an error.
(3) The text reads रसाधिकरण, which is incorrect.
(4) The text reads गल, which is senseless.
तत्साध्यं वज्रभूषणं ॥ पक्षयां निरचिन्नतः ॥
लोकमथानकरणं तत्समं तच्च निर्धचितः ॥
द्वां प्रकल्पयोग्यं ॥ कोष्ठिकं ३ विनिवेश्यितः ॥
अज्ञातं खट्टितृःतः धमेदुभभाइयं वे ॥
वक्रनालयुजा मच्छं ताथ्यह पति भ्रुवम् ॥
पुकारिश: समद्यः ४ यद्य: वेष्यानरो भवितः ॥
तदा मच्छं तु पति तं जानीयावान्यथा कृतितः ॥

रमकं हेदयेदारीं पदुबुल्लहतं वुधः ॥
चतुगणेन वस्त्रेण दर्भ वध्या च डोलिकाम् ॥

(1) तत्साध्यं वज्रभूषण is the reading of the text, which appears to be incorrect.

(2) The text पक्षयां निरचिन्नतः is evidently incorrect.

(3) कोष्ठिकं निवेश्यितः is the reading of the text, which has no meaning at all.

(4) The text reads समद्यः, which is grammatically incorrect.

(5) रमकं हेदयेदारीं is the reading of the text, which seems to be incorrect.
कल्ले भाग्येच सजले । स्वदेयेम्नासपद्दकम् ।
उदळ्य पश्याद्रस्कं खलम्यो विचृत्येव ॥
पार्टीशान् मालकोजां समुद्रं जीयं गुह्यकम् ।
गुजधूतर्म रचकाँ च निशांं जुलियरकान् ॥
तत्त सवसं चौरिञ्च कल्ले गोपंचकविभावितम् ।
कल्ले तत्रविका: पश्यत् कायां श्रोपर्याच: ॥
कोष्ठेनायणि ॥ पेशार्धमेद्भभाब्याचे: ।
सवं पतचयंबाजीं स्फिरराणं ढड़ बहु ॥
एकमांस हिमांसा वा रसकं स्वेदिं यदि ।
न भाति तव कोष्ठे धमितत् नालमूषया ॥

इति सम्पादितो मांगी दूतीनां पातने स्वुत्: ।
साचार्णभवेद्देशो न श्रुतो गुह्यनिर्दित: ॥

(1) कल्ले भाग्येच मजलेः is the reading of the text, which is incorrect.
(2) The text reads खलम्यो.
(3) The text has जीयं, which is grammatically incorrect.
(4) The text reads कोष्ठेनायणि, which is not correct.
Extracts from

RASARAJALAKSHMI.

विशुद्धिविरचिताया: रसराजलक्ष्मीः

प्रारंभः —
यथःच्छाद्युरविन्यं मुकुलिता नानाकलाकौतकः
चालुयेकविलोलपश्चवती कौर्चिप्रसूनप्रशृः।

(1) समास सुभम् is the reading of the text, which is not correct.
संनिर्वाप्यति ज्वरत्रयमही चर्यावकलापर्णां सोयं पातु विचारसूर्त्तिरिगिन्तं कालापलीं जगत् ॥ १ ॥

जयंति दुरीतसर्पस्मंडमंचोयदर्पः
प्रवलगद्रविनागः सेविविधोस्तनागः ॥
शिव इव विजः (वोज ?)मन्त्रः संहितायोगंमन्त्रः
विपुरहर्तनूजस्विनमः कायुङ्जः ॥ २ ॥

इति श्रीपणिलमहादेवतनयशोविषुदेवविशिष्यितायां
रसराजलचयामुखासः प्रथमः ॥

हट्टमं रससागरं शिवलक्तं श्रीकांचश्चेष्टारी-
tनवं चूतमहीदर्धं रससुधाभ्रोधिं भवानीमतम् ॥
यादि सशुलभमीणश्रृद्धयं स्वच्छंशतंक्षणं
श्रीदामोदरवासुदेवभगववदोगविद्नागार्जनान् ॥
प्रथमः उवाचः ॥

स्वच्छंशतंक्षणसारभूतः
समुद्रतो विषुभिषगविरेण ॥ ११० ॥

द्वितीयः उवाचः ॥
Foll. 1—43. Linn. 10. Rasarājacakshmis, de medicamentis metallorum et fossilium ope conficiendis liber. a Rāmeśvara (bhaṭṭa), Vishṇus filio, compositus. Incipit: 

Rāmābhodhi-gabhūragarbhātī śrī-Vishṇu-devi (o devi) labhate prajātāt śrī Vishṇuavatsād Rasarājacakshmiṃ ॥ ॥ 

Drīṣṭivem up Rasasāgaram, Sivakṛitaṃ śrī-Karkachandravatritantraṃ, Sūtamahodhadhin, Rasasudhābhodhiniṃ, Bhavāni-maṅaṇaṃ, Vyāli[m], Svārutaśatrūṇaṃ, Īsahṛidayaṃ, Svachchandasyaktyāgamaṇaṃ, śrī-Dāmodara-Vāsudeva-bhagavadvāgovinda-Nāgārjunān ॥ ॥ 

Aufrecht’s “Catalogus,” p. 321, No. 761.
Colophon at the end of the Rasarajalakshmi—
राजन् (सग)गावरिवसारायदिवसे वारे हिमांगोरिर्द्रं चंटटभूतलपचनी विजयिनि श्रीबुक्क्ष्य्य्यीपते।
शास्त्रं वैयकसाररस्यमयकरोल् ग्रीविश्वदेवं: कवि:
वामदेववर्णारविन्दसंरामोदमोरस्यवाक्।

Extracts from
RASANAKSHATRAMALIKA.

मथनसिंहविरचिताया: रसनचत्रमालिकाया:
उद्रता: श्रोका।

चतुचत:संख्यकपदिकानां
सतकजम्बीरविसंहितानाम्।
च्राफेनमाचीकविषहयानां
पलं पलं दन्तिफलान्वितानाम्॥ २५॥
यत्रभङ्गक्षमूत्ता हितयं वज्ञ्यं शहतीच्छविः।
दग्धा सुगृहं युक्तं चिन्ह्यं दल्चा रसायनविष्यः।
विक्रकशोत्तिगाविण्यं दशमूलं दव्यविन्दविश्वंगिः।
कलहसारविकारः प्रत्येकं भावनाचित्तमः।
दल्चा सुभिमात्रो मारिच्छुर्दैन घृपितं सम्यकः।
स्वर्णद्विभेदवाक्षो रसं सस्मायध्वंसः।
विक्रकुकर्षिन सुको विशेषतं सन्धिपातहरं।
ग्रहण्यां दामयशुलज्जाविष्ट्विन्दवात्तुल्लख्यः।
इति स्वर्णद्विभेदवो रसः।

द्यं मारिविभूषणलभिष्यं भिषजं मता।
इत्या म्यनसिंहिन रसनचयमालिका।

इति रसनचयमालिका समासं।

संवत् १५५३ चार्शिन कण्डः १ सौमी।

* The स्वर्णद्विभेद रस mentioned in the रसनचयमालिका is quite distinct from that, which is stated in the रसनचयमालिका. Neither has it any analogy with what is described in the रसनचयमुख्य.
Extracts from
RASARATNARAKA.

निल्यनाथस्वरचिदात् रसरतनाकराय
उद्धात: श्लोकाः ।

यदुज्ञ श्रम्भुना पूवँ रसखंडे रसार्यवि ।
रसस्य वन्दनायं च दीपिकारसमझले ॥
आधितानां हितार्थीय प्रोत्सा नागार्जुनीन यत् ।
उक्तं चपेटितसिद्धेः स्त्राणिवद्यकपालिकेः ।
अनेकरसशास्त्रेषु संहितास्नागमिषु च ।
यदुज्ञं वाभेत तन्वे सुयुति वीवसागरे ॥
अन्वेश बहुमिः सिद्धेः यदुकृष्ण विलोक्य तत् ।
तव यदुयदातार्यं स्थायिददूर्दुर्भमोऽधमस् ।
तत्तत् सर्वे परिश्चेत् सारभूतं समुद्रतमस् ॥
कविविच्छास्ये क्रिया नास्ति क्रमश्चापि न च कृतम् ।

(1) चपेटितसिद्धेः is the reading in the Sanskrit college MS.
मातायुक्त: कवितास्मि सम्ब्रादयो न च कृतः
तन सिद्धिन्त तत्तत्स्ति रसे वायु रसायने।
वैद्य वादे प्रयोगे च तम्रावृद्धिभो मया करः।
यदृयदृश्यमुखाज्ञातं खानुभूतं यथा यथा।
तत्र्योक्तितत्त्वाय प्रकटोक्तितेष्वरुणा॥

प्रथमोपदेशः

इति श्रोतायेनोपचन्तनयायसिद्धविरस्विते रसरहारे
रसखंडे रसपौडिका नाम प्रथमोपदेशः॥

परीचा मारिते सूति कवित्या च यथादिता।
चवलुपाविना तसो चक्रोणसिष्ठा यदा।
तदा सर्व विज्ञानोऽचुल्लां यांम् निरीङ्क्येत्॥

हरतीयोपदेशः

दले शुद्धायवा वंशी रत्नेित् साधितं रसम्॥

चतुर्योपदेशः

अख्यातः शुद्धस्य सुचिनाविधिरुचितः।
विवनादावचार्हित्यं शुद्धसम्र मृदुलां॥
नष्पिष्टन्तु तदुगोलं हिंदुना विषयेहव्हि।
पचेयवणंयमान्वं दिनैंकुं चगडवक्षिना॥
जहलमें समास्त्रं हड़ं वल्लेश वन्ययेत॥
जह्लाधो गन्धकं तुष्यं दल्ला सोमानलं परेत॥
जीवं गन्धे पुनर्यं झडित्वारेः समं समम्॥
पढ़ुर्गुणं गन्धके जीवं मून्यश्वी रोगहा भवेत॥
चतुर्थीपदुः॥

Extracts from

DHATURATNAMALA.

