# INDIC VISIONS

"*Indic Visions* is V. V. Raman's magnum opus. In ten succinct chapters, he traces the development of Indian religion and philosophy from its distant origins to its most recent evolutions in an age of science. Comprehensive, scholarly, and eminently readable, this work explores the great questions of humankind: the origins of life and the cosmos, the mind-body relation, the quest for knowledge and liberation, and the nature of the Ultimate. The more I immersed myself in these pages, the more my respect grows for the unparalleled achievements of Indian civilization—past and present—and the incredible author who has brought this altogether in this outstanding volume."

—Philip Clayton, Claremont School of Theology

"Steeped in science and soaked in spirituality, V. V. Raman blends vast scholarship and deep insights into the rich heritage of India with the great promise of modern science. This book gives a general architecture for constructing a global culture. Timely, stimulating, scintillating . . . *Indic Visions* should interest both scholars and students of science and culture in the East and the West."

—Ramakrishna Rao, Indian Council of Philosophical Research, New Delhi

"In his usual lucid style, V. V. Raman presents a variety of Indic visions . . . A must-read book for students, scholars, and enthusiasts who are interested not just in Indian culture and philosophy, but who are willing to contribute to the current intercultural and interdisciplinary discussions."

—Sangeetha Menon, National Institute of Advanced Studies, Bangalore, India.

"A truly remarkable and much-needed book. Clear, concise, and highly informative."

—Loyal Rue, Luther College, Iowa

"*Indic Visions* is a superb synthesis. After reading it, one will be compelled to discard the uncritically repeated textbook narratives on Indian religion and science. The book will be invaluable to laypersons and scholars alike."

—Subhash Kak, Oklahoma State University

"V. V. Raman's *Indic Vision* offers a fascinating panoramic view of a vast terrain stretched across space and time . . . With its lucid literary style and easy flow of language, the book makes for an enjoyable yet profitable experience. It is highly recommended to both beginners and experts."

—C. V. Vishveshwara, Indian Institute of Astrophysics, Bangalore

“In approaching India today and its many contributions to our emerging global civilization, we need not be blind men and women or partial perceivers of a greater truth. We have in the person of V. V. Raman, a king who grasps the whole elephant. Raman is a gifted and gracious guide, who helps us understand the whole fabric and see the rich details of Indic civilization in this age of universal science. In so doing, he offers us also a way out of dangerous culture wars and clashing civilizations . . . And no matter where you were born, what languages you speak, what beliefs you profess, what disciplines you practice, India is your civilization too. It is time you got to know her better.”

—William Grassie, Metanexus Institute

# Indic Visions

## In an Age of Science

Varadaraja V. Raman

Metanexus

Library of Congress Control Number: 2011909488

ISBN: Hardcover 978-1-4628-8364-6
Softcover 978-1-4628-8363-9
Ebook 978-1-4628-8365-3



This book was printed in the United States of America.

**Published by:**
Metanexus Institute
New York, NY
www.metanexus.net

Printing and distribution by Xlibris.com
98505

आ नो भद्राः करतवो कष्यन्तु विश्वतो.अदब्धासो अपरीतास उद्भिदः।

May auspicious thoughts come to us from everywhere.

—Rig Veda I.89.1

# Contents

## A Foreword

BY WILLIAM GRASSIE

The Indian subcontinent is a cradle of human civilization with a rich history stretching back some five thousand years. Today it is home to a quarter of the world's population. While the boundaries and identities of the modern states of India, Pakistan, Bangladesh, Nepal, Bhutan, Sri Lanka, and the Maldives are recent inventions, the history, cultures, languages, and religions of South Asia are a single tapestry woven from many colored threads over the long millennia of cultural evolution.

South Asia is home to four great religious traditions—Hinduism, Buddhism, Sikhism, and Jainism—but it also has the largest population of Muslims in the world. South Asia is home to many Christians who trace their lineage back to the apostle Thomas, who is said to have settled in Kerala in 52 CE. A scene of epic wars and foreign invasions, the conquerors and colonialists were invariably themselves won over and were as much changed by India as they themselves changed India's history.

In turn, missionaries and traders from the Indian subcontinent—Hindu, Buddhist, and Muslim—spread their religions and cultures throughout Southeast and East Asia, leaving a profound mark on the cultures of Burma, Malaysia, Indonesia, Thailand, Cambodia, Vietnam, Tibet, China, Korea, Japan, and the Philippines.

Today, South Asia is a nexus in a global civilization, its children and grandchildren having traveled to every corner of the world, frequently joining the educated elites abroad and making significant contributions to arts and letters, science and industry, politics and finance. The continued story of Indian civilization is now a global and cosmopolitan enterprise and can no longer be contained in geographical boundaries in one corner of the world.

The history and complexity of this cultural tapestry is daunting to the outsider unfamiliar with the geography, languages, and idiosyncrasies of the region. And even those raised and schooled in South Asia generally only grasp a small portion of the whole fabric. To this we must add the recent exponential growth in scientific knowledge

and the new understandings that this science and history bring to our different regional and religious narratives. All of this is also accompanied by new technologies and new values that threaten to undermine traditional cultures. India, Pakistan, and the other countries of the subcontinent are in the throes of fundamentalist reactions to modernity and globalization, much as we find throughout the world today in other settings and other idioms.

Understanding Indian civilization today brings to mind the ancient story of the blind men and the elephant—a fable whose origins are uncertain and which is appropriately claimed by Hindus, Sufis, Buddhists, and Jains as their own. Each blind man perceives only a piece of the elephant, and thus an argument ensues. As put to verse by John Godfrey Saxe, the story ends:

*And so these men of Indostan*
*Disputed loud and long,*
*Each in his own opinion*
*Exceeding stiff and strong,*
*Though each was partly in the right,*
*And all were in the wrong!*

The story typically involves a king, a seer who stands outside the debate, who provides perspective and understanding, and then pronounces the moral of the story:

*So oft in theologic wars,*
*The disputants, I ween,*
*Rail on in utter ignorance*
*Of what each other mean,*
*And prate about an Elephant*
*Not one of them has seen!*

Fortunately in approaching India today and its many contributions to our emerging global civilization, we need not be blind men and women or partial perceivers of a greater truth. We have, in the person of Varadaraja V. Raman, a king who grasps the whole elephant. In this book, Raman is a gifted and gracious guide, who helps us understand the whole fabric and see the rich details of Indic civilization in this age of universal science. In so doing, he offers us also a way out of dangerous culture wars and clashing civilizations. A wiser and more peaceful man I have never met.

I got to know V. V. Raman first at the annual conferences of the Institute on Religion in an Age of Science. He became a prolific contributor to Metanexus's online journal and a beloved speaker at our conferences. In 2004, V. V. was the Metanexus senior fellow and gave a series of six lectures at the University of Pennsylvania, which

evolved into this book. More significantly, V. V. and I travelled together in 2005 on a grueling and exhilarating three-week speaking tour of India—Bombay, Pune, Calcutta, Hyderabad, Visakhapatnam, Madras, and Bangalore. A better travel companion and guide to India, I cannot imagine.

Varadaraja V. Raman is a native son of India, now resettled in the United States. Born in 1932 to Tamil parents living in Calcutta, he bridges the divide between southern and northern India, as well as East and West. His native tongue is not one, but four, having grown up speaking Tamil, Bengali, Hindi, and English. In grade school, he learned to recite Vedic hymns in Sanskrit and the "Paternoster" in Latin. As a teenager, he witnessed the independence and tumultuous partition of India and Pakistan.

Hinduism, Islam, and Christianity were all part of the rich cultural milieu in which the young Raman was raised, but it was in mathematics and physics that he especially excelled. After receiving his degrees from Calcutta University in 1954, he completed doctoral work in theoretical physics at the University of Paris under Louis de Broglie, where he also learned French and German. His doctoral work was on the mathematical underpinnings of quantum mechanics.

Dr. Raman has taught in a number of institutions, including the Saha Institute for Nuclear Physics in Calcutta and the Universite d'Alger in Algiers. He worked with UNESCO for a few years and eventually settled at the Rochester Institute of Technology, where he is now an emeritus professor of physics and humanities.

The position at Rochester allowed him also to pursue a growing interest in the history and philosophy of science. He has published scholarly papers on the history of thermodynamics, the origins of physical chemistry, the genesis of the Schrödinger equation, the early reactions to Einstein's theory of relativity, the impact of the Copernican revolution, and on the Euler-D'Alembert controversy in eighteenth century mathematical physics. He has also written on such topics as the history of the theory of gravitation, of the energy conservation principle, and of acoustics. Raman has also devoted several years to the study and elucidation of Hindu culture and religion. He is an associate editor in the *Encyclopedia of Hinduism*. The manuscript you hold in your hand is his tenth book.

V. V. Raman is the recipient of numerous awards and honors, including the Outstanding Educator Award from the American Association of Higher Education and the Raja Rao award from Jawaharlal Nehru University. He has served on numerous boards, including that of the Metanexus Institute and the International Society for Science and Religion.

In this book, *Indic Visions*, you have an extraordinary guidebook to the history, culture, religions, and sciences of India from a guru like no other. Your guide—V. V. Raman—is a rigorous scientist and thoughtful humanist, conversant in multiple languages and disciplines, a bridge builder and peacemaker, a whimsical wordsmith and an activist for peace and compassion, a loving husband and father, and a man I am happy to call my teacher and friend. And no matter where you were born,

what languages you speak, what beliefs you profess, what disciplines you practice, India is your civilization too. It is time you got to know her better and take pride in your neighbor and yourself as we seek together to craft a safer and healthier world at an extraordinary moment in the cultural evolution of our species and the natural history of our planet.

William Grassie
Metanexus Institute
New York, New York

## Reflections in an Age of Science: A Foreword

BY E. C. G. SUDARSHAN

When it comes to discussing Indian civilization and Indian culture, there are two extreme views. One group takes the view that it is based on Sanskrit and Tamil, both in the realm of science as well as in the art of living. The first group traces the origins of science and of the spirit to the ancient tradition: they would cite the Upanishads, Yoga Sutra, and Pánini as the foundations. The second group treats the Vedas (including the Upanishads) as "pastoral poetry" and the accounts of advanced foundation in the Vedas as fanciful and insists that whatever is the Indian tradition in science is of relatively recent origin, maybe only two centuries old. Between these branches, Euphrates and Tigris, there lies the fertile delta, rich ground which recognizes ancient wisdom but does not trace all mathematics, science, and grammar as having origins in the earlier wisdom, instead insisting on new discoveries and insights. Both groups of scholars are of great interest to any student of history of the people of India.

Prof. V. V. Raman's book *Indic Visions in an Age of Science* carefully takes a middle view. While reference is made to modern theoretical physics, there is also a discussion of the three *guna* characterization of the human body. Mind and consciousness are taken to be clearly distinct, visions of Upanishads regarding the origin of the earth and the heavens are handled side by side. The view expressed in the Mandukya Upanishad and the Taittariya Upanishad may not have anything in common with the contemporary ideas of the origin of the solar system. The origin of the system of integers and the "place value scheme" are mentioned, but he is silent about the work of mathematicians like Nilakanta Somayaji, and Madhava is mentioned in passing. The complexity of Indian culture and tradition must involve Jaina cosmology. Jain monks even today take up the study of ancient manuscripts while staying in isolation in deep caves.

Raman navigates himself through these complications and presents a unified view in which illustrative statements are interleaved with a set of statements about the modern view, without losing track of the main purpose. Those people who know Raman's extensive scholarship and speaking style would find this book an interesting addition.

The book begins with a chapter on tradition, culture, and prehistory of the Indian subcontinent and their relation to the practices of the earliest society that we recognize. The distinct Dravidian culture is also related to the Harappan-Mohenjodaro inscriptions and seals. This is in contrast to the attempt of "scholars" to attribute everything non-European to the Middle East. Such a conclusion can be realized only by altering the dates of historical events. Along with this and partly to support it, there is the fable of the Aryan invasion. Raman makes several comments to point out the inappropriate assertions in the Indian prehistory. There are strong correspondences between Indic (Sanskrit), Middle European languages, and contemporary English.

There is a tendency of some modern Indian scholars to accept the preeminence of Western world view and chronology. Despite the accumulated account of ancient mathematics, many students are reluctant to be convinced by internal evidence of the originality of Indian mathematics.

In section III, titled "Origins and Ends," some of these themes are taken up. Here the theories of the ancient Indians with regard to matter, force, and cosmogony are considered.

In section 4 on theories of mind and consciousness, the distinction between these concepts are brought out. The question of bondage and liberation, the principle of "Tat" (that thou art) is illustrated.

Indian epistemology is the main topic in Vedic epistemology. It is in this context philosophic discussions like those in Yoga Vasistha and several Upanishads are to be taken. In the former, a curious Prince Rama raises many important questions of existence and the road to liberation. These questions, reminiscent of Prince Siddharta (before he became the Buddha), go to the fundamental notions of life. It is evocative of the young Buddha. The ultimate goal is to be liberated here and now. In the Upanishads similar questions are asked and answered.

Buddhist traditions are strongly reminiscent of the answers Prince Rama got from the sages Vasistha and Viswamitra. It is instructive to note that while Buddha does not discuss an afterlife or celestial beings, yet it is practiced in both traditions and are equally respected today.

Altogether this is a valuable and enjoyable book both for the casual reader as well as to students of Indian culture.

E. C. G. Sudarshan
University of Texas, Austin

## Preamble

This book grew out of a series of lectures I gave as the 2004 Metanexus Senior Fellow in Philadelphia. Dr. William Grassie, founder and director of Metanexus, has been urging me to write out the lectures as a full book. This is an all-too-brief survey of some aspects of Indic visions.

I discuss a variety of Indic visions in the chapters to follow—many of particular interest when science is approached as an intellectual and spiritual quest. I refer to Indic investigations in astronomy and mathematics, theories of cosmology, views on mind, consciousness, and epistemology. I mention episodes from the mythic lore which have interesting parallels with some of the wonders of modern science and technology. I reflect on some canonical works in the tradition. I also give brief sketches of some modern Indian scientists. These discussions are meant to give the reader a small taste of the enormous wealth of ideas and insights in Indic heritage from one perspective among several hundred million Hindus.

My own cultural background is that of a Tamil Hindu who grew up in Bengal. My attitudes were shaped by that tradition in the form it took during the first half of the twentieth century. My worldview has also been significantly molded by involvement with modern science and European philosophy and literature. I make no apology for the factors that have influenced me, not only because I have benefitted much from them but also because every writer carries baggage. With all that, as to how I consider myself, I resonate fully with a reflection by Ramana Maharishi:

> *naranilan curan iyakkan nánalan anatanan matru*
> *aracanum vanikan cúttiran allan narpiracári . . .*
>
> A man, a demigod, a dog, I am not;
> Nor a brahmin am I.
> A kshatriya, vaishya, shudra, I am not;
> Nor in one of the four stages am I.

Not a bachelor or householder,
Not a renunciant or forest-dweller.
I am none in any hierarchy.
Forms of our consciousness we all are.

Western thinkers sometimes adopt Hindu perspectives. In this book, a Hindu is viewing matters in a universalist and global framework.

Many books and websites richly expound and extol countless aspects of the Hindu world. Some of them claim the same kind of centrality and superiority for Hindu perspectives that Hegel claimed for German philosophy at one time and equally ardent exponents of other cultures do for their own. All this is good, but the goal here is to cherish and preserve some of the precious stones in the treasure chest of Indic heritage and to share these in the context of a new and changing world. I do not experience the fear that the gush of new ideas hacks at the sturdy roots of Indic culture with heartless rationality; rather I believe new ideas can only enrich that culture just as Indic visions enrich the world. Nor am I so intoxicated by the power and prestige of science that I relegate all ancient cultural worldviews to the archives of disposable history. But though I am concerned that many ancient visions, values, and worldviews are slowly losing their appeal, I see a resilience in Indic culture whose mantras and melas can outlive the glitz of neon lights and the glamour of night clubs inundating contemporary India. I am inclined to think that the true strength of Indic culture lies, not so much in the considerable material and scientific advances of modern India in recent decades, but in its breadth of visions on human awareness, depth of insights into the human condition, and richness in aesthetic expressions. These have remained unmoved but evolving over the ages. The capacity to transform without abandoning her deep-down roots is the secret for India's continued success at the most fundamental levels. Notwithstanding the sectarian exclusivism one encounters in Hindu society, at its heart the Hindu spirit is universal. As the philosopher-scholar Arvind Sharma expressed it so tersely in a recent book (*One Religion Too Many*), "If, as a Hindu, I inherit the Hindu religious tradition, then, do I not, as a human being, inherit the entire religious tradition of humanity?"

I have tried in these pages to recall what gave substance and richness over the ages to countless people in India. If appropriately remembered, respected, and interpreted, they can still serve a healthy purpose. This can be done without embracing every thought and belief that nurtured the past and blindly venerating everything that was said or written by the distant ancestors of humanity.

I am reflecting on the insights and variety of an extraordinarily complex tradition that is believed to be more than 3,500 years old. I have said nothing about the literary, poetical, musical, artistic, religious, and architectural richness of Indian culture. Nor have I said anything on the current political and social tensions plaguing the nation, because these I regard as passing phases, the birth-pangs of a new India that is trying to define herself for the new century. Volumes have been written about them also.

Inevitably, a book of this kind cannot be but incomplete in content, inadequate in scope, and subjective in treatment. However, it can inform those who know little about Indic visions and inspire them to delve even deeper.

Some of the passages in this book have appeared elsewhere in my articles and books.

Finally, like all authors who write on such matters, I am indebted to countless scholars and books and papers, many of whom are mentioned in the bibliographies of various chapters. In particular, I would like to thank the scholars who took the time to go through the raw manuscript, who made suggestions for changes, and who penned the brief comments that grace the back cover of this book. I would like to mention Professor E. C. G. Sudarshan explicitly for his foreword and Professors Subash Kak and Saraswathi Vishveshwara for giving me valuable pointers. Finally, I should mention Dr. William Grassie for his constant encouragement and unswerving support. Also, thanks to Marilu Raman, Erica Vinskie, Jonathan Camery-Hoggatt, and Gillian Grassie for their careful editing of the manuscript.

V. V. Raman
Ames, Iowa
January 2, 2011

# I. Deep Roots, Spreading Branches: History and Commentaries

> (India) has left indelible imprints on one fourth of the human race in the course of a long succession of centuries. She has the right to reclaim in universal history the rank that ignorance has refused her for a long time and to hold her place amongst the great nations summarizing and symbolizing the spirit of humanity.
>
> —Jawaharlal Nehru, *Discovery of India*

**Introduction**

In a translation of a collection of writings by ancient visitors to India, published in 1857 as *India in the Fifteenth Century: Being a Collection of Narratives of Voyages,* Richard Henry Major wrote: "Before the days when Alexander of Macedon sought to add to his triumphs the conquest of the Eastern world, India had been pronounced by Herodotus to be the wealthiest and most populous country on the face of the earth. The subsequent history of commerce has proved the correctness of his assertion."

By common consensus from ancient to modern times, India is among the major cultures and civilizations that have contributed most significantly to humanity's heritage. Indic civilization is as ancient as any, more ancient than many, and is remarkable in its uninterrupted continuity since misty millennia of unrecorded history. To this day, scholars are unable to trace the precise roots of Indic culture, except to note that cultures flourished in the ancient subcontinent, preceding the Vedic-Sanskritic and the Dravidian, which are the principal weaving threads in the fabric of current Indic civilization. The languages constituting the latter are Malayálam, Kannada, Tamil, and Telugu, each one with a rich literary and cultural tradition.

But in fairness and in the light of current awakening, it should be pointed out that when we speak of Indian culture, Hinduism, and the people of India in sweeping terms, we sometimes tend to ignore vast numbers of pristine people for whom India has been home for millennia as well. The constitution of India recognizes some 645

different tribes living in the Republic of India. They are generally referred to as *ádivásis* (original inhabitants), and they are sometimes referred to as *tribals*. The term *ádivási*, like aborigine, has acquired pejorative and political connotations in recent years. No matter how they are labeled, the fact remains that there are large numbers of people in India who are excluded from consideration as outside the mainstream. They correspond to the aborigines of Australia and the Amerindians of the Americas.

The *ádivásis* are both inside and outside of Hinduism. They have their sages and their saints. Perhaps even Lord Shiva of mainstream Hinduism has roots in tribal worship. It has been said that the great poet Valmiki, author of the immortal Ramayana, was a tribal, as was the saint Kannappanayanar of the Tamil tradition. And yet for far too long these people were excluded from mainstream Hindu society. The varna framework, also known as the caste system, which is endemic to all groups in India, did not include them either. They were *avarnas*: noncaste people. Yet they themselves followed some aspects of the *játi* (family lineage) division. As Koenraad Elst points out, "The Munda tribals not only practice tribal endogamy and commensality, but also observe a *játi* division within the tribe, buttressed by notions of social pollution, a mythological explanation and harsh punishments." Ignored or marginalized by the Hindu world for long centuries, many of them were lured to Islamic and Christian faiths with hopes of finding more respectful recognition. Now suddenly, many Hindus are claiming them to be their own. So Hindus, Christians, Buddhists, and Muslims are all eager to have these very people who had been marginalized for millennia. How diametrically history can reverse itself!

Whether in food or in costume, in marriage customs or in festivals, there are significant regional variations within India—let alone differences resulting from language and caste. These too change periodically. Not unlike Europe when Christendom reigned supreme, the people of India—even with their impressive linguistic and alimentary diversity—have long maintained a commonalty, bound together largely by their Sanskritic and Dravidian heritages. They are unified, as they have been for many centuries, in a multiethnic framework of religion and culture that should be the envy of the modern world. The categorization of the roots of Indic culture in these terms is resented by some, because it has the potential for dividing the Indian nation into cultural subdivisions. This is a valid concern. However, there are also divisions based on religions: it does not follow that we must argue that all the religions in India are derived from a single source. While it is important to foster cultural unity, this cannot and need not be achieved by insisting on historically questionable commonalty. In our own times, the English language and modern science are the major forces that bind the elite of the nation at the intellectual and discursive levels, while the people at large are held together in a political, cultural, and national fabric by a democratic and secular system of government.

A variety of complex peoples inhabit India. They range from simple folks who still guard their one-with-nature ways to an array of sophisticated people who contribute to international debates and to modern science and technology. There are astrologers galore in India but also astrophysicists; there are mantra-chanting medicine men but also

world-class heart surgeons; there are preachers who persist in the five-element theory of matter but also nuclear physicists. Notwithstanding their lingering caste consciousness and obsession with sectarian purity in matters of matrimony, present-day Hindus are products of healthy mixtures that have resulted from waves upon waves of immigrants and invading hordes. Aside from their indigenous lineage, today's Indians include descendants from ancient Africans, Greeks, Mongols, Portuguese, Persians, Afghans, and more. It is no longer possible to separate them out into indigenous tribes and people from alien seeds.

The tropical land of India has witnessed countless triumphs and tribulations. It has had more than its share of famines, frustrations, wars, and battles. The resilience of Indic culture to alien intrusions, whether of the pillaging and plundering variety or of the occupying kind, has few parallels in the history of humanity. When Christianity, Islam, and Buddhism brought their messages, they transformed many ancient cultures beyond recognition; but they did not destroy Hinduism, even though they affected it in significant ways. On the other hand, aspects of Hindu society and modes of worship have never left Hindu converts to any of these missionary religions. Thus Indian Christians and Muslims are known to be caste conscious. In this context, there are two underlying concepts in caste categorization to be noted. The first is that professions in any society may be broadly put under four groups: those dedicated to primarily intellectual and spiritual pursuits (*Brahmins*); those committed to the administration and defense of the county (*Kshatriyas*); those that contribute to the economy, i.e., traders and merchants (*Vaishyas*); and those that are engaged primarily in manual labor (the *Shúdras*). What made the system morally unacceptable was when these became hierarchical, rigid, and hereditary, making mobility from the lower to upper castes extremely difficult. Interestingly, there has not always been a correlation between caste and profession, certainly not in recent times. There have been Brahmin administrators, Shúdra saints, Vasihya scholars, and Kshatriya laborers also. And changes are occurring in claims of superiority of one caste over another.

The ideal would be to acknowledge the countless ways in which Brahmins (thinkers, scholars, and religious leaders) infuse life and learning, poetry and philosophy, profound wisdom and meaningful rituals into the tradition; the countless ways in which Kshatriyas (kings, administrators, and members of the armed forces) defend the tradition and administer various Hindu kingdoms; the countless ways in which Vaishyas (merchants and traders) keep the economy of the society alive and thriving; the countless ways in which Shúdras (laborers and farmers) work hard with physical exertion in fields and smithies and elsewhere to sustain Hindu society; and also the countless ways in which *avarnas* (Dalits), despite being excluded from the caste framework, served society, often in menial and degrading professions. Indeed, every class and caste has enriched the Hindu world in myriad ways. Therefore, it is important to acknowledge that no one group is intrinsically superior or inferior to any other.

Without condoning the fact that the people of the subcontinent were plundered and exploited many times in their history, it can still be said in fairness that India has also benefited from her contacts with the alien races and religions that barged into her shores

without being welcome. This, however, is a very touchy point in current postcolonial debates. Now ardent ethnic Hindu nationalists, recognizing the immeasurable cultural and economic harm that Mogul occupation and British colonialism inflicted upon Hindus, will not cheerfully concede the positive impacts of the *seigwailo*, a term the Chinese used to describe the foreign devils.

Though this is an understandable emotional reaction to the persistence of victimhood which is still there in the hearts of many Hindus, the historical fact remains that in music, art, and literature, in science, technology, and mode of government, as well as other contexts, India as a modern nation has become all the richer as a result of her contact with intruders. It may be said with good reason that many of these benefits could have accrued without the economic exploitation and political humiliation that the people suffered.

What really matters now is that India has maintained cultural integrity even in the midst of all the ravages she has suffered. The French Indologist, Sylvain Lévi, said this about India (*L'Inde et le Monde*, 1926):

> Her civilization, spontaneous and original, unrolls itself in a continuous time across at least thirty centuries, without interruption, without deviation. Ceaselessly in contact with foreign elements which threatened to strangle her, she persevered victoriously in absorbing them, assimilating them and enriching herself with them. Thus she has seen the Greeks, the Scythians, the Afghans, the Mongols to pass before her eyes in succession and is regarding with indifference the Englishmen—confident to pursue under the accidence of the surface the normal course of her high destiny.

**Range and Variety of Indic Visions**

The subject matter of Indic visions is vast. It is a fascinating chapter in human cultural history, splendid in expressions and considerable in scope. Any discussion of Indic civilization would include profound insights and illuminating thoughts that transcend national boundaries, as are reflected, for example, in the Vedas and the Upanishads, which are ancient texts of a religious and philosophical nature. Indic visions include unsurpassed poetic imagination and fantastic flights of fancy. These are ample in the epics and puranas of the Indic world, where we encounter beings with multiple heads, flying machines, mind-propelled missiles and more, which also include the development of ethical criteria ranging from the purely pragmatic to the impractically idealistic. On the social plane, one finds a variety of values and practices from unconscionable caste hierarchy to all-embracing universality, from relegation of women to domestic chores to veneration of women as cosmic energy embodied. India's cultural richness may be seen in splendid art and craft and architecture, in glorious music and mature mathematics, in profound philosophy and pleasing poetry, in complex grammar, gourmet cuisines, and tall stories, in the sinful and the sacred, even in erotic pornography.

One finds theists and atheists in India, believers, unbelievers and agnostics, broad-minded visionaries and narrow bigots, caring and cruel people, too. There have been original thinkers with countless perspectives and clever imitators who seldom acknowledge their sources. Given the richness and range of Indic culture, it would be presumptuous for anyone to speak or write about it in all-encompassing terms. So any pronouncement on any aspect of Indian culture should be preceded by an admission that the views expressed are based only on one's own limited understanding of a vast subject on which there can be countless perspectives. This I do at the outset.

**Vedic Civilization**

The roots of present mainstream Indic culture go back more than three millennia to the civilization that emerged from the Vedas. The Vedas are inspired works in archaic Sanskrit, authored by sage-poets of extraordinary vision who resonated with the beauty, splendor, and power of nature. Their worldviews and poetic utterances were extended in a hundred ways within numerous philosophical works and epic narratives, in the art and music and more of later generations. Even in the midst of modernity and even under a constitution that guarantees full protection and religious freedom to all of its citizens, the vast majority of people of India take cultural nourishment from the Ramayana and the Mahabharata, from the puranas and the classical saints of the tradition. Merging with the cultures of the South, Vedic civilization has flourished and grown on Indian soil since the dawn of India's recorded history.

True enough, alien religions and worldviews came into India; but while they enriched and even modified Indic culture to an extent, they never uprooted it. If anything, as noted above, the invaders absorbed elements from the local culture too. Muslim and Christian artists sometimes pay homage to Hindu gods and goddesses. Converted tribal people still celebrate pristine Hindu festivals. The situation may be compared to Western civilization, which has undergone numerous changes since the hoary days of Greece and Rome and Christian dominance. Today the West is secular for the most part. Rome and Greece may be distant memories, and Christianity may seem to be but a vestigial appendage to modernity. But Western civilization is deeply rooted in these traditions.

Likewise, Indic civilization is deeply rooted in the Sanskritic-Dravidian framework. This is what one tries to articulate through the term *Hindutva*—a term that unfortunately suggests religious rather than cultural affiliation and is therefore resented by secularists and members of other faiths who think it smacks of religious domination, even bigotry, in a secular democracy. I am not referring here to the political dimensions of the *Hindutva* movement, which is an altogether different subject. Claiming that Indic culture is wedded to its classical Sanskritic-Dravidian roots is no more narrow or chauvinistic than to saying that Western civilization is Judeo-Christian at its core. No matter how many immigrants of other races and religions pour into France or Germany, those countries are culturally French and

German, just as Chinese culture is basically inspired by Confucianism and Taoism, and Arab culture is Islamic in its essence. It is in this sense that Indic civilization is Hindu at its core. This is not to deny minorities their civil or religious rights but to recognize a historical-cultural fact. Cultural identification of a country is not always ill-motivated or xenophobic.

**The Idea of Indo-European Languages**

If we come upon the fact that the Latin and Sanskrit words for father are *pater* and *pitr*, for king are *rex* and *raja*, and for fire are *ignis* and *agni,* then it should strike even the most casual observer that these similarities are more than mere coincidences. In the sixteenth century, Thomas Stephens, an English Jesuit in Goa, recognized similarities between sounds in Konkani and Latin and Greek. At about the same time, Filippo Sassetti was struck by similar-sounding words in Italian and in Sanskrit: *serpe* and *sarpa*, for example, for snake. Consider again the following word similarities between Latvian and Sanskrit:

| **Sanskrit** | **Latvian** | **English** |
|---|---|---|
| *Asmi* | *esmu* | am |
| *Bhuti* | *buti* | to exist |
| *dina* | *diena* | day |
| *dhuma* | *duma* | smoke |
| *jivati* | *dzivuoti* | to be alive |
| *dyaus* | *dievs* | God |
| *kada* | *kad* | when |
| *nabhi* | *naba* | navel |
| *sunas* | *sunis* | dog |
| *vayus* | *vejis* | wind |
| *vira* | *vira* | man |

It may be noted in passing that the corresponding words in Tamil are *irukkirén, iruppadu, nál, pugai,* etc. revealing the fundamental phonetic differences between Sanskrit and Tamil.

As early as 1767, the French Jesuit, Gaston Coeurdoux, presented a memoir to the French *Académie des Sciences* in which he discussed the interrelationships between Sanskrit and a number of European languages including Russian. Almost two decades later, Sir William Jones proposed the idea that Sanskrit and the European languages had all descended from the same protolanguage. Max Müller later described Coeurdoux as the father of comparative philology. In the seventeenth century, soon after the British defeated the French in gaining territories in India, Antequil Duperron—one of the first to translate the Upanishads from Persian into French—warned the British that if they "neglect any longer to enrich Europe's scholars with the Sanskrit scriptures . . . they

will bear the shame of having sacrificed honor, probity, and humanity to the vile love for gold and money, without human knowledge having derived the least luster, the least growth from their conquests."

In that same century, William Jones formulated this in more scholarly terms. As a polyglot who had studied more than twenty languages, he was inspired, impressed, and thoroughly fascinated by Sanskrit, about which he famously wrote:

> The *Sanscrit* language, whatever be its antiquity, is of a wonderful structure; more perfect than the *Greek*, more copious than the *Latin*, and more exquisitely refined than either, yet bearing to both of them a stronger affinity, both in the roots of verbs and the forms of grammar, than could possibly have been produced by accident; so strong indeed, that no philologer could examine them all three, without believing them to have sprung from some common source, which, perhaps, no longer exists; there is a similar reason, though not quite so forcible, for supposing that both the *Gothic* and the *Celtic*, though blended with a very different idiom, had the same origin with the *Sanscrit*; and the old *Persian* might be added to the same family.

William Jones established the *Asiatick Society* in Calcutta, which became a fountainhead for scholarly research in Indology. Books in Sanskrit began to be published in presses in Calcutta and Serampur.

All this led Thomas Young to coin the term *Indo-European languages*. It may be noted in passing that Young was also a polyglot, but he is better known to physicists for his discovery of the phenomenon of interference, which eventually established the wave nature of light. A number of German scholars soon got into the act. It was largely through the work of Franz Bopp and others that the field of comparative linguistics emerged.

These facts need to be recalled to emphasize that the initial motivation for hypothesizing such commonalty between Sanskrit and European languages arose essentially from scientific considerations and not—as is sometimes suggested in postcolonial writings—to justify British colonial occupation of India. The study of the origin of languages is a fascinating scientific study. Though India can be justly proud of having initiated the science of grammar in the very distant past, the science of comparative languages began in Europe like many other modern scholarly, historical, and scientific inquiries. Unfortunately, like the study of history, these too have been tainted in recent years by culturally sensitive and political factors.

**Impact on European Thinkers**

When Europeans came to India, they found the local culture and religious practices to be significantly different from their own. As often happens when one encounters a totally alien culture, even in this day of easy travel and communications, many of them

formed grotesque pictures of India. Yet contrary to what is sometimes said, there were also Englishmen who understood the richness and value in Indian civilization. Thus Warren Hastings, the first governor-general of India, developed considerable interest in India's philosophical traditions. He was the one who encouraged Charles Wilkins to translate the *Bhagavad Gita* into English. In the preface to that translation, Hastings wrote: "I hesitate not to pronounce the Gita a performance of great originality, of sublimity of conception, reasoning and diction almost unequalled; and a single exception, amongst all the known religions of mankind."

Along with the language and grammar of Sanskrit, the Vedas, the Upanishads, the epics, and the puranas also slowly seeped into the psyches of German and French thinkers. This had several consequences. The first was to reveal to European thinkers that great literature, profound philosophy, and inspiring visions had arisen in India. As Raymond Schwab put it: "The publication of the Indic scholars at Calcutta ignited a kind of fervid intensity in certain young Germans. In philosophy, they included Schelling, Fichte, and Hegel—not to mention Schopenhauer and Schleiermacher." L. S. S. O'Malley tells us that "Victor Cousin, speaking of the poetical and philosophical movements of the East, and above all, those of India, which were, he said, beginning to spread in Europe, declared that they contained so many truths, and such profound truths, that he was constrained to bend the knee before the genius of the East and to see in that cradle of the human race the native land of the highest philosophy."

Immanuel Kant read books on Hindu philosophy too. Klaus Klostermeier, echoing a statement by other scholars, wrote that "Kant's differentiation between the physical world as seen in the space and time, and the unknowable thing in itself beyond these concepts, is very similar to the doctrine of Máyá. There are certain parallels between Kantian thought and Buddhist philosophy."

Arthur Schopenhauer, who had described the Upanishad as "the most satisfying and elevating reading," famously declared that "it has been the solace of my life and will be the solace of my death." He wrote in the preface of his famous *The World as Will and Representation* (1818):

> If the reader has also received the benefit of the Vedas, the access to which by means of the Upanishads is in my eyes the greatest privilege which this still young century may claim before all previous centuries, if then the reader, I say, has received his initiation in primeval Indian wisdom, and received it with an open heart, he will be prepared in the very best way for hearing what I have to tell him. It will not sound to him strange, as to many others, much less disagreeable; for I might, if it did not sound conceited, contend that every one of the detached statements which constitute the Upanishads, may be deduced as a necessary result from the fundamental thoughts which I have to enunciate, though those deductions themselves are by no means to be found there.

It may be added in passing that the philosopher and liberal thinker John Stuart Mill, who wrote against slavery, had only scant respect for Indian thought and culture. But this did not impede the interest of scholars like H.H. Wilson, Max Müller, and others to pursue their inquiries into Indic literature. Gradually, one began to discover that there are also some remarkable parallels between Indic, Greek, and Norse myths. In the Vedic vision, Indra was the chief of the Devas whose progenitor was Kasyapa. In the Greek world, Cronus gave rise to godlike beings whose chief was Zeus. Corresponding to Kailasha where Lord Shiva resides in the Hindu vision, the Greeks had Mount Olympus. Corresponding to the evil Asuras of Hindu lore, the Greeks had the Titans. These parallels led scholars to study India's languages, culture, traditions, and religions systematically. Their studies are a major part of what came to be known as *Indology*.

**A Note on Indology**

The field of scholarly inquiry and commentary which has come to be known as Indology had its origins, like Sinology, Egyptology, and other such disciplines, in the exploratory, intrusive, and scholarly interests of European Enlightenment, colonialism, and missionary zeal. In other words, there were other motivations for the Western pursuit of Indology aside from genuine intellectual curiosity. The need for a clear understanding of the history and culture of the people the colonialists wanted to govern was one such need. The other was to use that knowledge to persuade Hindus that theirs was a religion which—with all its inner light—needed to be replaced by a "better" religion, namely Christianity. This is one reason why not only independent scholars but also government-affiliated thinkers and missionaries took keen interest in Indology.

It may be recalled that many centuries earlier, Islamic expansionists had shown a similar enthusiasm for understanding, interpreting, translating, and critiquing the literature, philosophy, and traditions of other peoples as well.

For almost two centuries, thanks to Western scholars and their ever-increasing collaboration with Hindu academics, religious thinkers, and indigenous informants, Indology has been evolving impressively. Thanks to their untiring dedication, much of ancient Hindu history has been reconstructed. Western archaeologists unearthed the relics of even more ancient Indic civilizations. Bilingual dictionaries have been composed for Indian languages, and the literary treasures of Sanskrit as well as of Tamil and other vernacular literatures have been translated, commented upon, and propagated to the world by Western scholars and linguists. The world has benefited enormously. Ironically, this includes countless modern Hindus as well, who now learn about their tradition primarily in the English language.

Nevertheless, the colonizing and Christianizing motivations of early Indologists are, in retrospect, offensive to Hindus today. More regrettably, in the view of some, Indian minds have been transformed to Western modes of thinking and analyzing historical and spiritual matters in ways which differ drastically from traditional modes. As a result, a deep chasm has arisen between English-educated Indian scholars who

think like their Western colleagues and their non-English speaking compatriots, whose approach to religion and tradition are untouched by modern ways. There is also a growing divide between an awakened body of modern Indians who recognize the self-serving Eurocentric interpretations, misportrayals, and distortions of India's culture, traditions, and religions, and others who, even granting this, do not view every Western Indologist as a scheming servant of hegemonic imperialism.

Collaboration between Western and Indian scholars has also been subject to some serious assaults. A number of postmodern Hindu thinkers have been seeing in much of Indology, past and present, not only blatant errors of interpretation and culturally insensitive generalizations, but also racially motivated factors with more hidden agendas than had been surmised thus far. A new movement has been initiated with the goal of exposing, condemning, and keeping away what has come to be regarded as maliciously motivated misinterpretations masquerading as scholarship, with little reverence or sensitivity for the living religion of Hinduism. Given the global nature of today's cultural conflicts, this new vision has a number of Western scholars among its proponents. It is unfortunate that otherwise balanced scholars on all sides sometimes lose their cool in mutual invectives, making modern commentaries on ancient history unpleasant reading rather than intellectually stimulating or factually fascinating.

**New Rules of Engagement**

We live in an age of diversity and pluralism, which calls for appreciation of and respect for all cultures in the human family. It also sets lines which one is not supposed to cross through disrespectful pronouncements about other people's cultures. This means that Western scholars must be careful and cautious in their writings and interpretations concerning the non-Western world; they should strive to understand how the practitioners of a culture may feel upon reading their writings. Non-Western scholars who write in non-Western languages are not subject to such restrictions, because their audience does not spill over to the world at large.

In this context, it is good to remember that similar circumstances arose and are still present within the matrix of Western culture, which is largely Judeo-Christian. Many scholars in the West have written and continue to write cold-bloodedly, unsympathetically, critically, and even disparagingly on aspects of Christianity, incurring similar displeasure, anger, and protests. The scholars who are targets of such culturally valid protests point out that putting restrictions on the freedom to express one's thoughts and views on any subject is contrary to the tenets of enlightened discourse. Up until the eighteenth century, it was dangerous for Western thinkers to speak out or publish against traditional Christianity, which was the framework of Western culture. It was only after a long struggle that they acquired the freedom they have been enjoying for barely two centuries. They are not willing to give up the right to express their views about their own countries or the larger world, because those rights were acquired through great risks and great costs.

Be that as it may, one of two things will most probably come to pass. If the acrimony continues with increasing intensity, it is possible that interest in Indology will gradually diminish and evaporate in the West. This would be one unfortunate outcome, at least in the view of those committed to the framework of Enlightenment. Or again, after all the historical anger and missionary zeal calm down, after India asserts herself as an equal partner with the West in the fields of science and technology, in military and economic strength, after the West ceases to be hegemonic in global power, then perhaps Indian Indologists will join hands with their Western colleagues again to explore and enrich the fruitful and fascinating field of Indic culture and civilization even further. While one often quotes Rudyard Kipling's line "East is East, and West is West, never the twain shall meet," he also wrote perceptively:

> But there is neither East nor West,
> Border, nor Breed, nor Birth,
> When two strong men stand face to face,
> tho' they come from the ends of the earth!

**On the Indus Valley Civilization (IVC)**

The Indus Valley civilization is one of the most ancient civilizations archeologists have unearthed. Located primarily in Mohenjo-Daro and Harappa, this submerged civilization has received more attention and commentaries than most other such civilizations. It is said to have flourished between 2500 and 1900 BCE. The British archeologists Sir John Marshall and Sir Mortimer Wheeler often get the lion's share of the credit for its discovery, but other important scientists in the field, like D. Banerji, K. N. Dikshit, E. Mackay, and M. S. Vats have also played significant roles.

It is now well established that the people of the Indus Valley civilization were adept at many facets of civilized life, though they have left no big monuments or places of worship. One seal suggests the practice of human sacrifices. At least one unearthed building is thought to have been a granary. Brick-making technologies, road construction, elaborate sewage systems with running water, and residential structures have all been discovered.

And there were also works of art, ranging from pottery and jewelry to statuettes of dancing girls. Sir John Marshall reacted excitedly when he came upon the latter, exclaiming, "Now, in these statuettes, it is just this anatomical truth which is so startling; that makes us wonder whether, in this all-important matter, Greek artistry could possibly have been anticipated by the sculptors of a far-off age on the banks of the Indus." Prehistorians inform us also that the people of Harappa had domesticated fowl. Indeed, the world first learned from India to cultivate geese which have served humanity for alimentation since time immemorial.

On the basis of archeological findings and in contrast to what is generally regarded as the Eurocentric proclivity to preserve the Middle East as the source of all civilizations, many scholars now view the excavated townships in the Indian subcontinent as no less

original than Mesopotamian models. The people of that era manufactured terra-cotta ceramics and stoneware bangles. More importantly, well-constructed cities in the Indus Valley were larger than the ones in ancient Egypt or Mesopotamia. We have also come to see continuity in Indic civilization since the days of the Indus Valley. The *sindhur* that Hindu women wear to this day has its roots in the Indus Valley civilization. We also learn that those ancient peoples used a base-eight system from which the sixteen-anna rupee of later times arose.

The question of whether the Indus Valley civilization had developed a script is a fascinating one. Until recently, people thought that the question was only a matter of deciphering what seemed like hieroglyphics. Many still believe this to be the case. But a new hypothesis proposes that they are not scripts at all. There are divergent views among specialists in the matter of interpreting ancient data here too. The Finnish scholar Asko Parpola believes that the Indus Valley script had proto-Dravidian origins. Iravatham Mahadevan partially agrees with this thesis. Some scholars, like Subhash Kak, have argued that the Indus script is a precursor to the root script of all Indian scripts, namely the Brahmi. Others, like Steve Farmer and Michael Witzel, vehemently disagree. These differences are not so much between Indian and Western Indologists as between different schools of interpretation: some are convinced that literacy started in the Middle East, and others that it had independent origins that include the Indus Valley.

Interpreting ancient records is not easy. It is difficult enough when the records are in archaic versions of currently known languages, but even more so when they are written in symbols long out of use. This was the case with Egyptian hieroglyphics, for example. But human curiosity and ingenuity will not allow us to give up the quest to decipher what our distant ancestors were recording. So it was that the tireless work of people like Athanasius Kircher, Sylvestre de Saci, and others in the eighteenth century led to the triumph of Jean-François Champollion, who finally deciphered Egyptian hieroglyphics and rendered into a modern language portions of the famous Rosetta stone.

Ever since the unearthing of relics of a pre-Vedic civilization in North-Western India—the first of which caught the eyes of Alexander Cunningham in the 1870s and which date back more than 5,500 years—scholars have been deciphering what these seals actually convey. Two schools of thought have developed in this regard: one insists that it was not a script at all but merely unconnected drawings of an artistic nature, and the other school remains convinced that the unearthed seals are actually elements of a systematic linguistic system. In the first decade of the twenty-first century, the scholarly debates on this issue degenerated into mutually recriminatory platforms from which the proponents of the two views began to argue against each other more vociferously than for their own respective theses.

Recently, S. Kalyanaraman published a compendium of ancient tablets left by men and women of distant generations. To probe into the possible meanings of those silent seals is a commendable scholarly undertaking. The central thesis of the book is that artisans of the Indus civilization “created the Indus writing system” and furthermore

that "artisans of proto-indic language families . . . and Dravidian (languages) interacted with one another, absorbed many glosses and structural language features from one another." One may refer to this book to find out about the possible meaning of the figure of an antelope or the carving of a papal leaf, the etching of a waistband or an allograph or rebus. This is a fascinating pictographic dictionary that persuades the reader that the entries could very well have been entities of a language that once lived. One may expect severe criticism of both the methodology and the conclusions of Kalyanaraman's work from experts who hold competing views. It is doubtful that there will ever be unanimity on this complex challenge to our investigations on this matter, but the quest continues anyway.

In any event, it is important to recognize that archeology has been put to good use in resuscitating the forgotten past in India as elsewhere. Archeology sometimes resolves conflicts between believers and skeptics. Sometimes, in the interpretation of data, they intensify the conflicts. Those who reject the methodologies of modern science—and there are spokespeople in India and elsewhere who take this position—will have to reject archeology also and rely only on tradition, lore, and faith for some of their historical claims.

The course of history is often unpredictable, and the ironies it spells are not always pleasant. So the great river Sarasvati has itself disappeared due to geological forces, and the river Sindhu (Indus) which gave rise to India's name now flows through another country which was carved out of India in 1947, a country where the invocation of Sarasvati is anathema.

**The Aryan Invasion Theory (AIT)**

Phonetic similarities between Sanskrit and some European languages—as also parallels between Vedic and Greek mythopoeic worldviews—prompted Max Müller and other nineteenth-century European scholars to propose that in the very distant past a horde of Caucasians emigrated from central Asia, one group moving toward Europe and another toward Iran and to northern India via the perilous passes of Afghanistan. Furthermore, these invading Aryans, as they are called, pushed the indigenous Dravidians to the southern regions of the subcontinent, referring to them as *dasas* (slaves), and treating them as a lower class of beings. This might explain the origin of the caste system and seemed a plausible theory to many nineteenth century Western scholars.

However, this theory was held suspect right from the start by many Hindu thinkers because of its ominous implications. Modern Indians reject the notion that the ancient Hindus were foreign to Indian soil. Indeed, there is an unpleasant parallel between such an idea and the presence of European descendants in the Americas today, who acquired lands by displacing, ill-treating, or eliminating the original inhabitants of the so-called New World. There is something unsavory in such an occupation-ownership idea and many Hindus will have no part of the theory.

Remember that the rejection of the AIT is not new, nor is it only rejected by Hindus. In the nineteenth century, many people expressed their doubts. M. S. Elphinstone, the first governor of Bombay Presidency and British historian of India, argued that there was no conclusive evidence for the view:

> To say that it (Indic civilization) spread from a central point is an unwarranted assumption, and even to analogy; for, emigration and civilization have not spread in a circle, but from east to west. Where, also, could the central point be, from which a language could spread over India, Greece, and Italy and yet leave Chaldea, Syria and Arabia untouched? There is no reason whatever for thinking that the Hindus ever inhabited any country but their present one, and as little for denying that they may have done so before the earliest trace of their records or tradition.

In any event, the AIT has been subjected to critical deconstruction in recent decades. Though it still has a few lukewarm adherents in India and beyond, a vast and increasing number of modern scholars, both Hindu and otherwise, repudiate this view as unconvincing. As they see it, the fact that the Vedas make no reference whatsoever to an ancient trans-Indian home is ample proof that the Vedic Indians were not immigrants. Some even suspect that the AIT was a scheme, a trickery on the part of the colonial British agents to justify their occupation of India as only one more instance of a long pattern of alien intrusions. This idea is founded on the same sort of questionable moral principle, it would seem, that if a bank had been robbed many times before, I should have the right to rob it now. It has even been suggested that the British government paid Max Müller to put forward and propagate this myth. I too have been persuaded that there are very good arguments against the AIT—such as those which used to be taught in schools in India some decades ago—and that the AIT was most likely an incorrect reading of the very distant past. But I am inclined to think that attributing sinister motives to nineteenth-century Indologists in this matter may not be warranted.

In the din and drama of the political clamor, claims, counterclaims, and ethnic pride that dominate our culturally sensitive world, scholarly inquiries sometimes slide down into unpleasant exchanges. Debates on history and confirmation of the legitimate roots of one's civilization have become enormously important, since they touch on many aspects of cultural pride and national integrity. I recognize the political implications of the AIT. However, given that, as per current reading of prehistory we all migrated out of Africa, as per science we all have simian ancestry, and as per most religions we are all children of the same God, I am not very disturbed by who my very remote ancestors may have been. I respect cultural and evolutionary history. But I also feel that given the unseemly intercultural, interfaith, and interracial confrontations marring many marketplaces, it is important not to engage the distant past with too much passion and rancor, be it about the Crusades, the AIT, Caesar's conquests, or whatever.

We are on the threshold of a new global culture in which men and women of goodwill as well as scholars untainted by parochial perspectives will be working together to make a prejudice-free, collaborative, global, cultural composite. The transition period is inevitably wrought with much pain. But I cherish the hope that in every human heart of the new formative civilization whose birth pangs we witness, there will resonate the words of the ancient Tamil poet, Kaniyan:

> *yádum úré, yávarum kélír:*
> Everywhere is my country, everyone my family.

**Sarasvati Civilization**

Not only has the AIT been squarely rejected by many people in India, scholars and lay alike, a new paradigm is gaining ground and currency. According to it, Indic civilization has its roots in a Sindhu-Sarasvati culture which gave rise to Vedic civilization. In this view, the Sarasvati stream, emerging from the Himalayan peaks, grew into a mighty river which spread up to sixty kilometers wide in some places. As it surged through the northern plains, it engendered and nourished one of the most ancient civilizations on the planet. That was the Ur culture from which modern Indic civilization sprang. Its symbols grew over the ages and made India what she is now. Enriched and enhanced by countless generations, its voices still ring in India.

Sarasvati is not like the mythical Romulus who founded Roman civilization or a historical figure like Charlemagne, but is rather like the river Nile that gave rise to Egyptian civilization. Furthermore, in Hindu culture, Sarasvati is still the symbol for learning and knowledge, music, and numbers. She is the goddess who has been revered all over the Hindu world since time immemorial, like Athena in ancient Greece and Minerva in ancient Rome. She is the fount of wisdom, the supreme symbol of all that the intellect can accomplish. She is present in all places of learning, invoked by children in elementary schools and by professors in colleges. In the Hindu vision, Sarasvati is the all-embracing principle implicit in every book and notebook, in every paper and blackboard. She is present on every bookshelf and in every library. She is in every mind that thinks, in every eloquent tongue that speaks, and in the creative genius of sublime poets from whose hearts and minds words flow like pristine torrents. She is also in every musical instrument and in every contrivance that calculates. Myth or history, Sarasvati is a magnificent vision of learning and music in Indic vision.

**On the Roots of the Perception of Indic Civilization**

In his multitime retelling of the story of civilization, Will Durant wrote more than seven decades ago: “Nothing should more deeply shame the modern student than the recency and inadequacy of his acquaintance with India.” Well said, no doubt, but ignorance of distant cultures has always been a planetary plight. Then again, Indic

civilization is not given much importance in the global context these days, perhaps because there is no incentive to pay attention to a civilization, however great, unless its representatives wreak havoc and threaten the world order. Another reason for this benign neglect is that it is often cast in a religious framework. The vast majority of the people of India are affiliated with values and worldviews that are labeled Hindu. Not unlike what used to be the case in medieval Europe, practically every aspect of Indian culture is linked in some way or another to this religious framework. The general impression about Indic civilization that used to be and to an extent still is conveyed to the world is that it is essentially concerned with otherworldly matters and intensely engaged only in spiritual questions. There was perhaps some truth to this portrayal up until the beginning of twentieth century.

Quite a few modern Hindus have complained that only the spiritual dimension of Indic civilization has been given emphasis in the Western world. But one may ask, what caused this perception? One answer is that from the close of the nineteenth century, eminent spokespeople for Indic traditions stressed Indian spirituality rather than India's overall intellectual vigor. In other words, the impression of excessive spirituality arose as much from Hindu religious leaders, itinerant English-speaking monks, and exponents of Hinduism in the West as from ignorant misunderstandings and intentional distortions by Western observers. At least one source of what is sometimes described as Western misrepresentation of Indian culture may be traced to the powerful and persuasive writings of some illustrious Hindu scholars from recent centuries.

Thus, for example, the eloquent Swami Vivekananda declared: "This is the same land where wisdom made its home before it went into any other country, the same India whose influx of spirituality is represented on the material plane by rolling rivers like oceans, where the eternal Himalayas, rising tier over tier, look as it were into the very mysteries of heaven."

Or consider the interpretations of the Vedas and the Bhagavad Gita by Sri Aurobindo, one of the foremost scholar-sages of the Hindu tradition in the twentieth century, and his inspiring statement: "But why should not India then be the first power in the world? Who else has the undisputed right to extend spiritual sway over the world? . . . India can once more be made conscious of her greatness by an overmastering sense of the greatness of her spirituality." S. Radhakrishnan, a most learned scholar of the tradition, wrote quite rightly: "Hinduism insists not on religious conformity but on a spiritual and ethical outlook in life." And also: "The Hindu thinker dwells on the evanescence of the world and its pitiful futility if its connection with the eternal is snapped." In this context we may recall what A. N. Whitehead wrote in his *Science and the Modern World*, something which is not in content much different: "Human life is a flash of occasional enjoyments lighting up a mass of pain and misery, a bagatelle of transient experience."

In 2006, a scholar named T. C. Murali Madhavan reminded his audience at a national conference, "Our cultural heritage is based on dharma and truth. It believes that whatever we gain without dharma will not last. Brahma and dharma are misunderstood

but they are indispensable and two sides of the same coin. It is the basis of Indian culture." Many Hindu thinkers and writers emphasize, and rightly so, the primacy that Indic civilization has always given to the spiritual.

The deep conviction that "whatever we gain without dharma will not last" is indeed the cornerstone of Hindu insight, irrespective of whether or to what extent it is put into practice in everyday life by people at large. In any case, the works of these and similar thinkers were/are translated, rightly or exaggeratedly, in the industrialized and technologically shaped Western mind as a picture in which Hindus were drawn primarily to otherworldly matters, even in their secular ideals. Be that as it may, in the interest of obtaining a more complete picture, we need to bring out the material and this-worldly dimensions of Indic culture also.

Here it is important to note that the notion of dharma as a system of individual and collective conduct that is conducive to peace and harmony is, like the concept of zero, of more universal value and validity than its Sanskrit name would lead one to believe. Belief in and commitment to a cosmic order, both moral and naturalistic, need not be anchored to any particular culture and religion any more than entropy or the electric field. As T. S. Rukmani noted in her essay in *Hinduism and Ecology*, "Dharma appeals to the conscience for its different interpretations, and therefore has great flexibility in being understood and practiced in accordance with the necessities of different situations."

**On Awareness of Science History**

Granting that European images of Indian culture were incomplete, one may ask: how many *Hindu* thinkers gave the deserved importance to their own scientific heritage before Europeans came on the scene? The plain answer to this question is—not many. Eminent thinkers of past eras who extolled India's spirituality did not say as emphatically that India is also the land where poetry reached prosodic perfection, where epics running to thousands of verses were composed, where grammar was explored as never before, where astronomers gazed the skies and mathematicians pondered quadratic equations, where metallurgy had reached amazing technical sophistication, where sculptors chiseled wonders on rocks, and where craftsmen created marvelous merchandise.

Few of the works written or published by Indian scholars prior to the nineteenth century address the history of Hindu science. This is not surprising given that the history of science did not exist as a field of inquiry in India before that time. It is important to remember that, while the historiography of specific countries was largely inspired by and served the goals of nationalism in Europe, explorations into the history of science—especially of ancient science—was generally shielded from this consideration, if only because there was little fear that others had discovered in the distant past what the moderns were discovering.

In the context of India, as of many other cultures, until Western scholarship began to unravel the genuine scientific core, insights, and substance in classical Hindu thought, most people seem to have been quite unaware of this dimension of their own heritage. Even today, the weight of Indian writings on Hindu thought and culture leans more toward the spiritual, the religious, and the philosophical than the scientific. Even in the midst of modern historians' condemnation, variously described as secularist, colonialist, Macaulayite, and Marxist, the emphasis remains on spirituality and religion; classical Hindu science, when mentioned, is often presented as containing many results of current physics and biology.

One reason for this is that the vast number of investigators in this field have generally been from the humanities: philosophers, linguists, historians, and such—who do not have much interest in or acquaintance with modern scientific disciplines or even with the methodology, philosophy, and history of modern science. At the same time, professional Indian scientists and scientifically informed people seldom participate in these exchanges. But here again, Hindus are not unique: one may see their counterparts in all major religious traditions.

Incidentally, without diminishing the central importance of mysticism all through India's cultural history, it may be remarked that the mystical experience itself is universal. As Bertrand Russell pointed out in his *Mysticism and Logic*, the underlying idea in the mystical framework is:

> . . . the belief in insight as against discursive analytic knowledge: the belief in a way of wisdom, sudden, penetrating, coercive, which is contrasted with the slow and fallible study of outward appearance by a science relying wholly upon the senses. All who are capable of absorption in an inward passion must have experienced at times the strange feeling of unreality in common objects, the loss of contact with daily things, in which the solidity of the outer world is lost, and the soul seems, in utter loneliness, to bring forth, out of its own depths, the mad dance of fantastic phantoms which have hitherto appeared as independently real and living.

## Recognition of Science in Ancient India

In the seventeenth century, when modern instruments and mathematics-based science began to emerge, many European thinkers, reveling in their new discoveries, thought that the ancients were either ignorant or unintelligent. Francis Bacon, an eloquent propagator of the new empirical methodology, was also a leading disparager of the ancients. He called for a replacement of Aristotelian instruments, or *Organon*, by a new methodology, or *New Organon*. It was only in the eighteenth and nineteenth centuries that medieval and ancient scientists regained esteem and respect in the judgment of scientific thinkers in the West.

In the eighteenth century, the systematic inquiry into ancient science became a serious scholarly enterprise. This led to many fruitful results, especially regarding medieval and ancient Greek science. Jean Étienne Montucla was one of the first to write a history of mathematics. This was in 1758. By the early nineteenth century, some European historians began to realize that significant science and mathematics had been formulated in the Middle East and in the Indian subcontinent. Reuben Barrow, for example, published a paper in volume 2 of *Asiatic Researches* to prove that ancient Hindus were aware of the binomial theorem long before Isaac Newton. It was not out of the blue that the eminent French physicist and mathematician Pierre Simone de Laplace wrote early in that century:

> The ingenious method of expressing every possible number using a set of ten symbols (each symbol having a place value and an absolute value) emerged in India . . . The importance of this invention is more readily appreciated when one considers that it was beyond the two greatest men of Antiquity, *Archimedes* and *Apollonius*.

The research has continued. Whereas the distortions and misrepresentations of Indic culture by European scholars are widely publicized and rightly condemned by Hindus who are understandably offended, not many Indian scholars seem to be either aware of or willing to recognize that the whole field of uncovering and interpreting ancient Indian writings, whether religious or secular, was initiated and enriched by Western scholars. Indeed, such recognition by a Hindu is sometimes interpreted as a display of servility to the West. To that attitude, I would say that this is not worthy of a tradition which has always honored knowledge no matter what its origin.

During the past several decades, the number of scientifically informed investigators exploring the legacy of India's scientific thinkers has grown steadily, both within India and beyond. Through technical papers, colloquia, and books, these scholars have brought to light precious insights in classical Indic texts which have relevance and significance beyond the religious framework.

One of the many unfortunate consequences of Western hegemony in the modern world and especially of the English language is that some Indic scholars still look for recognition from the Western academic establishment when it comes to receiving credit. I have myself bemoaned this fact sometimes. Because the vast percentage of books and articles on the history of science is written in English or French and because of the continued academic dominance of the West even after more than half a century of decolonization, some feel that this is a justifiable reaction. Fortunately, a growing number of scholars in India are writing and speaking about India's rich heritage without complaining about how Westerners may have ignored or distorted it.

## On a Classification of Ancient Civilizations

Considered from a long-term perspective, the civilizations of the world may be classified into three broad groups. To the first belong those which flourished in the very distant past and have completely disappeared. Their precious legacies are relegated to artifacts in museums and to books and articles written by scholars. Such are the civilizations of ancient Egypt and Mesopotamia, as well as Norse, Mayan, and Aztec civilizations. Then there are civilizations that no longer bask in their former glory, but some of whose worldviews, creative ideas, and artistic geniuses continue to nourish modern civilizations. Such are the Greek and Roman civilizations, for example.

Finally, we have the Chinese, the Indic, and the Islamic-Arab civilizations—three major ones which flourished with great verve and vigor at one time, but which, because of various historical forces, became dormant in their scientific creativity for some time. Since the second half of the twentieth century, these great civilizations have been slowly, but surely, waking up from a long slumber. They have already asserted themselves globally in different ways, and they show every promise of becoming creative and active again in the scientific field, perhaps with even greater éclat than before.

It must be noted that the civilizations of China, India, and the classical Islamic world did not lose their creative capacities in art, music, and poetry during their scientifically dormant phase. And some argue that they were scientifically active even during the period from the sixteenth to the nineteenth centuries. However, it cannot be contested on the basis of factual records that *modern science* emerged in the matrix of Western European civilization. This has had drastic consequences on the self-appraisal of reemerging civilizations. The matter is complicated by the fact that the non-West has also suffered the adverse effects of European colonialism. This additional negative factor in the lives of these awakening civilizations is playing a role, both subtle and overt, in the process of their own scientific renaissances.

## Search for Roots

The search for cultural roots in the Western world led to a rediscovery of ancient Greece and Rome. Two things must be noted here. First, the unsavory memories of Greco-Roman cultural and political colonization had long disappeared from the psyche of the West when modern science began to emerge. And modern science was not imported into the West from an oppressing and exploiting culture, though it had been nourished, some say even instigated by its contacts with Arab scholarship. In any case, there was no reason to react with irritation toward Arab civilization in the West, much less Greece or Rome when science emerged in Europe.

Then too, in the enthusiasm of the discovery of Greek thought, some were overwhelmed by the ancient investigators. Here, for example, is what William Whewell wrote:

> The sages of early Greece form the heroic age of science. Like the first navigators in their own mythology, they boldly ventured their untried bark in a distant and arduous voyage, urged by the hopes of a supernatural success; and though they missed the imaginary golden prize which they sought, they unlocked the gates of distant regions, and opened the seas to the keels of the thousands of adventurers who, in succeeding times, sailed to and fro, to the infinite increase of the mental treasures of mankind.

Some slid into a romantic vision of the ancients almost unconsciously, which made them see more in the past than may have actually been present. What was ignored in such views is that there are basic methodological differences between ancient and modern science.

In the non-Western world, two major forces are at play in this context. One motivation is to join international science. This goads scientists to become part of the global scientific community and make contributions to the advancement of human knowledge. Hindu, Chinese, and Islamic scientists, like everyone else, have been making their marks in substantial ways in this regard. The other force springs from the memory of colonial oppression that is part of the non-West's recent history and from the fact that the West is still a major power in the international arena. Therefore, the rediscovery of non-Western cultural roots tends to be colored by an undercurrent of animosity toward the West. Added to this is the fact that Western historians and scholars—in their explorations into and commentaries on non-Western cultures—have sometimes transformed various aspects of those cultures, often portraying them as creatively inferior or as intrinsically limited in their capacity for scientific reasoning or rationality. This is no longer the case.

It is in this unsavory scenario that a good deal of writing and reflection on the roots of non-Western science are occurring. As a result, the joy of discovery is often tainted by cultural complexes, antagonisms, and acrimony, provoking unpleasant exchanges between otherwise serious and balanced scholars.

As in the West with respect to Greece, there is the risk of reading more into the texts than what their authors might have meant. It is important to differentiate between deep insights of keen thinkers from ages past on one hand and the quantitatively, experimentally, and instrumentally derived results of modern science on the other. This is not to undervalue ancient achievements but to honor them in their legitimate framework.

### The Multiple Roots of Classical Indic Culture

Indic visions were nurtured by several streams, much like the subcontinent's land is vivified as much by the rivers in the northern plains as from those in the southern peninsula. Of the many cultural roots, the two most ancient and influential have been, as noted earlier, the Vedic-Sanskritic and the Dravidian-Southern. Whether these two had

a common source is another issue of interest and debate among scholars and historians. It is hard to track down this matter because it too is wrought with political and cultural sensitivities. Ignoring the controversies which surround their common linguistic roots, the fact remains that, over the centuries, the Southern and the Northern traditions interacted and enriched each other in healthy and remarkable ways, and they absorbed worldviews from beyond to form a Pan-Indian culture that enlivens people today.

The Vedas are reckoned among the most ancient utterances of the human spirit in its quest to connect with the Cosmos. Composed in ancient Sanskrit, some believe that parts of the complete corpus of Vedic hymns are no longer with us. Tradition ascribes the Vedas to spiritually awakened sage-poets, reverentially referred to as *rishis*, who received them as revelations from beyond. It may be recalled that similar views are held regarding the foundational truths of other world religions also. Hindu tradition accepts as a fact that the Vedas are eternal and that the articulated hymns existed as cosmic vibrations for all time until the rishis heard and transmitted them for the benefit of humanity. I interpret this to mean that perennial truths about the human condition and mystical visions about the world beyond have more than temporal validity. They have a time-invariant aspect that constitutes what Leibniz called *philosophia perennis*. Indeed, the worldviews of the Vedas have not only stood the test of time; they have also inspired the major doctrinal tenets of Hinduism, the human family's third largest religion, numerically. Many Vedic *mantras* are recited to this day in solemn rites and rituals, in sacraments and worship services.

We may compare the conviction of the eternity of the Vedas to a corresponding one in the framework of science: the laws of nature have been there since the inception of the cosmos, serene and silent, until scientific minds, through arduous efforts, unraveled them so that all may be awakened by them.

Some traditionalists have insisted that acceptance of the Vedas as the absolute, infallible truth is a requirement for being a Hindu. However, not everyone attributes transcendental origins to them. Irrespective of whether one accepts or rejects the Vedas as ultimate, infallible, and of divine origin, there is no denying that Indic culture has been largely molded by the Vedic framework. The call of the Vedas can be heard with even greater loudness in our own times. Indeed, the future of Hinduism depends on how one responds to that call: with maturity and a mind awakened to the modern world or in ways that are rigidly anchored to unchangeable and inelastic frameworks.

As noted earlier, just as Arabic nations are rooted in Islamic culture and the secularized Western civilization still draws its sustenance from its Judeo-Christian roots, so too modern India is deeply embedded in a culture that has its origins in Vedic visions, even though it is a secular democracy. This is not to say that people of other faiths are not entitled to full equality in the political framework of the country, but to acknowledge the cultural roots of a country. Failure or refusal to recognize cultural reality can lead to unfortunate consequences.

Tamil is among the many regional cultures that enrich the tapestry of Indic visions. It is spoken by the inhabitants of the state of Tamil Nadu in India and by

millions more in Sri Lanka, Malaysia, South Africa, and other parts of the world. It is a language abundant in literature, classical and modern, an aesthetically pleasing alphabet, and with an extraordinary capacity for pithy pronouncements. Its intrinsic genius and unusual richness have been recognized by non-Tamil scholars as well. The language does not fit into the molds of the major language families. It is at least as ancient as Latin and classical Greek. The admiring Peter Percival, in a statement that sounds like William Jones's tribute to Sanskrit, declared that "no language combines greater force with equal brevity than Tamil, and it may be asserted that no human speech is more close and philosophic in its expression as an exponent of the mind than the same." I should add that similar encomiums by other scholars may be cited on other Indian languages as well. The poets of the non-Sanskritic traditions have also articulated many insightful views.

My reason for mentioning all of this is to point out that the spirit of multiculturalism which is fostered in our newly awakened world was celebrated in ancient and classical India without feelings of rivalry or mutual animosity. Hindus have welcomed and lived in harmony with Buddhists and Jains, Sikhs and Muslims, Parsees and Christians and Jews for many long centuries in spite of occasional episodes of extreme unfriendliness.

And yet unfortunately the recognition of Tamil as a language distinct from the Sanskrit family has led now and again to separatist mind-sets within India. Linguistic differences can lead to movements that are hurtful to national integrity. We have seen that happen in Québec in Canada, Flemish nationalism in Belgium, and Basque separatist movement within Spain. Fearing such linguistic nationalism within India, some scholars have spoken out eloquently against any suggestion that Tamil has an identity all its own. But then, consider *Cymraeg* (known as Welsh in English). It is a Celtic language and has nothing to do with the Anglo-Saxon family. It is a recognized language of Great Britain. Recognition of a separate linguistic root for Welsh need not divide the people of Great Britain politically into separate groups. Nor does it make much sense to insist that Welsh and English belong to the same family in order to keep British unity, much less to insist that those who recognize Welsh as different from English do so in order to sow separatist movements in Great Britain.

**Intellectual Tradition of Indic Culture and Foreign Commentators**

All dynamic civilizations have pondered questions of life and death. They have also wondered about the nature of matter and motion, gazed at the sky and the stars, developed methods of counting and computing, and forged instruments for action and medicaments for curing. So arose science in the ancient world.

Thanks to countless keen minds and ingenious craftsmen, India had her scientists and inventors in premodern periods as well. Investigators in India wrote on mathematics, astronomy, chemistry, physics, and medicine. From the comments of travelers and

scholarly visitors in the distant past, it is clear that people from many regions of the world looked upon India with awe, respect, admiration, and even adulation over the centuries.

Thus the seventh-century Chinese traveler Hiuen Tsang spoke of the munificence of Hindu royalty, saying that each of the ten thousand monks who attended an ecumenical conference received "100 pieces of gold, one pearl, one cotton garment, various drinks and meat, flowers and perfumes." He was so impressed by the intellectual vigor and curiosity of the people that he noted: "The day is not sufficient for asking and answering profound questions. From morning till night they engage in discussions; the old and the young mutually help one another."

Consider what Abu'l-Qasim, an eleventh-century scholar from Andalusia and court historian, wrote in *Tabaqat al-Umam*:

> Among the nations, during the course of centuries and throughout the passage of time, India was known as the mine of wisdom and the fountainhead of justice and good government and the Indians were credited with excellent intellects, exalted ideas, universal maxims, rare inventions and wonderful talents . . . They have studied arithmetic and geometry. They have also acquired copious and abundant knowledge of the movements of the stars, the secrets of the celestial sphere and all other kinds of mathematical sciences . . . Of all the peoples they are the most learned in the science of medicine and thoroughly informed about the properties of drugs, the nature of composite elements and peculiarities of the existing things.

We read in Henry Yule's translation of *The Travels of Marco Polo*, the thirteenth-century traveler, the following complementary things about the Brahmins of South India:

> [They] are the best merchants in the world, and the most truthful, for they would not tell a lie for anything on earth . . . They eat no flesh, and drink no wine, and live a life of great chastity . . . nor would they on any account take what belongs to another; so their law commands . . . These Brahmins are very long-lived owing to their extreme abstinence in eating . . . They have capital teeth, which is owing to a certain herb they chew, which greatly improves their appearance, and is also very good for the health.

These and similar comments by travelers over the ages reveal classical India as a dynamic culture, full of life, activity, and creativity. True, some aspects of the social structure in the Hindu world leave much to be desired. But this criticism, however valid, would be applicable to practically every other major civilization of ancient times. When we admire the pyramids of ancient Egypt, we seldom think of the myriad of slaves who bore the tons of stones and sand to erect the structures that stand as

monuments to human ingenuity. Even in the midst of all the grandeur associated with the magnificent cathedrals of medieval Europe, the plight of the serfs was as dismal as the people of the lowest castes in India. In the glory days of Arab civilization, when philosophers and scientists crowded the courts of caliphs, the common man and woman were not exactly enjoying life to the full. None of this is to condone social injustices in the Hindu world, but to remind us that a sad feature of all ancient and some modern civilizations was/is the gaping chasm between their creative aspects and the condition of what the Greeks called the *hoi polloi*.

In modern times, even thinkers from the colonizing West have paid homage to the intellectual and material grandeur of India. For example, the imperialist Thomas Babington Macaulay recognized India's greatness in his *Essay on Clive* in these terms:

> The people of India, when we subdued them, were ten times as numerous as the Americans whom the Spaniards vanquished, and were at the same time quite as highly civilised as the victorious Spaniards. They had reared cities larger and fairer than Saragossa or Toledo, and buildings more beautiful and costly than the cathedral of Seville. They could show bankers richer than the richest firms of Barcelona or Cadiz, viceroys whose splendour far surpassed that of Ferdinand the Catholic, myriads of cavalry and long trains of artillery, which would have astonished the Great Captain.

Then again, not all Western Christian scholars were ignorant of India's intellect. For example, Henry Steel Olcott pointed out in his book on *Theosophy* that Reverend William Ward, a Baptist missionary in Serampur, wrote:

> No reasonable person will deny to the Hindus of former times the praise of very extensive learning. The variety of subjects upon which they wrote prove that almost every science was cultivated among them. The manner also in which they treated these subjects proves that the Hindu learned men yielded the palm of learning to scarcely any other of the ancients. The more their philosophical works and law-books are studied, the more will the enquirer be convinced of the depth of wisdom possessed by the authors.

In a famous quote, Max Müller—who spoke of the childish thoughts in the Vedas (meaning that they were uttered in the earliest phases of human awareness)—wrote:

> If I were asked under what sky the human mind has most fully developed some of its choicest gifts, has most deeply pondered over the greatest problems of life, and has found solutions of some of them which well deserve the attention even of those who have studied Plato and Kant, I should point to India. And if I were to ask myself from what literature

> we who have been nurtured almost exclusively on the thoughts of Greeks and Romans, and of the Semitic race, the Jewish, may draw the corrective which is most wanted in order to make our inner life more perfect, more comprehensive, more universal, in fact more truly human a life . . . again I should point to India.

And in the twentieth century, Will Durant, the chronicler of human civilization, famously wrote:

> India was the mother of our race and Sanskrit the mother of Europe's languages. She was the mother of our philosophy, mother through the Arabs, of much of our mathematics, mother through Buddha, of the ideals embodied in Christianity, mother through village communities of self-government and democracy. Mother India is in many ways the mother of us all.