धातुरङ्गमालायः:

प्रारंभ:-

प्रम्प्य विनायेशे शरमं त्रिस्थल्युपत्तिकारिणी।
धातुनां रङ्गमालायामभिधायं करोंयहं॥ १॥
वज्रविश्लेषङ्गरायान् ते मत्ता ध्ययंति नित्यशः।
शास्त्रान्ध्र्यप्रदानाय से विक्षेपे मता॥ २॥
चथ धातूनां रक्तमालां वच्यामि।

रौथं हेमं तथा तामं नागं वंगं तथायसं।

खर्पराभवकमीतं च प्रवालं तालकं गिला। ॥ २ ॥

सुवर्णमाचिकं सूं तीरंकं च ब्रवीम्यं।

सर्वधातूपधातूनां लजणं मारणं गुणं। ॥ ४ ॥

चथ रोधमारणं।

रौथं शुद्धं समादायं नगिनं गुरुं शोधयेत्।

शुद्धं तातं पुनः प्रयात् सुचमपत्ताणि कारयेत्। ॥ ५ ॥

निन्वचिन्विनिम्द्राचारि: शोधयेत् पुष्कं पुष्कं।

चालयेदुक्ष्यं सारं तथा दुग्धेन शोधयेत्। ॥ ६ ॥

गंधवारदंगोंदं किङ्किनिहं च घरंयेत्।

द्राचायं द्वसंयुक्तं तारपत्ताणि शोधयेत्। ॥ ७ ॥

चक्रयन्ति विनिचिप्प लेपयेदूवस्मृत्तिकां।

द्विप्रजुषपुरे गतं ज्ञालयेदूवहंकारकान्। ॥ ८ ॥

समासिः—

गंधों वैद्यकनामायं रससिद्धान्तसागरात्।

धातूनां रक्तमाला च तत्तो वैद्यं हितवे। ॥ १७६ ॥
The following is taken from Aufrecht’s “Catalogus”—No. 760.

Incipit:—प्रणम्य सारदां शक्ति सुभृत्यस्ति-
कारकं। धातृनां रत्नमालां च विवेधाय करोम्यं
है। व्रजाविश्वेश्वरान् ध्यायिता ध्यायति निल्यमः।
तेषां वरप्रदानाच सा मथयामदीयति। ॥ २ ॥ रूपं
हिम तथा तामं नागं वंगं तथायसं। ख्रिःप्रेरं गाजनं
प्रोक्तं प्रबलं चालं शिला। ॥ ३ ॥ माचिकं गंधकं
सुरं हीरकं च ब्रजीम्यं। सर्वधातूपधातूनां लच्छं
मारणं गाजन। ॥ ४ ॥ रूपं शुद्धं समानीयं नाग-भूपा
इं शोधितं। शुद्धे नारे पुनः पदात् सूच्च-प्रज्ञाणि कार्यं
हेतु। निन्दुविंचिनिषोद्राचार्यिः शोधनीयं
प्रथक् प्रथक। चालयंदुकं सारं तथा दुग्धेन
शोधितं। ॥ ५ ॥ गंधकं पारं रूपं जिंचिद्वंगं च
HINDU CHEMISTRY

यद्यपि द्राक्षार्द्धन संयुक्त तारपदार्थि लेख्येत् ।
ना यथे विनिचिन्त्य लेखेदृस्त्रत्मुच्यति कां।।
चेर गज रोटे गर्ते ज्याद्विक्ष रघुपलः ॥ ८ ॥

In fine libelli disticha haece leguntur:

श्रीम वैद्यः नामायम् Rasasiddhántaság县域 ॥
धातृनां रघुमालां च झता वैशुष्णववै ॥ १ ॥
मरणंभी भगवस्त्र रोगस्त्रावाय वे नरा:।
रघुमालाः हि धातृनां झता तेषा हिताय वै ॥ २ ॥
Jātyā Gurjarakhaṇḍas cha, Devadatto
hi dharmavit ॥

Harer nāmābhidhānasya सुतस्य भिषगवरः ॥ ३ ॥
संहितारसकमर्माणि यस्य वुद्धिग्रोहसो।
तन्न ग्रामविधिनेन झता रघुस्य मालिका ॥ ४ ॥
इति द्वेष्टत्त्वेवायकशास्त्रे धातुरघुमाला ॥

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Extracts from

RASAPRADIPA.

रसप्रदीपापाठ्यम्: श्रोका:

A—MS. from Alahabad.
B—MS. from Benares.

चथ शह्द्रावरस्:

स्फटिकाः नवसारथ्य सुखेता च सुवचिन्तका।
प्रथक्क दशपलोच्चानं गत्यकः पिचुसंसिद्धः।
चूण्यित्वा चिरीपाठेण सच्छर्ये सूद्विलेपिते।
तदुँख सुद्रयेः सम्यक् सूद्वभागेनार्थवः।
सर्नायां तिर्यक्कूच्चर्यां सवर्णीयाप्रेप्त।
चथः प्रज्वालयेदद्रिं हठाद्वारस: स्ववेलः।

(1) A reads स्फटिका। B reads स्फटिका।
(2) B reads सुखेता, which is not correct.
(3) B reads पिचुसंसिद्ध्, which is not correct.
(4) सूद्व लेपिते is the reading in B.
B reads यमु.
(2) A reads चिन्ना.
(3) A reads विनिहिम्य.
(4) A reads चुड़शगंगा। B reads चुड़तशगंगा।
(5) B reads भिष्णांतमा, which is incorrect.
(6) B reads समथीयान्, which is incorrect.
(7) दिनसमषुकः, an incorrect variant in B.
सद्यता योलिकाः १ द्यया भौजनायं निर्दतरम् ॥
फिरख्याधिनाशाय वटिकेयमनुत्तमा ॥ ✤

(1) गौमसरीटिका इत्यः.

 взгляд is taken from दीगवरकिंग of Trimalabhaṭṭa, printed in Bombay in the Saka year 1810.

दिल्ली पुस्तक प्रकाशन
सूची के अनुसार कर्मचारी गंगा के साथ रोगी व परमो हितः।

सौगत उपायान्तरम्

सूची ¹ कुलक्षेत्र ² पारसीकयसानिका

भवातकालं चापि पलमानं प्रथक् प्रथक्॥

(1) B reads सूची।
(2) B reads कुलक्षेत्र चैव।
फलाद्विमानः स्नातः स्वातः प्रत्यज्जित्व युढः स्मृतः ।
एकोऽवाकिलं कुञ्जाोत् वटोः कर्ष्मप्रमाणेऽधि।
खाद्ये वटीं प्रात्यायवद्ग्रामगद्धेनस् ।
गोद्धार्णुपातीं फिरझामवनागिनीः ।
निम्मविकि २ विना नैव वर्णनीयमिहापेतरम् ॥

चय उपायान्तरम्
चोपचोनीभवं चूर्णं शास्त्रमानं समाचिकम् ॥
फिरझ्वाधिनागाय भचयेलवर्णं व्यजत् ॥

(1) B reads फिरझ्वाधिनागायी।
(2) B reads निम्मविकि।
Extracts from
DHATUKRIYA or
DHATUMANJARI.

The Ulwar MS. (A) reads धातुक्रिया, a part of the Rudraya'mala; but the Benares MS. (B) reads धातुमञ्जरी, a part of the same. The two MSS. are exactly the same in subject matter, differing only in name.

(1) A reads अध्यान्तत, which is grammatically incorrect.

(2) A reads धात्व्य संस्कृति, which is grossly incorrect.

(3) The sense here is not clear.
(1) A reads वणीत, which seems to be incorrect.

(2) A has गुणवती, which appears to be incorrect.

(3) काया वचनविवा, a variant in A, which is not correct.

(4) A reads erroneously कर्मस्.