I offer these quotations because if the primary goal of this book is to reflect on India's rich scientific, philosophical, and intellectual heritage, a secondary goal is to soften the harsh criticisms by a new and growing generation of scholars who believe that Western thinkers have been invariably Eurocentric and disdainful of Indian culture or India's contributions to world culture. Such views, though legitimate in many contexts, need to be nuanced. Little is accomplished by fanning the bitterness that has resulted from centuries of Western colonialism. It does little to bring about the greater harmony and understanding among the cultures and civilizations of the world that we direly need.

## II. Universal Science and the Subcontinent

> It is important to appreciate that the historical achievements in India in critical reasoning, public deliberation and analytical scrutiny as well as in science and mathematics, architecture, medicine, painting and music, are products of Indian society involving both the Hindus and non-Hindus, and including the skeptical as well as the religious.
>
> —Amartya Sen, *The Argumentative Indian*

### Introduction

Indic civilization, like the Chinese, is one of the oldest in human history. Therefore, many matters of civilizational import arose in India. As mentioned earlier, it is not only in spirituality and philosophy that India was alert. No less importantly, scientific thought and theorizing also marked Hindu, Jain, and Buddhist thinkers. Given her long history, the variety and richness in the technological and scientific manifestations of India were unsurprisingly considerable. It would be practically impossible to condense them all in the span of a few pages. Scholars have written extensively on these topics. Historical studies on the subject are continuing, but I will look into some key aspects in this chapter.

### Vedas as Scripture and Science

Passages from the Vedas continue to play a role in Hindu sacraments and ceremonies. The purely religious point of view sees neither science nor philosophy in them. Many Vedic injunctions guide the faithful in religious orthopraxis. Vedic rites are powerful elements in the performance of traditional rituals. The scriptures instruct all practitioners to recite passages from them meticulously, but scholars and pundits alone know their meanings—whether literal or esoteric. In recent years, thanks to the Internet, a great many religious enthusiasts have been spreading the meanings and relevance of Vedic wisdom to those who have a computer at their disposal. This is a

far cry from the eras when Vedic mantras were not to be uttered in the earshot of the uninitiated and those who were deemed unfit to receive their wisdom. In our own times, it is good that the Vedas' message is distributed to everyone interested, including noncaste Hindus and cultural aliens.

The assertion that *everything there is to know is implicit in the eternal hymns* might not appeal to many modern minds, but there are also other ways in which the time-honored opus may be considered. One could regard Vedic meters as grand poetry, for the hymns are governed by sophisticated prosody. One may discuss their contents from philosophical angles, for deep questions provoke serious reflections. Or again, one may analyze the Vedas in an effort to find out what information they might reveal about the ancient society in which they were composed, for the Vedas allude to places and practices that are a wellspring of fascinating historical data. Finally, it is possible to use the Vedas to unravel the knowledge framework in which the authors composed their works and to get a glimpse into their scientific worldviews. Fortunately for the tradition, all these approaches have worked, and with hardly any threat from any powers that be. Thought-stifling forces have rarely been able to subdue or silence dissenters in the Hindu tradition. One hopes that this spirit will endure.

The Vedas have been dated back more than 3,500 years even by conservative scholars, and they are considered to be much, much older by others. But the notion that science in the modern sense may be detected in the Vedas dates back only to the last quarter of the nineteenth century. The credit for initiating this search in Vedic hymns goes to the reformist revolutionary thinker Swami Dayananda Saraswati. At a time when the powerful presence of the British in India made many Hindus feel that all worthwhile knowledge had its source in Europe, Swami Dayananda whipped his people out of that stupor by proclaiming with erudition that the Vedas were treasure chests—not only of religious wisdom—but of science as well. He was the first modern Hindu to proclaim and promote the idea that much of modern science lay implicit in Vedic literature. According to an entry in the 1911 *Encyclopedia Britannica*, Swami Dayananda interpreted Vedic sacrifices as "the entertainment of the learned in proportion to their worth, the business of manufacture, the experiment and application of chemistry, physics, and the arts of peace, the instruction of the people, the purification of the air, the nourishment of vegetables by the employment of the principles of meteorology." He went on to claim that telegraphy and steam engines existed in India during Vedic times, which happened to be among the more spectacular importations of Western technology into India in Dayananda's time.

Irrespective of the historical basis of such claims, they served an important purpose. They filled the hearts of Hindus with a cultural pride that had been eroding under Western military power and dominance. Dayananda's message touched many souls in the tradition, infusing them with a much-needed moral boost. Though there is no longer any need for such morale-boosting tenets, such writings are growing in our own times, and they also accomplish the same goal effectively.

And they did more. Many non-Hindus in foreign lands picked up on these trends and formulated their own versions. This was fine in so far as they understood and appreciated India's cultural expression, philosophical insights, and spiritual visions; but some went a little too far and echoed untenable scientific affirmations. Thus, the American poetess Ella Wheeler Wilcox exclaimed,

> The land of Vedas, the remarkable works contain not only religious ideas for a perfect life, but also facts which science has proved true. Electricity, radium, electronics, airship, all were known to the seers who founded the Vedas.

Such statements are more embarrassing than pleasant for scientifically enlightened Hindus. Such claims are not too convincing to most modern readers, and they don't enhance the value of the Vedas by an iota.

In historical terms, a good many technologies flourished in ancient India such as brick making, pottery, and synthesis of cement. Archeological finds have revealed that the ancient peoples of India were familiar with the use of certain minerals, as well as with the extraction and aesthetic utilization of gold. Miniature terra-cotta seals representing animals and deities suggest refined levels of art and concepts. Archaeologists have also unearthed statuettes in lime and bronze, which show a technological knowledge of sculpting with specialized materials even in very ancient times.

Indians of the Vedic period and Dravidians of later times were familiar with fermented liquors. Passages in the Vedas have been interpreted by some as referring to ships and seafaring episodes. One Vedic scholar writes that "the need to study the properties of water, air, and fire for discovering and manufacturing aircraft, ships and other vehicles capable of moving in the firmament, land and water, are mentioned in Rig Veda and many other hymns."

Though this is a questionable interpretation of the texts, we gather from the epics and other classical literature that the people of ancient India were familiar with glass making, as well as with tanning, dyes, a kind of paper, cleansing materials, explosives, coloring cotton, paints, and other such elements of chemical industry. All of this was impressive ancient technology.

**Fruits of Scholarly Inquiry**

Two other approaches have proved to be meaningful in legitimate efforts to uncover scientific elements in the classical Hindu world. The first is to probe into known texts and look for others in order to discover the state and kind of scientific knowledge that ancient Indians possessed. Such searches began in the nineteenth century, albeit with the jaundiced eyes of Western scholars. That is to say their interpretations were often

constrained by cultural prejudices, but they laid the foundations for more objective assessments by future generations. The significant investigative and interpretive works that were initiated in late eighteenth century have developed considerably in style, substance, and objectivity, yielding rich harvests of interesting results in the still-growing field of ancient Indic science.

Serious scholarship bears ample testimony to the fact that, in centuries past, Hindus were engaged in a variety of intellectual inquiries and were both productive and insightful in the context of the knowledge of their times. We have come to know that much was accomplished in alchemy, astronomy, and algebra, in medicine, mathematics, and more. Contrary to the image of classical India as a civilization deeply entrenched in and primarily preoccupied with the spiritual and the supernatural, we now picture an India where vigorous minds probed into the nature of matter and motion, charted the skies, and pondered planetary periodicities, classified plants and animals, and analyzed the effects of herbs on human physiology. Likewise, archeological research has unearthed valuable information about textile and metallurgy. There is a vast literature, informative and reliable, in the forms of books and well-researched articles in learned journals elaborating on ancient Indian science and technology.

**Technology in Recent Centuries**

Let me refer to the important work of the Gandhian scholar Dharampal whose probing has illuminated many aspects of Indic technology which were all but forgotten. He researched writings from eighteenth century travelers, commentators, and scientific observers which reveal many aspects of Indian science and technology that showed a high level of advancement. In a collection of papers written by some investigators of the period, published by this scholar under the title *The Beautiful Tree,* one can read fascinating details on the state of affairs in the eighteenth century. Let me recall a few facts from that book beginning with J. Z. Holwell who in 1767 wrote the following:

> Inoculation is performed in Indostan by a particular tribe of Bramins, who are delegated annually for this service from the different Colleges of Bindoobund, Eleabas, Banaras, etc. over all the distant provinces; dividing themselves into small parties, of three or four each, they plan their traveling circuits in such wise as to arrive at the places of their respective destination some weeks before the return of the disease . . .”

Two years earlier in 1774, Lieutenant Colonel Ironside gave a detailed description of how one manufactured paper in India: “The manufacturer purchases old ropes, cloths, and nets, made from the *sun* plant, and cuts them into small pieces, macerates them in water for a few days, generally five, washes them in the river in a basket, and throws them into a jar of water lodged in the ground; the water is strongly impregnated

with a lixivium of *sedgimutti* (an earth containing large portions of fossil alkali) six parts and quick lime seven parts . . ."

In 1795, Captain Thos Halcott, writing on the *Drill Husbandry in Southern India*, observed: "Until lately I imagined the drill plough to be a modern European invention; but a short time ago, riding over a field, I observed a drill plough at work, very simple in its construction, which upon inquiry I find is in general use here, and has been so since time immemorial." In 1820, Major General Alexander Walker noted: "The Hindoos have been long in possession of one of the most beautiful and useful inventions in agriculture. This is the Drill Plough. This instrument has been in use from the remotest times in India . . ." He went on to say: "They have a variety of implements for husbandry purposes, some of which have been introduced into England in the course of our recent improvements. They clean their fields both by hoeing and hand weeding; they have weeding ploughs, which root out and extirpate the weeds . . . They have also Mallets for breaking clods, the usual assortment of Hoes, Harrows, and Rakes."

In a paper written in 1795 on *Iron Works in Ramanakapettah*, Dr. Benjamin Heyne quotes a certain Captain Presgrave who, referring to bar iron made in India, stated it to be "of most excellent quality, possessing all the desirable properties of malleability, ductility at different temperatures and of tenacity for all of which I think it cannot be surpassed by the best Swedish iron . . ." These excerpts suffice to give an idea of the technological advancement of India in the eighteenth century.

**Mathematics**

Mathematics has always been held in high esteem in India. Already in Vedic times, an aphorism compared mathematics to "the crests on the head of the peacock" because it is at the head of all knowledge. It was also compared to gems on the hoods of snakes.

Vedic literature prescribing rules and regulations for the construction of altars imply a knowledge of basic geometry. The skills for these included the fundamental operations of arithmetic and measurement as also abstract mathematical thinking. Subhash Kak, who combines expertise in computer science with Vedic scholarship, seems to have discovered some information on verse numbers in Vedic poetry which is not only interesting and consistent but also thought provoking. He argues from an analysis of the prosody of Vedic *mandalas* that their authors, while evoking the gods of fire and sky, also correlated patterns in the numbers of syllables, lines, and verses with celestial phenomena. He calls this the *astronomical code* of the Rig Veda. It has been suggested that the reluctance to accept Kak's thesis is due to Eurocentric prejudices, which resist any view to the effect that matters of scientific significance could have been known to non-Western peoples. However that may be, Kak's suggestions are compelling for at least two reasons. It is well known that the ancient Indian mind was intrigued by numbers and that it constructed inconceivably large magnitudes. It is

also an established fact that Hindu astronomers systematically observed the skies and recorded patterns in planetary motions. Therefore, in their mythopoeic meditations on cosmic forces and in their dedication to discovering order and symmetry, they could well have incorporated astronomical findings in their hymnal compositions.

Three points may be noted in the context of Kak's theories: First, they are among the earliest technically informed analyses of the number-aspects of Vedic hymns, leading to plausible hypotheses and transcending the traditional spiritual approach to the Vedas. Second, they break ground by providing a revolutionary new paradigm for understanding Vedic hymns. Third, the international scholarship in science history, which until recently has been dominated by the West, is slowly giving way to a diversity of culture-centered histories.

Incidentally, when we mention Vedic altars, we are reminded of the sacrifice of animals. So let us recall the following. We read in George Foot Moore's *History of Religions*:

> In private sacrifices the victim was commonly a sheep or goat; the blood was dashed upon the altar or poured out at the base, the fat of the inwards burned on the altar, the flesh boiled, and eaten by the offerer with his family and guests. Communal sacrifices offered by the elders or heads of families of a town took the same form. On extraordinary occasions the whole carcass of a victim was burned on the altar. The burning of the fat was attended to by a priest, at least at the greater high places, and he had a toll for his service.

This is descriptive indeed, but he is writing about sacrifices in Israeli places of worship rather than about Vedic sacrifices.

Indian mathematicians handled numbers of incredibly large magnitudes. The Yajur Veda Samhita lists multiples of ten up to a trillion and gives names to each of them: 1: eka; 10: dasa; 100: shata; 1000 sahasra; 10,000: ayuta; 100,000: niyuta; 1,000,000: prayuta; 10,000,000: arbuda; 100,000,000: myarbuda; 1,000,000,000: parardha; 1,000,000,000,000: anta. Another text, the *Sankhyayana Shrauta Sutra*, extends the list even further to $10^{17}$. A Buddhist text (Lalitavistara) introduces $10^{53}$! This number is called tallakshana. The work belongs to the first century BCE, but the dialogue is said to have taken place in the sixth century BCE since it is attributed to Gautama Buddha himself.

References to fractional numbers occur already in the Rig Veda. Reducing fractions was common practice. Ancient Hindu mathematicians had an uncanny skill in computational mathematics and for developing ingenious methods for arithmetical calculations, whether with integers or with fractions. Few other cultures developed multiplication tables for fractional numbers. In the Tamil world, there was a time (as late as the early decades of the twentieth century) when children were taught to learn by rote multiplication tables of fractional numbers. In one system 1/320 was regarded as

the smallest number, then 1/160, 1/80, etc. Multiplication tables (*enchuvadis*) had both integral and fractional tables. Children also learned by rote the names of the yugas, each year in the sixty-year cycle, and the zodiacal signs and lunar asterisms. These may have served little practical purpose, but they were good exercises for training the memory. Operations with fractions as well as the extraction of square and cube roots were also well known to ancient Hindus.

Hindu mathematicians were the first to use the place value system of numeration. The historian of numbers Georges Ifrah reminds us that the most ancient extant system that uses decimal-place values is the Jain book entitled the *Lokavibhága*. It was published in 458 CE. By the close of that century, Áryabhata famously wrote: *sthanam sthanam dasa gunam*—place to place, ten times the value.

In Indian writings of the first few centuries CE, there are references to the representation of numbers as is common today. The most efficient decimal notation had its origins in the concept of zero. An important term for zero was *shunya*: void, emptiness. This idea arose from the Buddhist metaphysical view of reality as nothingness. Thus what might appear as empty speculation about ultimate nature led to one of the most fruitful concepts in mathematical thought. The idealist extreme of regarding the world as no more than a passing illusion brought about by our senses called for a symbolic representation of the reality behind the illusion. Originally, this was a simple dot, and the dot grew into a small circle. As A. G. Halsted said in his book *The Foundation and Technique of Arithmetic*, this idea of zero "is giving to airy nothing, not merely a local habitation and a name, a picture, a symbol, but helpful power."

During the seventh century, the decimal notations had become quite common in India. Robert Kaplan pointed out, "Arab merchants found the zero of positional notation in India which they brought to Baghdad along with the other Hindu numerals by 773 CE." That is how they came to be called "Arab numerals" in the West. But it should be noted that Al-Khwarizmi's book, which was to have a great impact in medieval Europe, was entitled *On Calculations with Hindu Numerals* and it was translated into Latin as *Algoritmi de Numero Indorum*.

Hindu thinkers grasped the concept of infinity in a metaphysical sort of way as well. The famous invocatory verse of the Isopanishad says,

> *purnamadah purnamidam purnát purnam udatchyate*
> *purnasya purnamadáya purnameva vashisyate.*

Roughly translated, this reads:

> Whatever is produced of that which is complete, is also complete in itself. Even if many complete units emanate from the complete, the latter still remains complete.

If we replace the term *complete* (*purnam*) with the term *infinity*, the above statement expresses the mathematical insight that infinity multiplied by anything is also infinity, and that infinity minus infinity is again infinity—perfectly valid statements in the context of contemporary mathematics.

Hindu thinkers extended the mathematical idea of infinity, which they called *ananta* (endless), to other things as well. This is also the etymology of the English word from the Latin *infinitus*: that which is without end or boundary. Thus, Hindus spoke of nominal infinity (referring to greatness), epistemic infinity (referring to enormous knowledge), one dimensional infinity (observation along an uninterrupted line of sight), numeric infinity (fraction with zero in the denominator), and temporal infinity (eternity).

Although the idea of negative numbers seems fairly simple to the modern mind, it was quite intriguing to people for a long time, if only because negative numbers do not represent countable things. In Europe, negative numbers came into use only from the sixteenth century through Jerome Cardan and Thomas Harriot's work, but Indian arithmeticians had been using negative numbers consistently since the seventh century. Morris Kline points out in his book on *Mathematical Thought* that "the Hindus used negative numbers to represent debts; in such situations, positive numbers represented assets. The first known use of negative numbers is by Brahmagupta about 628; he also states the rules for the four operations with negative numbers."

Bhaskara (twelfth century) is credited with the authorship of the first book on modern arithmetic and algebra. It is named after Bhaskara's daughter, Leelávati, and has a romantic, though probably legendary, story behind it. It is said that astrologers had predicted that there would be no moment in Leelávati's life auspicious enough for her marriage. Bhaskara, being an astrologer himself, made extensive computations; and he recognized a precise congenial moment at which Leelávati could be betrothed without fear of an ill-starred married life based on her horoscope. He then constructed a device consisting of a cup with a hole, which was left floating in a bucket of water. Water gradually began to enter the cup. The instant when enough water seeped through to sink the cup would be the auspicious moment when the formal step for Leelávati's wedding was to be taken. Leelávati was so fascinated by the device that she bent over to gaze at the gradual trickling of the water into the cup. While she was in that state of wonderment, a little gem broke loose from her garment and fell into the cup. This blocked the hole and obstructed any further entry of the water. The carefully computed instant of good omen could no longer be caught. Leelávati was not to marry!

Bhaskara became as dejected as his daughter. To cheer her up, he decided to dedicate a work on mathematics to her. He assured her that while marital thrills would pass away in a few decades, she would forever be remembered on account of that work. Leelávati's name has indeed lasted a thousand years and more, since it is associated with a classic in the history of mathematics. We do not know to what extent this legend, worthy of a Bollywood movie, is true. But we do know that Bhaskara wrote a

mathematical masterpiece called *Sidhhantasiromani* which has three parts, of which the first one bears the title of *Leelávati*. To get an idea of the poetic format of the problems posed in this book consider the following (T. N. Colebrook's translation):

> Whilst making love a necklace broke.
> A row of pearls mislaid.
> One sixth fell to the floor.
> One fifth upon the bed.
> The young woman saved one third of them.
> One tenth were caught by her lover.
> If six pearls remained upon the string
> How many pearls were there altogether?

The book is a mathematical introduction to the last two parts which deal with astronomy.

Hindu mathematicians were among the first to explore algebra. One name for the subject is *avyakta-ganita*: mathematics of the unknown (unmanifest). In the seventeenth century, Brahmagupta stated that in order to become proficient in algebra, one should be acquainted with indeterminate equations of the first degree, zero, negative and positive quantities, elimination of the middle term, and the like.

Hindu mathematicians investigated quadratic equations too. They recognized both rational and irrational roots of quadratic equations, as well as positive and negative ones. In a discussion of the subject, Bhaskara II (eleventh century) implied that one root of the quadratic equation may not have any physical meaning in a physical problem. In such cases, we should ignore that root. He also went on to give examples where both roots would be physically acceptable.

The ninth-century mathematician Mahavira, while attacking quadratic equations, stumbled upon (what we now call) imaginary numbers. But he discarded them because the idea of a number whose square is negative seemed unacceptable to him. "A negative number by itself is non-square, so its square is unreal," he noted. In this context it may be recalled that A. L. Cauchy, the nineteenth-century creator of complex variable theory once declared that the symbol of the square root of negative one must be abandoned "because one does not know what meaning one should attribute to it."

Religious undercurrents have always been an important aspect of Hindu culture. It also permeated mathematics. Here, for example, is what Bhaskara II said about the Rule of Three:

> Lord Narayana who relieves the sufferings of birth and death, who is the sole primary cause of the creation of the universe, pervades this universe through His own manifestations as worlds, paradises, mountains, rivers, gods, men and demons, so does the Rule of Three pervade the whole of the science of calculation.

Notice how poetry and spirituality enriched the mathematics of the time. Statements like this also reflect the reverence for knowledge that was and still is an intrinsic feature of Hindu culture.

Geometrical figures were studied systematically, often in the context of constructions for religious purposes. The *Sulba Sutras*, dating back to the seventh century BCE, prescribe dimensions of well-defined forms and patterns. Baudháyana and Ápasthambha are credited with the authorship of the various chapters of the text. Familiarity with these enabled Hindu mathematicians to state methods for bisecting angles, for determining the midpoints of lines, and for evaluating areas. These books gave rules for transforming rectangles into square areas and approximated the value of *pi* in efforts to square a circle as also that of the square root of two. These numbers were used in the construction of sacrificial altars.

Some have suggested that Pythagoras probably visited India at one time and got to know about the theorem with which his name is associated in modern geometry textbooks. One of the first speculations about this is in a short story that the French satirist-skeptic Voltaire wrote *Une Aventure indienne*—not as a historian but as a writer of fanciful fiction. This was published in 1768. He says that Pythagoras learned the languages of animals and plants from Hindu thinkers, and he heard a blade of grass saying how unhappy it was that it was born a grass. Without realizing that this story is not exactly complementary to Hindu beliefs, some people quote this as a proof that Voltaire agreed with the idea that Pythagoras learned his theorem from India.

On the other hand, in 1785 William Jones wrote in a more well-informed tone:

> The six philosophical schools, whose principles are explained in the Darsana Sástra, comprise all the metaphysics of the old Academy, the Stoa, the Lyceum; nor is it possible to read the Védánta, or the many fine compositions in illustration of it, without believing, that Pythagoras and Plato derived their sublime theories from the same fountain with the sages of India.

Like their counterparts in Egypt and China, Hindu mathematicians were acquainted with the Pythagorean property of right triangles. There is reason to believe that this result was already known in Vedic times. Hindu geometry also referred to properties of similar triangles and to formulas for the solution of triangles.

Trigonometry was closely associated with geometrical computations. Working in the context of astronomy, a number of trigonometric formulas were developed in India from the fifth century onward. The *Paulisa Siddhanta*, prior to that, was the first to introduce a definition of the sine. Tables of this function were also constructed.

Some scholars detect clear insight into limits at the foundations of the calculus in the writings of classical Hindu mathematicians. Bhaskara II evaluated the volume of a sphere by subdividing it into many pyramids—a technique that is akin to integral calculus. He also introduced a concept to the study of planetary motions that suggests

the notion of instantaneous velocity, and this is closely linked to the differential calculus. We must bear in mind that flashes of insight need to be nurtured and furthered by others in the academic community before they can mature into major, universally recognized breakthroughs. Such a community of mutually enriching scientific thinkers had probably not emerged in India yet, which would explain why these ideas were not developed further.

Vedic hymns reveal interesting symmetries in their poetic meters, suggesting that their authors were as much concerned with the patterns in the numbers of syllables and lines as they were in evoking the gods of fire and sky. These considerations led to ideas of permutations and combinations. The *Anuyogadvara Sutra*, for example, spoke of direct, reversed, and mixed arrangements of a given number of elements. It also explored the problem of permuting six objects among themselves. The *Chhanda Sutra*, belonging to the third century BCE, introduced the concept of *Meru Prastara,* which is an arrangement of numbers in pyramidal form, resembling what is usually called *the Pascal Triangle* in modern books.

In recent years, attention has been drawn to an important finding of the last century, which had been neglected in standard accounts of the history of mathematics. This relates to the discovery of a creative school of mathematics in the south of India, the so-called Kerala school, which flourished from the fourteenth to the seventeenth century. To this school belonged mathematicians whose works were significant advances in mathematical thought. It has been suggested that they had the seeds of what we now call the calculus. Again, in the absence of effective communication systems and the printing press, those insights did not spread to other regions of the Indian subcontinent and therefore did not bear the fruits they might otherwise have. Some believe that this work was translated by Portuguese Jesuits, transported to Europe, and eventually found its way to Isaac Newton.

In this context, we may recall that there was in the eighteenth century a dispute over who originated the calculus, Newton or Leibniz, a fascinating episode which A. R. Hall has narrated in detail. Now as then, perhaps an international impartial jury should be appointed to verify or refute claims as to whether indeed Newton had been inspired by the Kerala school via Portuguese translations. But now, as with the Newton-Leibniz controversy, it is not likely that the findings of such a commission would be accepted unanimously. Cultural predispositions usually trump factual findings in these matters.

The matter of the Kerala school of mathematics reveals the dual aspect of European scholarship on India—its ethnocentrism as well as its universality. The Eurocentric element is revealed by the fact that the discovery of the ancient Kerala manuscripts and their scholarly commentaries in the nineteenth century were largely ignored by Western historians of mathematics. In the historical paradigm of that century, except for a few insights here and there, all matters of deep import were imagined to be ultimately of ancient Greco-Roman origin. On the other hand, the universality of Western scholarship is attested by the fact that the discovery itself was made by Charles

Matthew Whish, a British scholar and employee of the East India Company. In a paper published in *The Transactions of the Royal Asiatic Society of Great Britain and Ireland* in 1834, he wrote: "Kerala mathematicians had . . . laid the foundation for a complete system of fluxions . . . and their works . . . abound with fluxional forms and series to be found in no work of foreign countries." This was resuscitated and explored further by George Ghevarghese Joseph, a scholar from Kerala affiliated to the University of Manchester toward the close of the twentieth century.

**Astronomy and Astrology**

In the Vedic worldview, there were three regions which constituted space: the earthly, the aerial, and the celestial. The sun and the planets belong to the heavens; the wind, lightning, rain, and storms belonged to the aerial sphere, while we ourselves dwell in the earthly region. But the deities are present everywhere.

Recall that rituals and sacrifices have always been important elements in Hindu culture. These had to be performed on well-defined days of the year and at precisely specified hours. This called for exact time divisions and reckonings. Astronomy inevitably came into play.

The year was divided into three *ritus* or seasons: spring, summer, and autumn. The month, called the *masa* (Latin *mensis*), consisted of thirty days. It takes about twenty-nine-and-a-half days for the moon to go from one full-moon phase to the next. Hindu astronomers divided this path of the moon around the earth into twenty-seven (sometimes twenty-eight) *nakshatras* (lunar mansions or asterisms). This was a kind of lunar zodiacal division, except that instead of the zodiacal constellations, one had specific stars in the moon's background. Because there were only twenty-seven or twenty-eight *nakshatras*, but thirty days in a month, at the beginning of each new month the moon appeared in a different lunar mansion. The names of the months in the Hindu lunar calendar were derived from the names of the *nakshatras* in which the moon first appeared in the various months of the year. The *nakshatra* system probably dates back to the eighth century BCE.

A series of influential texts were written, whose object was to present the conclusions and solutions of various astronomical problems. These were called *Siddhantas* (meaning theses), and at least five of these have come down to us through commentaries by later scholars for the most part. The best known is the *Surya Siddhanta*. The work was certainly much older than the extant version which dates back to 600 CE. An English version by Ebenezer Burgess is now available. This treatise includes not only astronomical definitions, descriptions, and problems, but also trigonometric and computational details. What is interesting here is an idea that was adopted later in the Julian calendar system: one counts the number of days elapsed since a particular event. For example, one considered the number of days since creation, which was thought to be almost two billion years earlier.

Periods involving multiple years were considered in Hindu astronomical texts. These were called *yugas*. In Vedic astronomy, one spoke of yugas made up of four, five, or even six years. In later Hindu lore, however, yugas came to mean much longer periods, involving hundreds of thousands of years. In the *Surya Siddhanta*, for example, the yuga consists of 4,320,000 years. Hindu astronomers also spoke of the *kalpa,* which equaled 8,640,000 years. This was taken to be a mere day in the life of Brahma. Here is a poetic rendering of the kalpa concept in Kalidasa's *Kumarasambhava* (Griffith):

> Thou countest not thy time by mortals' light,
> With Thee there is but one vast day and night;
> When Brahma slumbers fainting Nature dies,
> When Brahma wakens all again arise.
> Creator of the world—Thou uncreate !
> Endless ! all things from Thee their end await;
> Before the world wast Thou !—each Lord shall fall
> Before Thee, mightiest, highest, Lord of all;
> Thy self-taught soul thine own deep spirit knows,
> Made by thyself thy mighty form arose;
> Into the same, when all things have their end,
> Shall thy great self, absorbed in Thee, descend ;
> Lord, who may hope thy essence to declare ?
> Firm, yet as subtle as the yielding air—
> Fixt, all-pervading; ponderous, yet light,
> Patent to all, yet hidden from the sight.

It is worth noting that there are several interpretations and reckonings of the yuga unit in Sanskrit literature, ranging from the epics and the puranas to astronomical texts and commentaries. Some modern writers who feel uncomfortable with exorbitantly huge figures have tried to give new interpretations to reduce these figures to more reasonable measures, not unlike scholars in the Judeo-Christian tradition who try to stretch the one-week cosmology of their scriptures into a few billion years to make it more in tune with the findings of modern science. Thinkers fettered to the past seem compelled to show that the ancients of their own traditions were as well informed about the physical world as moderns. They are so culture-bound that they would defend the science of their ancestors at any cost—sometimes through clever reasoning. Unfortunately, this is often convincing only to their coreligionists. Be that as it may, what is truly impressive is that time scales we find in the yuga framework do not seem to have any parallels in the history of human thought until the advent of twentieth century cosmology.

Another interesting insight in the yuga concept is that the world is more or less completely destroyed at the end of each yuga, to be recreated again by Brahma, the Creator Principle. At the end of each kalpa, the entire universe regresses into its pristine

chaotic state—actually dissolves into nothingness—only to reemerge again with new law and order. The modern picture of an oscillating universe seems to be a present-day echo of this ancient suggestion.

The *Vedanga Jyotisha* dates back to the seventh or eighth century BCE. Vedic views continued to have their impact on Indian astronomy even after Mesopotamian and Greek astronomy began to infiltrate the Indian scene. It often happens in the history of science that imported ideas and information grow with fresh color and fragrance in a new locale, enriched as much by the originality of the thinkers who receive them as by the traditions and cultures to which they are heirs.

The following statement reflects the high esteem in which ancient India held astronomy: "He who is versed in astronomy, the science of time reckoning, knows the sacrifices." This statement recognizes the role that careful observations of stars and planets play for practical purposes. It is one of the most ancient examples of the use of scientific knowledge for a societal activity.

The astronomer Áryabhata I (fifth century) began his treatise with a detailed mathematical introduction. Besides defining astronomical coordinates, his work also explains the rising and setting of the sun and stars by the earth's rotation.

For many long centuries, Hindu astronomy was linked to astrology. The intertwining of these two fields was not peculiar to the Hindu world. But folk astrology continues to exert considerable influence in the lives of many people in India to this day. Hindu almanacs present auspicious hours for initiating tasks, journeys, and happy events; they prescribe months, days, and hours for matrimonial and other celebrations. Specific hours—declared to be under the evil dominance of Ráhu, a mythical inauspicious personified planet—are declared unpropitious for any enterprise. The compatibility of horoscopes, revealing planetary and zodiacal influences on human life, still governs the choice of marriage partners in many cases. Major festival and fasting days, pilgrimages, and rituals are determined by the positions of the sun, moon, and stars. Of late, Hindu rationalists have been vigorously challenging the authenticity of astrology as intrinsic to Hindu culture.

**The Physical Sciences**

In their interpretation of the physical world, ancient Hindus developed ideas and theories that resemble some aspects of ancient Greek and Chinese sciences. It would be unreasonable to deny mutual influences, but one hesitates to declare categorically who influenced whom in what matter or how. These questions are interesting to professional historians of science, but they need not concern us in our discussions, because there is hardly any unanimity among scholars.

As elsewhere, Hindu doctrines on the nature of matter were related to philosophical positions. They transcended pure intellectual analysis, however, as their ultimate concern was with spiritual enlightenment. Unlike the Judeo-Christian tradition where spiritual knowledge primarily dealt with theology and ethics, in Hindu thought there

were also extensive discussions of matter and consciousness in this context. Physical as well as metaphysical reflections abound in Hindu philosophical writings.

The Nyáyá school of philosophy propounded the Five Element theory of matter in Hindu science. Here, aside from earth, water, fire, and air, there was *ákásha*, corresponding to the Aristotelian ether. But the ákásha had a variety of contextual meanings as expounded in great detail by Jonathan Duquette. Jaina metaphysical speculations dating back to the sixth century BCE developed an atomic theory which was akin to the Democritean idea. This theory underwent modifications over time. In its Nyáyá version, the ultimate atoms differed from one another, whereas in more ancient times they were all imagined to be identical. Atoms in the Hindu framework had taste, smell, color, and two forms of touch. Ancient Indian thinkers seem to have realized the ultimate minuteness of atoms, for they stated that their existence could only be inferred, never directly put into evidence—an idea that was also expressed by Jean Le Rond d'Alembert in the eighteenth century and by other nineteenth-century scientists. It would be a stretch to contend that because the ancients (Chinese, Greek, Hindu, or Jain) talked about atoms, they knew all about atoms as the moderns do.

The Vaiseshika Sutra discusses the nature of motion. Motion, it says, could exist only for a few moments because it has no intrinsic quality of its own. Motion ceases to exist as soon as it produces an effect. This statement is equivalent to saying that a moving body would cease moving once its kinetic energy is exhausted. Motion is also described as something that can be both cause and effect. If we take on the kinetic energy aspect of motion, this view makes sense. After all, kinetic energy can result from an external agent (such as a push), and it can also cause certain phenomena (such as heat). It is important to remember in such interpretations that the precise notion of kinetic energy and its quantitative measure did not emerge until the nineteenth century.

The commonly observed phenomena of falling bodies and arrows in flight must have provoked inquiring minds into theoretical considerations of motion. Indeed, such examples are often cited. One also finds in these writings glimmers of the concepts of impetus, which was considered by some medieval European thinkers. There were considerations of concepts akin to force and momentum, which again came to be defined and discussed thoroughly centuries later by medieval thinkers. They explored the concept of perpetual motion. In fact, in the seventh century CE, Brahmagupta toyed with the idea of constructing a wheel that would turn ceaselessly: *ajasram brahmati.* In Bhaskara II's twelfth century work, *Siddhanta Siromani,* there are instructions for making such a machine. Zaheer Baber recalls in his Science of the Empire that according to the eminent historian of medieval science Lynn White, Bhaskara's idea seeped into Europe via Arab scholars and led the way to the idea of power technology in Europe.

Heat and light were regarded as related because of the commonalty of their source: fire. We may recall that the identification of the two as aspects of energy was a nineteenth-century discovery of modern science. The heating of a body was analyzed in terms of different stages through which its atoms pass. Flame was regarded as a

large collection of particles of light. Hindu physicists spoke of light corpuscles—which some relate to the photon concept—but they also believed that such particles emanated from the eye and that by falling on bodies, they rendered them visible. Empedocles of ancient Greece expressed a similar idea.

The phenomenon of the falling of bodies was attributed to two of the four elements: earth and water. Calling this property *gurutva,* which simply means heaviness, but which some have liberally translated as gravity, Hindu thinkers regarded it as the qualitative attribute of all material substances rather than as resulting from external causes. In this sense, it was quite different from the modern notion of gravity. *Gurutva* was looked upon as a macroscopic property, which the individual atoms did not possess.

Other properties of matter defined and studied in classical Hindu science included fluidity, viscosity, and elasticity. All these were explained in terms of the corresponding properties of the constituent atoms. Thus the atoms of water, fire, and earth were supposed to have fluidity, while viscosity was a property of water only. Only earth substances were endowed with elasticity. It must be emphasized that, like all ancient physics, these properties were investigated entirely at the qualitative level. No measurements were involved. What is impressive is that investigators considered these physical properties of matter. Science consists in explorations more than in the final results.

Hindu thinkers also explored the notions of space and time. They regarded space as a substance which has its own individuality. This was the non-metaphysical meaning of *ákásha*. This was taken as all-pervading, eternal, and a fundamental cause of physical phenomena. It has been compared to the vacuum state of quantum field theory. Hindu thinkers gave a special role to the sun. They suggested that it was the sun which, by its rising and setting, specified directions in space, such as east and west. Indeed, in an imaginary empty space there are no visible or absolute directions. There is a glimmer here of what is known as the cosmological principle in modern science. The thinkers also contended that the sun was responsible for our recognition of the flow of time. If the sun stood still, the day would not advance, and there would be no perception of cosmic time advancement. This reflects the insight that there can be no measure, even experience, of time in a world where there is no motion. All time reckonings depend on some motion (often periodic) or other. It was not until the nineteenth century that the connection between the arrow of time and irreversibility was understood by modern science.

Time was regarded as a physical reality. Its role was stated to be the production, sustenance, and annihilation of things. In this context, Indic thinkers went beyond Ovid—who described time as only the devourer of things. In the Indic view, time connects individual events with the revolution of the sun. It is also responsible for the aging and decay of everything in the world. Some thinkers introduced the notion of a time atom, like the idea of the *chronon* suggested by modern physicists like Robert Lévi and Henry Margenau. It was called *truti* and corresponded to 1.33750 seconds.

Hindu thinkers imagined the universe to have arisen from water, reminding us of Thales of Miletus. In the Chhandogya Upanishad, we read, “It is simply water that

has solidified: the earth, the air, the sky, the gods and men; beasts and birds, grass and trees, animals and worms, flies and ants; all these are just water solidified." What matters here is the insight for the search of something physical and fundamental from which everything arose. Such ideas, whether in India or elsewhere, were the precursors of what physicists now try to find—a Theory of Everything (TOE).

**Chemistry**

Human beings have always manipulated matter. While shaping clay and forging metals, they developed a keener understanding of materials and their properties. Thus chemistry arose in very ancient times. But substances are also eaten and ingested. Food is a substance. Therefore, a study of its properties is a branch of chemistry. We chew and swallow not only for nourishment and palatal pleasure, but also to cure ailments and diseases. Medicinal materials thus came to be studied, and this too became a branch of chemistry, called iatrochemistry.