(5) A reads उपकार, which is grammatically incorrect.
महाद्वीव उवाच।
पुष्पिण्या गर्भस्ये तु चरेका धातुस्तिथिति¹।
विमुटा² कियत्कालेन धातुनानाविधोदिता³ ॥
गुणलच्छसंस्युतां⁴ साध्यं न खरामिस ⁵ ॥
कथं ते काठयिष्ठास्ति⁶ वद व्रह्मार्धवासिनिः ॥
पार्वेत्युवाच।
वे केविचत् स्मर्येन्⁷ व्रेष व्यतं कक्ष्य साध्यतम।
भवतो⁸ तुयन्हेति व साधनार्थव्र ⁹ सिध्यति ॥ १० ॥

(1) चरेका प्रापि तिथिति, a variant in A, which treats the word प्रापि in the masculine as well as in the feminine genders.
(2) ड्रार विमुटा, which is not correct.
(3) धातुनानाविधोदिता, an incorrect variant in A.
(4) ड्रार मंजुका, which is grammatically incorrect.
(5) ड्रार खरामिस, which is incorrect.
(6) कक्ष्यासाम is the incorrect reading in A.
(7) A and B read खरामिस, which is grammatically incorrect.
(8) भवतो is the reading in A and B, which is not correct.
(9) साधनार्थव्र is the incorrect reading in A and B.
महादेव उवाच।
श्रुणु देविव प्रवच्यामि धातुं नानाविधस्थितिम्।
गुणलचणसंयुक्तां यथा बुद्धः।¹ कथिष्यति ॥ ११ ॥
सुख्यप्राधान्यता² एति रंगलोभक्तामः॥
रजतिनेव³ संयुक्ता धातोपश्चात्मा सदा ॥ १२ ॥
मध्यमा सत्काधातुः।⁴ नीचा च चयुसोसयोः।
संयोगी धातुनामा च नीचा नीचतरा स्मृता ॥ १३ ॥
संयोगानि चिधा प्रोक्ता उत्तमा मध्यमाध्यमाः।
तामवज्जसल्योयोऽयोऽः⁵ नारीधातुः। प्रजायते ॥ १४ ॥

(1) A and B read बुद्धः।
(2) सुख्यप्राधान्यता is the correct reading. प्राधान्यता is grammatically incorrect.
(3) A and B have रंगलोभक्तारः, which mars the metre.
(4) A reads रजतिनेव, which is not correct.
(5) धातु is used here in the feminine gender: both by A and B.
(6) Vide verse 20.
एषा¹ मध्योत्तमा प्रौढ़ा काय्यकारणयोगके ।
चपुतामसंयोगीन² जाता धातुब मध्यमा ॥ १५ ॥
सीसके³ भड्डाप्रौढ़ा काय्यकाले सदोकिता ।
चननेव प्रकारिण वेन वेन च कथ्यसु ॥ १६ ॥
कर्त्तर्या जायबो विद्या नाला⁴ वुद्विग्यादः ।
अभिन्न सीसके जातं शुद्ध उत्पत्यकारकम् ॥ १७ ॥
हाटके शेतता जाते⁵ बच्या⁶ रजते यदि ।
लवलवः शुद्धे लोणे च द्वाविनी कला ॥ १८ ॥

(1) Both A and B read तति, which is grammatically incorrect.
(2) संयोगि is the reading in A and B, which mars the metre.
(3) A and B reads शीशके।
(4) A reads नाला, which is incorrect.
(5) A and B read जाति, which is incorrect.
(6) A reads चच्च्यि। B reads चच्चनी। Both the readings seem to be incorrect.
(1) जाते भ्रमति श्रद्धितः, a variant in A. जाते भ्रमति रघितः, an incorrect variant in B.

(2) A and B read प्राते, which is grammatically incorrect.

(3) A reads नारोधवत्सु. B reads नारोधवस्तु. Both seem to be incorrect. (Vide verse 14.)

(4) B reads पात्रामोदस्तु, which is unintelligible.

(5) A reads मता.

(6) Both A and B read एतद्, which destroys the metre.
(1) A and B want सूचना, thus rendering the foot incomplete.

(2) A and B read व, which is not correct

(3) काल्पनिक is the variant in A and B

(4) A and B read विधायिका, which is grammatically incorrect.

(5) A has an incomplete foot सम्बन्धता B also has सम्बन्धता.

(6) A reads पाचवें शन. B reads पाचवें शन. Both of them seem to be incorrect.

(7) B reads संधुः.
(1) A reads सुधामय. B reads सुधामय. Both are unintelligible.

(2) Both A and B read संख्या, which mars the metre.

(3) संख्या वर्तन में विभि, a variant in A and B, which is grammatically incorrect.

(4) A and B read only संक्षर, which is incorrect.

(5) Both A and B read कारक, which seems to be incorrect.

(6) B reads ख्यान तेषां.
कथ्यतां देवदेवेश्व लच्छलच्छसंख्यतः।
भेदोभेदोश्यः योगश मारणं चारणं तथा || ३१ ||
पातनं द्वारणं चैव चोटनं जारणं तथा।
मारणं जीवनं पंछं गोपं लेपं युनः।२ || ३२ ||
जातितिदश: सुगन्धश्च मिलनं जरणं परम्।
समर्थं कथ्यतां देव उपधातुकरी किया || ३३ ||
महादेव उवाच।
शृणु देवव्रत्वचारम् धातुश्रानानि लच्छम्।
उपधातुरनेका चितः तेनां मारणचारणम् || ३४ ||
अचणयं राग(?)कारं च गोवनं वनवनं तथा।
मारणादि च यत् प्रोक्तं तत् सन्ध्यं गृहयतां शुभे।३५।।

(1) भेदभेदश्य यौगिक मारण चारण तथा।
(2) अ लेखन की आवश्यकता है।
(3) उपधातुरनेका, यह एक गलत वैलिका है।
(4) दोनों A और B इसे चाहते हैं, जो कि कुछ उपलब्धि है।
(5) तत्त्व सबक में कथ्यामि है, यह एक गलत वैलिका है A में।
वाचनवाच।
प्रथमं वद देववेग धातुनुक्तमलचणम्।
प्रतियोक्त्यान्तर हि गुणसम्बन्धकारकम्॥ १६॥
महादेव उवाच।
श्रुणं देवव प्रयोगेन सिद्धान्तवचनं सम।
वेन विशाखमानवेण जायती धातुनुक्त्यक्रिया॥ २७॥
प्रथमं धातुनामानि संचिपात् कार्यकारणम्।
कथयामि नि मद्रे पद्यात् स्वात्मस्य संपदः॥ ३८॥
आदी सुवर्णनामानि संचिपात् श्रुणतां प्रििे।
स्वर्ण सूर्यच हातकं वज्ररोचनम्॥ ३८॥
सु(स)र्र्चं च तथा लोहं देवधातुमनोहरम्।
वेशीं विश्वासं चैव धत्रिनं कविव्रेत।॥ ४०॥
जीवनम् अर्हतं चैव हि२ हिमवन्तर्वमिः।
देववाच भमं दिव्यं संसारोशारं महत्॥ ४१॥

(१) बोल A and B read संपदि, which has no sense.
(२) A reads वेशी।
(३) हि२ is generally used.
(४) हिमवन्तर्वमिः is the correct term.
(1) The first term in the previous verse is only जीवन. But here it is सम्बंधोकार्यां। Hence there is no repetition.

(2) अन्त्यानि विविधनामानि, an incorrect variant in A and B.

(3) गोपाणोत्तरणि च is the reading in A and B, which has no clear sense.

(4) A and B read शुभज्ञोत्तरक, which is incorrect.

(5) A reads लोकिका विना, which leaves out चैव.
रतिदं वहुवीर्यं च शुभधाम च संवचयम्।
पतानि रजतनामानि ग्नान्यन्यानि सक्ति कि ४४६॥
तासं चः चाम्मकाधिष्ठं शुल्कं नागस्य मद्देिनम्।
नीलं च नीलविभमं वमानं ३ चैव पानकम्॥ ४५॥
उद्धमु उष्णकरं सिरं कक्षं कालमद्देिनम्।
हंगर्मः वयं वासं विषां विनाशम्॥ ४५॥
आरक्षसः सहायः मयं सर्वको यथवच।
पतानि शूलनामानि ग्नान्यन्यानि विविधानि च॥ ४५॥
जासलं च जगातीतं राजतं यंदायकम्।
रूपमलाता वरीयं चोटकं कीमलं लघु॥ ५। ०॥

(1) A has ग्नाानि वत्वे. B has ग्नाानि वत्वे. Both the readings are grammatically incorrect.
(2) च is dropped in A and B.
(3) The sense of नीलविभस्म seems to be नीलशिभस्म = नीलशेशम्. A reads चमनं, which is incorrect.
(4) A reads हंगर्मं.
(5) A and B read सहायं च.
चन्द्रकं खर्परं चैव रसकं रसवदेकम्।
सतापथं बलोपितं पीतरागं सुभाषकम्॥ ५.१॥
एतत् खर्परनाम काम्यकर्मण्यु सिद्धिदम्।
रसराजाद्वैकं कर्मण् कर्तं सिद्धिं जायते॥ ५.२॥
चूपुस्तापहरं वद्वं रजनारिष्ट नीरदम्।
शीतवैयकरं शीदं गर्तिदं तापजहारकम्॥ ५.३॥

(१) रसचारेकं, the reading in A and B, is not grammatically correct.