Herbs, plants, and mineral concoctions not only cure diseases; sometimes they also bestow health and strength. One is tempted to explore these if they can restore youth to aging bodies and if they can prolong life indefinitely. Such were the inspirations for the ancient science of alchemy, the progenitor of what we call chemistry. Immortality is not merely imperishability but continuation without damage or decay. Many materials persist forever and ever, but they rust and rot in the meanwhile. The elements (water, air, and fire) seem to hurt and harm substances slowly or quickly. But not all substances are subject to the ravages of the elements. Glittering gold and shining silver seem to be beyond corruption. So these so-called noble metals came to be venerated from time immemorial. If we can find potions that will render humans immortal, we should also be able to come up with methods for transforming ordinary substances into the immortal substances of the material world, namely gold and silver. This became a concern of alchemists as well.

Nonalchemical chemistry flourished in India in the arts of metallurgy and ceramics, in the smithies and *múrti* (idol) factories of the land. Efforts were also made to find substances that would beautify the body and add fragrance to the skin. In later times, explosive salts were prepared for pyrotechnic spectacles. Oils were extracted and candles were made. All this was chemistry too.

Alchemy dominated the scene for at least five centuries in medieval India—from the tenth through the fourteenth centuries. Whether indigenous or of alien import, it evolved in local settings with its characteristic flavors. It became wedded to Hindu mythology and mysticism, and it developed secret ways and grotesque methods in attempts to achieve impossible goals of immortality and transmutation.

Mercury was the supreme substance of sanctity for alchemists. Struck perhaps by its unusual state (the only metallic substance that is liquid at ordinary temperatures), alchemists revered the element mercury and imagined that it had extraordinary prowess. Mercury was called *rasa* (Sanskrit for *essence*), and alchemy itself was

known as *rasavidya*: knowledge of rasa. The properties of mercury are elaborated in a tenth century alchemical text called *Rasarnava*: Sea of Mercury. Here it is stated that a material is to be treated in eighteen different ways before its full potential can be realized. These include steaming, grinding, distillation, blending, etc. This passage suggests that the ancient practitioners were familiar with these processes. Rules were prescribed for the construction of the room where alchemical experiments would be carried out. The laboratory had to be in a region blessed with medicinal plants. There were to be four principal doors, furnaces had to face the southeast, instruments had to be in the southwest, and so on.

The alchemical laboratory contained a variety of apparatuses. These included sieves, bellows, crucibles, pans, and retorts. It also had a phallic symbol made of an amalgam of gold and mercury, or of sulfur and mercury, facing the east. This was because—in the symbolism of Hindu alchemy—mercury represented the seminal essence of Lord Shiva and sulfur represented the menstrual flow of his consort, Gauri, of golden hue.

A vestige of ancient Hindu chemistry may be found in one of its metallurgical marvels. An impressive iron pillar stands near the Indian capital of New Delhi—more than twenty-four feet tall and weighing more than six tons—that is known to have been erected sometime in the distant past. Depending on the historian you consult, it was erected in the fifth or in the tenth century. But what is really impressive is that it contains minute proportions of carbon, silicon, sulfur, and phosphorus—revealing an understanding of metallurgy more than a thousand years ago. The pillar has not suffered the passage of time. From a long inscription etched on it, historians have concluded that it was a commemorative pillar to record the victory of a king by the name of Chandra (Chandragupta Maurya), not unlike Napoleon's *Arc de Triomphe* in Paris to commemorate his victory at Austerlitz. Valentine Ball, a late-nineteenth-century geologist from Ireland, concluded upon inspecting the pillar that it furnished "evidence of the existence of a metallurgical skill at that early period which could not have been equaled in Europe a few years ago. It is only within a very short period of time that it has become possible for the iron forges of England to manipulate equally large masses of metal."

S. Kalyanaraman has suggested that "the chronology of Hindu civilization may unravel as the sequencing of metallurgical tradition unravels, culminating in the magnificent monument called the Delhi Iron Pillar,"

**Medicine**

As in China, the Indian field of medicine has an elaborate system. It involves a complex theoretical framework and well-defined practice that developed over two thousand years ago and continues to exert its influence down to our own times both within India and beyond. It must contain intrinsic merit to have persisted. Unlike theories as to the nature of matter or the universe, or fantasies of astral influences, medicine affects those who accept it in very personal ways.

The ancient Hindu theory of diseases was based on certain fundamental ideas. To begin with, there is more to us than body and mind. We also have a soul. There will be good health for the body as long as it is in balance with soul and mind. In other words, equilibrium among body, mind, and soul is a *sine qua non* for healthy life. But once in a while, the equilibrium is perturbed. Mutual imbalance results in ailments.

Now we may ask about what breaks the balance. Ayurvedic theory says this could be due to three kinds of correlations between time, mind, and the senses. These correlations are described as adverse, null, and excessive. In this context, time refers essentially to one's chronological age and one's stage in life. For example, when a youth runs for an hour without stopping, he may not be affected at all; whereas an old man might breathe heavily or even collapse. Here we have cases of null and excessive correlations.

In this theory, there are also three basic principles in the body that require proper balance. These are *vata, pitta, and kapha*—wind, bile, and phlegm—each a combination of two of the five basic classical elements—earth, water, fire, wind, and ether. Any disturbance in their equilibrium is known as a *dosha*: fault. Specific medications are prescribed for each particular *dosha*. Experts point out that the terms *vata, pitta, and kapha* do not refer to the usual products of processes within the anatomy but to certain overall states of the body. We are reminded here of the four humor theory of Hippocrates of Kos according to which black bile, yellow bile, phlegm, and blood are in balance in a healthy individual; and when that balance is disturbed, ailments ensue.

But there is a difference between the historical status of Hippocrates and the founder of Ayurveda. Hippocrates is still remembered in Kos where tourists are shown a five-hundred-year-old tree under which the ancient Greek is said to have taught his pupils. In India, on the other hand, Dhanvantari, the referenced founder of the system, is alive and well only in mythology. No one has any idea when and where Dhanvantari lived or even if he was a historical person. No tourist spot claims to be his birthplace. But he is regarded as a personification of Vishnu. He is pictured with a conch shell, an energy discus, a leech, and a vase containing *amrita*, the immortalizing potion. He is evoked in a hymn that says he destroys disease like a forest blaze. There is a shrine for him in the celebrated temple in Srirangam. There is a magic in the spiritualization of every aspect of culture that secularization of history destroys. Such secularization has not happened in many contexts in Indic culture, though there are forces afoot to do just that.

The four-humor framework of Hippocrates has been discarded as an erroneous, though interesting, interpretation of bodily functions. No physician in the West takes the four humor theory seriously anymore, but the *tridosha* concept is alive and current in the world of Ayurveda. Indeed, the framework of Ayurveda has been growing and expanding with further research in several prestigious institutions. It is a fruitful and successful school of medicine. It is also gaining popularity beyond the borders of India. Its greatest merit lies in the intelligent and effective use of medicinal plants and

herbs instead of potent, synthesized drugs, some of which tend to be addictive and may lead to serious and unwelcome side-effects.

The Hindu genius for taxonomy may be seen in the medical texts that teem with categories and subdivisions. Sometimes the same item is classified in different ways based on different criteria. Thus, diseases are classified as physical and mental; as accidental and constitutional; as resulting from disturbances in wind, bile, phlegm; or as easily curable, as curable with difficulty, or as incurable. Ancient medical texts list a variety of diseases: of the eye, of the lungs, of the heart, of the urinary tract, etc. There are references to skin eruptions, rheumatism, asthma, epilepsy, tuberculosis, and leprosy. The lists include not only plain headaches but also loquacity.

The origin of diseases is also traced to three sources. Inherent diseases belong to the first category. These are said to arise from factors that are part of the individual since conception and birth. They correspond to what we call congenital or genetic diseases. The second type of origin is external. Diseases could arise from unexpected events over which the sufferer might have little control, such as a snakebite or finding oneself in a region where there is an epidemic. These are referred to as accidental diseases. When we catch a cold by being enclosed in a plane where lots of people are sneezing, we have a case of an accidental disease. Finally, there are diseases with origins in the wrath of a god or a demon or from time and old age. These are regarded as inevitable and incurable diseases. Such would be a sudden affliction of cancer.

Although the physical basis of diseases was recognized, as elsewhere in the ancient world, there was also a strong belief that magical influences were present in all diseases. All this was part of the ancient worldview in which the supernatural was taken for granted. This essentially is where modern and ancient science diverge: the former rejects the hypothesis of the supernatural completely, whereas the supernatural is an integral part of the ancient. Because of this hypothesis, there were also spells and incantations, prayers and pilgrimages associated with all traditional Ayurvedic medicines. Needless to say, in many instances, these had therapeutic effects, if only because of the psychological basis of many common diseases. However, in the modern practice of Ayurveda this component is rarely if ever mentioned.

Diagnosis was stressed. Charaka, the greatest physician of the tradition, if not the name of a group of them, warned, "The physician who, without carefully ascertaining the disease, commences his treatment, seldom meets with success even if he be well conversant with medicines and methods of application." The cure of an ailment results from the effective manipulation of the patient by the physician, the drug, and the nurse, says the same ancient authority. He compares medical treatment to the process of cooking where "a vessel, fuel, and fire are the means in the hands of the cook."

The list of drugs in the medicinal lore is impressive. Several hundred concoctions of plant, mineral, and animal origin are mentioned. It is clear that these developed as a result of frequent use and considerable experimentation, although astrology and analogy also suggested some of them. Mercury and gold, a variety of herbs, salts and gems, milk and marrow were all used in preparing a range of medications.

The principal aim of medicine is no doubt good health and longevity. Hence ancient Hindus called their medical science Ayurveda: the science of longevity. Ayurvedic treatises date back to the early centuries of the Common Era, but their framework was already laid in Vedic literature. The two most outstanding names that occur in the classical medical texts are Charaka and Sushruta. Their works have survived almost in their entirety and are the sources of our knowledge of ancient Hindu medicine. The age in which these men lived and practiced is not known with any certainty.

Sushruta is regarded as the greatest of Hindu surgeons. The *Sushruta Samhita* discusses surgery with references to the dissection of cadavers. Here we find a remarkable listing and classification of surgical instruments. Razors, forceps, pincers, needles, and hooks were among the many surgical tools mentioned in this text. It is also stated that physicians should have these instruments made by capable blacksmiths who use only strong and tempered iron.

The names of Charaka and Sushruta stand out as the spiritual masters of Indian medical writers. We remember them because they have left behind treatises that tell of their works, thoughts and philosophies. But there surely must have been many more physicians and surgeons who attended to the ailments of countless people all through the ages without leaving any written legacy.

Since time immemorial, their analyses of medical knowledge and rules governing good health and medical practice have been held in great reverence by physicians in India. In medicine, perhaps more than in any other field, science combines with humanity to bring out what is best in our endeavors, for ultimately our efforts are for reducing pain and suffering and for bettering the human condition. This is illustrated in a passage from the *Charaka Samhita:*

> Of all the physicians, he is best who practices medicine, not for wealth or personal gratification, but purely out of compassion for life. Those who exploit medical knowledge as just another commodity, purely for monetary gains, run after a heap of dust while ignoring the real mound of gold. None offers greater blessings, moral or material, than the physician who severs the death-noose and restores life and health to the victims of fierce disease. He who performs the healing art with care and compassion, regarding this as the noblest of professions, is entitled to the greatest happiness.

Other items of medical interest mentioned in some of the *samhitas* include amputation, rhinoplasty, and trepanning. Strict rules of hygiene were prescribed. Principles governing sexual encounters were enunciated. Even hypnotism seems to have been practiced for curative purposes.

In his systematic study of ancient texts, the Marxist scholar Debiprasad Chattopadhyaya has brought out the important role that medicine played in the growth and development of ancient Indian science in general. He concluded from his analyses that the scientific development of medicine was a threat to the highly organized religious

orthodoxy. Because of this, he says, the more rationalistic and secular aspects of medical theories were condemned by the establishment which would rather stress the ritualistic and magico-mystic sides. This self-serving preoccupation of the priestly class, contends this scholar, thwarted the full blooming of the positive sciences in ancient India.

It should be mentioned that Ayurveda was not the only medical system in India. There were, and still are, other medical traditions too, such as the Tamil *siddha*, the Greek/Muslim *unáni/tibb* that are practiced in India—underscoring the multicultural aspect of the tradition and multifaith landscape that has always been the strength and stature of the land. Indeed, the greatest lesson we learn from the Indic approach may best be described as the doctrine of polyodosism: there are many paths to truths and fulfillments, whether spiritual or religious, or to the practical problems facing the individual, a group, or humanity.

**Sanskrit and the Science of Grammar, Acoustics, and Phonetics**

Sanskrit is generally known as the sacred language in which Vedic hymns and the Bhagavad Gita are written. But there is more to the language than its religious relevance. The vast corpus of writings in Sanskrit includes every conceivable topic, from mythology and philosophy to prayers, law, mathematics, and science. As Dasgupta and De eloquently declared in their *History of Sanskrit Literature*:

> The majesty and grandeur of the Sanskrit language, the sonorousness of the word music, the rise and fall of the rhythm rolling in waves, the elasticity of meaning and the conventional atmosphere that appears in it have always made it charming to those for whom it was written . . . The wealth of imagery, the vividness of description of natural scenes, the underlying suggestiveness of higher ideals and the introduction of imposing personalities often lend great charm to Sanskrit poetry.

W. C. Taylor, writing in the Journal of Royal Asiatic Society, said that India

> possessed . . . a language (Sanskrit), the parent of all those dialects that Europe has fondly called classical—the source alike of Greek flexibility and Roman strength. A philosophy, compared with which, in point of age, the lessons of Pythagoras are but of yesterday, and in point of daring speculation Plato's boldest efforts were tame and commonplace. A poetry more purely intellectual than any of those of which we had before any conception; and systems of science whose antiquity baffled all power of astronomical calculation. This literature, with all its colossal proportions, which can scarcely be described without the semblance of bombast and exaggeration claimed of course a place for itself—it stood alone, and it was able to stand alone.

Science is a methodological inquiry into any aspect of perceived reality and of human experience. The structure and syntax of language may also be studied in systematic ways. Sanskrit and Tamil and their derivatives are unique in that their consonants are arranged in a sequence of sounds that begin from the throat and come to the lips via the turned and unturned tongue with corresponding nasal sounds. Indic thinkers were the first to undertake a systematic study of vocal sounds and language structure. They carefully analyzed spoken Sanskrit and the hymns of the Vedas. This was deemed necessary as language gradually deviated from the still more ancient sacred texts. Between the fifth and the seventh centuries BCE, a scholar by the name of Pánini wrote a classic work which continues to hold a prestigious place in the study of Sanskrit to this day. The book has been taught for centuries to all students who study the language in any depth. Few other works in the history of science have achieved such uninterrupted respect and longevity.

Pánini's four thousand aphorisms describe the rules by which words are formed and the correct use of the language. The terseness of the aphorisms is valuable for committing them to memory. Pánini's insight lay in recognizing that the words of a language are derived from certain basic roots through inflections and other modifications—not unlike that of the chemists of the eighteenth century who realized that all substances are derived from a set of basic elements. He listed some two thousand such roots for Sanskrit and stated strict rules for the combinations of words in accordance with the laws of euphony. His work has served as a model and inspiration for philologists and grammarians for two thousand years.

The discovery of Pánini's work by European scholars gave rise to the science of comparative philology in the eighteenth and nineteenth centuries. It is widely recognized that Pánini's work contains concepts that are part of modern linguistics. The notions of the phoneme and morpheme in modern linguistics are akin to Pánini's views. It is generally agreed that Páninian grammar influenced many modern linguists—directly or indirectly. Pánini invented what is called a syntactic metanotation similar to the context-free grammars of current linguistics. This is a remarkably penetrating insight into complex and fruitful ideas that occurred to an ancient thinker who clothed them in the framework of his time. Its full significance could be grasped only centuries later.

**Centers of Learning**

In the Western world, Plato's Academy and Aristotle's Lyceum were the first formal centers of learning. Then, after long centuries the schools and universities of medieval Europe evolved into our current institutions of higher education arose. There were many centers of learning in ancient and classical India too. Students from far and wide thronged here by the hundreds, sometimes from countries beyond. Archeologists and historians have brought back to life the buried relics of several such centers. There was a renowned school at Takshasila (Taxila) in the sixth century BCE, for example. It is said that Kautilya, the political scientist; Charaka, the physician; and

Pánini, the grammarian—all illustrious names in Hindu intellectual history—were among its immortal alumni. Then we have relics of schools at Káshí and Kánchí which were renowned for their religious studies. There was also one at Ujjaini, which was a major center for astronomical studies in its glory days. This was also where the great Vikramaditya ruled and where Kalidasa—the king of Sanskrit poetry—lived and composed. But perhaps the most famous of all ancient Indian universities was Nalanda, a Buddhist monastic school where aspirants spent more than a decade learning and practicing spiritual disciplines through canonical texts. Logic, grammar, and medicine were also taught.

During the reign of the Emperor Kao-Tsung of the Tang dynasty in China, several works were published by Chinese scholars on their travels to India. Many of them are lost, but some have survived. The most famous of those scholars was Xuangzang (seventh century CE) whose name has been written in at least a dozen ways. He was eager to collect as much knowledge and books on India as he could to add to the growing corpus of works on Buddhism in his native country. With this in mind, he started his journey in 605 CE. He broke the rule imposed by the local king, which prohibited the Chinese from crossing the boundaries of their country because of the troubled political situation of the time.

He also visited Mathura, whence he turned north to Thanesar and the upper Jumuna and Ganges, and south to Kanauj, one of the great capitals of India. The pilgrim entered some famous cities such as Ayodhya, Prayaga (Allahabad), Kausambhi, Sravasti, Kapilavastu, Kusinagara, Pataliputra, and Rajagriha. Thanks to his writings, we know that there were fifty monasteries in Pataliputra and that some ten thousand monks were affiliated with these. He reports having seen temples to Hindu deities and hundreds of monasteries in ruins. He secured admission into Nalanda University. He has left behind vivid descriptions of its splendor. The entrance exam for the university used to be very difficult: barely 30 percent of the applicants were successful. He studied Sanskrit as well as Hindu and Buddhist philosophies under Shilabhadra and Buddhabhadra.

There were several other major centers of learning in ancient India: Somapura, now in Bangladesh, Valabhi in Gujarat, Vikramshila in Bihar, and Ratnagiri in Orissa. He explored the south and west of India, going as far as Kanchipuram. He speaks of countless monasteries and thousands of Mahayana monks there, and about a famine in Sri Lanka in which many people died. Xuangzang went to Konkanapura, Maharashtra, and the caves of Ajanta. It is hard for us to imagine how—in the seventh century when roads were not as direct or well-laid and motels were nonexistent—a man covered that much territory and carried manuscripts all the way back home. He was at least seventeen years away from his native China.

In recalling our history, we seldom express our gratitude to the scholars who have resurrected the past for us. Thus the world would have left all this buried in the obscurity of the forgotten past were it not for two scholars, one French and one British. Stanislas Julien translated Xuanzang's book into French in 1857, and Thomas Watters brought out an English version under the title *Journey to India in the Great*

*Tang Dynasty* in 1905. The second book prompted the archeologist D. B. Spooner to undertake the project of unearthing the relics of Kanishka Stupa, which is said to have been more than six hundred feet tall.

It has been recorded that aside from a great many works on Hindu philosophy and on Buddhism, Xuanzang carried back with him statues of Buddha made of gold and sandalwood and that he was received with much honor in his native land where a special pagoda was built to house his scholarly acquisitions.

We do have a few biographical details about the great Chinese scholar. He came from a family imbued in Confucianism. He himself is said to have become a ritualistic Confucian even as a lad of eight. Later, following the steps of his older brother, he became a Buddhist monk. In 918, political upheavals drove him and his brother to a different region of China whose ruler was a Buddhist. It was from here that his travels began.

The skull of this great man is still preserved. It is said to have been in China for a long time, and in 1956 it was brought by the Dalai Lama into India and presented to the Indian government. Today, it is in a museum in Patna. Xuangzang is honored and revered both in India and in China. His life and work illustrate the contributions that scholars make to the dissemination of culture and the transformation of societies.

**Concluding Remarks**

We have seen in the brief references made in this chapter that ancient and classical India made impressive progress in crafts and technologies as well as in the sciences. In astronomy and mathematics, in alchemy and medicine, records show that inquiring minds have been active in the subcontinent from time immemorial. There surely were exchanges and interactions with contemporaneous science and civilization in other parts of the world, notably with China, Greece, and (later) the Arab world, beginning probably with Babylonia in more ancient periods. As elsewhere, Hindu science had to give place to newer conceptions and worldviews of the modern scientific era which emerged in Europe by the seventeenth century.

Of the principal characteristics of science in classical India, computational techniques were certainly the most salient. There was also rich imagination. Astrological emphasis was unusually dominant, so far as to neglect in later times the observational side of astronomy. Rituals and mysticism were closely linked to alchemy and medicine, while metaphysical speculations, intent upon seeking liberation for the soul (*moksha*), were often the mainsprings for physical theories. All this did not deter serious investigations and discussions, competing worldviews, and theories within the constraints of the cultural framework. At the same time many technologies also thrived: iron and paper, silk and textile, pottery and distillery, to name a few.

In this context, one may ask some questions: Why did such an intellectually alert people fail to develop what we call modern science? Why did they not bring about what we describe as the Scientific Revolution and the Industrial Revolution? But

then one may raise the same questions with respect to ancient Egypt and Babylon, China and Greece also. These are difficult questions, and scholars have tried to give various answers to them. In practically all cultures, external and/or internal forces arise, overtly or subtly, to stifle the victories and vitality of a people after a reasonably long time-span of robust activity.

In the case of India, on the one hand, the inordinate reverence for ancient writings because of their close association with religious matters carried over—and still carries over in certain circles—to scientific matters as well. This tended to deter independent thought and the spirit of questioning. On the other hand, a series of external forces in the form of subjugating invaders put the people on the defensive. Foreign cultural and religious intrusions have the effect of pushing a people even more intensely toward whatever they can claim as their own. This is not very conducive to the development of new ideas and perspectives either. Finally, in order for science to develop in the modern sense, knowledge must become more widespread, rather than be confined to a handful of pundits. This could not be achieved before the invention of printing and other social changes.

In the self-appraisal of cultures, it is important to avoid what the eminent scholar and historian of Chinese science, Joseph Needham, described as *arrogant ignorance*. He wrote this with reference to Western historians of science who believed that all worthwhile science had its origin in the West—with perhaps some nourishment from ancient Greece and the Arab world. But it is equally important to remember that there are Indians who think that everything worthwhile in the world started in India and Chinese who are convinced that everything of significance has its origin in China and so on.

Indians sometimes remind Westerners that when Europeans of a distant age were in a rather primitive state of culture, Hindus were writing sophisticated poetry and engaging in lofty philosophy. Indeed, Western scholars willingly accept this. Oliver Goldsmith, in his *An Abridgment of the History of England*, said this about his ancestors:

> They sacrificed human victims, which they burned in large wicker idols, made so capacious as to contain a multitude of persons at once, who were consumed together . . . They lived in woods, caves, and hollow trees; their food was acorns and berries, and their drink water . . . Their lives were simple, but they were marked with cruelty and fierceness . . . The Britons had long remained in this rude but undependent state, when Caesar having overrun Gaul with his victories . . . determined upon the conquest of a country that seemed to promise an easy triumph . . .

One should also acknowledge that when many cultures were still steeped in supernatural fantasies and superstitions in their efforts to explain natural phenomena, Europe was harvesting and distributing knowledge that came from the framework of

modern science—knowledge which has now become universal in the international scientific community.

Modern science had inputs and inspirations from other cultures, no doubt. Yet the scientific revolution initiated in Europe in the sixteenth and seventeenth centuries was utterly different in methodology and tools. It was not a mere continuation or elaboration of previous endeavors. It broke from past constraints, worldviews, and assumptions. All who contribute meaningfully to modern science do just that.

## III. Mythos: Origins and Ends

*Who really knows, and who can swear,*
*How creation arose, when or where!*

—Rig Veda (Book X)

### Introduction

Questions related to origins are among the most intriguing ones that taunt the human mind. How did we humans come to be? What is the origin of the physical world in which we find ourselves as conscious entities for a few decades? Why did we emerge at all? Equally perplexing are questions relating to the eventual destiny of individual human beings, for after a brief span on earth, everyone dies. What happens to our individual consciousnesses once our physical bodies cease to function? Then again, one may also wonder about what will happen to the earth and the stars and to the whole universe in the very long run.

These are not only interesting questions in themselves; they are inescapable when one reflects on the nature of things. Human minds in every culture have been grappling with questions of origins and ends since time immemorial. The religious traditions of the human family have provided various answers to such questions.

Traditional creation stories may be considered from three different perspectives: They may be regarded as profound revelations of how all of this came to be—revelations to the prophets and sage-poets of religions who have proclaimed the truths such as they have received from a higher source. Or they may be taken as profound truths hidden under the veil of symbolic poetry—presented in ways that are more easily grasped by ordinary minds. Finally, they can be taken as ancient attempts by keen thinkers to account for the puzzling and fascinating questions challenging us.

It is difficult to take the creation stories of the traditions literally if one is committed to the modes, methods, and results of modern science. Some of the ancient narratives on cosmogenesis and biogenesis will have to be replaced by more recent ones, because the latter are based on more knowledge, information, and more stringent

criteria for truth content. If one takes any scriptural cosmogenesis literally and insists on its validity in the context of current science—as some well-meaning religionists do—then unhappy and awkward encounters between religion and science become inevitable. This is as valid in the context of the Hindu world as in the Judeo-Christian, Islamic, and Buddhist worlds.

Religious visions on origins and ends are invariably tied to supernatural sources—those of science decidedly are not. It is understandable, and some find quite reasonable, in the context of a clash between science and religious doctrines, to relegate the methodology of science to one of several equally valid approaches that the human mind might adopt to grapple with ultimate questions. This is a postmodernist approach and may have a culturally satisfying merit, but it is not one that most practicing scientists are inclined to adopt.

**General Comments on Ancient Visions of Cosmogenesis**

In every culture, one particular approach to cosmogenesis has come to dominate the group's collective worldview. Like the inventor of the wheel, the names of the originators of mythopoeic pictures of cosmogonies have dissolved in the haze of prehistory. By that very fact, it would seem that their visions acquired an immortality that eluded Thales and Chárvaka, Descartes, Kant, Laplace, and Lemaître. Whereas the cosmologies with which the names of these mortals are associated have been debated, accepted, and discarded with the passage of time, those of the more ancient and anonymous texts persist in their venerated status as divine revelations. It would seem that the less we know about who propounded a view of the beyond, about its how and when, the more firmly it tends to be engraved in the consciousness of cultures. Thus the verses of the Bhagavad Gita, the sayings of Zoroaster, and the contents of the book of Genesis have acquired a sanctity that the works of Pythagoras, Newton, and Chandrasekhar can never achieve. It is as if the ideas of the anonymous ancients seeped surreptitiously into the collective spiritual psyche of communities. When there is no one to be challenged and the source is taken to be supernatural, others of the group repeat what they have been told and taught, or they interpret the same when times change. Thus were formed the traditional religious beliefs on cosmogenesis, sprouting out of nowhere, as it were, and taking deep root in the languages and lore of peoples. When years rolled by—then decades and centuries—the images became ever more indelible, acquiring with time a protective sacredness that guards them from iconoclastic onslaughts. They persist as *the real* in the mind and manners of cultures.

Those ancient visions may appear to be fantasy unrestrained to those who are not of the tradition and to those who have been touched by the methods and instruments of ever-changing science. But they are and were never regarded as colorful concoctions of the mind by the elders or by the common folk of traditional communities. Rather, these are authentic descriptions of how it had happened. In ages past and in many cultures still, those who listened to the sacred narratives of cosmogenesis received them as

seriously as students in science courses have been taking Cartesian vortices, Kantian nebulae, the Standard Model, and the Big Bang story of how the universe began.

On the other hand, in our own times, the vast majority of the educated public who read an article in *Scientific American* or a book by Stephen Hawking or Joseph Silk on the subject tend to trust every line of what the experts write—irrespective of whether or how well they understand the reasoning and the data on which the scientific theories rest. They imagine that the truth has at last been found and enunciated by the wise men and women of the scientific establishment. It is important to remember that many scientific theories of cosmic birth have risen and fallen like children's castles on sandy shores. The difference between the modern scientific modeling and prescientific visions lies not in which is real and which is not but in the awareness of reflecting scientists that for all their sturdy factual foundations, scientific imageries have a finite probability that they would be modified or overthrown in due course.

Thus we have this interesting fact in the history of ideas: Whereas religious answers to fundamental origin-questions vary from place to place, the answers given by science tend to vary from time to time. On the other hand, whereas religious answers have remained unaltered for many long centuries, few scientific theories of cosmogenesis have enjoyed acceptance in the scientific world for more than a century. New theories keep coming and going on the basis of newly acquired data and insights of investigators. Put differently, scientific answers are culture invariant but time variant, whereas religious answers are time invariant, but culture variant.

**Frameworks of Religious and Scientific Traditions**

The thesis of the religious view is that humans play a central role as a purported end product, i.e., as the intended goal of creation. From the religious perspective, the will and guidance of an omnipotent and omniscient Creator has always been there throughout the history of the universe. Earthlings for whom all this was made can still invoke the Creator in times of joy and need, pain and panic, and Divinity will answer their prayers; that is to say, alter the course of natural events to ease the life of the devotees of the Divine.

This worldview is significantly different from the framework of science in which inexorable and mathematically precise laws operate without pause or exception to keep the universe rolling in time. It should be pointed out, however, that a great many scientists of the past, whether the Áryabhatas and the Bhaskaras of the Hindu world, or the Keplers and the Newtons of the Western world, have been deeply religious personages who believed in a Divine Being.

One of the first modern estimates of the age of our sun was given by William Thomson in an article with the title "On the Age of the Sun's Heat" in which he wrote:

> It seems, therefore, on the whole most probable that the sun has now illuminated the earth for 100,000,000 years, and almost certain that he has

> now done so for 500,000,000 years. As for the future, we may say, with equal certainty, that inhabitants of the earth can not continue to enjoy the light and heat essential to their life for many million years longer unless sources now unknown to us are prepared in the great storehouse of creation (*Maxmillan's Magazine*, Vol V, March 5, 1862).

Thomson missed the mark in his figures, but he was very correct and original in affirming temporal limitations to solar brilliance.

In the current scientific paradigm, the universe stumbled into existence on its own, currently reckoned at 13.7 billion years ago, because of a mishap in a silent and latent symmetry, intelligible only to those initiated into the theory of special unitary groups and high-energy physics. It was born from a point of singularity with a bang that was truly big, spewing out matter and radiation every which way, creating space and time in the process. The cosmology of today's physics suggests that the gestation period for the universe was inconceivably small. In the fantastically infinitesimal interval between $10^{-43}$ and $10^{-35}$ seconds—known as the Planck time and forming the GUT (Grand Unified Theory) era—there was a major splitting of a unified field into two: the gravitational and another. It must be realized that in this picture, the density of the universe was infinity to begin with, because all its mass was concentrated in zero volume. After the Planck time, during a millisecond, the universe grew to the size of a mini-marble, and then the whole thing expanded to about $10^{30}$ times its size. In the meanwhile, there were further separations of force fields into what we call the gravitational, the strong, the weak, and the electromagnetic. As a result of the conascent laws of nature and the fundamental interactions, matter and radiant energy such as we know them came to be. Then in the course of a few billion years, stars and planets were slowly formed by gravitational enticements, heavy elements were synthesized in the crushed core of super-hot supernovas, and so on.

**Cosmogenesis: A Vedic Vision**

There are some beautiful visions of how the world came to be in the Rig Veda. The best known of these is in the *Násadíya Súkta,* or the Creation Hymn. It has been rendered into English in many ways, but it is hard to capture the majesty of the original in translation. My own English version is the following:

> Not even nothing existed then
> No air yet, and no heaven.
> Who encased and kept it where?
> Was water in the darkness there?
>
> Neither deathlessness nor decay
> No, nor the rhythm of night and day:

The self-existent, with breath sans air:
That, and that alone was there.

Darkness was in darkness found
Like light-less water all around.
One emerged, with nothing on
It was from heat that this was born.

In it Desire, its way did find:
The primordial seed born of mind.
Sages do know deep in the heart:
What exists is kin to what does not.

Across the void the cord was thrown,
The place of every thing was known.
Seed-sowers and powers now came by,
Impulse below and force on high.

Who really knows, and who can swear,
How creation arose, when or where!
Even gods came after creation's day,
Who really knows, who can truly say

When and how did creation start?
Did He do it? Or did He not?
Only He up there knows, maybe;
Or perhaps, not even He.

In a truly anthroposensitive way, the verse says that desire found its way into the eerie void, suggesting the primordial seed was born of a cosmic mind. This vision affirms a spiritual grounding to the world at large. Note the statement here: "Even gods came after creation's day." In this Hindu reflection on Genesis, we also find a disarming modesty, for the sage-poet exclaims, "Who really knows, and who can swear!" There is no known scriptural text in all the world where an admission of the finiteness of the human mind has been so openly expressed in trying to grasp the grand mysteries of existence. It is simplistic to imagine that a religious worldview will necessarily have to be dogmatic.

On all counts, this hymn is one of the most sublime visions of cosmic creation one can find in all of human legacy. It is certainly one of the most sophisticated poetic reflections on how our magnificent universe may have emerged. As S. Radhakrishnan said, "The metaphysical agony, which alone makes man great, bursts forth in the

famous words of the Rig Veda. These words of spiritual yearning, metaphysical unease and intellectual skepticism set the tone of India's cultural growth."

Let us now consider the Násadíya Sukta from different perspectives. The first, which illumined the spirit of its author, is mystical. The hymn strikes one as a deeply experiential outpouring of a mystic poet's rhetorical response to the greatest mystery of all: existence and transformation, being and becoming. When mystical visions are not felt but analyzed, not shared but dissected, not chanted but translated, they lose much of their passion and potency.

Another mode is to regard it as a deeply reflective poet's utterance. Though this approach will not enable us to resonate fully with the divine music that rings in the verse, it will help us get a glimpse of the truth that the work conveys. We may consider the Násadíya hymn with this awareness of the limitation of the intellect in the face of mystical poetry.

What also strikes us in this piece is that the sage-poet speaks of a precreation stage in which there was really nothing in the universe. This is a remarkable vision of the pre-Big Bang state. That unimaginable phase is described as a mysterious nothingness where there was no air or heaven. By referring to air and heaven, the poet tells us that there was neither the subtlest matter of any kind, nor the loftiest thought of any kind, for ultimately the universe is pervaded by thoughts and things. What else? Then there is wonderment about who might have encapsulated such an awesome void, and where in the world it could have been when there was no *where* at all in the world. And what about the ubiquitous water that covers so much of the world? Here we may consider water as a life-giving principle. Was such a thing there? The sage-poet wonders.

He goes on to reflect on other features of the perceived world, such as decay and deathlessness, and the routine rhythm of day and night. If anything was there in such colossal emptiness, it must have existed all by itself. If it was dark, it must have been embedded in utter darkness also, a darkness which must have been like the abyss of obscurity in the depths of the sea. For the entire universe to emerge from this, there must have been unbounded energy. Modern cosmology speaks of no original energy whence it all came. The Vedic poet postulates that the universe must have come about from an innate spiritual energy. He refers to this spiritual energy as *tapas* which is sometimes crudely translated as *heat*.

Then comes a most meaningful imagery which touches our core: namely, that there was a deep desire on the part of something to manifest itself and that the first seed of creation must have germinated in a cosmic mind. When the sage-poet suggests that desire found its way into the utter void, he probably referred to desire as a primordial force that leads to creation in the biological world. It has no explicit purpose, but it is an uncontrollable urge that leads to the emergence of something. In this sense, the world was born of a powerful force in a Cosmic principle with potential for creation, which led to the unleashing of it all. Creation, in this view, was not an intended act but the consequence of a powerful urge. This probably explains Steven Weinberg's famous

comment that "the more the universe seems comprehensible, the more it also seems pointless."

In the Vedic poetic view, whatever we see as tangible in this world is ultimately intertwined with the intangible, nonexistent principle. Here is a profound reflection: the interconnection between the perceived world of crass matter and the insubstantial reality of thought which is nonexistent as a tangible entity. There can be no world such as we know it without thought. The universe is not a ream of paper with random scribbles scratched on every blank sheet. It is more like a beautifully bound volume with poetry and plays, essays, and stories inscribed on its countless pages; for that is what the laws of the physical world are. The creation hymn goes on to say that cosmic forces were unleashed, and thus did creation come to be, and there arose more creative principles for the subelements in the universe.

Then suddenly, the intellect jolts the mystic; and the sage-poet wonders if those awesome images of a grandiose nothingness, of primordial desire and seed sowers that gushed into his mystic vision were all really there. Or were they perhaps only the dreamy delusions of a speculating mind? He is not sure. He is not even sure if the very creator has answers to his questions. The mystic turns into a realist thinker now and he reminds us that when it comes to origins, not even God, let alone the best among us, can be cocksure of what we imagine to be the truth.

This kind of skeptical attitude is truly commendable from a scientific perspective. At the same time, it is also an expression of enlightened humility and the admission of utter bewilderment in the face of the grandest mystery: the how and the why of cosmogenesis. As John Dryden was to exclaim millennia later in *The Hind and the Panther*,

> But how can finite grasp infinity?

As long as there is mystery there will be mystical spirituality in the best sense of the term. As soon as the mystery is unmasked by answers, there can only be dogmas, and religious conflicts then become inevitable.

Thus the most sacred scripture of Hinduism expresses an enlightened tentativeness in its version of origins. This is in glaring contrast to the emphatic affirmations that we find in most revealed religions, including some branches of Hinduism. It is in passages like this that we see the source of the doctrinal tolerance that is built into the Hindu mode of responding to ultimate questions. This is why it is easier for the spiritual Hindu to pay homage to the visions of other religions than it is for the faithful of other traditions to feel oneness with a tradition that is not their own.

In this context, let us recall the opening lines of Sri Aurobindo's *Sáviti* where modern India's sage-poet recast this vision of the pre-Big Bang state as follows:

> It was the hour before the Gods awake.
> Across the path of the divine Event

The huge foreboding mind of Night, alone
In her unlit temple of eternity,
Lay stretched immobile upon Silence' marge.

Almost one felt, opaque, impenetrable,
In the sombre symbol of her eyeless muse
The abysm of the unbodied Infinite;
A fathomless zero occupied the world.
A power of fallen boundless self awake
Between the first and the last Nothingness,
Recalling the tenebrous womb from which it came,
Turned from the insoluble mystery of birth
And the tardy process of mortality
And longed to reach its end in vacant Naught.

Oh, the humor of history! An Indian poet composes a work in the tone and of the caliber of England's own Milton.

**Other Hindu Visions of Cosmogenesis**

The Hindu response to fundamental questions about origins is also unique in that it presents more than one view of cosmogenesis. In another Vedic hymn, a second theory as to how the universe began is given by means of a metaphor. Here the poet pictures the world as having emerged from the cosmic womb. For so magnificent an entity as the vast universe, the generating womb had to be grand and glorious and golden, the visionary felt. Thus, the sage-poet described it as *hiranyagarbha* or the golden womb. Hiranyagarbha is also personified as lord of the mountains and of the seas. The magnificent sky and the earth and the sun came from him. Hiranyagarbha gave life and strength, and all the gods obey him. Both death and immortality are his shadows.

So the poet goes on to glorify the primordial principle whence everything emerged, repeating the refrain that we should worship him with oblation. In this creation hymn (*Hiranyagarbha*, Rig Veda RV 10:121) that proclaims that the Golden Womb was there before there was Creation, we see an integration of science and religion. It is science in that it offers an explanation as to how it all came to be, but in the narrative there is a recurring line that we worship the source of it all (*kasmen deváyahavishá vidhém*). The implication is that we have come upon this great experience called life in a world that is stupendous and splendid in countless ways, and for this experience we need to express our gratitude to whatever gave rise to it all.

In several Puranas, the original state of the universe is pictured as an enormous egg associated with the mythic image of Brahmá, and so it is called Brahmánda: the All-pervading Egg, or the Ur-Egg, or the Enormously Grand Egg. It is interesting that

in the twentieth century, Georges Lemaître, a proponent of what came to be called the Big Bang theory, used similar imagery in a technical paper in *Nature* ("The Beginning of the World from the Point of View of Quantum Theory," 127, 1931) when he spoke of "the Cosmic Egg exploding at the moment of the creation."

The Brahmánda notion describes how the primordial emergence divided itself into two parts, the upper golden one becoming the celestial world and the lower silver one, the earth below. Within each of these arose several layers, twenty one of them in all: seven in the heavenly world, seven in the terrestrial world, and seven in the nether world.

Traditionalists regard the Golden Embryo and the Brahmic Egg as the enunciation of religious truths, just as literalists in other traditions take pictures painted in their respective holy books to be recordings of scientific knowledge. Thus there still are well-informed thinkers in the Hindu world who, like their counterparts in other religions, attach more than poetic truth to these. This is not surprising given the appeal that ancient worldviews have to millions of people of all faith systems.

But these pictures are only of slight significance to the scientific inquirer. In fact, the pages of the Puranas strike many scientifically informed readers as imaginative tales. To me, it is no less meaningful to look upon these as the efforts of thinkers to formulate hypotheses to account for the origin of the world and as insights into how it could have come to be. In any case, such hypothesizing soon morphed into what reads like science fiction constructed by rich imagination.

What is impressive about the Brahmanda concept is that it envisions the birth of the universe as from a point, not unlike the primal singularity of current cosmology. It is in such uncanny insights of ancient Indic thinkers that one finds their penetrating intuition. If only such ideas had been pursued in more systematic modes rather than confined to mythic musings, who knows how much more positive sciences might have emerged in the Indian subcontinent!

The Mundaka Upanishad says that the Creator, Brahmá himself, arose as "the first among the gods, and as the creator of all." If we regard Brahma as the dimensions of M-theory and gods as the laws of physics that gave rise to the universe, this statement in the Upanishad may well be interpreted as a perspective on the current paradigm. In a famous passage, this Upanishad also gives beautiful similes for how the universe arose: "As the spider generates, and draws in (its filaments), as the herbs grow from the ground, and hair from the head and body and head of a living man, so from the imperishable, the universe springs." The filaments of the spider refer to the creation of something from a central source and its withdrawal into where it came from, the herbs refer to life, and the hair from the body brings home the idea that the created elements are spread all over. Just as the jargon of modern physics is utterly unintelligible in its mathematical opaqueness, mythic utterances often hide truths of deeper significance behind simplistic tales.

It should be noted that in the speculative legacy of the Hindu world there have been a good many different explanations for cosmogony other than what one finds in Vedic poesy. As in ancient pre-Socratic philosophy (Thales, Anaximenes, Anaximander,

Heraclitus, etc.), Hindu thinkers had also speculated that the world arose from primordial water, fire, air, and earth. Some said the whole thing was a mere accident, blind chance giving birth to the cosmic show. Some argued that it has always been there, so there was no question of a cosmic birth reminding one of a steady-state theory of midtwentieth century that Hermann Bondi, Fred Hoyle and others proposed.

**Nataraja**

In the sacred city of Chidambaram in South India, there is a magnificent icon of Nataraja which is surely one of the most widely known artistic-spiritual symbols of the Hindu world. The focus of the temple is in the Hall of Cosmic Consciousness (the *Chit-sabha*). One can see here a sublime representation of Shiva, known as Nataraja. This is the original of that most famous image of Hindu culture, more spectacular than the fading eighth century figure in an Ellora cave. Sacred history records that the cosmic dance of bliss (*ánanda tándavam*) of the Divine occurred in Chidambaram. That dance is remembered to this day in a dynamic choreography of *bharata náttiyam*. Nataraja, the bejeweled eternal dancer with four hands, holding drum and fire, and in a blessing posture—his left foot raised and his right foot crushing a human form that signifies the Grand Illusion (*Maha Maya*) of the physical world, reflects the eternal dynamism of the universe. The dance is said to occur at the close of every eon in the endless cycle of an oscillating universe.

Much of the Shiva lore is given form in this sculpture: a crowning skull to symbolize the starkness of annihilation, a crescent moon standing for Divine grace, the sacred Ganga to remind us of life-giving water, and the venomous cobra around his neck, signifying that the Divine is beyond mortality. There is much spiritual grandeur and esoteric meaning here, much majesty and mystery.

The Nataraja is perhaps the best-known sculpture ever to have emerged from the mind and hands of an Indian artist whose name, alas, is forever lost in the void of unrecorded history. This supreme work of spiritual grandeur has inspired more commentaries and reflections than any other work of Hindu art. It has given rise to rapturous music and traditional dancing in the culture. It is magnificent in its conception, profound in its symbolism, and penetrating in its vision of the transcendent.

Some have compared the insight implicit in this symbolism of cosmic energy to the fundamental findings of modern physics about the substratum of the world where matter and energy create and annihilate each other in incessant dynamism, a perpetual cosmic dance, as it were. The creation and annihilation of hadrons and leptons and the fluctuations of the vacuum are the heart-throb of the physical world, and they bear fascinating parallels to the vision of a universal spirit dancing endlessly, giving rise to the phenomenal world. Here is mythopoesy at one of its best. Not surprisingly, Carl Sagan reflected on it this way:

> The most elegant and sublime of these is a representation of the creation of the universe at the beginning of each cosmic cycle, a motif known as the

> cosmic dance of Lord Shiva. The god, called in this manifestation Nataraja, the Dance King. In the upper right hand is a drum whose sound is the sound of creation. In the upper left hand is a tongue of flame, a reminder that the universe, now newly created, with billions of years from now will be utterly destroyed. These profound and lovely images are, I like to imagine, a kind of premonition of modern astronomical ideas.

What the Mona Lisa is to Western painting, the Nataraja is to Hindu spiritual sculpture. Like Leonardo's creation, the Nataraja has been imitated and replicated as none other, it too has been seen by millions over the centuries, it too has given rise to scholarly discussions and interesting interpretations. As modified replicas, the Nataraja statue may be seen in many museums of the world as well as many Hindu homes.

But there are important differences: The Mona Lisa is mundane mystery; the Nataraja is esoteric mysticism. The Mona Lisa captivates our physical being; the Nataraja touches the soul. The Mona Lisa has the serene smile of worldly charm; the Nataraja has all the majesty of spiritual splendor. The Mona Lisa is admired; the Nataraja is worshipped. The Mona Lisa radiates beauty; the Nataraja radiates ecstasy.

**Notion of Cyclic Time**

Hindu thinkers also developed a theory of time flow by which the hatching of the cosmic egg and its subdivision into various sectors becomes a periodic recurrence. In this picture, the physical universe will change, evolve, and eventually dissolve into nothingness once again—retracting to its original phase. In modern scientific imagery, this would be like zooming back before the formation of galaxies into the initial Big Bang singularity only to reemerge and repeat the process all over again. As noted earlier, this is somewhat like the so-called oscillating universe model of current cosmology.

When this concept, which was mentioned earlier, was formulated in the epics and sacred histories in terms that are intelligible to the layperson, they became the four *yugas*: long periods of time of unequal duration. As per this reckoning, we are currently in the fourth phase known as the Kali Yuga. This yuga is said to have begun some five thousand years ago, and is expected to last for a total of 432,000 years. The preceding Dvápara Yuga lasted for 864,000 years; whereas the one before that, known as Treta Yuga, lingered for 1,296,000 years. Satya Yuga, the very first yuga, had a span of 1,728,000 years! It takes the sum of all these for one full yuga cycle.

The total period of time forming all the four yugas adds up to 4,320,000 years. This is known as a Maháyuga or Great Yuga. A thousand Maháyugas make up an Ardhakalpa, or a half day in the life of the cosmic Creator. Thus, a full day or Kalpa for the Creator is 8.64 billion years. Proponents of this line of thinking point to the remarkable coincidence between this and the currently held view of the age of the universe as being about thirteen to fourteen billion years. The kalpa comes uncannily close to current estimates!

Brahma lives for one hundred full years (8.64 × 365) on this scale before the universe dissolves. That is of the order of 311 trillion years. This cycle is said to go on endlessly, each manifested phase and its inert counterpart lasting together for immensely long periods. The enormity of time spans envisaged in the yuga paradigm is thus absolutely mind-boggling. No culture aside from the Indic even fantasized such humungous time periods when talking about the universe. Others spoke only in terms of a few thousand years or sometimes a few million years at most.

Whether or not one accepts these numbers, what is really remarkable is that ancient Indian thinkers proposed that the age of the universe was enormously greater than anything imagined elsewhere. The inconceivability of such time scales is made clear through the following story, usually attributed to Lord Buddha. In answer to a question on how much time constitutes a kalpa, he is said to have said something to this effect: Consider a gigantic mountain, much, much taller than the Himalayas. Suppose that one wipes a part of the mount with a silken cloth ever so slightly once every year. Each silken scraping will tear off a tiny bit of the rocks. The entire mountain would be erased before a kalpa on Brahma's time scale elapses.

In the eighteenth and early nineteenth centuries, fossils were estimated to be a few million years old. Even nineteenth century physics had no context in which to speak of time periods of the order of billions of years. It was only after the discovery of radioactivity and half-lives of radioactive elements that one was forced to think in terms of billions of years.

As another coincidence in numbers, we live in the fifty-first year of a Brahmic year by one reckoning: just over half the life span of a hundred. On an entirely different scale and from very different considerations, by current reckoning our sun is about half its age. It is tempting to declare that ancient Hindus were familiar with the reckonings of modern cosmology.

Then again, the notion of time, both in other traditions and in modern science, had always been unidirectional, always advancing, without a return to an initial state. Hindu thinkers were the first and perhaps the only ones in the ancient world to have envisaged a cyclic time—one in which there was periodicity in the age of the universe. This is an extraordinary leap in theorizing about the nature of cosmic time because it is counterintuitive. Yet it is a natural extension from celestial periodicities. In the modern scientific world, it was only after the development of statistical mechanics in the latter half of the nineteenth century that the idea of this kind of recurrence was brought in through the so-called ergodic theorem (roughly: that every accessible microstate has the same probability of occurring over a very long time interval). Only after the discovery of an expanding universe and its theoretical connections with general relativity did the idea of a contracting universe and a possible oscillating model emerge—reminding us of the repeating yuga concept of ancient Indic thinkers.

It may be pointed out that the concept of the yuga cycle handles cleverly one of the most intriguing conceptual quandaries pertaining to the physical world: the origin and end of time. The Big Bang model, with all its merits, fails to explain why the universe occurred

at all in conceptual time, marking the beginning of physical time. Nor does it cope well with the asymmetry of time having a zero-point origin and no apparent end point. It is like a number system without negative integers. The yuga notion cleverly resolves this impasse by postulating that the cycle rolls on and on, without beginning and without end, not unlike the circumference of a circle which has no starting or boundary point.

**The Why of the Universe**

Granting that there was a Big Bang a few billion years ago, it is legitimate to ask, "Why did it happen?" If it is the case that the entire universe is but the material manifestation of Brahman, one may still wonder why it was that Brahman chose to manifest itself at all. It is simply beyond the scope of science to answer this. Any answer to this question will have to be poetic or theological, not scientific. This is because science precludes questions referring to purpose as a cause of natural phenomena, and the birth of the universe is only a natural phenomenon. Religions may contend that God created the universe for the benefit of human beings, who are His choicest creatures, but science may still wonder why God wanted to create human beings or why He should bestow this blessing on humans rather than on some other creature.

One answer to this question in the Indic tradition is at least as interesting as any other. A view developed to the effect that all of creation is the play of the Divine. This theory is referred to as *lílá-váda*. In this view, put simply, the Divine was bored with emptiness in endless time and decided to make a universe with activities and humans so that it could watch its evolution and be entertained. In other words, there is really no ultimate purpose or aim to creation. It is there for nothing more than to enable time not to stand still. Perhaps staring at the void for too long could cause headaches even in the Almighty! God is thus a cosmic doodler, weaving away patterns in accordance with a set of self-prescribed rules.

We may recall that in the first decades of the twentieth century, Johan Huizinga formulated the notion of *Homo ludens*, the playing human in contrast to *Homo sapiens*, the knowing human, and *Homo faber*, the making human. According to Huizinga, with the eventual development and sophistication of machines, everything would be done for humans by such devices, and human beings would spend time in purely recreational activities. We see that long before him, Indic thinkers, even while recognizing a *Deus faber mundi* (a world-creating God), came up with the idea of *Deus ludens*, the playing God, to explain the emergence of the world.

This is neither more nor less demonstrable than any other theory conceived by the human mind to account for the purpose of Creation.

**Cosmogony According to the Triguna Theory**

In this context of multiple theories of cosmogenesis, let us consider one that is associated with what is known as the Sámkhya-Patañjali school. A key idea here is that the entire physical universe may be traced to three basic principles referred to

as *gunas* or intrinsic natures: the *sattva*, the *rajas*, and the *tamas*. The first of these, namely sattva, is the ultimate essence whose manifestation is the physical universe. The second one, rajas, is the root of all dynamism and activity. It may be compared to what we call energy. Tamas, the third one, is the principle that resists change—the principle of inertia. In the beginning, all these were in unity and in equilibrium in what is called *prakriti*, which had no form or character. It may be compared to the primordial void of the Vedic poets, except that the three gunas were latent. A classic text called *Jayákhya-samhitá* compared this to the unity by which wick, oil, and flame maintain the integrity of the lamp as a whole. The world results from the separation of these basic entities which were in total balance to begin with.

The germinal idea in this worldview is that the physical world results from the transformation through rajas of an ultimate essence sattva in the context of a principle called tamas that resists change. When the transforming and resisting principles balance each other with the essence, the universe is still, and nothing happens. We know from basic physics that every equilibrium in the world is the result of balancing forces. Acceleration occurs when the net force overcomes inertia, i.e., when rajas overcomes tamas.

Another interpretation that may be given to these ideas is that tamas represents mass, while rajas represents energy, and both lay balanced and implicit in the premanifestation stage of the universe. Then again, since tamas and rajas have been there since cosmic birth, and neither can be created or destroyed, some have gone so far as to suggest that Indic thinkers were aware of the principle of conservation of matter-energy. It is difficult to maintain this given that the idea of conservation in physics calls for measures of quantitative entities, which had not yet been introduced in ancient physics.

In any case, what is interesting here is that this theory of origins bears a resemblance in its imagery to the standard model of current physics, which attributes the origin of the world to what is called a *symmetry breaking*. When a very small fluctuation occurs in a system and crosses a crucial point, significant changes can result. When this happens, the system breaks up from a completely disorderly state into two states. Thus for example, the symmetry of a vertically spinning top (perfectly symmetric with respect to the ground) is broken when it falls.

### The Purusha-Prakriti Model

There is an idea somewhat like the Cartesian principle of *res cogitans* associated with the triguna theory of cosmic emergence: thinking thing or experiencing principle, and *res extensa*, the extended thing or substance principle. However, the *res extensa* transcends local, terrestrial significance. In this view, the physical universe that has emerged from the symmetry-breaking of the gunas is called prakriti. It consists of myriad modifications of the three gunas. Now corresponding to the totality of prakriti, there is a *purusha* or cosmic consciousness, which experiences the former. Prakriti is

the experienced and purusha, the experiencer. If prakriti is compared to all the books in the world, purusha would be like the totality of all the readers. Without purusha, prakriti would be as if all the books lay buried deep under the sea.

Just as there are countless readers for the countless books, the cosmic purusha manifests itself into countless subentities or *jívátmans*. The jívátmans are essentially the individual consciousnesses at the core of every one of us. The jívátmans are always engaged in interactions with prakriti. Of jívátman's many activities, two are of particular significance. One is the search to understand the ultimate nature of prakriti. This is what constitutes science, for science is essentially the effort of human consciousness to figure out the ultimate nature of physical reality. The other is the pursuit of the jívátman to grasp the nature of the cosmic purusha of which it is a minuscule manifestation. This is what constitutes religion or the spiritual quest. In other words, the human spirit is capable of engaging in two lofty activities: trying to disentangle the puzzles of the physical universe and uncovering our spiritual dimension.

From this perspective, both science and religion strive to attain a full grasp of two aspects of human experience. The first is the world of external nature, the second is the realm of consciousness itself. The successes in these pursuits are not necessarily guaranteed. The theories of science may or may not be correct, but the search will always continue.

It may be mentioned in passing that the Italian astrophysicist Paola Zizi proposed a theory a few years ago that has come to be called light-heartedly the Big Wow Theory. According to the Big Wow Theory, at the earliest phases the universe was a quantum computer, which gave rise to consciousness when it achieved a certain degree of computational complexity.

**Science and Consciousness**

It was not until the twentieth century that modern science began to inquire into the nature of consciousness. What began as investigations into how the brain acquires knowledge led to the variegated cognitive sciences, which are in the forefront of attempts to unravel the neuronal roots of consciousness. Significant advances have been made in understanding many aspects of innate experience in terms of the roles that different parts of the brain play. These have been possible thanks to sophisticated experimental techniques involving many instruments and interesting models for brain functions. But philosophical doubts still persist as to the possibility of penetrating the nature of consciousness by consciousness itself. Few neuroscientists would disagree with the position that the full exploration of consciousness is an extraordinarily challenging problem. For one thing, it is not easy to even define consciousness in scientific terms. One simply uses the term to refer to certain overall states of the brain. Scientifically anchored philosophers generally ascribe three distinct functions to consciousness: subjectivity, unity, and intentionality. All these are present in a state of awareness.

The subjectivity aspect corresponds to what Indic thinkers described as *aham-kára*, sometimes translated as *egoity*. The term literally means the *I-maker*. Clearly, there is some complex process in the brain that creates the impression of a separate *I* in each of us, circumscribing our individuality and separateness from everything else in the universe.

By the term *unity*, one refers to the wholeness of the experience. Consciousness is a feeling of totality, never piecemeal awareness. This does not mean that one is fully aware of everything but rather that all that one is aware of at a given instant is unified into a single, overall fullness. Indic thinkers insisted that consciousness constrained by *akam-kára* is only partially total: that is to say, the normal modes of consciousness screen us from experiencing a grander totality that becomes obvious only when the *aham-kára* is dismantled.

The term *intentionality* refers to the fact that more than mere perception is involved in consciousness. Whatever we perceive through the senses combines to make some sense. In other words, consciousness implies the experience of meaning.

Many eminent philosophers hold the view that there is as yet no known principle by which sensory input gets transformed into experiences and consciousness. Even if one were to grant that consciousness is the result of neuronal firings in the brain, we do not have the faintest idea of what causes this or how it comes about. Die-hard scientists are convinced that it is only a matter of time—a few decades to a few centuries—before the mystery is unscrambled by pursuing current reductionist approaches. However, there are also philosophers who feel that current scientific frameworks, methodologies, and paradigms are simply not equipped to solve this problem. These philosophers are likely to be proven right during their lifetime. They maintain that there needs to be radical shifts in the scientific worldview if we wish to understand consciousness. The Indian psychologist-philosopher Ramakrishna Rao, for example, has expressed the conviction "that classical Indian philosophies of mind backed by the widely prevalent practices that are aimed at enhancing human wellness and cultivating consciousness to achieve extra-ordinary and exceptional cognitive abilities and states of self-realisation contain the seeds for developing a new landscape of human science. The meeting of cognitive science and the Indian philosophies of mind would likely be the true meeting of East and West."

**Law of Karma**

Another interesting question that has intrigued the human mind for a long time relates to the future. What will happen eventually to each of us as individuals, to humanity as a group, and to the world at large. Here again, traditional religions have offered different views, and so has science. In the religious framework, the origin is related to the end. God or divinity is involved in both. In the scientific framework, the two are quite independent.

Religions declare that our own individual fates will be determined by how well or badly we have behaved during our lifetimes. For science, this makes no difference at all because the end of the physical body ends individual consciousness too. The laws governing the physical world cause physical death, and there are no laws governing the aftermath of consciousness because, says science, there is no aftermath.

In the Hindu worldview, post-mortem states are much more complex than in the Abrahamic religions. Yes, in the Hindu world there are visions of heaven and hell as in other traditions; but there is a framework of laws as to the evolution with time and the fragmentation of cosmic consciousness, which we call the soul or the *átman*. This is the *karma* principle.

The word *karma* literally means "action" in Sanskrit. In Vedic literature, it generally refers to ritualistic duties. In the context of what is known as the *law of karma*, it refers to any consequential action. Some of the acts we do are inconsequential; others have consequences. Scribbling on a piece of paper while waiting for a person may be inconsequential, but offering a helping hand to a person in need is a consequential action. Thus every karma has some impact on others, on oneself, or on the world around us. The law of karma states that all consequential acts will have experiential effects on the doer. That is to say, every individual will experience something as a result of a karma.

The fruits of our current actions may occur right away or at some future time. No one can escape the sweet fruits or the bitter berries arising from one's karma. But what about little children who undergo pain or experience pleasure without having done anything to earn it? And how do we explain the fact that many people get away with all sorts of mischief and crimes without ever apparently experiencing anything for their misdeeds? It is in such contexts that the notion of reincarnation becomes meaningful.

In the Hindu worldview, the átman migrates from body to body. The phenomenon of physical death is thus the disembodiment of the átman which enters another body. One of the earliest expressions of the transmigration of the átman is to be found in the Brhadáranyaka Upanishad (IV.4.4): "Just as a leech that reaches the end of a blade of grass jumps over to another blade, so too the átman after leaving behind an unconscious body, enters another body." A famous passage in the Bhagavad Gita (11.22) propounds the doctrine of metempsychosis with this simile: "Just as a man discards worn-out garments and puts on other new ones, so too the souls abandon the old bodies and take on new ones."

Reincarnation is called *samsára* in Sanskrit. It is a basic tenet of Hinduism. Its fundamental thesis is the periodic reemergence of the átman in physical encasements—the continuity of the átman on the temporal plane in association with different bodies.

There can be two positive effects of belief in reincarnation. First, the notion that the átman is imperishable is a source of immense strength to survivors when a dear one passes away. At that saddest of all moments in a family's history, there is the assurance

that all is not lost. The individual has literally departed, not died. Second, there is also the hope that the disembodied átman will reappear in the family as a member of a generation yet to be born. It is not unusual for grandchildren to be named after their deceased grandparents for this reason.

The idea of transmigration of the soul was accepted in many ancient cultures: in Mesopotamia, Egypt, Greece, and even medieval Europe. Plato referred to the Orphic tradition, according to which "soul and body are united by a compact which is dissolved by death; but only to re-imprison the liberated soul after a short time; for the wheel of birth and death revolves inexorably." In the Hindu framework, the ultimate goal of spiritual evolution is to break away from *samsara*, the repetitious birth-death cycle with its attendant woes and passing pleasures. This is to be achieved through right action and spiritual effort.

In the history of ideas, there have been two views as to our present condition and future prospects. One is fatalism: everything was predetermined by an Almighty God, and we cannot change the course of events. The other is free will: we have the choice to do good so as to ensure everlasting peace in heaven. The law of karma may be looked upon as a blending of the two views in more earthly contexts. It accepts that our present condition was predetermined, not by God, but by our own previous actions. What this means is that we cannot point the finger at a merciless God for our sufferings. It also accepts free will in that it says we have the power to choose good actions, for this will ensure future positive experiences. In other words, the law implies not stoic acceptance of what is happening to us now, but accepting blame for one's plight while leaving the future open for us to shape. Recognizing the law can inspire us to good and meritorious actions in the present life so as to ensure happier states in future incarnations.

In this way, the law of karma is a wise blending of determinism and free will. It regards as unalterable what has already happened yet as transformable what is yet to transpire. When something good occurs to you, you may give credit to yourself as having played a role at some time in the past to merit it. When something bad occurs, do not search for others or God to blame. Explanation in terms of the law of karma is as sound as any to reconcile assumed divine justice with observed social and hereditary non-uniformity in endowments and experiences.

**Eventual State: Indic Vision**

What does science have to say about what is going to become of this planet and our sun? What will happen to stars and galaxies in the very long run? What will become of man and microbe, of bird and insect, in the very end? What will happen to the physical world, to the universe at large eventually? These questions may not be a matter of immediate concern to us, but they are interesting nevertheless.

For almost three centuries since the rise of modern science, these questions were never taken seriously in the scientific context. There was the implicit assumption that the sun and the stars would shine forever and that the world was stable and permanent.

In 1852, William Thomson published a short paper which contained an ominous statement to the effect that, "within a finite period of time past the earth must have been, and within a finite period of time to come the earth must again be, unfit for the habitation of man as at present constituted, unless operations have been or are to be performed which are impossible under the laws to which the known operations going on in the present material world are subject." This was perhaps the first severe statement that science made about the fate of humankind. It is clearly clothed with the caution that is becoming of a scientific declaration. Nevertheless, it is not a happy one in sheer human terms. However, because of the technical context in which it was published and because of the relatively secure positions that scientists held during that period, there were no immediate unpleasant repercussions to Thomson's paper. The discovery of Copernicus some three centuries earlier had kicked man from the center of the universe. This had been disturbing enough. Then systematic biology and geology came to upset the teachings of the Scriptures. In the middle of the eighteenth century, Comte de Buffon suffered a humiliation not unlike what Galileo had suffered in the seventeenth century: of repentant recantation of his views. And by the middle of the nineteenth century, theological-scientific efforts were still being directed toward reconciling fossils with the consequences of the biblical deluge in the story of Noah. Hence Thomson's prediction of a slow and static doom did not provoke reaction at once.

A major step in the exploration of the second law of thermodynamics was taken by Rudolf Clausius in the epoch-making memoir in which the concept of entropy was introduced. In terms of entropy, Clausius formulated the second law through the statement: "the entropy of the universe tends toward a maximum."

This and the first law regarding the constancy of the energy in the universe were perhaps the first general statements made by scientists about the evolution of the universe as a whole. They gave rise to interesting philosophical questions. The extreme confidence with which such sweeping generalizations were made by physical scientists provoked objections from philosophers who felt that Clausius had no business making declarations about the whole universe, whose limits and possibilities are far beyond our ken, on the basis of experiences limited by the confines of space and time. Over the decades, scientists have discussed such dismal eventualities with suggestions of more hopeful alternatives. Thus for example, it has been argued that cosmologists assume a closed universe subject to the second law of thermodynamics, but we do not know that the universe is closed. It may be that gravity—in shaping the structure of the galaxies and stars—is a force operating beyond the second law. The religious intuition is that the universe is open, that there is a transcendent force standing outside.

In the Hindu framework, global terminus will occur with a *pralaya,* which is a sort of Noachian flood. However, human beings will not be drowned but saved. There may also be lesser pralayas such as the great flood of Manu. The real eon-based end will come with the mahapralaya, which would be the end of a yuga. After this natural dissolution of the entire world, the universe will reemerge. Thus, like human life, the universe is also subject to regular cycles of life and death.

The Indic version, like its counterparts in other traditions, is a mythopoeic vision and is thus not based on observational data or mathematical theories as scientific theories are. However, the scientific worldview on this matter is an extrapolation from our current theories and understandings of the laws of nature. Moreover, the principle of verification and falsifiability cannot be easily applied to cosmic eschatology. Therefore, the most we can say about the end of the world at large is that the issue is a matter of speculative interest, and no answer can be taken to be the absolute truth. One may choose from among the many proposals and conclusions on the matter based largely on which one is most appealing to one's own intellectual framework. Whether the universe will end with a bang or a whimper, in cosmic death or with sparse matter everywhere, with stellar explosions or eerie quietness, on a judgment day or in Shiva's sigh, who can swear with certainty? What must be recognized here is the vision in which the thinkers spoke of the planet's day and of a cosmic calendar, as it were.

It is important to stress that the singularity of the black hole in current cosmology has nothing whatever to do with that of the Big Bang, nor is there sufficient evidence in favor of the oscillating model. Physicists like Hawking and Roger Penrose have proposed that the universe would eventually be permeated by only dispersed radiation, and the very existence of time would be no more. In this model, that final state would become the next phase of the cosmos, and in this sense one may envision a cyclic evolution.

**Biogenesis: Some Traditional Views**

From the perspective of traditional religions, life forms were invariably created very soon after the creation of the physical world. In the Hindu vision, the Divine process is not simply a straightforward fabrication from clay. The Divine is described as self-existent (*Svayam-bhú*): this definition snubs the question of what gave rise to God. It is said that Svayam-bhú divided itself into a male and a female. This is not like the Adam and Eve of Abrahamic poetry, but from the Divine itself several creative principles arose which gave rise to the first progenitors of humankind as also to a whole class of good and bad supernatural beings, animals, plants, and all. Known as Prajápati, this cosmic creator is regarded as the source of every entity in the animate world—both physical and mythical.

In the Brhadáranyaka Upanishad one reads: "There was only water in the beginning. From it emerged satya (the Real), and this satya is the All-Pervading one (Brahmá). From Brahmá emerged Prajápati, and from Him all the gods."

Prajápati is described elsewhere as "the source of what does not exist and of what does, and Prajápati is intrinsically indestructible (*aksharam*)." The name of Prajápati occurs in a variety of other contexts as well. According to a classical treatise on surgery (*sushruta-samhita*), Prajápati was the venerated personage through whom the creator Brahmá transmitted the knowledge of Ayurveda (science of longevity), the classical

Hindu medical corpus. This text also uses the name Prajápari for the male generative organ.

In Vedic mythopoesy, Prajápati is also related to the epithet Ká, which means "who" in Sanskrit. Thus one of God's many names was simply *Who*. Long before the popular British TV series *Doctor Who*, the longest running science fiction series on television, Hinduism imagined a Divine Who traveling through space-time, exploring and saving civilizations everywhere. This designation of God as simply Ká, the interrogative "who," suggests that the unfathomable mystery of cosmic authorship is best visualized through the wonderment of a question.

It is important to recognize that mythic accounts of creation such as we read in the sacred works of traditions have a majesty and sweeping vision that can fill the heart with awe and reverence, for they describe the ultimate mystery of existence. But they should be distinguished from scientific *explanations* whose goal is something very different. The assertions of science arise from the adoption of an altogether different methodology in investigations, which is different from the approaches of religions in their *reflections* on the mysteries. It is therefore not surprising that the two offer dramatically different perspectives. In the Indic tradition, poets also incorporated the philosophical and metaphysical views on biogenesis in their works. Thus Kalidasa, in his masterpiece Kumarasambhava says, addressing the Creator:

> Thou, when a longing urged thee to create,
> Thy single form in twain didst separate;
> The Sire, the Mother that made all things be
> By their first union were but parts of Thee;
> From them the life that fills this earthly frame,
> And fruitful Nature, self-renewing, came. (Griffith)

**Biogenesis: Some Current Scientific Views**

Per current science it was only billions of years after cosmogenesis that biogenesis occurred. In the remote past, more than three billion years ago and barely a billion years after the formation of our planet, there were lands barren and waste, volcanoes steaming and puffing sulfuric fumes, and oceans of salt-free waters. The earth's atmosphere consisted largely of hydrogen, ammonia, methane, and a few other gases. Gigantic clouds and torrential rains rose and fell, seeping salts from land to pristine sea. In the mammoth laboratories of the earth's oceans and airs, kindled by heat and lightning, by radiations from the sun and other excitants, the turbulent chemistry of the early molecules churned out the first organic structures. Carbohydrates and amino acids were thus concocted. These increased in complexity as further reactions took place. The waters of the period constituted what has been described as a primordial soup in which mutual

interactions of the components gave rise to molecules of ever-increasing size and intricacy. Energy-trapping mechanisms came into play. After myriad patterns and permutations, mysterious entities with the property of self-replication emerged. These again grew in number and variety until nucleic acids and proteins formed at last. The wonder of life had begun.

It is difficult to be one hundred percent sure of this version of chemical evolution which has been challenged by may biologists. All we can say is that these could have been natural consequences of the physicochemical context in which the earth found itself at that time. Whatever the ultimate cause of it all, the end result, Life, was truly magnificent. But this was only an inkling of grander glories yet to come. Once the spark of life was lit, the self-replicating systems began to multiply in number and variety. The nucleic acids embodying the subtle coding that preserves life patterns slipped now and then. These changes in structures were the mutations which may be looked upon either as responses to the unceasing turmoil in the earth's physicochemical features or as alterations resulting from changing conditions.

The first palpitations of life began to evolve along countless directions. As ages rolled by and grand upheavals shook the planet's crust, ever newer plants and creatures shaped themselves. Both land and sea became homes for innumerable life forms. Amphibians, insects, reptiles, and mammals evolved along with a picturesque plethora of plants and trees. After well over one billion years of such experimentation, the evolving principles brought forth the product we call the human race. Homo sapiens emerged from apes and began roaming the wilds. Then thought and language and agriculture and culture arose—and thinkers who argue about how it all came to be.

To form some idea of the mind-boggling time scales involved in all of this, one sometimes considers these changes in a more familiar time-reference system. Suppose that the earth was formed a hundred years ago, which we shall take to represent four-and-a-half billion years. Then humanoids began to emerge barely three weeks ago, and the Common Era is only some twenty minutes old. Astrophysicists assure us, again on this scale, that the sun will extinguish itself in another one hundred years or so, probably after an orgy of conflagration during which it will mercilessly swallow up Mercury and Venus and perhaps even our dear Earth.

This picture of the origin of life was not painted overnight. It did not arise from the meditation of a serene sage or the proclamation of the elder of a clan or from revelations from archangels to a selected personage. Rather, it developed from the search and struggle of countless people doing experiments, gathering data, formulating and weighing possibilities, mutually critiquing, revising, reviewing, verifying, rejecting, and finally accepting those ideas that seem most plausible. And yet this may not be the final word on biogenesis from the world of modern science. What matters in science is not the correctness of the picture painted, nor the sanctity of the source, but the reasons and routes by which one arrives to conclusions.

## Differences in Perspectives

As noted earlier, the account of the origin of life given by science is considerably different from hallowed religious views, and so it is quite unsatisfactory to many traditionalists. Other persons find it to be at least as interesting as what our distant ancestors proposed and also find it persuasive because it is fortified by charts and data and mathematical theories. The scientific view is a conjectural *conclusion* of life emergence from the data of observation and not a solemn proclamation or intelligent speculation based on ancient authorities. Those who are inclined to scientific cosmology grant that there is, as there always will be, something tentative in the scientific vision, but its reasonable coherence makes it more appealing to them. After all, if explain you must, then you better pay attention to detail and to the deductive mode.

On the other hand, to those who are conditioned to scriptural authority and revealed truths, scientific cosmology is one drab and dismal story in which human beings are mere byproducts, accidents, or worse—like inconsequential mushrooms that sprout in the wilderness and perish. All the grandeur of a magnificent universe with splendid stars in the firmament is reduced in this picture to tenuous hydrogen gas pervading all over and concentrating here and there, to dying stars with nuclear fire at the core, to galaxies running amuck like swarms of frightened fowl, and sea salts cooking themselves into animalcules. More seriously, the scientific picture seems to give God Almighty the cold shoulder; it leaves no room for reverence or thankfulness.

Then again, though *Homo sapiens* may be one of the latest products of evolution, we are by no means the most important in the global ecosystem. In fact, the contrary is the case. As William Stevens crisply stated in a newspaper article:

> Humans may think they are evolution's finest product, but the creepies, crawlies, and squishies rule the world. Remove people from the face of the earth and the biosphere would perk along just fine, ecologists say. Remove the invertebrates . . . and the global ecosystem would collapse, humans and other vertebrates would probably last only a few months, and the planet would belong mostly to algae and bacteria . . .

All this, from the perspective of traditional religion, is not so much poverty of thought as mischievous materialism, haughty in its cocksureness, lacking in humility, ignorant of the divine, and it pales in comparison to the power and poetry of a glorious, God-engendered Creation story, sanctified by meaning, morality, and purpose. Cosmologists, like Laplace, may not need a God hypothesis, but many find it to be beautiful, soothing, and worth having.

**Reaction of the Mystic**

The more spiritual members of the tradition have little interest in abstract cosmologies, present or past, Hindu or non-Hindu. Thus, Ramana Maharishi, a highly evolved twentieth-century spiritual giant of the Hindu tradition, said with much wisdom (David Godman ed. *The Teachings of Sri Ramana Maharshi*):

> All metaphysical discussion is profitless unless it causes us to seek within the Self for the true reality. All controversies about creation, the nature of the universe, evolution, the purpose of God, etc., are useless. They are not conducive to our true happiness. People try to find out about things which are outside of them before they try to find out "Who am I?" Only by the latter means can happiness be gained.