(२) तत् is the reading in A and B, which is incorrect.

(३) Both A and B read काम्यकर्मण्यु सिद्धिदान्, which is grammatically incorrect.

(४) रसराजाद्वैकान् कर्मण्, an incorrect variant in A and B.

(५) A reads कर्तं सिद्धिं. B reads कर्तं सिद्धिं. Both are incorrect.

(६) Both A and B read रजनारि च, which is senseless here.
मिच्छन्म माहिलादृ(?)भूतं सहायं धातुशिष्योऽः।
एतानि चपुनामानि सुमिति कार्यकारकम्। ॥ ५.४॥
सोसम् धातुभंजं च खतकं रोचकं परस्।
रत्नं च रत्नवीणं च रत्नवस्तुविवर्धेनम्। ॥ ५.५॥
ग्राहकं च गम्भीरं धातुभंजनकारकम्।
ग्राहकं रसराजिन ग्राहयोयां भवेन परस्। ॥ ५.६॥
विचित्रं विनं च चाव नानारज्जुप्रदायकम्।
नागं नगालयं प्रोतं सितं कर्णशोधनम्। ॥ ५.७॥
प्रशं धारकरं च चाव दुर्वरिः प्रशंकारकम्।
एतानिः नागनामानि कार्यकाले प्रयोजयत्। ॥ ५.८॥
वों च धारिः सूरं सूर्यकृष्टिविशारदम्।
हतकं खननं खण्डमारकं ताष्टकं मलम्। ॥ ५.८॥

(1) सुमिति कार्यकारकान्, an incorrect variant in A. and B.
(2) A and B read श्रीमकां.
(3) B has only रक्षा वीणं च, which is incomplete.
(4) A reads खंड खंडकर चौँ.
(5) A and B read एतानि, which is incorrect.
(6) A has खण्ड प्रारकं.  B has खण्ड मारकं.
चः ज च जरायुतं धारायम् चवनीसुतम् ।
कालियं जीवं कालं कुर्षिदं रोगास्यन्म ॥ ६० ॥
यन्निष्ठं सर्वंधातूनाम् चचचोथ्यं जलवक्षेप ।
वल्लिंदं वक्षियोजं च सर्वंधातुसहायकम् ॥ ६१ ॥
एतानि लोहनामाणि जात्वा कप्राशिणि कार्येत् ।
जायते¹ सकलं सिद्धिवियोगगोगसंयुता² ॥ ६२ ॥
नामाणि धातुसंयोगी जातानि तानि च श्रुण् ।
गुल्ल्वपरसंयोगी जायते पितलं गुभम् ॥ ६३ ॥
पितलं चैव नारोकं कपंडं गम्भुद्दर्ज्यरः ।
वशिन्दं दुबैवं चैव राजं वनं बल्लं लघु ॥ ६४ ॥
वल्लतामसंयोगिन जायते तीन⁴ कांस्ककम् ।
कांस्कं कोमलं चैव नैरंसं रसकाठिनम्⁵ ॥ ६५ ॥

(1) A reads मीयतेन।
(2) वियोगायोग is the variant in A. वियोगायोग is the variant in B. Both the readings seem to be incorrect.
(3) ज्ञातानि च तेन श्रुण, an incomplete variant in A and B.
(4) A has जायतेनव. B has जायतेनव.
(5) A and B read erroneously कथिणः.
(1) A reads सहस्र्यम्. B reads सहस्र्यम्. Both the readings are incorrect.

(2) A reads व्राह्क, which has no clear sense.

(3) A and B read एकमि, which is incorrect.

(4) पार्टिय दिशाम् is the reading in A and B, which is incorrect.

(5) B reads रहस्ति, which is not correct.

(6) कामलाद्विप्रशङ्क्य is the reading in A and B, which is not correct.
(1) A reads एनेका. B reads एतेका. Both are incorrect.
(2) A and B read कल्पितरोचना.
(3) सा is not found in A and B.
(4) A and B read रमरसमशिङ्गु, which is incomplete.
(5) गाराजकलागति, a variant in A. गाराजकलागति, a variant in B. Both the readings seem to be incorrect.
(6) A and B read शुभविधि.
(1) A reads द्विकृतिन्. B reads द्विकृतिवतः.
(2) A and B read नामकेदार्जाति, which is unintelligible.
(3) A and B read निम्मल, which is not grammatically correct.
(4) A and B read श्रेष्ठ, which is incorrect.
(5) A reads कालकाशं. B reads कालकाश. Both the readings are incorrect.
(6) Both A and B read गुणानि च, which is incorrect.
हरितालं विस्मेषं च राज्ञीदीर्मिकरी सदा।
तालं च हरिता हमीं खतपीतविधायिनीं।
नचकस्य प्रिया देशी निशा चैव निशाचरी।
पारद्ध चयकरी पचच्छेदकरी स्मृता।
रोगह जोविनी जेठी जरादारिद्रिनाशिनी।
एतालि तालनामामि संचेपाय वधितानि।
युक्तो ज्ञानिन यः कर्ता ग्रन्थोऽः।
चर्चनेव प्रकाजिः कर्ता कमायिः साधिषेऽ॥
मन् ज्ञिला ज्ञिला शृंगी कुण्टी च झलोधमा।
दरद्रा। भगिनी देशी सिन्दूरस्य सखी सदाः॥

(1) The 78th and 79th slokas are not found in A.
(2) मन्त्रिप्निताविन्दि, a variant in A and B, which has no sense.
(3) ग्रन्थिनन्दि यो, an incorrect variant in A and B.
(4) A reads चर्चनेऽ, which is incorrect.
(5) B reads दरद्रा।
पुष्पापुष्पवन्ति
पत्री श्लालिनी रसिनी गुणा।
एतच च शिलानाम तत्थीकाले प्रयोजयेत्।
धर्मशेषे चैव शौम् च गगनं ग्राहकं परम्।
दुस्तवीयं वातचं विकालोपनिराकारित।
धर्मम् धर्मां घोरं घोरवश्वतनाशनम्।
रसमुलरसातीतं रसन्तं राज्यवर्धनम्।
धर्मम् धर्मां चैव महामुद्दयुविनाशनम्।
एतान्यभक्तनामानि ढळा बोधिणि करिष्ठिष, कार्येत्।
सोमलं महारजं च विषं वातविनाशनम्।
शेतवीयं बलग्रंथि नीलउज्वलकरारकम्।
सेद्रनं मेद्रनं चैव कामशेत्यविक्षेत्तम्।
बम्बनं सच्छाहूनां मारणं पाठने रसे।

(1) A reads पुष्पवन्।
(2) एतसी च शिला गानान्, an incorrect variant in A and B.
(3) Generally used as शौम।
(4) A reads विकालोपनिराकारित। तत्थीकाले प्रयोजयेत्।
(5) A and B read खंडन, which is incorrect.
(6) A repetition of the name.
गगनयाकावै दिये रसयुग्म प्रसिद्धनम्।
एतानि मक्कनामानि कार्याकले प्रयोजयेत्॥८५॥
हीनधारोप नामानि संचिपात् तानि च स्तुतु्॥
येन विज्ञानमाने जायति पार्वती क्रिया॥९०॥
मुक्ता मुक्ताफलं वारि वारिजं स्वातिसम्भवम्।
शुष्किपं॥ च सगरं शुक्कारं मकुलदिर्यम्॥८१॥
तैतसम्॥ चम्रतोदतं शीतलं शिलोमं सम्॥
स्वयम्भुवं कलं टॉसं स्त्रिय सोभाम्यद्रायकम्॥८३॥
रतिराजयः सोभाकामसंडीयनं तथा।
मुक्तानामानि रम्याणि॥ ताला कर्मकाणि कार्येत्॥८३॥

(1) A reads बने शुक्कु, which is incorrect.
(2) B reads मुक्किपं, which is not correct.
(3) B reads सैनम्, which is incorrect.
(4) B reads सम्, which is not correct.
(5) स्त्रिय सोभाम्यद्रायिनं, an incorrect variant in A and B.
(6) A and B read ते रम्यान, which is incorrect.
विद्युं वर्द्रः २ वेलावलीजातं प्रवालकम्।
नृगस्मः ३ ग्राहरसीमा धिखर धिखरोइवम्॥ ८४॥
वर्षंद्र विवरं चैव ग्रेवत्यं ५ च विभूपशम्।
विद्युम्केरत्रामानि ४ काय्यकाले प्रयोजयेन॥ ८५॥
चर्मं जूंमेंकं चैव कमश्यं सकालकम्।
कमश्यं कर्मशं चैव कलिनजातम:भिषकम्॥ ८६॥
कचकं कहु: ५ कर्म लोके कचकटं तथा।
एतानि कृंश्चिन्यस्य नामानि च विशिष्यतः॥ ८७॥
श्रीं च जलं चैव देववार्तितेव च।
विश्ववल्लभकं ७ चैव सोमदेवतकं शुभस्॥ ८८॥

(1) A reads विद्युं वर्द्रः. B reads विद्युं वर्द्रः.
(2) A reads नृगसे।
(3) A and B read ग्रेवत्यं।
(4) A has बिद्मेनावि। B has बिद्मेनावि। Both are incorrect.
(5) कलिनजाश्वम् is an incomplete variant in A and B.
(6) A has कचकं कहु:। B has कचकं कहु:।
(7) B reads erroneously विश्ववल्लभकं।
Both A and B read वर्षं, which destroys both grammar and metre.

(2) A and B read एतचे, which is grammatically incorrect.

(3) A reads वामद्रिविषणकावभू. B reads वामद्रिविषणकावभू.

(4) B has only श्रीका.

(5) A and B read पद्मगम.

(6) नायुद्वा तन्म्रीचा, an incomplete variant in A.

नायुद्वा तन्म्रीचा, an incorrect and incomplete variant in B.
(1) A and B read एतसू लच्छन शुक्लः, which is an incorrect variant.

(2) कर्मकारः प्रयोजने, a variant in A, which seems to be incorrect.

(3) A reads बर्द, which is incorrect.

(4) अय्यं मध्यमानि च, a variant in A and B, which is grammatically incorrect.
नखं सहदवपुरं धातुकोमलकारश्चम्।
वज्रं दुर्गभिं चौव तुरीतापस्तु चोभकम्।
कचं केसं च वालं च मूर्ह्वजालकमेव च।
श्लामं चौव घनं प्रोक्तं कक्षं नम्बरदं लघु॥
एतानि धातुनामानि यथाकथ्याभिधानकम्।
शाब्दा चारभभ्ये कक्षं खस्ये सिद्धं प्रजायते॥

dhr̥taḥ r̥ṣṭhaḥ

पानीत्युवाच।
श्लोक श्रस्य विशेष विश्वनाथ जगद्वगरो।
श्रुतानि चौव नामात्वि स्थानाति कथ्यतां॥

(1) न हृदयपुरं, a variant in A. न हृदयपुरं, a variant in B. Both are incorrect.

(2) B reads कारक।

(3) B reads वज्रें, which is not correct.

(4) A reads तुरीतापस्तुचोभक।

(5) A and B read कथ्यति, which is grammatically incorrect.
महादेव उवाच ।

श्रुतं देवि प्रयोगेन स्मानानि विविधानि च।

सुवर्णस्योदयो धातोः सर्वं यथापचारणेत्। ॥ ११२ ॥

पार्थिवं हि च तत् सवेः मद्याखात् प्रजायते।

तथात् स्मानस्य संतोषः सूचतां सादरं ॥ ११४॥

हमे च प्रथमं कल्यं महर्मध्ये सदेव हि।

दुःखधेम महर्मस्य काठेनेव तु लभ्यते। ॥ ११५॥

पुनहें माद्रिष्णा तेन जायते सच्चेदा शुभे।

महाशोतकला ॥ तेन दुःखधेम स्मान सदेव हि। ॥ ११६॥

प्रश्नाम्बून्दरस्तुं जम्बूशादीयां जायते।

तत्त्व कष्टतरं मन्ये दुःखधेम तत् सदेव हि। ॥ ११७॥

(1) A reads वल्ललतं, B reads शायलतं. Both the readings are incorrect.

(2) पार्धवानि च तें सवेः, an incorrect variant in A and B.

(3) A and B read सादराम, which is incorrect.

(4) A reads महामोहतकतं, which is incorrect.

(5) B reads सदेव हि, which is incorrect.
प्रथियां धातुमधेयु स्त्रेषामधिकं सदा।
लोहाधिकतरं तत्र ज्वालथं सत्त्वदा शुभे॥ ११५॥
कष्टे निःसारणं तेषां मौल्यादधिकं ज्ञायते।
तस्मातेनैव यज्ञन साधनं न्युत्त्र क्रियते न:॥ ११६॥
असाध्यसाधनं तथा जातं सत्त्वयुगी शुभे।
तस्मात: २ वहंसूक्ष्मसत्त्वधातूपरिशिष्यितः॥ १२०॥
पुनः स्त्रानं करं तेन लोकायां च सदेव हि।
उद्विंत तेन यज्ञन मत्तातः ४ बोतं मया शुभे॥ १२१॥
पावेष्युवाच।
महाराज श्रीगुरु ग्रीमन् ५ लोकनाथ जगद्युपते।
कथं ते मानुषी भोति: ५ कथ्यतां परमेश्वर॥ १२२॥

(१) A has कथ्यते नरः. B has कथ्यते नरः. Both are incorrect.

(२) A and B read तय्याचि, which is incorrect.

(३) सत्त्वधातूपरिशिष्यि, an incorrect variant in A and B.

(४) A and B read erroneously सत्त्वादः.

(५) ग्रीमन्, a reading in A and B, is not correct.

(६) मानुषादभोति, is the correct form.
महादेव उवाच ।
सुविष्णुशेष सहतो । भौतिकमाृतमनुसभव ।
उच्चै नीचमपं सत्यक जायते बहुखि रतिः ॥ १२३ ॥
मयं मानुषबोधितेन । उष्ट्वेऽ सार्द्रेण च ।
दुस्मं च विशिष्टेऽप्राक् कालियुगे । इत्म ॥ १२४ ॥
पार्वेलुवाच ।
मदीये मानसे नाथ जातोसी संशयो महान् ।
भवतं मानुषी भौतितः काय तु जगद्दीशवर ॥१२५॥
महादेव उवाच ।
कारणं वर्त्तेऽदि तच्च चयायेयं सदैव हि ।
कायोयं लयिः भद्रे यत्स्वं ॥ सम वस्ममा ॥ १२६ ॥

(1) A and B read सुविष्णुशेष सहतो, which is not correct.
(2) मां च मानुषबोधितेन, an incorrect variant in A and B.
(3) A and B read इमः. This foot is incomplete.
(4) A reads काय ते जगद्दीशवरं, B reads काय ते जगद्दीशवरः.
Both are incorrect.
(5) कलियुगः is an incorrect variant in A and B.
(1) A and B read भवति, which is not correct.
(2) A and B read तथाच्यि, which is incorrect.
(3) A and B read तेच.
(4) A reads मत.
(5) A and B read सुवर्णसाधिनी विया.
भाद्रेव उवाच ।
मानसं मद्दोन्यं देवि जातं सम्यक् सुनियत्वलं ।
तथापि मातुरि मोतिविद्या¹ गन्धकपारदी ॥ १२॥
सहभच्छाः कर्म्मः² उभे मिलायनं महत् ।
नुषु मन्नज्ञति वश्च ज्ञलति तत्त्वज्ञानः ततः ॥ १३॥
मन्नवत् साध्येद्विद्यां साध्येद्यज्ञः क्रमात् ।
सम्मार्थेनेव महता गोप्या रिद्धिकरी क्रिया ॥ १४॥

पार्भेनुवाच ।
पूरा प्रोक्तं तया नाथ पठले पञ्चदशके ।
कैलासात् परमं सौख्यं भजित मन्नविज्ञः ॥ १५॥
क्रिया गन्धकिनी¹ मधे ब्रह्मवा पारदी शुभे ।
कैलासाद्विधां सौख्यं मुन्नज्ञति विधिवनन्तः ॥ १६॥

(1) A and B read विधि, which is senseless.
(2) A and B have काश, which is incorrect.
(3) पठलि पंचाधिके, a variant in A and B, which is incomplete.
(4) A and B read गंधकिनि.
(5) A and B read नर, which is incorrect.
(1) A and B read संयुत:, which is not accurate.

(2) Both A and B read संयोग्यति: स्थलं, which is not correct.

(3) A and B add च after स्थलं.