# IV. Mind: The Science of the Self

> Classical Indian thought is rich in psychological content. However, it is in the raw, covered by concerns and issues extraneous to academic psychology. They need to be mined from the depths of classical writings, cut by current analytical tools, crafted by concepts in vogue and displayed in contemporary discourse so that one can see their natural brilliance and radiant splendor.
>
> —K. Ramakrishna Rao, *Towards a Spiritual Psychology*

## Introduction

Science is an attempt to understand and interpret the world of experience. In this context, two fundamental questions arise: First, who or what is it that tries to understand and interpret? Human beings, of course. But what aspect of human beings? The eyes see, the ears hear, the nose smells, the tongue tastes, and the skin feels; but it is the mind that thinks, analyses, understands, and tries to explain. This leads us to a second, more difficult, set of questions: What is this mind? What is its innate nature? How does it arise? What are its limits? What is its scope? Such questions have been raised since time immemorial. In this chapter, I will reflect on some of the answers given by Indic thinkers to these questions.

The subject matter of science may be broadly divided into two categories. To the first belongs all that we see and hear, smell, touch, and taste. These constitute the external, so-called objective world. In the second category are elements of the internal world of thought, reflection, feelings, and inner experience. The sixteenth century Galilean-Cartesian worldview was that the first category of knowledge can be explored through scientific methodology, but the second category of subjective experiences remains beyond the scope of such exploration. This bifurcation of the world into extended things (matter) and experienced things (mind) is regarded by many to have been an error. There is a vast and growing literature on the negative impacts of the Cartesian dichotomy of the world into humans and nature, body and soul, etc. Some writers have gone so far as to declare that ruthless exploitation

of Nature is the basis of the industrial revolution and that this had its origins in Cartesian dualism.

Be that as it may, Indic thinkers investigated and reflected upon mind and consciousness in a variety of ways. There have been many healthy debates among scholars in India on the interpretations that could be given to the original texts on these matters. What is unique in the classical Indian context is that in many of these discussions the protagonists of specific views were often spiritual personages—that is to say, not just scholars, but saintly individuals. In this, we may compare them to the scholastic philosophers of the Christian tradition, like Thomas Aquinas, Jean Buridan, and Anslem of Canterbury, who were also deeply religious thinkers. Likewise, Hindu philosophers who explored these ideas were interpreting earlier texts regarded as sacred. They seldom claimed they were propounding their own ideas.

Influential philosophical schools arose from their diverging perspectives. They were powerful in that these schools gave rise to different religious sects on the basis of the spiritual frameworks on the nature of mind and consciousness. The thinkers themselves propounded many theories relating to the ultimate nature of the world. Their ideas were based on observation and analysis—but no less on deep spiritual experiences. The founders of some of these systems are therefore regarded with great reverence by their followers.

**The Nonidentity of Mind and Consciousness**

Thinkers in all cultures have often wondered about mind and consciousness. Modern science does not make any distinction between the two; it tends to regard both as emergent properties of the brain, though some scientists would agree with J. B. S. Haldane when he stated: "It seems to me immensely unlikely that mind is a mere by-product of matter."

In classical Hindu theories, mind is different not only from matter but also from consciousness. As psychologist Ramakrishna Rao explained, "Perception is sensory awareness. Cognition is reflective awareness. Consciousness is awareness-as-such. In Indian psychology, as represented by Samkhya-Yoga and Advaita Vedanta systems, consciousness and mind are fundamentally different." However, the mind has a material aspect, supersubtle in its substantiality. It is seen as the instrument through which consciousness perceives physical reality.

The sensory organs are essentially instruments. The centers in the body that perceive sight, sound, smell, and taste are regarded as the organs (*indriyas*) of perception. The mind (*manas*) is linked to these and experiences them all. Again in the words of Ramakrishna Rao, "Mind is closely connected with the different systems of the brain. In normal perceptions, the mind takes the forms of objects via the channels of the sensory system and the processes in the brain. The forms themselves are non-conscious representations of the world of objects . . . All conscious perceptions are therefore cognitions."

Thus the mind creates a world of reality with all its aesthetic, pleasurable, and painful features. We experience the phenomenal world through our senses, and we enjoy and suffer through the mind. In other words, it is the mind that creates reality for consciousness. In this view, the mind is more than a mapping device that charts the external world into decipherable, colorful figures. It creates its own reality. This is not solipsism but a recognition that when the mind ceases to function, there will be no physical reality for the corresponding individual consciousness. As Erwin Schrödinger noted, "Every man's world picture is and always remains a construct of his mind, and cannot be proved to have any other existence."

**Spiritual Energy: Yogic Perspective**

There are detailed theoretical and experimental views on consciousness from the perspective of the science of yoga. To begin with, it is affirmed that there is a subtle trans-physical body in each of us aside from our normal physical body. This is referred to as *súkshama saríra* or *linga saríra*. It reminds one of Louis de Broglie's hypothesis in quantum physics according to which a wave is associated with every particle. The subtle body is sometimes pictured as the seat of spiritual energy and consciousness. Furthermore, in the Vedántic framework, it is enveloped in five sheathes which in turn are related to our faculties of perception. The subtle body carries within it traces of the current life. The subtle body is transported from one physical body to another in the process of transmigration, the seed of karma in the process of reincarnation.

Packets of spiritual energy move within the human body through channels called *nádís*. The subtle nádís and the physical spinal cord intersect at various points. Various esoteric centers of spiritual energy known as *chakras* are at these points. They are located at specific centers from the bottom of the spine to the very top of the head. Chakras have been variously named and given specific functions, and they play a very important role in yogic awakening. In the chakra model, when Creation occurred, vital spiritual energy was stored in the so-called *kundalini*. It is visualized as a coil in the *múládhára chakra* at the base of the spine. The goal of some yogic exercises is to unleash the latent power of the kundalini. We are told that the awakening of kundalini energy and the gradual uplifting of it to the *sahasrara chakra* (the highest chakra in the head) is what the ultimate yogic experience is all about. When that happens, so say the experts, the person will experience unadulterated ecstasy.

The chakras do not have any physical reality. Dissection of the body and microscopic inspection of the spinal cord have not revealed anything like the chakras described in ancient texts. This is not surprising, because chakras are part of the spiritual dimension of existence. The mixing of the spiritual view of life with the materialist can lead to confusions and paradoxes. The *chakra thesis* is that there are untapped spiritual forces in each one of us. It reminds us, as few cultural traditions have done, of the enormous potential of the human spirit. It also offers a framework in which that potential is

stored within the human body and can be actualized. Yogic practitioners exemplify the enactment of this spiritual worldview.

In his *Perennial Philosophy,* Aldous Huxley noted that "in every age there have been some men and women who chose to fulfill the conditions under which alone, as a matter of brute empirical fact, such immediate knowledge can be had . . ." Huxley added that these are the people we call a saint or a prophet or a sage. I would add that these are the people we call yogis who have attained the pinnacle of yogic experience.

**The Proactive Mind: Desire and Its Expression**

The mind is a dynamic entity that uses the sense organs and illumines the world around it. It is like a flashlight focusing on objects and ideas at different times. But one may wonder, what is it that fuels the mind? The answer, from the Hindu perspective, is *desire*. Desire is at the root of most aspects of perceived reality. It is remarkable that Sigmund Freud reintroduced this idea in his psychological theories through the notion of the libido centuries later. We recall that—according to Freud—libido was simply the sexual drive which manifests itself in various ways at various stages in the development of a person. In the Hindu perspective, desire refers to any attachment in general, sexuality being only one of many, albeit the most powerful, manifestation of it. And we are reminded again and again that desire, especially of the carnal kind, can land us in difficulty. The statement in the *Mahabharata* (*Viráta Parva*) that "Overcome by ignorance sinful men under the influence of desire come by either extreme infamy or dreadful calamity" is all too sadly applicable to many public figures in our own times.

Carl Jung's characterization of desire as psychic energy would probably come closer to the Hindu view in that it is desire that keeps the mind active and dynamic.

In the classical Hindu view, many emotions (*rasas*) are classified under desire. These range from the urge to provoke or feel anger and the proclivity for humor to sexual urge and the wish to become a parent. In other words, our entire conscious life functions in a framework of desires. This thesis has serious implications. Since desire is the fuel that propels the mind, the mind will cease to function when it is deprived of this fuel. What this means is that the mind will reach a peaceful calmness when it is cleansed of all desires—just as the engine of an automobile will cease to function when the fuel tank is empty. Such a cessation of desires may happen either by the arrest of brain activity or by complete detachment. Desire implies a target. In fact, desire is intense psychological focus on or attachment to a target. And such attachment is the cause of much sadness and sorrow. Desire is regarded as evil for this reason. Detachment is recommended in Hindu and Buddhist teachings not just for moral reasons, but also because *desirelessness* is a means, indeed a precondition, for experiencing pure consciousness and avoiding sorrows. In the Hindu system of values, that experience should be the ultimate goal of human life.

Now we see why there has been much lauding of efforts to curb desires within the tradition. The great men and women of the culture, both saintly and sacred-historical, have been ascetics of the highest order who not only relinquished all desires but undertook great penances as well. This is symbolized in the fasts prescribed by the religions of the world.

Unfortunately, many well-meaning individuals have wrecked their lives in premature and inordinate attempts to curb natural desires. It has also been argued by some Indian thinkers, past and present, that strong admonitions to curtail desires may have played a role in India's not having explored the physical and material dimensions of the world in past centuries to develop positive sciences and technology.

On the other hand, it must be remembered that the injunction to rein in desires was intended to provide a framework in which greed and addiction are curbed and to enable a person to cope with the frustrations associated with unattainable wants and inevitable losses. In the context of a major loss, whether of money or of a near and dear person, the spirit of detachment could help one bear the consequent emotional burden. In today's world, industrial extravagance is tantamount to a reckless assault on nature and damage to the environment. Moreover, resources are drastically shrinking while population is growing uncontrollably. In such a world, curtailment of desires would result in lessening consumption, and that would be in the interest of humanity. The newly emerging ethical philosophy that calls for downsizing lifestyles is essentially a rediscovery of the ancient Hindu injunction to curb our desires, especially for a surfeit of material gratification.

We may note here that in the classical Indian context, psychology was not intended to simply understand the nature and functioning of the mind nor even to cure diseases to which mind might succumb, but rather to help confront life's problems from a better understanding of the nature of mind. Just as scientific knowledge is used for many a practical purpose in the modern world, knowledge of the mind likewise was expected to guide us through life more sanely.

Moods and experiences are associated with all desires—some positive and some negative. Thus, one analyzed the variety of moods in Hindu aesthetics. These include eros (*shringara*), valiance (*vírya*), humor *(hásya*), and marvel (*adbhuta*)—all positive—fear (*bhayanaka*), pathos (*karuna*), repulsiveness (*ribhatsa*), and anger (*raudra*). These are referred to *rasas*. Sometimes peace (*shanta*) is added to the list.

What is interesting is that these form part of a classical treatise on Indian dance (*Nátyasástra*) ascribed to an author named Bharata. In this work, the author explains how these various feelings and moods can be facially expressed in dancing. This is a remarkable instance of the merger of art, philosophy, psychology, and analysis.

### Consequence of View of Knowledge as Interpretation

The point of view that mind grasps the world rather than that it merely receives information about it is quite important. The mind is compared here to a fishnet that

brings fish into its domain rather than a boat into which the fish jump. This view can have two significant consequences for our concepts of truth. First, it implies that mind can only apprehend some aspects of reality: indeed those that it cares to look for. Second, no mind can ever hope to have a full or complete understanding of the whole, for all the fish caught in a boat could never exhaust the ocean's supply. This approach instills a humility that is becoming in any enterprise. More importantly, it fosters epistemic humility not as an ethically commendable attitude, which it may well be, but rather as an expression of the recognition of the nature of the mind and the world.

The apprehension of truth may not be dissimilar to the appreciation of art. Not everyone may concur on the beauty or ugliness of a painting or a piece of music. Just as beauty is in the eye of the beholder, truth may also be in the mind of the seeker. Even if this seems to contradict the standard criteria of objectivity, it provides an explanation for the perennial and often unbridgeable differences of opinion among well-meaning and clear-minded thinkers.

It is important to distinguish between facts as such and our awareness of them. The existence part of the physical world is trivial in that it could be there whether or not we are here. But in either case it will not contribute to human knowledge unless a mind is involved. We each live a life of our own, and as we go through life's journey, we are totally ignorant of a myriad things and events because our minds have not been involved in them. At this very moment, there are events occurring in the world, which we may discover upon reading a newspaper. We are totally ignorant of the contents of millions of books, of prehistory, and the culture of other people; only a small fraction of all this may be brought to our ken when our minds get a chance to gasp them.

In other words, the incorporation of external facts (existence) in the human mind is what constitutes knowledge. And here, the individual mind plays a paramount role. Moreover, the mind not only grasps but also interprets what is grasped. And that interpretation depends on its previous inputs. Therefore, what we accept as truth is a function of a good many factors which are independent of what is being grasped. That is why no two minds react to the same incontrovertible fact in identical ways.

Thus, differences of opinions are essentially differences in modes of interpreting what has been grasped by the mind. This idea is relevant and obvious in aesthetic appreciation and literary criticism, but it also has a more practical value: it explains and enables one to grant that other minds, i.e., other people, can grasp the same situation or set of facts in different ways. This view of the mind is helpful in coping with controversial positions in sympathetic ways.

In other words, this understanding can foster ideological tolerance. Unanimity is often achieved when the minds in a group are formed in like manner so that their apprehensions tend to be similar when they confront a situation. This enables us to understand the like-mindedness of people who are brought up in the same tradition and culture or are subjected to the same news media or indoctrination.

### *Chit*, Its Three Aspects, and Mind

In one Indic view, what we normally call the mind is the bottommost part of a three-layered structure called *chit*. This term has several connotations. It is sometimes translated as "pure consciousness." The essence of the universe is known as *sat* (pronounced as *sutt*). The union of *chit* with *sat* leads to *ananda* or supreme bliss. This triple union is referred to as *sat-chit-ananda or sacchidananda*: a term that is sometimes used to refer to the Divine Principle. When we reach pure consciousness, we also experience what is known as bliss. At the more mundane level, one might reach the highest level of joy when one becomes fully aware of nature, complexity, and the unity behind the diversity of human existence. Sacchidananda is such a fundamental tenet of certain schools of Hinduism that the phrase is used by many as a mutual greeting. Thus, instead of saying good morning or good evening, one simply says *sachchidánand*. This is just one instance of how deep philosophical views have seeped into everyday life in Hindu culture.

Mind itself is referred to as *manas* (cf. Latin mens); it deals with the data of sense perceptions. Sense perceptions are acted upon by another faculty, *buddhi*, which imprints individuality, or ahamkára (I-maker), on the whole process. These elements are components of mind.

Hindu psychologists place the various stages of mental processes in three categories: thought, assimilation of thought, and reflection on the assimilated thought. As you listen to a speaker or read a book, your manas is at work. That is to say, the mind grasps what is being heard or read. As you assimilate what you are hearing or reading, your ahamkára is at work, and your individuality comes into play. Other minds, receiving the same input, interpret the information differently. When you agree or disagree with what you hear or read, your buddhi is at work. *Chitta* is like the overall process of reading, understanding, and evaluating. In the spiritual context, these categories take on different connotations. In this school of thought, buddhi refers to an enlightened understanding of the nature of perceived reality. It is the capacity to discriminate between reality and appearance. One who has refined this capacity to its full potential is a Buddha.

One mode of attaining wisdom, or the faculty of buddhi, is spiritual discipline. There is a verse in the Bhagavad Gita (X:10) which says that those who persistently revel in singing the glories of the Divine acquire the buddhi faculty—by which they can attain the Divine. This may be interpreted to mean that those who are given to spiritual pursuits can make the enlightened discrimination between what is of profound significance and what has only ephemeral and trivial value. In a secular context, this verse from the Gita could be taken to mean that those who are fully committed to the pursuit of a discipline will surely attain its highest levels.

This framework synthesizes how the mind and its interpretive potential. With questions relating to the origin of the universe or the nature of matter, there is little connection between abstract theory and everyday life. This is not so with theories of mind. Here the concepts can touch our lives in profound and meaningful ways.

**Chitta as cosmic root**

In one school of Hindu thought, chitta emerges in the cosmos as a great fundamental principle (*mahátattva*). It spans the length and breadth of the universe. It has a threefold nature, referred to as *sattva*, *rajas*, and *tamas*. It combines both the centers of consciousness and the associated material elements. In the theological framework, sattva, rajas, and tamas are embodied in the triune of Brahmá, Vishnu, and Shiva. In this context chitta may well be called the Mind of God, for it reflects the omniscience that we attribute to the divine. And it splits into countless parts, the countless islets of consciousness that we all are.

Here we have the magnificent vision of a universal thought pervading the whole world and giving rise to the material world. Thus, the individual thoughts generated in our minds are but sparks of a cosmic conflagration of thoughts. This could also be taken as implying that not just in human brains, but in every creature and non-creature there is a subtle potential for mind and consciousness. Such views cannot always be verified through empirical means. But they are deep insights which enable us to see order and meaning in the complex world we experience.

**Yoga**

Now let us consider what might be India's greatest contribution to spiritual life and applied, humanistic science: the sophisticated system of physical and mental discipline known as *yoga*. The etymology of the term conjures up harmony and synthesis; the word is derived from a root meaning *union*, since its purpose is to unite the individual with the cosmic levels of existence. The very same Indic approach to understanding the complex foundations of consciousness also prescribes techniques for harnessing the limitless potential of the human mind. Whether or not one does yoga or accepts its philosophy, it is difficult not to be impressed by its mind-expanding thesis. If one evaluates the significance of cultures by the concepts, ideas, visions, and ideals that emerge from it, then Hindu culture would rank high for the theory and practice of yoga alone.

Outside observers once treated yoga as a strange local cultural practice. Today—like the goal of human rights and the commodities of current technology—yoga has moved beyond India's borders. During his Gifford lectures, William James quoted a European who witnessed aspects of the Vedas and said yoga "makes its true disciples good,

healthy, and happy men," though it is not clear why the word *men* was used instead of *people*.

By the second half of the twentieth century, yoga had attained a universality that can only be compared to that of modern science. Paramananda Yogananda reminds us in his *Autobiography of a Yogi* that many decades ago Carl Jung perceptively observed:

> Quite apart from the charm of the new and the fascination of the half-understood, there is good cause for Yoga to have many adherents. It offers the possibility of controllable experience and thus satisfies the scientific need for "facts"; and, besides this, by reason of its breadth and depth, its venerable age, its doctrine and method which include every phase of life, it promises undreamed of possibilities.

It may not be widely known that at least part of the credit for making yoga practice popular in the West goes to Yehudi Menuhin. He was so impressed by how much he benefited from learning yoga from BKS Iyengar that he invited the yoga master to come to the West to spread the knowledge and practice of this Indian spiritual and physical discipline. We read the following in Kofi Busia's biography of Iyengar: "In 1982, for example, he (Yehudi Menuhin) was invited to conduct the celebrated Berlin Philharmonic Orchestra at its one hundredth jubilee celebrations. He conducted the opening of Beethoven's Fifth Symphony standing on his head while directing the orchestra with his feet." Under the program of asanas that Iyengar prescribed, Yehudi Menuhin's muscular pains disappeared completely. Menuhin wrote that "yoga made its contribution to my quest to understand consciously the mechanics of violin playing," and he also called Iyengar "my best violin teacher."

To call Yoga Hindu is as partial a truth as to call modern science Western. It is true that Yoga is Hindu in the sense that it has been associated with the Hindu world for millennia. But its underlying philosophy is in a trans-religious framework. In so far as it is a profound discovery of the human potential, it is more of a scientific discipline than a religious practice. Electromagnetic theory had its origins in the works of giants like André Marie Ampère, Michael Faraday, James Clerk Maxwell, Heinrich Hertz and J. C. Bose; yet the subject itself is of panhuman interest and validity. Even those outside of Western culture, who may reject modern science, benefit from the countless applications of electromagnetic theory. Likewise, one can benefit enormously from yogic exercises and approaches to life irrespective of one's affiliation to any particular religion even though its earliest practitioners were culturally situated in India. In other words, insights and knowledge acquired by original investigators belong to all humankind.

In recent years, some Hindus have argued that Westerners who practice yoga should pay royalties to India where the system originated. This would be like saying that all who use the motor, the generator, or any electromagnetic gadget should pay

royalties to England and Europe. Scientific discoveries transcend national, cultural, and religious demarcations and belong to humanity at large, irrespective of where they were made or by whom.

Then again, there are Christian and Muslim religious leaders who contend that followers of their faith should refrain from yogic practice because it had its origins in the Hindu world. They certainly have the right to guide their followers the way they think is appropriate, but one wonders if they would advise their flock to keep away from some vaccines and inoculations because they were synthesized by Jewish scientists.

The yoga system had its origins in the writings of Patañjali and in the works of countless practitioners. Patañjali lived in the second century BCE, most likely. He must have been a remarkable thinker and practitioner of spiritual disciplines. Unfortunately, very little of historical reliability is known about him, although magical accounts of his life abound both in the Sanskrit and in the Tamil traditions. Patañjali is remembered through his classic masterpiece, *Yogasutra*, which has been translated and commented upon countless times.

There is a broad range of yogic postures. They involve both body and mind. The originators of the system devised eighty-four *asanas* or sitting postures for spiritual exercise. In our own times, there are several masters who have developed their own systems, each associated with one or more *mantras*.

Yoga's practitioners were some of the earliest to discover the connection between bodily functions and altered mental states. Breathing is a physiological function that is both voluntary and involuntary. It is at the very basis of life and consciousness. The brain quickly loses awareness when it is deprived of oxygen. Breathing is thus a far more powerful process than one normally imagines. Indic thinkers discovered this truth and developed techniques for harnessing the power implicit in simple respiration. Regulated four-phased breathing—known as *pranánáyama*—involves inhalation, exhalation, retention of air in the lungs, and keeping the lungs airless for a while. It plays a central role in yogic practice.

There is no doubt about the efficacy of yogic exercise. Writing in 1937, the psychologist K. T. Behanan made the following observation in his book *Yoga, A Scientific Evaluation,* after spending time in an ashram in India:

> I have had the privilege of watching at close range the daily lives of more than a half-dozen yogis for over a period of one year. I can testify without any reservation that they were the happiest personalities I have known. Their serenity was contagious and in their presence I felt always that I was dealing with people who held great "power" in reserve. If the saying "radiant personality" means anything, it should be applied to them.

Since these words were written, there have been several scientific studies on the effects of yogic practice as well as of the therapeutic value of yoga in ailments ranging

from asthma and depression to insomnia and memory loss. Yoga also helps countless soldiers returning from combat recover from post-traumatic stress syndrome.

The theory underlying yoga is complex. It presupposes a spiritual component in human existence. The attitude of the individual to life is as important as the motions and postures of specific exercises. A yogi is one whose thoughts, words, and actions are governed by the awareness of the spiritual dimension of the world. To be a scientist, it is more important to weigh facts and reason than to work in a laboratory. Likewise, one may derive the benefits of yoga by engaging in modest meditation as long as one does not forget one's link to the cosmos. To attain yoga's full benefits, one needs to transform one's daily life into the spiritual mode.

**The Five Functions of Chitta**

In the yoga framework, *chitta* is the overarching principle of consciousness. It is constantly subjected to a vortex of modifications, known as *vrittis*. These are at the basis of right notion, misconception, fancy, sleep, and memory. All our conscious experiences are rooted in these modifications of the components that make up the mind. That is why it is so difficult to keep the mind focused on a single idea for more than a minute. In other words, the mind is constantly in a state of flux because of the vrittis, and yoga is meant to bring the turbulent chitta to a state of calmness.

In yoga, the practitioner's aim is not to control bodily functions in order to perform a feat, to impress spectators, or to experience a thrill. The ultimate goal is to erase individual consciousness altogether and come upon a state of bliss in oneness with the whole. Deep probes into the submerged caverns of consciousness lead, according to experienced practitioners, to mystic delights of unsurpassed intensity. That is why yoga has been described as *the technology of ecstasy*. As George Feuerstein pointed out,

> The civilization of India has spawned an overwhelming variety of spiritual beliefs, practices, and approaches. The goal of Yoga, the most famous and globally widespread of India's spiritual traditions, is to take us beyond ourselves to the Absolute Reality, to the utterly blissful union of the individual self with the transcendental Divine.

There are several levels of mystical experience. The joyous response of a loving parent to a giggling offspring, the enchanted walk of the nature poet through autumnal woods, and the recognition of a new pulsar by a radio astronomer all may be regarded as uplifting positive experiences of varying intensity. But they are not what the yogic mystical experience is said to be in its essence. The ecstasy of the yogi who has attained the pinnacle is said to be of a different order, both in quality and in intensity. At a more modest level, yoga can provide the practitioner with an inner peace that eludes

many people in the hustle and bustle of everyday life. This accounts for its enormous popularity in hectic, industrialized societies.

**Meditation**

As noted above, the mind is in a constant state of flux. That is to say, if it is regarded as a receptacle of thoughts, it seldom has the same contents. Thoughts come in and go out of the mind like passengers in a bus, never the same at all times. What is the cause of this incessant flow? In the yoga framework, this is explained by saying that there is in the depth of the human psyche an ardent and insatiable desire for fulfillment. The fulfillment is to be achieved through actions. The totality of the un-actualized desires constitute what is called *vásana*. All through our lived life we manage to achieve many of our desires, but not all. The unfulfilled desires are carried through into the next birth. This remnant vásana is what keeps the mind in a constant state of flux.

The challenge is to curb the vásanas, for ultimately they inevitably lead to re-birth. A variety of techniques for constraining the mind from its wanderings for desire fulfillment have been developed in the Indian tradition. They constitute what we call meditation. The popular version of these is simplistically called navel-gazing, but there are serious and systematic modes of meditation into which a competent guru can initiate a disciple. The goal of meditation is as much to impede the mind from engaging in desire-fulfilling excursions as to harness its full potencies. The method is to withdraw from sensory allurements.

We may approach all this from spiritual-yoga perspectives, or from everyday practical perspectives. The sense of it all is that if we wish to benefit from the resources and capacities of the mind, we need to be aware of the obstacles that stand in the way as distractions (anger, lust, idle thoughts, etc.), and focus on specific goals and ideals. The theoretical framework of Indic psychology thus becomes enormously valuable in many practical contexts also.

**Levels of Awareness**

We acquire knowledge over time. But as noted earlier, countless other matters occur beyond our awareness. Reality, for each of us, is essentially that which is brought to our attention, directly or indirectly, through our normal modes of perception during our finite lives.

Then again our perceptual awareness recedes into temporary oblivion when we fall asleep. In this context, the Mandukya Upanishad offers an interesting insight into the levels at which the human mind develops awareness of the world. The Mandukya Upanishad tells us that the brain can be in one of three possible states of awareness: waking (*jágrata*), dreaming (*svapna*), and dreamless sleep (*sushupti*). In the waking state, we interact with the world through our sensory faculties, experiencing pain and

pleasure, suffering and joy. This is the state in which we spend two-thirds of our lives. In the dream state, our experiences are not concrete, for what we feel are not material things. They are abstract, subtle, and unsubstantial; yet they create the impression of reality. This reminds us that we can never be certain that a conscious experience has its roots in a physical reality. In the dream state, the brain is not bereft of the deep desires with which it is most often afflicted, for it can still experience some pseudoenjoyments. In the deepest level of sleep, the brain loses its individuality. All barriers between knower and known are dissolved. The separated consciousness merges with totality, yet this is still a state of ignorance in that the experiencing self is not aware that it is part of the whole.

Hindu thinkers contend that there is a fourth level. It is called *turiya*—the purest state of awareness. Here, consciousness transcends causal and spatiotemporal categories as it merges with the ultimate. This does not happen with all brains, but only with some. This is what constitutes spiritual enlightenment. Turiya-yoga, which the Siddhas are said to have practiced, promises such experiences. It is clear that the sages who spoke of turiya spoke from direct knowledge.

An analogy from physics may clarify this point. The matter we perceive with our senses consists of material objects with shape and color and tangible properties. However, at the plasma state, atomic nuclei are in pure electron-free states. This is how it is in the core of stars. But some stars can reach a state where the space-time continuum merges beyond distinction, and physical laws fail as we know them. This ultimate merging happens at the core of black holes, for example, and it may be said to correspond to the turiya state of which Hindu mystics speak.

Modern scientific studies have revealed that there are at least two stages in sleep: One is the rapid eye movement or REM cycles, which occur several times a night and correlate with dreaming. The other is nonrapid eye movement, or NREM. During these phases, different types of brain activities occur. It is interesting that Indic thinkers of ancient times already recognized different phases of sleep and interpreted them as stages of awareness. This maps onto the current paradigm of multiple types of brain activity. Hindu thinkers showed foresight by suggesting that sleep states are altered modes of awareness, and awareness is a function of processes in the brain. In other words, the dichotomy between sleep and wakefulness is, in fact, a transition from one mode of brain activity to another.

There have been a number of scientific studies on what is called NDE: near-death experience. According to Raymond Moody (*Reflections on Life After Life*), a respected expert in the field, this is generally a positive experience, involving a sense of absolute peace while moving through a brightly illuminated tunnel. It also includes looking at one's own body from the outside. Some believe that reports of NDE provide ample proof for life after death, while others interpret them as manifestations of a brain that is at the tail end of its active state. It should be noted here that sleep-state and dreams are studied by neuroscientists through the empirical methods of science. Their interpretations of how dreams come about are quite different from the metaphysical perspectives of the

Upanishads. Current science tells us that during sleep the brain tries to perform its image-creating function without the benefit of the usual sensory inputs, as a result of which incoherent impressions are created. These have no relation whatever to the actually experienced real world, except that rough images formed during waking hours are shuffled randomly in the dream state, causing chaotic image-sequences. Current science tries to understand sleep in terms of neurotransmitters like norepinephrine and acetylcholine. It is important to distinguish between scientifically framed explanations and philosophically meaningful insights on any phenomenon related to the human condition.

**On Attachment, Bonds, and Bondage**

Traditionally, in Hindu-Buddhist philosophy, one speaks of bondage as the cause of all suffering. Freedom from bondage is the key to ultimate liberation—the escape from the cycle of birth and death. It says explicitly in the Buddhist sacred book *Samyutta Nikáya* that sorrow arises from craving, which leads to rebirth, which brings delight and passion and seeks pleasure, now here, now there, craving sensual pleasure, craving continued life, craving power, all leading to a perpetuation of the birth-death cycle.

This idea has enormous religious/spiritual significance, and it has played a major role in the development of Indic civilization. Therefore, it has been analyzed and discussed by many scholars and commentators over the ages.

A related element—bond—is no less important in Hindu thought. The essential thread connecting all strands of Indian philosophical thinking is yoga. The goal of yoga is, no doubt, to liberate us from the bondage of rebirth. Yet yoga is, by definition, a binding also. It is the establishment of a bond, a cosmic connection, or union with the Infinite. Perhaps, this is to remind us that bonds are as relevant to earthly existence as the breaking of bondage is for psychological and spiritual liberation.

Bond is seldom discussed as a positive force in classical Hindu philosophy. The attachment of the mind to worldly objects and experiences is an aspect of life that has been extensively commented upon. They are bonds that tie us to earthly life and are the root cause of our sufferings and pleasures as well. Bonds are psychological and are regarded in the tradition in negative terms, because they result from desires that chain us to the material world. This is a deep insight into the human condition, and it is as good an explanation as any to account for emotional suffering. It is therefore important to reflect on the various facets of bond creation.

A bond is any significant connection between two or more elements. It normally serves to enhance, enrich, and/or transform those elements. When a bond becomes too rigid and unbreakable, it restricts individual freedoms of members in the system. In such a case, the elements in the system may be said to be in a state of bondage. Bondage stunts self-expression and growth, and it brings about unpleasant and undesirable consequences. Thus a bond may have a positive potential, but bondage

has negative potential. Every bond is capable of becoming bondage. Indeed, one aim of yoga is to develop a perspective in which this distinction is borne in mind as we go through the chores and charms of life. Patañjali stated that the ability to differentiate between the self and the other leads to liberation. This implies two elements, and their union (bonding) constitutes yoga.

Failure to recognize the difference between bonds and bondage can lead to confusion. It can lead to unwise or hurtful decisions. It has been argued that overemphasis of bondage and identification of all bonds with bondage generates pessimism. This was not the case in ancient India. From the life-affirming spirit in Vedic hymns and epics, it is clear that there was considerable *joie de vivre* in ancient Hindu society. Vedic hymns affirm life and good health, wealth and prosperity, as in:

> . . . cultivate the cornfield:
> Delight in that wealth, thinking highly of it (Rig Veda, X. 34.13).

And in:

> Let a man think well of wealth and strive to win it
> By the path of law and worship (Rig Veda. X.32.2).

When a couple has a child, a natural bond of love develops between parents and progeny. This bond results in joy for all concerned. However, the bond of love between parent and child could degenerate into a state in which the parent becomes obsessively possessive of the child even after the child reaches adulthood. This would be a case where bond degenerates into bondage. Pain and suffering invariably result from the breaking of a bond. This was probably the reason why some thinkers suggest that bonds should not be formed. That is what abstinence and control of the senses imply. As an extreme instance of this, one may decide not to have any children; because if one has no children, one will never experience the pain of losing them. This reminds one of what Heinrich Heine wrote: *Gut ist der Schlaf, Tod is besser, das best aber wäre nicht geboren warden*. Sleep is good, death is better, but never to be born is the best of all.

This is surely one way to avoid pain and suffering. It is like following the injunction "Don't do anything, for then you won't make a mistake." Many people have been inspired to search for higher spiritual truths, so they leave their families and worldly possessions precisely for this reason. The decision to join a celibate monastic order is provoked by similar considerations. Proponents of this view often ignore the fact that by not forming bonds one also erases the positive aspects of bonds: joys and sharing. Moreover, while these thoughts might be theoretically compelling, they are socially impractical.

Given this, we may distinguish between bond and bondage. The eminent, saintly theologian Sankaracharya explained in his commentary on the Bhagavad Gita that

although certain actions may have a binding nature (*bandh-svabhavini*), this binding nature will not come to fruition if the actions are done with equanimity. We may interpret this to mean that we can prevent bonds from becoming bondages with the appropriate understanding and attitude. In many instances in the Gita, Krishna insists on action in the everyday world (which could be bonds) as long as one adopts the appropriate approach. The key notion of *nishkáma karma* (desireless action) is a psychological immunization against bond degenerating into bondage.

The notion of renunciation is central in the traditional Hindu framework. Ordinarily, it is recommended as the last stage of life (*sannyásin*), when, having discharged the responsibilities which accompany being a member of society, one is expected to sever all worldly connections and take on a life of detachment. The significance of this is twofold. First, there is the insistence that one needs to fulfill one's duties at different stages in life. Second, one must realize that there comes a time when one has to bid farewell to worldly pleasures and begin to reflect more seriously and systematically upon the hereafter. That realization enables one to confront life's reality in a mature manner.

Here we may recall the notion of *purushártha* (goals of a full life) concept in the Hindu framework, elaborated in various books on practical ethics (*Dharmashástras*). We are told that there are four principal goals in life, none more and none less important than the others. These are the pursuit of knowledge through systematic study and the practice of ethical behavior (*dharma*), the fulfillment of normal human desires (*kámá*), the acquisition of economic wherewithal to live without dependence in society (*artha*), and the attainment of spiritual enlightenment and liberation (*moksha*). It is important to emphasize that the stages of *brahmachárya* (celibate student life) and *grihasta* (householder's), which are conducive to the fulfillment of three of these goals, involve many bonds—attachment to knowledge and commitment to family, for example. The *Bhaudháyana Dharmasútra* (2-10-17) recommends:

> *. . . praják svadharma prathishthápya vá*
> *saptatyá úrdhvam sanyásam upadishanti*
>
> After offspring are well established
> in their own responsibilities (*svadharma*), or
> From seventy years onwards
> (People are) instructed to lead an ascetic life.

Thus the classical Hindu worldview valued bonds highly. Indeed, one Sanskrit word for family members is *sambandhi,* which means auspicious bonds. The otherworldliness for which Hinduism became famous is a matter that is emphasized only in the last stage of life. In this context, it may be helpful to note that there are not many references in the Ramayana or the Mahabharata where young and middle-aged people renounce the world.

On the other hand, a number of saints of medieval and modern times often gave up life and enjoyment before they grew old. This happened in many cases because of intense personal disappointment. This is healthier than taking to the bottle to drown one's sorrows. In any case, the impact of these renouncers of life (who have become saints of the Hindu tradition) on the formation of medieval Hindu worldview was considerable. During one phase of Hindu history, many eminent spiritual leaders undertook renunciation at earlier stages in their lives and dominated Hindu religious discourse, preaching about bondage-free states.

While it may be true that one attains spiritual liberation by breaking the bondage, it is no less true that one can contribute to the happiness and welfare of society by engaging in bonds. In fact, this is implicit in the Bhagavad Gita where the importance of karma yoga—spiritual fulfillment by dutiful right action—is stressed no less. Therefore, any discussion of bondage should also emphasize the role and importance of bonds in human life.

The crucial idea in the concept of renunciation is that the bonds in life that play positive roles during many years of activity in society have to be severed before they degenerate into bondage. For many normal people, it can be a psychologically traumatic experience to enter old age. They miss the vigor and potency of youth and sometimes long for the pleasures of a bygone period of their lives when the body was more vigorous and hormones flowed more freely. They begin to realize that these are beyond their reach when they are in bondage, and this causes suffering. The *sannyasin* stage is to help people cope with or avoid this frustration.

"Bonds without bondage" summarizes the enlightened framework. What Edward Dowden wrote in *A History of French Literature* about Rabelais reflects the mature practice of the Indic perspective on life:

> He would enjoy the world to the full, and yet at the same time there is something of stoicism in his philosophy of life; while gaily accepting the good things of the earth, he would hold himself detached from the gifts of fortune, and possess his soul in a strenuous sanity. Let us return—such is his teaching—to nature, honouring the body, but giving higher honour to the intellect and to the moral feeling (and to the spirit) . . .