(4) A reads पावकाद्रिश्च शुभावः. B reads पावकाद्रिश्च मुनावः.
तत्र तत्रोत्पत्तिस्तेषां यत्र यत्र हिमद्रवः।
प्रसरन्ति भूवि संघा:। संशयो नास्ति ते सदा॥ १४२॥
तामोत्पत्तिस्तिः महता सुखेनैव प्रजायते।
तेषां स्थानानि कच्चे शंौ ॥ यायात्मणौ च सृगु॥ १४३॥
नेपाले कामरूपे चौ विकाले मदनेन्द्रे॥
गङ्गाहारे मलाद्री च क्षेत्रङ्गे तथैव च॥ १४४॥
पावकाद्री जोश्ठुगे रूमद्रे फिनङ्गे।
एतान्युदितस्थानानिौ सर्वप्रवर्तकैौ सदा॥ १४५॥
जासलं यजु ॥ दिव्यं हि स्थानानि तत्स्य च सृगु।
कुम्भदारावधे ॥ कामोजे रूमद्रे वलचति॥ १४६॥

(1) याणि is the variant in A. याणि is the variant in B.
(2) श्यानान् प्रवीचाह is the incorrect variant in A and B.
(3) A and B read ते सृगु.
(4) नेपाले कामरूपे च, a reading in A and B.
(5) वज्ञानं मदनेन्द्रें, a variant in A and B.
(6) एतान्युदितस्थानानू, an incorrect variant in A.
(7) A and B read सप्तगनि, which is incorrect.
(8) A and B read याणि.
(9) A and B read कुम्भद्रे, which is incorrect.
एतान्युभयो: ख्यानानि¹ रजःख्यानं च² उच्चति।
जासलं वज्ञलिं नागं नेपालिं च सदैव हि ॥ १४७ ॥
केदारिः कर्षिकाशे स वाम्बकी तिपुरे तथा।
एतत्ख्यानानि दियानि³ गोघायन्यानि
तावः हृ ॥ १४८ ॥
 लोहाद्रि⁴ लोहकत्कस्म गयाद्रि⁵ गोतमाद्रिकिः⁶।
विवास्माणे⁷ हि सर्वेच नलाद्रि⁸ निष्कलिपि वा
॥ १४८ ॥

(1) एति उभयो: ख्यानात्, a reading in A. एति उभयो:
ख्यानात्, a reading in B.

(2) A and B read रजस्यमानि।

(3) A and B read ख्यानकान् दियानु।

(4) ख्यान गोघ्या तितिति ह, a variant in A and B, which is senseless.

(5) A and B read लोहाद्रि, which is incorrect.

(6) Do. Do. गयाद्रि, Do.

(7) Do. Do. गोवतमाद्रिकिः, Do.

(8) Do. Do. विवास्माणे, Do.

(9) Do. Do. नलाद्रि, Do.
(1) A reads चिमले.

(2) लोहाकगालिवाहने, a variant in A and B, which is incorrect.

(3) A reads हाटके।

(4) किचित् is the reading in A and B, which is incorrect.

(5) A reads न। B reads न।

(6) A and B read लाभते, which is not correct.

(7) Do. Do. यंग्योष्पकर्त्, Do.

(8) Do. Do. लाभते, Do.
 अन्यथा नैव लभ्या तु विना मन्केण सिध्यति।

तम्मातवे प्रयोजन निषेधं मानसं शुभम् || १५४ ||

शुभं समलं चैव मानसं मर्यादा भवित्।

तम्मातु चतुराणारः मर्यादा शुभसमानम् || १५४ ||

जायते च क्रिया मिहा छातकी भवति मर्यादा।

सन्दर्भिः प्रजायित मर्यादक्षमाणि माधवेत् || १५४-५५

भ्रेणेन्द्र प्रकारणं उत्तरं हङ्क की क्रिया।

मर्यादायंकरणे नृणं चतुर्गण्यायणप्रदा || १५५ ||

महारावं उवाच।

प्रोक्तामुपट्के चैव खङ्गकाच्यैयकेन च।

रश्याज्ञाकरणं अन्यों। मुभ्रं छागर्वकामक्म || ५ ||

(1) A and B read नभ्यं, which is not correct.
(2) A and B read तम्मातन, which is not correct.
(3) A reads चतुराणारि, which is unintelligible.
(4) A reads क्रेष्टंग्रि। B reads चन्दरग्रि।
खपेरांक्ये पुटे चैव चारश्चोत्पलकेन च।
धारीं विनास्ति (? )गति च ज्वलितं चढ़ैमर्दिगे। ॥ १०॥
एवानुक्रमम्तो योगे पुटमिकं च जायते।
चतुरंशिन जासलं सुवर्णादापयित् सुधी: ॥ ११॥
प्रति संपुटपुटे चैव उदधयित् कुर्ष्टखपरे।
स्वाष्ट्टीत: सबुज्वले लेपमुनारयित: ॥ १२॥
पुनः: प्रदातवः पुन: चारान् प्रदापयित्।
पुनरेव घोटनं देयं सादरं पुनरेव हि ॥ १३॥
अननेव प्रकारिण: तुष्यांशमंसुपेन हि।
सुवर्णसंयुतं तत्स: ॥ १४॥
गालयित् चारसंयुतम् ॥ १४॥
ज्वलिति तौलयलयेव तिलां च संपुटं प्रति।
नमोभूतं ृ च रक्षियं संस्कारः: शुध्य साम्प्रतम्भ ॥ १५॥

(1) A and B read ज्वितिर्ह्रैरंगेमा।
(2) सबुज्वले is the reading in A and B, which is not accurate.
(3) A and B read लेपमुनारयित् तत्:, which is incorrect.
(4) A and B read पुनः: प्रदातवः, which is not correct.
(5) A and B read तः, which is incorrect.
एतत्क्रममणिैव सुवर्णः मनुसंचयः
तदृश्च शोषिष्मापति महत्ततः प्रजायति || १६ ||
आरत्सं पौत्रसंयुक्तं जायते हाटकं महत्
हाटकं मत्स्यं चैव न च हीनेन योजयेत् || १७ ||
कलागुण्गते विद्विद्धायते उत्तमे नरेः
हीनेव प्रकारेण मात्रादिगुणं द्रापयेत् || १८ ||
कलाच्यौ मितिः विद्विद्धपिता विद्विद्धियति
निद्धेषं जायते दिव्यं द्रव्यसंपत्तिदायकम् || १८ ||

पार्वेत्तुवाचः

अधिकेन कति तथा श्रीण्यानि सुगीतभनि
जायते कोषाणं दैव संयोगिः अधिहे सति || २० ||

(1) A and B read सुवर्णानु, which is not correct.
(2) A and B read हाटके मस्यके चैव.
(3) उत्तमे नरः, a variant in A and B.
(4) A and B have कलात्सकः.
(5) A and B have ते च, which is incorrect.
महादेव उवाच।

श्रीण्यानि च संयोगिभवशः उस्ति1 निधियः।
हिगुग2श्रीण्यानिन कच्चकं जायतेशुभम्3 \| 21 \|
विधसंगं सुधनार्थी तरिशांशि तिक्पलोपमम।
अतिरिक्तकातं तत्त्र जायति सगुरं महत्। \| 22 \|
गायःयेद्यवादपूवेषः कायेद्रसस्मांगकि।
समांशि गन्धर्कं दैवं सुदं पीतकं रागकम्। \| 23 \|
चयतुर्वांगकं तालं द्रापयेद्रस्मोदितम।
तद्रज्ञ सादरं दैवं महंयतं कन्यकारसि। \| 24 \|
यामचन्त्रमामद्धि5 क्रायाशुष्कमगड्जि रसि।
अतिशुल्लेत्रे सब्र्ह्म चयवा लोहसंभवि। \| 25 \|

(1) A and B read भंगदा चक्षु, which is incorrect.
(2) Do. हिगुगः.
(3) Do. शुभम्, which appears to be incorrect.
(4) Do. पीवत्, which is senseless.
(5) यामचन्त्रमामद्धि, an incomplete variant in A and B.
मद्रयंद्यमपूव्वेश क्रायायायमिति कार्येत्।
काचुक्त्ये प्रदातवयं वन्नमालुकादयं।

नखसंम्यामिति यामे पाचयोद्रसं शोभन्।
स्वाज्जगोति तु संजाति पुनः खक्षे निधायपेत्।

रमेनान्नन ग्रामधु क्रायायमिति कार्येत्।
उक्खामि सैं दसि पुनः शोष्यं प्रदातपेत्।

उक्खामि द्राप्यलेख पुनः संख्यारसार्वचेत।
मंखारेन चिविधि जाति चन्द्रपूव्वं क्षमादिति।

जायति रसराजोऽसि मवबसामवहङ्वत।
मंत्रेत्तलस्तुतलादिकृतिविविवेगवान्।

जायति प्रवचनं बुधि: चिदिन्त सेवतं यदि।
माहीविदिकमेश्विन दिने मासफलं सदा।

(1) प्रदातवया, a reading in A and B.
(2) चलुमा, a reading in A and B.
(3) रमी is the variant in A and B.
(4) शोष्य is the incorrect reading in A and B.
(5) A and B read संख्यापिति, which is grammatically incorrect.
(1) कैन कामेश, an incorrect variant in A and B.

(2) जासले is the reading in A and B, which is not correct.

(3) A and B read निक्षेत.
निष्प्रेर्ण धातुं द्रावं स्वावचूर्णं दालयेत्।
यदं च ख्वितं निद्रं तल्कां दापितं सुधीं। || 82 ||
उपरि संपुर्ण देयं समुद्रकुकुटे पुटे!।
स्वाजीगीतं समुद्रकु र्त्च जायते निष्प्रेर्णं महत्। || 83 ||
जामले सोमलं देयम् उक्तभागन्त्व साम्प्रतम्।
चूणिन्तर्गतं कला उत्त्वलं जायते महत्। || 84 ||
नदिवं जामलं चेव दिव्यम् उत्त्वलं सदा।
रूपार्ड मेलयलेव जायते गुप्तं गुप्ता। || 85 ||
चनिनेव प्रकारणं धनं किन्निच जायते।
धनं चेव तु संजाते कारयेंदूर्वजा। क्रिया: || 86 ||

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आनीव गोभमा विद्या रसगंधकजा सदा।
आतिमोभाग्यदासा मात्र च साधकी सुखदायिका। || 87 ||

(1) समुद्र कुकुटे पटे, a variant in A and B, which seems to be incorrect.
(2) उक्तभागन्त्र, a variant in A and B.
(3) A and B read म प्रत्र, which is not correct.
(4) Do. न, Do.
एताद्यं च जास्वं श्रोधितं गवर्त्तेन च।
धान्यधौतिन ताम्बोण पुज्ञितः सुभंगं सदा॥ ६३॥
पुज्ञितं जायने दिखं शुल्कपीयं शुभोदितम्।
निन्देन्ते जायने च तत्र हीनहारकम्प्रतिभम्॥ ६४॥
लघुता जायने तथां किष्टिकायों गुरुता सदा।
जायते गुरुता दिखा पुज्ञिते हार्तक्केन च॥ ७०॥

२८. गण्यस्वलादुद्धुताः श्रीका:।

पार्वतीसुबाच।
पूज्यमुकं लघा नाथ धनि सिद्धिसु जायने।
लघुत्रकस्तं धान्त: २ वद्यं किं तत्र सुभं॥ ४२॥

महादृढः उवाच।
ऋया चरमिन: सुभा तेषां द्रव्यसिद्धिविविधायिनि।
शुष्क यवनं तां भद्रे क्रियां रंगीति नागजाम्॥ ४४॥

(1) A and B read पुज्ञित।
(2) A and B read धले, which is incorrect.
(3) A reads दच्. B reads दच्.
हानिकाल् पारंदे दियम् अधजज्ञविपातितम्।

चालनयेद्यायपूर्णेन खण्डे पिरं तु कार्येत्। ॥ ४५ ॥

तैलिनानिन श्रामधी भावना चण्द्रावतः।

निसैं धर्मः यस्य अनिन्द्र द्याप्रूप्विचलम्। ॥ ४६ ॥

उत्तरेद्यायमयुगमेन खािङ्गीतं समुदायत।

पुनः समाननागिन पूर्भवत् चालनेद् सुभ्रि:। ॥ ४७ ॥

पुनर्येव ठठाद्रमो उक्यामिन सिद्धाति।

गमे दिनारः चेव होनिमोमार्मोत्तमः। ॥ ४८ ॥

नौसिके रत्किकायुगम दारिते वर्णपञ्चकम्।

अनेनेव प्रकारिण जायलि योडङ्ग कला। ॥ ४८ ॥

द्र्यायविकारं तव जायनि नाव संग्राहः।

पुनर्येव क्रिया सम्या पारदे नागचारिणी। ॥ ५० ॥

हिगुणा चारिते तत्त जायनि चन्द्रिका शुभा।

आभासिनि गिरिविवीवा जायनि नाव संग्राहः। ॥ ५१ ॥

(1) दीनिमोत्तमः: an incomplete variant in A.

(2) पची: is the reading in A and B, which is in correct.

(3) त च is the incorrect reading in A and B.
(1) A and B read च, which is incorrect.
(2) A and B have ताः, which is incomplete.
(3) A and B have ना, which is not correct.
(4) A and B have विधिमत्तम, which is grammatically incorrect.
(5) A and B have खान् instead of च, which is a tautology.
वद वैभवद्वारां । वञ्जु विन्दानदायकम् ।
चाला सिद्धिमवाप्रोति गुणः। सोख्यकः च यम्॥१॥

महादेव उवाच ।

चानयेच्छ्रोभम् वञ्जु विन्दाचलसमुङ्गम् ।
गालगिर्यलपूर्वेण ठालेत् कुष्पाण्डे रसे॥ ५॥
विषमकाले ततः जायते निश्चीलं शुभम् ।
तदुभान् कार्येत् पवान् ॥ शुचिविद्यान् यथोदितान्
॥ ५॥

रचयेद्वर्पुर्वेण चानयेद्वर्तिकं यथः।
भावेत् शुभिकार्णेः उज्ज्वलं विन्दुग्रोवितम्॥ ६॥

(1) दशा च, a variant in A and B.
(2) दायकः, a variant in A and B.
(3) ते च is the incorrect variant in A and B.
(4) A and B read तदेवभान्, which is incorrect. The word पृष्ठ is used here in the masculine gender.
(5) B reads वद्रिः.
(1) यात्राप्रथा लचेत, a variant, which seems to be incorrect.

(2) मुश्क्रम, a variant in A and B.

(3) सङ्गशीत, a variant in A and B.

(4) ये केलित मुक्ति न च, an incorrect variant in A and B.

(5) महेंद्रायायेभ, a variant in A and B, which is unintelligible.

(6) A and B read उज्ज्वल कठिन, which is incorrect.
अनिश्चित तब जायते नात्र संबंधः।
मद्वेक्षकेनकरं श्रेष्ठ नानाभागेन पुत्रितम्। ॥ ६६ ॥
भोगभागसमायुक्तं वज्रं च गुणसंयुतम्।

लक्षणादीं धनार्थ च संयोगे साधिवेदः मद्त। ॥ ६७॥
जायते सुभागं तद्भ संसारे गोभयं भवेत्।

चन्द्रेन्व प्रकारिणां जायन्ते धनसम्पदाः। ॥ ६८॥
पाब्यंपयावः।

चप्प शुद्धतः जाते का क्रिया वद मे विशेषः।

लक्षणादिः धनसंपत्तः क्रिया या च प्रयक्त प्रयक्त। ॥ ६८॥
महादेव उवाच।

लक्षणः च नारोणां भिक्षा भिक्षेन वचनः।

चन्द्रेका धनदा विद्या जायते सुभागा महत्। ॥ ७०॥
चतीव गोभया सा च गुणसमार्थंदायिका।

येन विद्याांमार्गेन साधकं धनसूत्तमम्। ॥ ७१॥

(1) B reads लक्षणादी।
(2) धनार्थ is omitted in B.
(3) जायते धनसंपदा, a variant in A and B.
(4) A and B read लक्षणेः।
जायते नैव सन्तद्धि धनसामय्येकां महत्।
उतिसीभाग्यसम्पत्तिजायते नात्र संख्य।।७२॥
आनयेत् शुद्धं तं बद्धं गालयेत् ठहर्येन। सह।
पित्याकसुरसे दिथे ठालयेदूयलपूर्वंकम्।।७१॥
समदालखति शुद्धं कठिनं रजतोपमम्।
जायते नैव सन्तद्धि पुनःति रजति गुम्भं।।७४॥
रजतं जायते शुद्धं संभारं कारयेत् सुवी।।
अनेशेषेव विधिदिधियो दिव्यरजतसंबव।।७५॥
आनयेत् शोधितं बलं तद्भेदं पारस्ते क्लेत्।
निधायः शोभनि खल्ले सुर्यांशि दापयेत्तत्।।७६॥
महतेि कन्यकावीथि यामं धोधश यन्त।।
हंसपदा रसे दिथे तलान्म महतेयत् सुधी।।७७॥
समानाश्वरसेवन महतेदूयलपूर्वकम्।।
कामायुस्कि च। संजाति शोभान्ति।।बालुके पचेत्।।७८॥

(1) दिधिदिधि रजतसंबव, a variant in A and B.
(2) A and B read निधाया or निधाया.
(3) ऋतःबृजः, a variant in A and B.
(4) कामायुक्त, a variant in A and B.
(5) A reads शोभान्ति। B reads सोभान्ति।
अनेनेव प्रकारिष्ण क्रमादिन्न प्रदापयित्।
प्रहराष्ट्रकेस्तकेविवारं हरठ दापयित्॥ ७८॥
जायते च रसं दियं भच्छि च सुधासमम्।
नारीणां दापायेदूयबे संयोगे नागकेसरे॥ ८०॥
तदायः सूचु ३ गोधुमा: सहेवं तोलकाभिम्।
अतिसौख्यकरं तब ३ रतिमात्रागिन वदेत॥ ८१॥
पुमिः प्रजगुशोपिनि यथा च गंधकी गति।
नराणेऽभच्छि याती जातिचयसमनित।॥ ८२॥
अनेनेव प्रकारिष्ण क्रमेण वदेयेद्वसम्।
जायते ससा सिद्धि: नात कायाम विचारण।॥ ८३॥
सुकप सुधाकरं वलं गालयेदूयबपूर्वकम्।
तजलं गोधुमेव गदांशे रसरापिते॥ ८४॥
रजतं जायते गुढः कलाहानिंशतः सुतम्।
अन्यं वै मेलयेव विक्रते गुवतं महत्॥ ८५॥

(1) A reads नागकेसरे।
(2) B reads चिन्ह।
(3) A and B read छ, which is incorrect.
(1) A and B read रघु, which is incorrect.