Now there is another type of bond relating to the cultural history of a people. The *historical bond* connects a people to their past, not simply at the informational level but in emotional and psychological modes as well. History comprises the collective memory of a people, so tradition is an important element in collective consciousness.

When one recalls an eminent personage in one's history, it could result in a sense of pride. When one celebrates a festival, one not only partakes in the associated customs and foods but also relives the past and recalls the values and belief systems of one's ancestors. When one recounts an epic of one's culture, one not only retells an

interesting story but also remembers incidents, heroes, and heroines who have given meaning and inspiration to a long chain of generations.

A people's cultural bond with the past is special because the rites and rituals, the mantras and myths that breathed life into it over centuries and millennia continue to be vital forces to this day. It is thanks to the strong historical bond that cultures continue as dynamic and resilient systems. But this bond can also degenerate into bondage. It becomes historical bondage when one believes that our ancestors had the right answers for every question, that everything there is to be known came from one's ancestors. Historical bondage can blind a people to the fact that not all the problems of the current complex world can be solved with insights from ancient aphorisms alone, however meaningful and profound they might once have been. New and never-before-experienced challenges require new and never-before-articulated visions for their solution. The bondage with the past must become bonds.

For almost two long centuries, the historical destiny of India was intertwined with Western powers, especially Great Britain. What began as commercial bonds soon degenerated into political bondage. For a considerable period of time, the country was under the demeaning state of being stamped British India. Thanks to the tireless struggle and sacrifice of countless patriots, the country finally achieved its political independence, becoming a free and modern nation more than sixty years ago.

While one is happy to have broken the bondage that subjugated people, one cannot ignore the fact that the bond aspect of the bondage did have some positive consequences. Leaving aside the long range economic gains that resulted from the introduction of tea on Indian soil, the initiation of coal mining, the establishment of industries, and the laying of railways, the country was emancipated from Mogul monarchy and eventually unified politically under a single tricolor. These have been among the long-range positive consequences of British occupation of India. The linguistic and intellectual unification of the peoples through the English language is another, though this last item has had both positive and negative impacts. None of this can be mentioned as a justification for the bondage under Britain.

Another unfortunate consequence of India's long political subjugation is the emergence of another type of bondage: a *psychological entanglement* with the West. This expresses itself as a perennial obsession with the West's perception of, and what its media thinks and says about, India. Many Indians are not simply satisfied with their own successes and achievements, whether in the present or from the past. They often sense an urgency to proclaim these successes to the West for its applause and approval. There does not seem to be as much concern with what the Chinese or the Indonesians, the Nigerians, or the Arabs think about us. Because Christianity is associated with the West, there is great concern about how Christians view Hindus, while the not so positive appraisals of Hinduism by other religious propagandists do not seem to bother us to the same extent. We are pleased or bothered by Western interpretations of ancient Indian history. If a Western scholar holds unfavorable views about India, we are prone

to ascribe sinister motives to the person. On the other hand, if a Westerner extols our culture unreservedly, he becomes worthy of veneration and honorific titles.

**Bond and Bondage in the Physical World**

The physical world as we know it would be impossible without bonds. Whether it be at the subnuclear level of quarks, at the nuclear level of protons and neutrons, at the atomic level of electrons and nuclei, at the molecular level of interatomic forces, or at the gravitational level of planets and galaxies, bonds which are described in physics as arising from force fields are ultimately responsible for the cohesion and stability of matter, planetary systems, and galaxies.

If these bonds become too rigid—if they degenerate into bondage—the world would be frozen into a cold inertness where there would be no change, no transformation, no phenomenon. Everything would stand still, and that would be the ultimate cold death of the universe, a lifeless rigidity with no action, consequence, or import.

So here, too, we see the difference between bond and bondage. Take away the bonds, and the myriad components of the universe will fly off every which way, fritter away into independent nothingness. There would no longer be a material universe such as we know it. Viewed thus, there is much wisdom in the ancient rishis' perspective that once all bonds are severed, the world will be reduced to a state that transcends space and time, matter and energy. That, in a sense, could be interpreted as the ultimate liberation of physical entities.

In the meanwhile, we need to recognize that there can be no meaningful existence without bonds. As long as we are creatures in a material world, we are bound by the constraints of physical laws, psychological bridges, and emotional interconnections. As such, we must nourish our bonds with kith and kin, with community and country and humanity. We must also seek to forge a spiritual bond—a communion—with the cosmic principle. All psychological bonds lead to experiences. We need to stress the enrichments that come from bonds, always remembering that true wisdom lies in not allowing bonds to be reduced to bondage.

**Mind-Body Relationship**

A question that has interested many philosophers is the relationship between body and mind. In the human context, as far as we know, there cannot be mind without body. Now if one equates mind with soul as is done in some religious contexts, and if one believes in a disembodied soul, then one can imagine mind without body.

It is important to recognize that the body can function in a healthy human being even while the mind is temporarily inactive, as happens during deep slumber or when one is in a coma. Likewise, it is possible for a person to be so deeply engrossed in meditation or thought that one is not aware of one's physical dimension. Thus there

seems be a Cartesian mind-body dichotomy here. From the perspective of science, it is the brain-body from which the mind emerges.

In one traditional Hindu view, the opposite is the case: it is the mind that gives rise to the body. Traditional Hindu philosophers have presented several arguments for the existence of mind/consciousness independent of the brain/body, i.e., that it is possible for mind to exist on its own. An analogical proof that is sometimes given for this is as follows: We cannot see anything without light. It does not follow that light cannot exist without the human brain. Likewise, we cannot know anything without the mind. It does not follow that the mind cannot exist without the brain. Indeed, in a metaphorical mode, one can say that the mind can leave the body and move as far away from it as it may wish. Is that not what imagination is all about: where we can let the mind wander wherever it wants, into the past, into the future, far away to a friend or to a distant star. In these contexts, the mind may be seen as leaving the body and taking flight to places beyond. However, it must be remembered that this is possible only as long as the associated body is well and functioning. So any mind independent of the body is like a dog with a long leash; it can move here and there, but it is always anchored to that to which it is tied.Then again, from the traditional Hindu perspective, there is more to the human body than its anatomy. The flesh and bones constitute only one component of the body, as are the organs and the fluids. The human body is, in fact, a miniature version of the universe: a microcosm indeed. Everything in the world without is there within the human body. The material elements are obviously there. It is because ultimate truths occult in our physical frames that through them we also become aware of ultimate truths. Aside from the gross body (*thúla-sharíra*), there is the subtle body (*súkshma-sharíra*). It is here that the soul (*jívátman*) resides. The gross and the subtle bodies intersect at the *chakras*. The sensory faculties, the limbs and the orifices, the vital principles and the thinking mind (*manas* and *buddhi*), all these belong to the subtle body. The subtle body, as the carrier of the soul, persists even after the gross body perishes.

Then there is a third dimension to the human body: the causative body (*kárana sharíra*). It is here that all our experiences are carefully maintained. It is here that transcendental experiences such as bliss are kept and made possible. It too goes away with the subtle body when we die, and what is stored in it determines the nature of our future incarnations.

We thus see that the so-called mind-body dichotomy does not arise here in the same way as it does in Non-Indic frameworks. When Walt Whitman wrote, "If anything is sacred, the human body is sacred," he was unwittingly echoing this Hindu view.

The quest for transcendence is not simply an empty thirst for a fantasy. Even as a heliotrope is drawn to light, the evolved brain may reach out for the transcendence that made it conscious. The thirst for transcendence is the yearning of the human spirit to remember its own pre-physical origins. Such is the Hindu view of consciousness.

When we look deeper into this mythopoesie, if that is all it is, we come to an elegant model for explaining what science and religion are all about. *Brahman*, the spiritual-ground stuff, subdivides itself into *purusha*, the cosmic consciousness person, and *prakriti*, the world of nature. These are, as noted earlier, the experiencer and the experienced. Prakriti now bifurcates into animate and inanimate realms with only a fuzzy dividing line separating the two. On the other hand, purusha with its thousand heads separates into countless *jívátmans* or individual units of consciousness, which fuse into the mind and body of the animate branch of prakriti. The conscious jívatmans endeavor to recognize their source, namely *Brahman* through the modes of religion and spirituality. Aside from the faint memory of its sublime source, the jívátman also recognizes the multifaced manifestations of the stupendous prakriti surrounding it, and it makes an effort to unravel these. This endeavor constitutes science.

It is therefore not surprising that every culture in the human family has sought to connect with the Cosmos and thus has formulated religious frameworks, and all cultures have also erected explanatory structures to understand the phenomenal world through their various scientific frameworks.

**On Science and Religion**

The science that undergirds our world is privy to only a handful compared to the world's population at large. However, we live in an age of material and medical technology of undreamed of power and potential, all offshoots of modern science. The practitioners of science are immersed in its methodology in their commitment to extend the frontiers of human knowledge while some philosophers explore its complex roots and critique its metaphysical foundations. The benefits that have accrued to humanity from scientific knowledge and its countless applications range from the eradication of dark-age superstitions and effective cure for diseases to never-before-imagined creature-comforts and ease of communication and travel. With all that, science's framework is neither appreciated nor embraced whole heartedly by the general public the world over. Instead, there are doubts about science's capacity for objective knowledge, suspicions about its goals, and charges to the effect that it has landed us in life-threatening environmental predicaments. There are also deep concerns about its sweeping epistemology that forecloses important dimensions of traditional religious worldviews.

There are many arenas where humanity is fighting tugs of war. Race, religion, language, and gender conflicts are among these. Then there is the uncomfortable coexistence of science and religion. If science is making enormous headway in its goal of unraveling the puzzles of the physical world, religions are coming back to the public arena with a zest that is heartening to their followers. But some of its expressions, such as the anti-science stance of those who call for the teaching of ancient worldviews on cosmogenesis, anthropogenesis, astrology, and the like in schools, are

problematic. The resurgence of religions is also frightening to many because some of its expressions reflect bigotry, hate, and intolerance. But it would be rash to conclude from all this that religions are intrinsically maleficent enterprises. Even granting that sectarian persecutions, inter-religious wars, marginalization of people on the basis of their birth, and other moral misdemeanors and atrocities have been perpetrated in the name of God and religion, it cannot be denied that religions have been the source of time-honored wisdom and some enlightened ethics, and have contributed immensely to art and architecture, music, poetry and sophisticated philosophy. They continue to serve billions of human beings in a variety of ways, such as sharing joys in feasts and festivals, providing solace in times of grief and emotional turmoil, and supporting communities in the context of collective tragedies. Religions give meaning to individual lives, and comfort from convictions on matters relating to the Ultimate.

Analyzing every facet of poetry, imagination, and spiritual experience under the microscope of rationality, empiricism, and scientific argumentation may not be the best application of scientific methodology.

No one can deny the enormous expansion of knowledge and enhancement in perspectives, let alone the plethora of creature comforts and ease of action and communication that Goddess Science has brought for humanity. These gratifications have been responding to our thirst for knowledge and quest for understanding about the physical world.

But in the process of embracing the scientific approach we have sometimes diminished other dimensions of being fully human. Sensitive poets and thoughtful philosophers have been warning us that reducing everything to order and pattern, evidence and objectivity could have unhealthy impacts on some important facets of our humanity. However, the appeal of pure reason and meticulous rationality subtending modern science and the lure of the fruits they bear through technology for lessening muscular efforts and providing sensory enjoyments make it difficult to take their admonitions seriously.

Our unquenchable hunger for energy has pushed us to an orgy of consumption and the rape of Nature. Our scant concern for the environmental assault is driving us to the brink. We are unable to heed the scientific alarm-bells for impending climate-catastrophes.

Likewise, insightful peering into the nature of the phenomenal world has turned into a frenzy that attacks everything regarded as sacred, holy, and meaningful myth by past generations. The recent past has seen increases in psychological illnesses, broken marriages, and diseases arising from promiscuity. These are not regarded as solid proofs for a possible mental and spiritual chaos when the religions of the world are downgraded in humanity's psyche. Therefore, remembering only the atrocities committed in the name of God and religion, many rationalists do not seem to care what our destiny may become if or when our deepest longings and visions for something beyond are completely eradicated.

## Concluding Thoughts

If the brain of a fish or a frog is among the marvels in the universe, the mind that emerges from the complex human brain is truly miraculous. It is a miracle not in that it defies any law of nature—and cannot someday be tracked down to its last palpitation—but in the sheer inscrutable wonder it provokes when we contemplate what it is and how it transforms the expanse of space and the ticking of eternity, the plethora of matter, and the insubstantiality of time into meaningful, intelligible, and enjoyable elements. We all know that we have minds and that fellow humans have them too. The mind is not visible in the face of the one with whom we communicate, but it is the visible indispensable element in the other that enables us to interact. We see piercing eyes, a projecting nose, adorning ears, and pronouncing lips; but it is the mind that makes them glow as a conscious creature. So thinkers, philosophers, and scientists are all out to grasp its secrets; and this can be done only with human minds. The mind is the microscope enabling us to reflect, react, and remember. It is an expression of consciousness, the identity-creating factor in our lives which makes each one of us separate and different and unique from every other.

The investigations and reflections of Hindu thinkers have not only provided interesting perspectives on the nature and complexity of the mind, they have also led to worldviews that have served us well in coping with the chores and problems that confront us mortals during our journey through life. For in the field of applied psychology, the traditional Hindu approach has been primarily to enable wholesome functioning of the mind. At its core, the spiritual view of life of which periodic prayers, penitential fasting, and joyous celebrations are common expressions, make living more fulfilling. No less importantly, they also help people live in peace and harmony in society.

As Don Solomon pointed out, a number of modern psychologists have had more than a passing interest in the philosophies of yoga and the Upanishads. Thus, one can list Carl Jung, Ken Wilbur, Roberto Assagioli (who introduced the notion of psychosynthesis), and many more who have referred explicitly to the influence of Upanishadic thought and Yoga in their writings. J. J. Clarke wrote an entire book expounding this topic. Beyond the work of specialists, the positive impact of meditation has been acknowledged by millions of people all over the world. The National Institute of Health in the United States has funded millions of dollars of research work on various aspects of meditation. Many modern philosophers, psychologists, and neuroscientists, like Patricia Churchland, Daniel Dennett, and John Searle have written on the nature of the mind. Some, like Roger Penrose point out (Shadows of the Mind) that conventional science may never be able to unravel what the human mind is. Yet, search for the deepest roots of the mind continues in the scientific world. But the fruits of ancient Hindu reflections need not be hurt or rendered irrelevant by the successes of the scientific endeavor. They simply provide additional insights of the ancient puzzle of mind and body.

# V. Knowing: Indic Postmodernism

> You cannot see that which does the seeing, you cannot hear that which does the hearing, you cannot think that which does the thinking, you cannot understand that which does the understanding. That is your átmá which is in all things.
>
> —Brihadáranyaka Upanishad (III.4.1)

**Introduction**

Whether it is about a matter of common experience, an assessment of a situation, or our view on an issue, we speak on the basis of the knowledge and information that we seem to possess. Our entire worldview—resulting from science, religion, or everyday experience—rests on our knowledge of things, persons, places, and the world at large. Most often, like the money that we spend, we do not always inquire into how we came upon that knowledge nor into the bases and validity of its sources. Philosophers probe into the nature and reliability of human knowledge.

*Epistemology* is the technical branch of philosophy that systematically explores these questions. This is an important subject because much of what we normally take for granted turns out to be either of only partial validity on rational grounds or downright unacceptable on careful analysis. It may be said that many of the tensions and controversies in the world arise because people seldom examine the bases of their knowledge, beliefs, and opinions.

When something is accepted as true without a careful examination of its rational validity, it becomes a matter of faith. Questioning the truth content of an article of faith constitutes doubt which is considered inappropriate in most religious contexts. Heraclitus was right when he said that "knowledge of divine things is lost to us by doubt." That is why it says in the New Testament that "he that doubteth is damned," or in the Koran: "there is no doubt in this book." We also read in the Bhagavad Gita that "there is happiness neither in this or in the next world for the doubting soul."

In the Western philosophical tradition, some ancient Greek and Roman thinkers considered the reliability of accepted truths. The skeptic Pyrrho's famous statement that "nothing is certain, not even that" is a quip intended to convey the unreliability of human knowledge. When the Roman Cicero said that we arrive at the truth by doubting, he was recommending a careful examination of the bases of our knowledge. A number of writers in the sixteenth and seventeenth centuries, such a Michel de Montaigne and Pierre Bayle, expressed skeptical ideas as well. The modern impetus for systematic epistemology in the West came only in the eighteenth century, primarily from the writings of David Hume, Immanuel Kant, and John Locke.

In the Indic tradition, doubt goes back to Vedic literature and the philosophical offshoots of the Vedas. A little known fact about Indic visions is that skepticism, agnosticism, and atheism are as ancient in India as any philosophical system. Skeptics were simply classified as unbelievers or deniers. But some prestigious names of such schools have survived to this day. In this chapter, I discuss some of the epistemological theories and insights of classical Indic thinkers.

## Variety of Knowledge

Indian thinkers spoke of different grades of knowledge. Thus knowledge that is transmitted in educational institutions is called *vidyá*. In common parlance, it refers to scholastic knowledge, to knowledge of various subjects found in textbooks. But in philosophy it means something more: it refers to deeper understanding of things. There were also branches of vidyá, such as *brahmavidyá*, *bhútavidyá*, etc. The opposite of vidyá, *avidyá*, refers to simple ignorance of true knowledge, that is to say, of the true nature of things. In this sense, it is also used to refer to scientific or empirical knowledge from time to time. Knowledge of the transcendent is referred to as *jñana*. It is knowledge of the essence of things, of what is ultimately true. There is another term, *pramá*, which can be translated as valid cognition. One also speaks of *prajñána*, which is knowledge gained through intuition. The challenge for epistemology is to pick out valid knowledge from all awareness. Equally, one should be able to distinguish that which is invalid knowledge from what is untenable. Criteria for this were spelled out in what are called *pramána* theories. Different schools spelled out different sets of rules for the acceptance or rejection of propositions. As often happens with theology whose goal is as much to convince the doubters as to give a firm standing for believers, Indic epistemology arose in response to skeptical and agnostic views which were propounded by Buddhist and other Hindu scholars. It was quite common in classical India to hold philosophical debates in which the proponent of a thesis had to defend a set of ideas against criticisms from philosophers holding opposing views. There are passages in the Upanishad that are pure dialectical dialogues. Theses and antitheses were discussed in the open—not just imposed by authorities.

What is to be noted in all this is that Hindu thinkers had keen analytical minds. They reflected on epistemological questions with great care. Herein lies their greatness much more than in the answers they gave to fundamental questions.

## Two Kinds of Knowledge: *Aparā* and *Parā*

Vedic thinkers distinguished between what we come to know through our senses (*pratyaksha*) and the knowledge that is remote from the senses (*proksha*). In the Vedic framework, the latter type of knowledge is acquired through divine testimony, or revelation. This idea gradually developed into the view that there are essentially two kinds of knowledge. First, there is knowledge about matters of everyday interest. Empirical knowledge, our knowledge of history, literature, philosophy and of practically everything we learn from books and teachers constitute this kind of knowledge. It is described as *aparā vidyā*. It is the kind of knowledge that tells us about our past, about this world, about arts and culture. This type of knowledge is interesting, fascinating, and may also be useful for practical purposes. Indic thinkers emphasized that such knowledge invariably relates to that which is transitory and impermanent. In this view, even our scriptures belong to this category. This shows that the thinkers recognized the historical and human sources of even sacred writings. This was an extraordinary recognition in those days. It is difficult for many people, including Hindus, to recognize this even in the twenty-first century.

One unexpected and perhaps unintended consequence of the view that aparā vidyā pertained to the ephemeral dimension of reality led to a devaluation of impermanent experiences. What the seers probably meant to say was that even as we are engaged in a life of joy and sorrow, even when we are confident about what we regard to be the truth, it is good to remember that these have no lasting or even long-range value. Unfortunately, this nugget of wisdom was translated as a recommendation to look down upon worldly life—a theme persisting to this day in swami-talks and writings on religion and spirituality. Underscoring the evils of addiction to materialism should not be taken to mean that commerce, economics, or the joy of living are intrinsically evil.

The other kind of knowledge is about that which never perishes. It tells us about the essence of things. This is the knowledge that all spiritual aspirants seek and some find, and lesser mortals think they have when they engage in prayer and meditation. This knowledge, known as *parā*, is related to the transcendent Brahman of which mystics speak. The Upanishads discuss this kind of knowledge in great detail. Parā knowledge is not something that one acquires through books or understands by listening to learned gurus. It is something that one experiences.

*Parā* knowledge may be compared to Gnosticism in the Western tradition, which is also based on mysticism and esoteric practices. Here, too, it is said that the human soul can pierce the intervening opaque worlds between us and the realm of the Divine by these means. Like all revealed knowledge, it is to be accepted without proof or demand for proof. Parā, like Gnosticism, is about ways of finding our way back to where we came from and about the ultimate dissolution of the world.

Thus, the parā view speaks of an unfathomable mystic undercurrent, of higher knowledge and an indescribable transcendence. We read in the *Mundaka Upanishad*:

> That which is ungraspable, without family, without caste, without sight or hearing, without hands or feet, eternal, all-pervading, omnipresent, exceedingly subtle, that is the undecaying which the wise perceive as the source of all things.

This recognition of knowledge as belonging to two categories clarifies many confusions in discussions on the ultimate. Hindu thinkers understood that while we may have discussions which resolve intellectual disagreements on certain issues, when it comes to the nature and attributes of the transcendent, no amount of logic and proof can persuade people one way or the other. Ultimately, the unfathomable mystery can only be revealed at the deepest personal level. Then the experience becomes ineffable: its authenticity can only be felt, not conveyed through words and reason.

An analogy that is often given is the following: Cup and bowl, doll and icon formed out of clay are certainly interesting, and we may well appreciate their shape and form. However, the clay itself is the essence of them all, and it is of an altogether different category. So it is with entities in the physical world, which consist of myriad manifestations of a single ultimate principle. Science goes to the heart of the matter with respect to the physical world, whereas spiritual disciplines unravel the core of a reality that transcends these; and therefore by definition, they cannot be tracked down by the methodology of science, just as no physical instrument or mathematical analysis can uncover the structure of love and compassion.

Incidentally, Cardinal Newman, an avowed Christian, expressed a very similar idea with a different simile when he wrote in his *Apologia Pro Vita Sua*:

> . . . minds in different states and circumstances cannot understand one another . . . that children do not apprehend the thoughts of grown people, nor blind men the perception of light . . . there are people of matter-of-fact minds, who cannot take in the fancies of poets; and others of shallow, inaccurate minds, who cannot take in the ideas of philosophical inquirers.

**Kshara, Aksharam, and Avyaya**

The paradigm of *pará* and *apará* may be further elucidated by means of an analogy. Consider a sumptuous dinner that you are enjoying. This is the immediate level of experiencing the food through your perceptual channels of taste. You also know that the dinner became possible because of the process of cooking which involves a whole array of rules such as cutting the vegetables, boiling, frying, addition of the right amounts of spices, etc. If these do not occur in precise and well-defined ways, the food will not appear in its delectable form at the table. Finally, beyond the cooking and the resulting products, there is the essence of the food itself: the proteins and the starches, the vitamins and the minerals, etc. which lie hidden from our normal view. Ultimately, it is the life-fueling energy implicit in the food that is responsible for the health and

well-being of the individual. This energy is all too abstract to be visualized in its stark purity. In fact, it finds expression through a hundred different biochemical molecules. Thus we see that we may consider three distinct dimensions of the food we enjoy: the directly perceived level, the processes engendering the perceived level, and the basic invisible level which is the ultimate source of it all.

Similarly, in the course of our everyday experiences we become aware of many things and events. The totality of all this constitutes our perceptible universe. It consists of everything from the minutest entities at the core of physical matter to the giant stars and receding galaxies. The one common characteristic of these tangible constituents of the universe is transience: sooner or later they all transform and dissolve. This dimension of the cosmos was described by the Hindu philosophers as *kshara*: that which is perishable. Science explores the nature and basis of the perceptible component of the universe. The investigations of science reveal that underlying the tangible material universe are immutable fundamental physical laws that are responsible for the sustenance and functioning of the world such as it is. These laws are not directly visible to us, but their nature and complexity can be grasped by the human mind. The totality of the principles and laws constitutes the *akshara* or inerasable dimension on account of which arises the kshara component of the universe.

Hindu thinkers go a step further and say that beyond the intellectually grasped features, there is a third dimension. This is the ultimate substratum of the universe, somewhat like the essence of the food we considered. It is recognizable neither mentally nor perceptually because it does not manifest itself in any way. It is therefore referred to as the *avyaya* or unmanifest dimension. Yet its existence and essence can be apprehended by human consciousness by processes that transcend the perceptual-mental modes. This, in effect, is what *aparâ* knowledge is all about.

This unmanifest root of the cosmos is called Brahman. Brahman is the equivalent of god in the Hindu framework. Brahman is beyond the constraints of space and time, of logic and causality. That is why verbal discourses on the nature of god always lead to contradictions and confusions. Brahman is to be apprehended, not comprehended; experienced, not described; vouched for, not proved. Those who have realized Brahman speak of ecstasy and bliss, not of belief or faith. It is not within reach of one and all to realize Brahman in all its splendor that is brighter than a thousand suns. The unmanifest Brahman, by its very nature, leaves a void in our attempts to visualize it.

Yet it is not impossible to get an inkling of this ultimate root of the cosmos. Over the ages, the Hindu tradition has developed a variety of devices for accomplishing this. The mantra or the sacred utterance is one such device. Another is through abstract symbols of geometric forms, known as *yantra*. A third device is through the concretization of the limitless aspects of Brahman through countless poetic and palpable imagery. The saga and symbolism of these gods find rich and colorful expressions in the religious literature and traditions of Hinduism.

## Contexts and Sources of Knowledge

It is generally accepted in Indic epistemology that there are four types of knowledge. First there is knowledge about what is right and wrong: that is, knowledge of ethical principles. Thus it was recognized at the outset that any acquisition of knowledge should include what we call moral values. Without that, all knowledge would be useless or it could even be dangerous. In modern philosophies although one may still speak of ethical principles, there is little unanimity as to the ultimate source of our notions of right and wrong, or good and evil actions. Science has tried to trace many of these to evolutionary principles. In the ancient framework ethical principles were clearly defined by the religious codes to which the people are tied. In the traditional Indic framework, the codes of moral and traditional behavior (*smriti*) give us knowledge about what is permitted and what is not, what is right and what is wrong. In secular societies, the statutory codes impose these on people. What is interesting is that ancient Hindus took this factor in their discussion on knowledge.

Then there is knowledge about the existence and properties of tangible things. We know the knife is sharp, the sky is blue, there is music in the air, the rose is fragrant, and sugar is sweet. How do we acquire such knowledge? I will mention only the *Nyáya-Vaisheshika* system, one of several systems of Indian philosophy dealing with theories of knowledge. This has also been the most influential school in the history of Indic epistemology. The ideas presented in this system are complex and sometimes controversial. They are closely linked to purely logical systems, some of which are non-Aristotelian in structure. Its theoretical framework involves many technical terms and concepts.

The *Nyáya-Vaisheshika* introduces the notion of truth content of propositions in terms of the modes by which they are arrived. The completely dependable sources of correct knowledge (*pramá*) are known as *pramánas*. The system asserts that any knowledge acquired via our perceptions should be valid. This may be taken to mean that what we learn through our sense perceptions is what seems to be true. In other words, we rely on our faculties of perception for acquiring any type of knowledge. Bereft of these, we can know nothing about the world. Sensory perception is referred to as *pratyaksha*. The word is derived from the Sanskrit phrase *in front of the eyes*. It is thus a metaphor for all perceptions. We note again the recognition that the senses play an important role in how we perceive the world. There is something compelling about the testimony of the senses, sometimes expressed through the exclamation, “I’ll believe it when I see it.” This is therefore regarded as the most fundamental of all.

Nyáyá-Vaishehsika philosophers included here not only sensory perceptions but much more. Specifically, they considered here how the mind judges what is perceived. In other words, knowledge is not mere sensory experiences but what the mind makes of them. They also stated that some human beings are endowed with better judgment than others, something that one does not even mention in objective

epistemology. Furthermore, they noted that there are conceptual categories involved in human knowledge that go beyond sensory inputs. This became abundantly clear with the emergence of modern science. Our current understanding of the physical world would be impossible without concepts like entropy, the Lagrangian, spin, and parity, for example, which are not direct sensory perceptions. It was also asserted in that school that some individuals, through spiritual disciplines, acquire capacities that enable them to see, foresee, and recall bits of knowledge which would be beyond the reach of ordinary minds, through sensory perceptions alone.

Again, we need to have some knowledge to function meaningfully in society. For this, one needed to have knowledge about the importance of festivals, about the days when we must fast, and so on. This kind of knowledge comes from tradition or *aitihya*. The term literally means "thus it was." Whether one accepts the report or not, reports are what give us information about distant events. Thus the source of that useful knowledge regarding days and hours of observance, regarding when a ceremony is to be performed, etc., is tradition and sacred history.

Then comes the question of how we get knowledge about what might happen. For this we need to use our logic to infer things. From the fact that a student is absent in class we may infer that something has happened to her which is why she could not attend class. Or again, if we see an overcast sky and dark clouds we may infer that it is going to rain. This inferential knowledge is referred to as *anumána*. In the Nyáyá system anumána is discussed at some length. Many technical terms are introduced in this context. It is explained that we can become aware of the existence of some things through logical deduction, even without directly perceiving something. One common example of this is that if we see smoke at a distance we infer there must be fire somewhere there. If we see a child crying, we infer that it is experiencing something unpleasant. In any inference, there are three elements. One infers something (A) about entity (B) from a sign (C). That which is inferred (A) is known as *sádhya*. That about which one makes an inference (B) is known as *paksha*. That which serves as instrument or sign (C) enabling us to make the inference is known as *linga*. Thus every inferred statement is of the form: by observing C, one concludes A about B.

To illustrate, if I hear a siren, I may infer that an ambulance or a police car is speeding by. The motion of the car—which is what we infer—would be sádhya in this case. The car itself would be paksha, for it is about it that we make the inference. The sound of the siren, which serves as the indicator for what is inferred, would be the *linga*. From the siren I conclude the passing of a speeding ambulance or a police car.

We note that in this chain of reasoning, we assume an invariable correlation between what is inferred and the sign. In our example, we take it as a fact that a siren is always associated with an ambulance or a police car. On what basis do we take this to be case? On the basis of numerous past experiences. In other words, the reasoning based on inference is not a case of Aristotelian syllogism which is purely deductive, but an application of inductive reasoning. Inductive logic is at the root of empirical

science, but it is also wrought with complex philosophical questions which were not fully resolved until many centuries later. But I will not go into those details here.

Another important element in knowledge acquisition is *upamána* or comparison. It is not always recognized that a good deal of understanding occurs through analogies. They serve to clarify what is presented as the truth. Lord Kelvin, a great physicist of the nineteenth century, had difficulty accepting Maxwell's theory of electromagnetism until he could construct a mechanical model to grasp it through that analogy (which is what a model is). That is why he famously declared, "I am never content until I have constructed a mechanical model of the subject I am studying. If I succeed in making one, I understand; otherwise I do not."

Analogies are also very helpful in explaining how a system works. Thus knowing the sizes of planets relative to the earth gives us a better picture of how big they are. The effect of a heavy body on a stretched rubber sheet is a useful analogy to understand Einstein's notion of space-time curvature. In recent decades, philosophers and cognitive scientists have been drawn to the role and importance of metaphors and analogies in human understanding.

Nyáyá epistemologists added *shabda* (sound) as another important source of knowledge. When they said shabda, they had in mind scriptural testimony that was recited in those days. We may extend this idea in modern terms, however, as any oral articulation of knowledge. A good deal of our knowledge, whether reliable or otherwise, results from what we hear from others. So shabda as another source of knowledge is a deep insight. To understand why this is so, let us recall that in schools, students learn from what teachers say. We find out about what is happening in the world by hearing the news from the radio and television. People derive information about their community from gossip. Courts try to find out the truth by hearing many witnesses. A government might try to find out about an issue from congressional hearings. We see in these examples how shabda furnishes us with knowledge.

Classical Hindu philosophers emphasized that not every sound is to be trusted. Three criteria determine the acceptability of knowledge derived from the speech of others. First, the source must be reliable. (This should negate a large percentage of what we hear in the media these days.) In the traditional context, this often referred to canonical authorities. Second, even if the person offering the knowledge is thoroughly dependable in terms of honesty and integrity, he/she must have expertise on the topic that is being presented. If a respected teacher who is qualified to teach history comes to a class and begins to lecture on calculus, the shabda produced may not be worth listening to. Finally, for sound-transmitted knowledge to be of any value, the listener should have the mental wherewithal to grasp the significance of what is being said. Or else it would be like the biblical casting of pearls before swine. The criteria for shabda-knowledge, spelled out by Nyáyá-Vaisheshika philosophers, are enormously relevant in the world in which we live where many inspired individuals have the resources to becomes swamis or achárya via the Internet. It is good that some of them are converts to Hinduism. This enriches the tradition.

Sometimes, it is easy to write off certain sources of knowledge as quite unreliable. For example, one would discount what a habitual liar says. It would be unwise to trust news about a war broadcast by the media in a dictatorship where there is no free press. Hindu thinkers recognized sources of invalid knowledge and called them *a-práma*. For example, they regarded the knowledge one obtains from dreams as invalid.

**Shabda in the oral tradition and epics**

There are two others context in which *shabda* plays an important role in Indic culture. First is in the oral tradition: the mode by which Vedic hymns were transmitted from generation to generation with all the glory of impeccable diction. Here the dual aspects of sound—production and hearing—both come into play, for the sonorous voice of the preceptor needs to find appropriate target in the keen ears of the disciple.

Or again consider the ancient epics. Imagine what a tremendous effort it must have been for an ancient blessed bard to compose in perfect prosodic periods sagas running to several thousand verses. The voluminous composition was done at a time when presumably there was no paper or pen, nor proofreader or electric light. This was no ordinary accomplishment. It is for us as difficult to picture the modes and means by which the Ramayana and the Mahabharata were constructed as it must have been for people of antiquity to conceive of how we moderns use computers to compose. Scholars have devoted considerable time and energy to date the year when Rama was born and the Battle of Kurukshetra took place. According to Dr. Vartak, for example, it began on October 16, 5562 BCE. Other scholars have been led to other conclusions: 2559 BCE, 1177 BCE, 1194 BCE, and more—all in addition to the traditional view that it all happened in an altogether different yuga, meaning hundreds of thousands of years ago. Subash Kak (http://www.ece.lsu.edu/kak/MahabharataII) who has made a critical analysis of various proposed dates is of the opinion that "the pre-urban core events of the Epic would fit [a] 3137 BCE date."

It is entirely possible that many aspects of the epics have a historical basis. Perhaps someday one may uncover more archeological relics to substantiate that possibility. The situation is not very different from investigations into the historicity of Homer and Troy. Yet with due respect to the many probes into this issue, I myself feel that rather than attempt to prove that ancient epics are literal historical records, we should be filled with awe and reverence for the almost superhuman capacities of humanity's distant ancestors to create and propagate visions and poetry of such extraordinary sweep, and spread them to the distant corners of the vast subcontinent and beyond. Homer's *Iliad* has fifteen thousand lines. Arnoul Gréban's *Le mystère de la passion* (fifteenth century) has thirty-four thousand lines. But Válmiki's Ramayana has twenty-four thousand verses, and Ugrashrava's Mahabharata can boast of one hundred thousand verses (*shatasahasri samhita*).

Be that as it may, here again shabda has always played an important role. In the tradition, the great episodes of sacred history are narrated with wit, wisdom, and vivacity by learned rhapsodists for the entertainment and edification of eager audiences. This unique art form is known as *katha*.

It may be mentioned in passing that a few other ancient epics from other cultures have also survived to this day in this way. Homer and Virgil of the pre-Christian world as well as Shahnama by the Persian poet Fedowsi of a much later period come to mind. All this was possible because in the ancient world there was *orature*, as the oral tradition is sometimes called. It is remarkable that ancient Hindu thinkers had recognized it all through the concept of *shabda*.

**Other criteria for valid knowledge**

Some Indian logicians maintained that the ultimate criterion for the validity of knowledge is its concordance with observed data. This was a remarkable proposition in ancient times when, all too often, pure rationality and speculation were the principal sources of theories. Concordance with observed facts as a criterion for correct knowledge is at the root of empirical science. However, such a perspective did not find universal acceptance in theory and certainly not in practice. Indeed, it is fair to say that beyond philosophical debates and the world of practicing scientists, not too many people in the world today or ever before adhere or adhered to empirical confirmations for their innermost beliefs.

Another interesting rule enunciated by some thinkers for knowledge-validity is the success of an affirmation in a practical context. In other words, if something that is held to be true turns out to be useful in a given context, then one may accept its validity in that context. Thus imagining the earth to be at the center of the universe around which planets and stars orbit is scientifically wrong, but this model is quite adequate for predicting eclipses. Many people practice this in religious beliefs. They are not worried so much about the logical foundations or tenability of the belief so much as whether it provides the needed sense of security and hope. Even in the world of technology, if one can build a steam engine on the basis of the fluid theory of heat, then one may accept that theory as acceptable in that context. Long before the pragmatic epistemology and instrumentalism of Charles Peirce and John Dewey, Indian epistemologists adopted very similar views of knowledge.

**The Triple Aspects of the Knower**

The Nyáyá-Vaisheshika system holds that there is a body of substances, composed of atoms, which the mind experiences via the senses. Knowledge thus derived, however, belongs not to the physical system that is studied nor to the mind that grasps, but to the self's consciousness. This self is something unique. Besides knowledge, it also has feelings and will. Given that these attributes of the self are not physical, the self itself has to be transphysical, said those philosophers.

Here is an interesting perspective from which a paradox that often arises in science-religion exchanges may be resolved. Science functions uniquely and especially in the framework of reason and logic. In so far as science is active in that framework,

it is extraordinarily successful. However, scientists sometimes fail to recognize that the motor powering the self has three engines: logic, feeling, and volition. Religion and spirituality attend to the experiential aspect of the self where feeling and will, rather than logic, dominate. That is why science by itself is ill-equipped to embrace the human personality in its totality. This truth is embedded in Einstein's oft-repeated quote that "science without religion is lame**,** religion without science is blind.''