(2) मिश्र नामविधानकं, an incorrect variant in A and B.
हानिकालिकां दिशां पोतगम्यकसभवम् ।

दाशिन्हेक्षोभनि ख़ने भक्तचेरिण भावयेत् ॥ ४७ ॥

महेष्वरस्तपुर्वेण याममात्रमखल्लिहितम्।

तेनैव धातुयोगिन सुवर्णः सुलभता व्रजेत् ॥ ५० ॥

एताहेव परा धातुवर्णस्ते धातुर्मूल्यम्।

सुलभा शुभदा प्रोक्ता मम साविष्यगा सदा ॥ ५१ ॥

पार्श्वमुवाच ।

ये गुणा नागजे तामै वद विवश्य वस्मभ ।

प्रयोजनवलु श्रव्यं चतुर्गैव चोदितम् ॥ ५५ ॥

महादेव उवाच ।

ब्रनिका गुणा२ नारेशु पूव्वेमुका हिः पारदे ।

किंचित्त् शेषतरा ये च गृहु दैवि प्रयजत: ॥ ५६ ॥

(1) A reads याममात्रमखल्लिहितः. B reads याममात्रे मखल्लिहितः.
(2) A and B read सुवर्णः.
(3) ब्रनिकान् गुणाः, a variant in A and B.
(4) सुकानि पारदे, an incorrect variant in A and B.
नागस्थ सम्बन्ध तान्त्र सभ्य मेलापानं कम्।
विभागे तु कार्तिक नवं । जायते कुम्भिका शुभा।
नवधे गालायेनां चिवारं यज्ञपूर्वकम्।
जायते रिश्यलं स्वर्गं उदिनं चौबं कुम्भिके।
विभागे सामग्रतं दृष्टं अश्रमं जायते शुभम्।
उष्णकायेष्करायते नायका वचनं सम।
समातु साध्यते दिवं भूतागोङजवं शुभम्।
अनेका साध्येष्वर्या रसमाम्येदायिका।

Colophon in A

दति श्रीसुद्रयामले उमामहेश्वरसंवादं सुवर्णकल्पे
सुवर्णप्रशंसा नामाध्यायः।

Colophon in B

दति श्रीसुद्रयामले उमामहेश्वरसंवादं धातुमजज्ञां
सुवर्णप्रशंसा समासा।

(1) A and B read ने च, which is incorrect.
Extracts from
SUVARNATANTRA
or
SVARNATANTRA.

A = MS. from Benares.
B = MS. from Ramnákháli's matha, Dacca.

The name of this MS. is सुवर्णतन्त्रम्.
The name of this MS. is स्वर्णतन्त्रम्.
पूर्वे तु कथितं देव रत्नतन्त्रं लया समं \\
गुटिका: कथिता: पूर्वे सहस्रहितं शिव II २ II \\
पारदा: कथिता: पूर्वे पत्रशतं मृतिरुपः \\
धातूनामस्त कल्याणु पूर्वीभव प्रकाशितो \\
धातुरागाध्वकल्याणु पूर्वीभव प्रकाशितं \\
रत्नानं करणं तन्त्रं पूर्वीभव प्रकाशितम् II ४ II \\
किन्तु स्वर्णोक्तन्त्रं तु न महा कथितं प्रभो \\
कश्यपेन महेश्वराभ्यदितोरद्वीप महेश्वर \\
भूमिदानं मया दत्तम् कृष्णे कश्यपाय वें \\
कश्यपेन मयि प्रोत्तं भूमिभागं लवजः प्रभो II ५ II \\
स्थानाधि तु महेश्वर राजाविधि: प्रार्थितो मया \\
वाणमात्रं स्थलं तेन दत्तं समं महेश्वर II ६ II \\
स्थानं प्रासं महेश्वरं भ्रमणं समं नासितं वें \\
भ्रमणं दृष्टि में देव यदि पुरोक्षसिमि शब्द: \\
ईश्वर उवाच \\
श्रृणु राम प्रवच्यामि रहस्यातितरहस्यकम् \\
स्वर्णसत्वाभिरं तन्त्रं कल्युपिण्यं कथयते II १० II
तत्वायं स्वर्णतन्त्रय कलं श्रृंगु सुपुष्कक ।
तैलकृत्याभिधि: कन्दः सिद्धकन्दः प्रकृतितितः ॥ ११॥
कन्दः कमलवत्तमः पत्राणि कल्वचिलाः ।
तथैव तु महत्यतं तैलं स्वर्णि सम्बंदा ॥ १२॥
जलसध्यं सदा पुत्र लाउँ एव प्रतिष्ठति ।
विषकृती विष्यातो विष्याः कायनामपनः ॥ १३॥
तैलस्वाति महाकन्दः परित्सिलवल्लम् ।
दशहस्तमिति देशे सरति तैलवल्लम् ॥ १४॥
महाविषधरः पुत्र तद्धो वस्ति स्रुवम् ।
कन्दाधः कन्द्धचायायां नान्यथ गच्छति प्रिय ॥ १५॥
तत्त्वोचाविधानाम् कन्दे सूचिः प्रवेगतेऽि ।
सूचीद्रावः चशात् पुत्र तलकं त्यु समाहितः ॥ १६॥
तलकं तु समादद्य शुद्धसूतं खलिच्छिद्धा ।
सूचयां निचिपितः तन्तु तसैं तव निचिपितः ॥ १७॥
दीर्घाम्बि तु महाराम वशाङ्गारिः द्रापयेऽि ।
तत्वचावमूतिमयाति लचविधी भवेत् सूतः ॥ १८॥
तत: प्रभचयेऽद्राम चुबिद्राहरकी ध्रुवम् ।
तानं शुद्ध समानीय तत्त्वादेन खलिलेन सूतः ॥ १९॥
समधा प्रवहं राम लेवं विण्डिण्डं ध्रुवं
| हरि तालो मतिमिति निर्धमो जायति ध्रुवम् || २० ||
| भगो पुत्र ततो द्वान्तिरधमो जायति सुत।
| नतालं यात्रधातीतु द्वायादावे कति मति || २१ ||
| सर्ववेदां भवेदब्ध शतविचु भवेत् सुत।
| नतेलं तु समधां तामङ्कावे विनिविपित || २२ ||
| तत्तच्छादमणिवेदः खात् दिब्यं भवति काच्छनम्।
| वद्य कांशे यदा द्वायाचतरा रीघं भवेत् सुत || २३ ||
| नामे लोके तथा रीघं तारे खपरसूत्तक।
| तत्तच्छात् विध्वंसारात्ति दिब्यं भवति काच्छनम्॥ २४॥

* * * * *

शंख्रावस्थ भेदान् हि तत्काल्यान् चेव ताम्रांतम।
| लोह्रावस्थास्थ तामङ्क्रावस्थ कंतियकः || १ ||
| शंख्रावस्वतीयः खात् हल्लालश् (?) चतुर्थकः।
| द्वायावः पञ्चमः खात् भवेदि तु मध्यमः || २ ||

* The above 24 Slokas are not found in MS. A.
(1) The above 7 hemistichs are not found in A.

(2) A reads वटायाभि. B reads इलामाघ्री. Both the readings seem to be incorrect; since B has इलामाघ्री चतुर्वेदः in the 2nd Sloka.

(3) B reads पुनःधार्म, which is not correct.
स सूती मुततामितिै नाव काय्या विचारणा।
प्रख्यातपुष्यं तं सूतं दीप्त काश्चनं त्रिजीत् || ८ ||
तं सूतं भच्चयद्यो द्वि सोभमरलस्मवाप्रयात्।
तस्य मूलपुरोपिषु गुल्लं भ्वति काश्चनम् || १० ||
तामद्रावप्रयोगं वै युथं यहि न साम्यतम्।
तद्रसं तु समाद्राय श्रुवतामरे विनिचिपितं || ११ ||
तत्ताम् स्थर्णं याति भौरंव्यः प्रसादं: || १२ ||

Colophon in A—इति श्रीमुरणंतन्त्रे हर्पार्वेनसंवादे
दुम्शार्कल्प: हितीयः।

Colophon in B—इति स्नर्णतन्त्रे लोहद्रावादिपछ
फलकल्पो हितीयः।

(1) B has सा मूच्य मृतिमाफ्रोती।
(2) A reads स गच्चदमरल्लतां, which is incorrect.
(3) B reads गुल्लः।
(4) गुल्लपवें निचिपितं, a variant in B.
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