**Jaina Theory of *Anekántaváda***

No matter how objective we think our appraisal of truth is, there is an inevitable factor influencing it. This factor is our perspective, or *naya* in the Hindu framework. Every statement of truth is anchored to a framework. In postmodernist jargon, interpretation matters. This fact was recognized by some ancient Indian philosophers belonging to the Jaina school. Their view was that reality is characterized by *anékatva* or plurality, meaning that anything we consider has multiple facets. From this, they propounded a doctrine that became known as *anékántaváda*: literally the not-one-doctrine. It arises from two basic recognitions: one philosophical and the other physical. The philosophical insight is that the contradictory elements implicit in many systems, joy and sorrow, knowledge and ignorance, light and darkness, life and death, etc., are invariably attributes of the same entity. The physical insight is that not only the world, but also its components, consist of countless characteristics. This means that our reflection on any aspect of the world will focus on one or another of these. Hence whatever we say about something is in the context of what we are focusing on—in other words, from our particular perspective. Thus anakántavada rejects absolutism and totalizing tendencies.

This Jain doctrine of epistemic relativity becomes specially relevant in issues relating to the human condition, i.e., topics relating to history, religion, philosophy, politics, and the like. In all these cases there is a multiplicity of theses concerning any issue. It is important to understand that anékántaváda does not imply that any and every belief or opinion counts or that one should attach equal weight to every dogma or doctrine. It merely reminds us that no matter what view one holds, it is a function of the perspective from which one considers the issue. The associated truths are endopotent: that is, they have impacts on the inner experience of the self.

As to ultimate questions, philosophers of the Jain tradition also proposed another doctrine called *syád-váda* or the maybe-doctrine. It has technical and esoteric aspects, yet is essentially a logical system which, like Gödel's theorem in mathematics, establishes that with our finite minds we can never be completely sure of fundamental issues. We are like the six blind men who were asked to report on the nature of the elephant. Each gave a different answer, because each person groped with his hands a different part of the elephant and came to a different conclusion. This is to remind us that with respect to the Ultimate we are all blind. We can at best get partial visions

of it with our finite minds. On such matters, the most that one can say is that it is perhaps true and perhaps not. Or it can be one of many things, but one particular thing in a given context. The syád-váda idea received many metaphysical extensions and interpretations. But the simple essence of the thesis is that one cannot claim one's own vision of anything as embodying the whole and absolute truth.

It is remarkable that this insight arose among thinkers in India centuries before Thomas Huxley famously wrote in the nineteenth century:

> The one thing in which most of these good people were agreed was the one thing in which I differed from them. They were quite sure they had attained a certain *gnosis*, had, more or less successfully, solved the problem of existence; while I was quite sure I had not, and had a pretty strong conviction that the problem was insoluble.

One may apply the syád-váda principle in modern physics where, for example, an electron is perhaps a wave or a particle, it is one of these in a given context. A microcosmic entity is simultaneously in one of several quantum states. It is in a particular state when a measurement is made on it, i.e., in a specific context. Truths beyond our perceptual reach may be anything. So everything we say about it can be only a perhaps.

**Universals and Particulars**

We see around us things: trees, houses, plants, birds, bricks, and many, many other things. This list is made up of general items. Under each of these there are countless specific examples. We actually see and experience only particular things: the car in which we are riding, the house in which we live, the bird perched on the tree, etc. These seem to be the real things. But what about the abstract tree, house, bird, etc.—the words found in dictionaries and the ideas that the mind entertains? Do they exist in the physical world? Not anywhere in particular except in our minds. And yet every house and tree and bird we see will perish sooner or later; but the universal things, what Plato called the ideas, will persist for at least as long as there are minds to envision them.

So we have this ancient philosophical question: which is real—the imperishable but universal, or the perishing and tangible particular? What may be safely said is that reality has a universal side and also many particular sides. Beyond this it is difficult to get any consensus. Some Indic thinkers, *advaitins* and *sámkhyas* for example, claimed that only the universal was real. This follows from their view that only that which is eternal is real. Others, like the Chárvakas, held that only the particulars were real. Yet others, like the *nyáya-vaiseshikas,* regarded the universal and the particular both as real but distinct. To them, a pot has particular features: its shape, color, weight, etc. Its universal aspect is the material from which it was formed. The particular features are passing, the ultimate is permanent, but both are real.

**Tools and Instruments: Traditional Perspective**

Ultimately, all our knowledge about the world is derived through our faculties of perception. We are born with five sensory perceptions that have evolved over the ages. These appendages to the normal human body may be regarded as the first indispensable instruments for the acquisition of any information about physical reality. Ancient Hindu thinkers regarded these as intrinsic to Indra, the supreme Vedic Divine principle, and so referred to them as *indriya*. This is a metaphorical way of saying that unlike inanimate matter, we as humans are endowed with capacities to become aware of the nature and attributes of the physical world by a cosmic principle, as it were. The five doors of perception were known as *darshana* (seeing), *sparshana* (touching), *shravana* (hearing), *ásvádana* (tasting), and *avaghrána* (smelling). To these, they added a sixth: the mind. Thus, one talked about indriya.

Vedantic philosophers analyzed this further. They recognized that the body is also endowed with organs that enable it to do things. These were also referred to as *indriyani* or instruments. More exactly, they were called *karmáni-indriyáni* or action-instruments. These are the hands, feet, voice, generative organs, as well as the anus. The idea was that these enable the body to function fully and effectively. This was a deep insight in that it recognized that our understanding of the world is no less related to what we do in it. Action, through speech and with the aid of our limbs, connects us to the world as much as the passive reception of information through our sense perception.

If the perceptual instruments gather information, the action instruments enable activity. Aside from these, in the Vedantic system there are also four internal instruments called *antar-indriyáni* or *antar-karana* (internal faculty). These include *manas* which is sometimes called the lower instinctive mind; *buddhi* which is the discriminating and logical/analytical faculty; *ahamkára* which is the impression of separateness from the rest of the world, i.e., the ego; and *chitta* which refers to full awareness or consciousness.

This again reflects a sophisticated understanding of epistemology. It is not enough to recognize that our sense organs furnish us with information about the external world. How this information is processed, analyzed, reasoned out, and made an intrinsic ingredient of our own being is another profound puzzle. Modern scientists and philosophers say that the transformation of sensory inputs into the realm of experience is one of greatest challenges to science today. John Searle has called this the hard problem. Perhaps a harder problem is to figure out how those experiences are elevated to a higher level when they are reasoned out, reflected upon, and evaluated. The brain does all these other things and more at the abstract level. Clearly, Hindu thinkers were aware of this dimension of brain activity. And they attributed these to other faculties in humans beyond the pure perceptual capacities.

Indian thinkers who were very keen in analyzing these matters were drawn to another aspect of the *indriyas,* which was to have a great impact on Hindu culture. They realized that organs of perception are also the channels through which we derive

physical gratification. The eyes enable us to enjoy the beauty of the world around, ears enable us to be thrilled by beautiful music, the nose brings to our delight the aroma of flowers, the tongue gives us the gratification of sweetness and curry, and through touch we enjoy the softness of silk and the closeness of one dear to us. Now, since sensory enjoyment came to be regarded as inducements to attachment and thus obstacles to spiritual liberation, the indriyas came to be looked down upon in spiritual contexts. Thus in one highly regarded spiritual text, we read that "in the forest of material existence, the uncontrolled senses are like plunderers."

The aversion for and denigration of sensual pleasures are characteristics of many religious-spiritual systems. The notions of penance and asceticism are linked to it. In so far as these lead to self-control and self-discipline, they are commendable injunctions. Unfortunately, they can be taken to extremes, leading to deprecation and condemnation of experiencing the joys of life. More seriously, by shifting the role of sense perceptions from knowledge acquisition to worldly enjoyment, incentives for expanding their capacities are also curbed.

When matters like this are pointed out, traditional apologists are quick to respond by saying that those who mention these do not understand the deeper meanings of these or that they have been brainwashed by alien modes of thinking. Such comments are hardly incentives for inquiring Hindus to question traditional views. The discouragement of questioning thwarts creativity and productivity, and leads to stagnation.

**Tools and Instruments: Scientific Perspective**

Tools are devices for the purpose of accomplishing something specific or making the accomplishment of a goal easier. They are generally materially constructed. Thus everything from a flint and stone to a spade and a slide rule is a tool. Many tools of practical value were invented by ancient peoples all over the world. In India too, dating back to the Indus Valley civilization, down to modern times, a whole variety of tools have been invented.

Sometimes, tools may be abstract. Thus language and writing are also tools. One may include yoga and meditation as tools that have proved to be very effective in achieving some practical goals, such as peace of mind and awareness of higher levels of reality.

In the context of science, however, an ingeniously constructed device is one whose goal is to expand, enhance, and make more precise the knowledge of the world that is normally gathered through our sense perceptions. In other words, the function of an instrument is epistemic rather than pleasurable. The faculties of perception accomplish both.

In the ancient world many simple instruments had been devised. The goal of those instruments was essentially for measurement. Thus, for example, there were instruments for measuring time, for observing the position of stars, for weighing things and measuring lengths, areas, and volumes. All these were for practical purposes and not for acquiring new knowledge.

It was only after the rise of modern science that the idea of devising instruments in order to obtain more knowledge about the world came about. Scientific instruments are of two kinds: those that are used to simply detect and observe and those which are also used to measure. The former are usually called scopes, and the latter are meters. Thus we have telescopes, microscopes, stethoscopes, spectroscopes, and also voltmeter, ammeter, ohmmeter, seismometer, gravimeter, etc. Some meters also give charts, and they are usually named with the suffix *graph*. Thus we have magnetograph and spectrograph. With all of these instruments, the goal is the acquisition of more and new knowledge.

Scientific instruments have extended the boundaries of human knowledge a thousand times beyond what the ancients were aware of. While we must recognize and admire the insights and achievements of the ancients, it is no less important to be aware of the differences between the methodology and achievements of modern science and of the distant past.

**Concluding Thoughts**

There are many philosophical treatises and commentaries related to epistemology in Indic writings. References to these matters may also be found in the epics. For example, in the Mahabharata (*Shanti Parva*) one character is made to say that in a former life, "I always sought for reasons and had very little faith . . . I used to utter words based on plausible reasons . . . I used to speak irreverently of the declarations of the Shrutis . . . I was an unbeliever, skeptical of everything, and though really ignorant, proud of my learning." In this we see that questions of reasoning, criticisms of esoteric knowledge, belief, faith, skepticism, were all part of the daily discourse. In the Ramayana (Ayodhya Kanda: 108), there is an episode in which the learned sage Jábáli discusses the materialist philosophy with Rama, urging him not to cling to his idealism, but to enjoy life while it lasts. He challenged traditional doctrines by saying, "These people say, 'The eighth day should be given up to sacrifices for the spirits of our ancestors.' See the waste of food. What will a dead man eat? If food eaten by one here reaches another's body, then let a sacrifice be offered for those who are setting out on a distant journey. Will it not become a food on their path? Perform sacrifices, distribute gifts, consecrate yourselves, practice austerity and renunciation . . . '" Jábáli articulates the tenet of the naturalists by declaring that "there is nothing beyond this Universe." He also says, à la Karl Marx, that these writings (scriptures) "are composed by learned men for the sake of inducing others to give."

Hindu thinkers stressed the fact that much of human knowledge is acquired through our sense organs. This may seem a truism when it is pointed out. However, it has profound implications when it comes to evaluating human knowledge. First, given that the senses can create illusions, whether optical, auditory, olfactory, gustatory, or tactile, it is clear that information acquired through sensorial means is not always 100

percent reliable. This recognition is the first step in epistemology, and it is also the first step in humility in the context of human knowledge.

This leads to another intriguing thought. Given that our sensory perceptions are determined by the kind of bodies we happen to possess, all knowledge is ultimately a function of human brain chemistry. No matter what or how the external world of reality is, the phenomenal world is different from the noumenal world. This leads us to the conclusion that what we call objective knowledge is actually species-subjective.

The Hindu view is that human knowledge is to be acquired for its positive elements, but its negative aspects should not be ignored or forgotten. There is also a type of knowledge beyond the categories of space and time. It cannot be dissected and analyzed nor traced to our channels of perception. It is more an experience than an understanding. The pursuit of this is what constitutes the spiritual quest.

The Socratic turning away from science in favor of ethics and right living is an example of how sometimes one makes a decisive choice between what is only intellectually satisfying and what ultimately matters. It has its parallel in Hindu thought. As with Athenian rationalism, Hindu worldviews have their roots in the ascetic and spiritual quests of its seekers. In our own times, with all our accumulated knowledge and the recognition that science has not just satisfied our curiosity but has also served us in many practical and important ways, perhaps we should take the position that each type of knowledge has a role in the life of the individual and the culture. We can respect one form of knowledge without looking down upon the other. This would also be a wise perspective for those involved in dialogues between science and religion to adopt.

# VI. Classical Philosophies in New Light

> It seems probable that the Hindu systems of thought originated among the sages who though attached chiefly to the Upanishad circles used to take note of the discussions and views of the antagonistic and heretical philosophic circles. In the assemblies of these sages and their pupils, the views of the heretical circles were probably discussed and refuted. So it continued probably for some time when some illustrious member of the assembly such as Gautama or Kanada collected the purport of these discussions on various topics and problems, filled up many of the missing links, classified and arranged these in the form of a system of philosophy and recorded it in shástras.
>
> —S. N. Dasgupta, *A History of Indian Philosophy*, Vol II

**Introduction**

In philosophical reflections the classical Hindu mind expressed itself with extraordinary genius. Given the complexity, metaphor, imagery, and impenetrable poetry in Vedic wisdom, the surge of rich debates, discussions, and interpretations was only to be expected. The result of it all was the emergence and abundant development of major philosophical systems whose founders may not all be identified with historical definiteness, but whose impact was to be felt far beyond the portals of academia. A remarkable feature of the history of Indian thought is this: in the classical period vigorous debates and divergences among keen original thinkers and their followers were customary. In the modern post-English period, most eminent philosophers have largely been able exponents, erudite interpreters, and enthusiastic defenders of various classical schools much more than originators of new systems of thought.

One reason for this is that all through history, the keenest philosophical thinkers of the tradition considered their inquiries to be a search for ancient occult truths. Just as one might search relentlessly for a lost key somewhere in the house, rather than create a new key, the wisdom they sought was not a new insight but rather the discovery of an

ancient treasure that had been lost or forgotten with the passage of time. This reminds us of the title of Houston Smith's exploration into the religions of the world, *Forgotten Truth*. In this view, the truths of the ancients are regarded as perennial, if sometimes obscure. They need to be carefully looked into and properly interpreted, not discarded for the pursuit of newer ones.

One of the prices humanity has paid for the new knowledge and insights acquired through the scientific quest is that many ancient nuggets of truth and clarity have slipped away from our collective psyche. This is largely due to the hegemonic power of science. As Swami Vivekananda said at the beginning of the twentieth century, "Religions are falling apart under the sledgehammer blows of science." This observation is as prescient as Nietzsche's announcement of the death of God. We must interpret these statements to mean that science and science-informed visions of the world, based on rationality and empiricism, drastically affect many doctrines of all traditional religions, as well as their anthropocentric God visions.

However, it would be a misleading generalization to state, as Frank Thilly did in *A History of Philosophy (1914),* that all philosophy in India was merely "mythological and ethical doctrines, and not thoroughgoing systems of thought: they are shot through with poetry and faith." This ill-informed judgment was amply rebutted by the eminent scholar Surendranath Dasgupta when he wrote his erudite five-volume work, *A History of Indian Philosophy*. Ironically, he was inspired to write this magnum opus as a result of an interaction with the then-governor of Bengal, Lord Ronaldshay, when the latter visited him in Chittagong College.

Be that as it may, in no other culture has philosophy permeated into the general worldview of the masses, in however nebulous a manner, as it has done in India. Not every Indian may be able to spell out the tenets of the various systems of Indian philosophy; few can even list their names. But the epistemological essence of the different schools, their claims and theses are felt and referred to even by many nonliterate members of the society. This should not be altogether surprising. All through India's history, philosophy and religion have gone hand in hand, not unlike in medieval Europe. More importantly, the great philosophers of India have also been, for the most part, men of faith and spiritual integrity, not just scholars of the read-think-and-publish variety. The eminent masters of classical Hindu philosophy were given to simplicity and serenity also, not just to books and discourses on metaphysical subtleties. However, although there are ardent efforts to reaffirm India's cultural past against what are perceived as modern social, cultural, and intellectual threats, new generations are rising with far less academic interest in—and weaker emotional attachment to—ancient modes and spiritual outlooks. With the advent of modernity, the echoes and practices of ancient philosophy are changing faster than may be in the best interests of the culture.

The various systems of philosophy which arose in classical India are generally divided into two broad classes: the orthodox and the nonorthodox. The latter are conventionally called heretical in English. This is a misnomer as the notion of heresy in the classical Hindu world did not carry the condemnatory connotation it does in the

Christian and Islamic worlds. It simply referred to an understanding that did not take the Vedas as the ultimate infallible spiritual authority. One word for heresy is simply *mithyadhrishti*: false vision.

The orthodox systems are described as *ástika*. The name is derived from the Sanskrit phrase for *it is*. It would correspond to coining the word *estum* in Latin from *est*. These schools of philosophy affirm the infallibility of the Vedas. There are six major canonical systems of thought, known collectively as *shad-darshana* (six darshanas). By nonorthodox systems one usually means the Buddhist and Jain schools, which do not accept the infallibility of the Vedas, as well as purely materialist schools which deny the existence of physically intangible and empirically unverifiable (supernatural) entities such as soul, spirit, and after-life. These are the *nástikas*: (*non-estum*) schools. They may be called non-Vedic.

It is clear from this categorization that ancient Indian thinkers were either believers in traditional modes or skeptics with regard to the same. This has not changed, except that ástikas are no longer philosophical thinkers who have read, understood, and analyzed the Vedas, but simply traditionalists who have reverence and respect for religiously sanctioned rites and rituals. Most modern day nástikas still go through traditional practices and few of them articulate their skepticism in public regarding the Vedas being of transcendental origin. Fewer still explicitly declare themselves to be atheistic or scripture-skeptical.

What is interesting is that this classification of philosophical systems is universally applicable in all cultural contexts. Whether within a specific religious fold or in modern secular societies, people may still be put into one of two groups: those that take ancient and culturally constructed worldviews as the absolute truth and those who do not. It is the potential for generalization from one cultural context to the world at large that makes a perspective meaningful and insightful. There are *ástikas* and *nástikas* in Christian, Judaic, and Islamic worlds as well as in Communist and Confucian contexts. The difference between tradition-bound societies and modern ones is that in the latter *nástikas* declare their disbeliefs openly without fear of condemnation or persecution.

**A Basic Tenet**

All around us, we see chaos and cacophony cluttering the world. Even up there in the heavens, amidst stars and galaxies, there is incessant turbulence and turmoil. Underlying all this is an all-pervading harmony that keeps everything in balance. This is the *rita* of Vedic vision. Associated with it is a transcendental peace that is invoked by the *shanti mantra* (peace-chant) of the Indic tradition:

> Om dyauh shántirantarikaham shántih
> prithiví shántirápah shántirosadhayah shántih
> vanaspatayah shántirviśvedeváh shántirbrahma shántih
> sarvam shántih shántireva shántih

sá má shántiredhi
Om shántih, shántih, shántih

Aum! May there be peace in the sky and peace in space.
Peace on earth and in the waters
Peace in herbs and trees and creepers.
Peace in the whole divine universe.
Peace in the Supreme Being.
Peace in All. all peace and peace alone.
Aum! peace, peace and always peace!

This is the prayer, and this is the spiritual basis of the universe. The Indic spirit says that it can be experienced and envisioned in a variety of ways.

To the scientific inquirer, this universal harmony is unveiled as the laws of nature which govern the world. These laws are intangible. Who can see or touch the law of gravitation or electromagnetism or the symmetry groups that orchestrate the song and dance of the world from the minute microcosm to the inconceivably vast galaxies sprinkled in the cosmic stretch? Their effects on matter are perceived as reality. Yet the laws have been there all through eternity and are omnipresent in the cosmos. They are the imperishable essence of the universe.

One may get a taste of this essence in the ecstasy of devotional music, in the *bhajans* and psalms and sacred utterances of religious traditions. Or again, one may feel the vast encompassing magnificence of it all through concentration and contemplation. Thus every heart that prays, every soul that meditates, and every mind that reflects and probes into the complexity of the cosmos gets a glimpse of the spiritual ocean in which we are submerged, whether we recognize it as such or not.

Modern science has unraveled the principles governing the physical world. This is not unlike the discovery of the rules of grammar and prosody, symmetry, and syntax that govern every line in a sonnet. Such analyses, impressive as they are, say little about the grandeur and glory of the poetry. The unraveling of meanings and feelings that are implicit in the cold and calculable world is accomplished through other modes.

At the purely material level, we humans are insignificant and inconsequential in the vastness of space. We do not play even a marginal role in the functioning of the universe. But take away the human spirit, and the world would be dark and dismal like a deep dungeon in stark midnight. All the light and color, all the splendor and beauty of the universe, are unraveled only in the human head. No proton or planet, no star or supernova has the slightest inkling of the magnificence of the multisplendored universe wherein they have been spinning and whirling for eons. They know nothing of shrieks of joy or pangs of pain.

But for human consciousness, all the dust and stone, waves and vibrations would be cast in the dark expanse, unnoticed and unsung for all of eternity. Without human awareness, there can be no images of orbits elliptical, no reckoning of space or time and

their intertwining. Neither the golden sunset nor patterns on butterfly wings, neither the fragrance of jasmine nor the sweetness of honey would be aspects of the physical universe without the supercomplex sensory apparatus associated with our cerebral paraphernalia. And of course, there would be neither art nor philosophy, science nor technology, music nor mathematics in the cosmos without embodied consciousness. The emergence of awareness was therefore as great an event in cosmic history as the first big blast of its material birth. It is awareness that detects meaning in a mechanical and mindless world. It is as if by our presence, we have lit up the whole universe.

But how did the world subsist for eons before *Homo sapiens* emerged, and how will it subsist for eons to come after earthlings are erased? The cosmos without humans is like a mindless blind monster wandering in the wilderness of uncharted space-time, and yet without missing a step on the path that has been meticulously carved for it by mathematically precise laws.

**Darshanas**

One meaning of the word *darshana* is demonstration. Another is vision or perspective. In the classical Indic framework, darshana refers to a canonical philosophical system. More generally, we may take it to mean a philosophical system, and here is an important insight: Philosophy is not the revelation of absolute truths, but perspectives on them. It is, moreover, a vision one gets on the nature of complex problems.

In the classical world, there were six schools of Hindu philosophy that shared some common threads. As noted earlier, they are known collectively as *shad-darshana* (six darshanas). They probably evolved over a stretch of several centuries, in the opinion of most scholars, from about 200 BCE to 500 CE. Much of the original writings of those systems would have been lost, and practically unintelligible to us, were it not for the commentaries on them by several later thinkers. The most important of these was by the eleventh century scholar Madhva. His compendium analyzed with remarkable erudition and objectivity sixteen different philosophical systems that were in vogue in South India in the fourteenth century. These have been presented and debated by generations of Indian philosophers over the centuries, revealing the immense interest that philosophy held in the culture. An English translation of Madhva's compendium was published by Edward Byles Cowell and Archibald Edward Gouch in 1882.

The six darshanas discuss a wide variety of topics relating to philosophy, metaphysics, psychology, and epistemology. I referred to Nyáyá and Vaisheshika in the chapter on Indic epistemology. These were part of the shad-darshana corpus.

The Sánkhya system of philosophy attempts to coordinate the various facets of human experience into a universal framework. It is a bold and fascinating theory of human existence transcending the simplistic formula by which God made the world the way it is.

The underlying concept in the system is the duality of matter and spirit. The universe is permeated with these two fundamental entities whose interplay produces the phenomenal world. The Sánkhya system undertakes to expound how this interplay occurs, but it does not talk about what caused this to happen in the first place.

The undeniable attribute of human existence is, according to the Sánkhya view, misery. Fleeting joys and passing pleasures there surely are. Ad hoc remedies and temporary alleviations may also be found for this ailment or that pain. But in the meanwhile there are pangs and sufferings. The sorrow of loss and the anguish of grief are inescapable. The very impermanence of youth and success, of happiness and human life, is a source of sorrow. Misery is the victor in the game of physical life.

The cause of it all, maintains Sánkhya, is ignorance of the true nature of things. As the man in the dark is overcome by fright by a strange whisper of unknown origin, the human spirit experiences its torments only because it does not know what this is all about. The frightened person simply smiles upon discovering that the strange whisper was just the rustle of leaves; so too, the spirit, upon recognizing the true nature of the world, is filled with infinite bliss.

The physical world of experience is in a state of continual transformation. It must have arisen from some original eternal entity, since something cannot arise out of nothing. In other words, a precreation principle must have potentially contained the totality of the experienced universe. That principle is called *prakriti* (from the Sanskrit *pra*: before; and the root *kr*: to create). Prakriti is thus the substratum of the physical universe. Its existence may be derived from logical reasoning and also verified by yogic exercises. Prakriti is compared to a seed which, in effect, contains the tree with its branches and leaves and fruits. It is itself uncaused and eternal, all-pervading and immobile, uniform and independent, homogeneous and immanent. There is no implication here of a personal god with attributes like goodness, intelligence, or mercy.

In its primordial state prakriti is not inert. It is in a state of dynamic equilibrium. It is characterized by three mutually opposing qualities called *gunas*. When imbalance occurs between these, disequilibrium sets in, and the phenomenal world arises. As mentioned earlier, there is an uncanny parallel here with the symmetry-breaking view of current physics.

The spiritual component of the universe is known as *purusha*. There are a great many of them, each a center of conscious experience. Indeed in each one of us there is a purusha that enjoys and suffers, thinks and wonders. Purusha is the subtle, immaterial, pure consciousness. It is unchanging and eternal, passive yet experiencing. The evolution of the physical universe is for the enjoyment of the purusha. The changes in prakriti are somewhat like the play on the stage, enacted mainly for the benefit of the audience (purushas).

Ordinarily, purusha is ignorant of its separateness from prakriti, of the illusoriness of the changes in the phenomenal world. Like the child which gets frightened on seeing a monster movie, the unenlightened purusha in its state of *aviveka* (nondiscrimination),

suffers and struggles. However, as soon as the purusha recognizes its true nature, it sees the play for what it really is, enjoying even high tragedy as an example of fine acting. The purusha which has attained this stage is said to have attained *jivan mukti* (life-experience-freedom).

I have merely sketched here the basic ideas of an elaborate and complex theory of consciousness. Whether one accepts the details of this theory or not, one cannot deny that there is much wisdom in this view of human existence. If we can realize this, then like the tears and laughter of the play actors, our own sorrows and joys will also eventually fade away. If we can manage to separate out our individual self from the troubles and turmoil of the storms of life and become peaceful observers of what goes on, our own experiences will be at a loftier level, and we are less likely to be tossed around by grief and gaiety.

The tenets of Sánkhya philosophy are very old, and were certainly known in the pre-Christian era. The essence of Sánkhya philosophy is also found in some of the Upanishads and in the Bhagavad Gita. Per tradition, the originator of the Sánkhya school of thought was Sage Kapila who has also a presence in the *puranas* which are the sacred history of the Hindu world.

**The Pùrva Mimámsa**

This system of philosophy attempts to give a consistent interpretation of the Vedas. It recognizes that doubts and misrepresentations might arise in the study of Vedic literature. Therefore, in the texts of this philosophy, the Vedic mantras are stated explicitly, and then analyzed carefully. This school is concerned primarily with clarifying the notion of *dharma* on the basis of the sacred works. Vedic writings consist of three parts: the hymns (*mantras*), the rituals (*Bráhmanas*) and the philosophies (Upanishads). Púrva Mimámsá is interested most of all in the prior (*púrva*) sections of the Vedas, namely, the mantras and the Bráhmanas.

The classic text on the Púrva-Mimámsa system consists of twelve books that are made up of over two thousand five hundred aphorisms. These books treat a variety of topics of which the following are some examples: supremacy of certain words in Vedic texts, differences between various rites, exposure of erroneous proofs, relative importance of passages in scriptural writings, qualifications of those that perform rituals, how sacrificial rites may be transferred, and tantric writings.

Just as the Yoga school stresses the importance of personal experiments (the yogic exercises) for attaining the spiritual goal of self liberation, the Mimámsa underscores the value of rituals for achieving the more immediate goals of good health and prosperity here on earth, and ultimate salvation later on. The Mimámsa school even categorizes the rites into several groups: those that are optional (*kámyakarma*), those that are required (*nitya*) and those that happen to arise (*naimittika*). If any of the latter two kinds are omitted, one accumulates nonmerit. Note that even though this categorization was made in the context of religious rituals, it is a very insightful one in

that it is equally applicable in a more secular context. After all, anything we do can be classified as optional, required, or circumstantial.

But there is more to the Púrva Mimámsa system than preoccupation with rituals. There is also an elaboration of ethical conduct. Indeed, this system of philosophy explores the idea of *dharma* in such detail that it is also sometimes referred to as Dharma Mimámsa. Two interesting ideas of Mimámsa ethics may be noted. First, it strongly prohibits any violent act, especially one leading to the death of a human being or an animal. At the same time, it does not regard the sacrifice of animals to gods as unethical. Indeed, this is recommended.

This apparent contradiction is removed when we consider the second aspect of the Mimámsa position: that our actions are to be judged not by themselves, but in the context of their motives. If killing is done out of anger, hatred, or other selfish considerations, it is of course bad. If the killing is for a sacrifice to the deities, however, the motives are quite different. Though one may disagree with the specific example given, the principle by itself makes a good deal of sense.

The Mimámsa is also very keen on emphasizing the rewards or punishments for our actions. The law of karma is taken very seriously. We are ultimately responsible for what we do. Not even the gods can interfere to remove a karmic consequence.

In all of these, direct spiritual experience is considered to be far superior to mere intellectual discourse. In other words, the mind and its antics may be interesting and sometimes even fruitful. However, they are by no means reliable in the recognition of the Absolute. To grasp ultimate truth, one needs an intuitive grasp of the true nature of ultimate reality. This, it is averred, is obtained only through spiritual enlightenment.

This is a very important thesis. Just as learning about astronomy without ever looking at the sky or peering through the telescope would be an insufficient, not to say a shallow grasp of the subject, the mere theoretical acceptance of this or that principle is not enough. Someone who reads about chemical reactions from a college textbook without ever going into a laboratory and doing experiments with beakers and pipettes would be as superficially informed about the subject as the philosopher who lectures on metaphysical reality without ever having done yoga or meditation. This is why all the darshanas insist on a marriage between theory and practice. The goal of philosophy, they contend, is not simply to enable us to comprehend the world of experience from a theoretical framework, but to transcend it. This is a central refrain of classical Hindu Indian philosophy.

Here we may draw an analogy with debates between science and religion. Though there are competent scholars and participants on both sides, we often find that there is seldom agreement between hardcore scientists and deeply religious people on fundamental issues. One reason is that very few of those who point to the inadequacy or limitations of science have done any actual science themselves. One cannot, as many do, make serious comments on quantum mechanics without ever having done a single calculation oneself. Likewise, many who attack religions from rational, empirical, and physical-laws perspectives have never had any meaningful religious

experience themselves. If you have never knelt in prayer, done a namaz, or chanted a mantra, you simply cannot make a significant statement on the value of religion. Thus, the lesson we draw from the Hindu view is that prior to making pronouncements on any discipline, we need to have not only an intellectual grasp, but also a fulfilling experience of it.

**Vedánta**

Vedánta is the sixth system of classical astika philosophical schools. It is also sometimes referred to as Uttara Mimámsa (later Mimámsa). It has been the most influential of the philosophical systems, for its central ideas have penetrated the spiritual psyche of India through the Upanishads and the Bhagavad Gita. Vedánta philosophy also rests on the Brahma Sùtras, a work that was expounded, commented upon, and made widely popular by the writings of the great scholar Sankaracharya of the eighth century as also by later saintly commentators.

The name *Vedánta* literally means the "end of the Vedas." This may be interpreted in two ways. First, it can be understood to mean that this philosophy comes at the end of the Vedic writings, not before and in the body of the Vedas. On the other hand, end could also mean ultimate purpose or goal as when one asks, "To what end is this being done?" In this sense, Vedánta could be used to express "that which is the purpose of the Vedas." We may note in passing that the English word end is cognate to its Sanskrit equivalent anta.

The Vedánta school has given rise to enormous technical discussions and debates about the nature of god, soul, and reality. But the essential theses of the system are fairly simple. It maintains that Brahman (God) is the all-knowing and all-powerful root cause of everything there is. Brahman causes the world to emerge, evolve, and dissolve. The world results because Brahman so wills. To use Aristotelian terms, Brahman is not only the efficient, but also the material cause of the universe. It is the one and only principle there is. There is no second principle involved. Everything is Brahman: *sarvam brahma mayam*.

In the voluminous discussions on Vedánta philosophy, one explores the ultimate nature of Brahman, whether Brahman is identical with or separate from what it creates, or if it is something in between, etc. These considerations lead to a good deal of subtle epistemology and hair-splitting metaphysics.

If we regard a merger with the supreme Brahman as the ultimate goal of human life, then, according to the Vedantic school, the path to this goal consists of three stages. In the first stage, it is action that is important. However, the action that is undertaken should be unselfish. It should not be tainted by any desire to get something for oneself in return. It must be action that has no ulterior motive and no preoccupation with its fruits and rewards. This mode of action, this phase in one's gradual approach to the final identification with Brahman, is known as *karma yoga.*

The next stage is called *jñána yoga* (from *jñana*: knowledge). In this stage, the individual attempts to realize that the *entity* which experiences the world, the

consciousness that thinks and feels and reflects, is quite distinct from the physical body and mind. This knowledge of the self is attained by introspection and sustained inquiry into the nature of our being. The jñána yogi will also realize that the individual self is completely dependent on Brahman, the Supreme One.

When one has reached this level of realization, one passes on to the next stage. This is the stage of intense love and emotional entanglement with the Ultimate, the *bhakti yoga* stage (from *bhakti*: devotion). Now action and knowledge recede into relative unimportance. Instead, there is an intense experience of joy with the whole universe, a divine rapture resulting from a love of God that transcends anything experienced in the physical frame. In this highest stage in the path to spiritual fulfillment there is total and complete surrender at the level of feelings and emotions. It is brought about by a new vision of godhead, of spiritual reality.

Let us note two things in this context. First, we find here a profound insight into the nature of spiritual development. One cannot, indeed should not, aspire to it by shirking one's role and responsibilities to the world: hence the importance of the karma phase. Our work and activities should be selfless and dedicated; they should be done for no other reason than that they need to be done—and done well. At the next level of maturity, we inquire into the deeper questions relating to our presence in the cosmos, to the nature of that subtle entity which constitutes our individuality. Finally, for true and unadulterated spiritual experience, it is not action or knowledge, but pure love and intense emotional entanglement that become primary. It is not through logic and reason that one discovers God.

This thesis of Vedánta philosophy has had an enormous impact on Indic thought and culture. It has inspired countless poets and spiritual aspirants to plunge into the bhakti phase. Also, because of the hierarchy in the system, the common people respect jñána yogis, but revere and worship the bhakti yogis.

Ignoring for a moment the spiritual reference frame in which the three yoga systems are explained in Vedantic literature, we may still see in it an insight into the nature of human attitudes and aptitudes. In society, among our friends and kith and kin, as also among leaders and thinkers, we find people of varying strengths and inclinations. Broadly speaking, they can all be put into one of three categories: Some are good at completing tasks, at accomplishing things by actions, at getting things done. Engineers and builders, mechanics and business people, belong to this group. These are the doers, the karma yogis. Then there are those who are good at intellectual explorations, at analyzing problems, at reflecting on issues, at debates and discussions. Theoreticians and philosophers, pundits and scholars belong to this category. These are the jñána yogis. Finally, there are those who are touched more deeply by emotions and feelings, who are moved more deeply by the sight of suffering or the beauty of the rainbow. Artists, musicians, and poets, for example, may be put in this class. These are the feelers, the bhakti yogis.

This may not have been exactly what the authors of the Vedánta system had in mind, for in this analysis we do not make reference to spiritual truths nor consider one type to be

at a higher level than another. From this perspective, no one can be fully one particular type of yogi. But in each of us, one rather than another, predominates. This point of view makes the Vedantic classification more relevant in our own times. We may also see the deeper message of Vedánta in the following terms: Action there must be for the practical needs of society, reflection and analysis for culture and civilization. Fulfillment there never can be without love, be it for God or for fellow human beings and fellow creatures of the planet.

Once again, we have to plead ignorance as to the identity of the original authors of the Vedánta system. Badaráyana, who is generally regarded as the author of the Brahma Sutra, and described as another incarnation of "Vishnu's cognitive energy," is reckoned as the primary author of this system. He is also sometimes referred to as Vyasa (literally, the Arranger). The original works on the system date back to several centuries before Christ.

In classical India, many eminent scholars and philosophers wrote extensively on Vedánta philosophy. The most illustrious among them include Shankarácharya (eighth to ninth century), Ramánuja (eleventh century), and Madhva (thirteenth century). All of them gave varying interpretations of the underlying metaphysics of the system. Thus for example, in the exposition of Shankara there is but one Ultimate Reality (*Brahman*), all else is mere máyá (appearance or illusion), arising from our own ignorance. Prayers to personal gods (*íshvara*) are fine as long as we are in this world of appearances. Through yoga, however, one reaches a state in which all distinctions dissolve: all is One in the cosmic sea. This insistence on the Oneness of Brahman is referred to as *advaita* (nondualism). But this realization cannot be accomplished through reasoning and analysis alone.

It should be noted that the feeling of oneness of the mystic, though often associated with Hindu thinkers, was not peculiar to them. Parmenides of ancient Greece spoke of mysticism of this kind and even defended it in a logical framework. As Bertrand Russell pointed out in his *Mysticism and Logic*, "This form of mysticism, which appears, so far as the West is concerned, to have originated with Parmenides, dominates the reasoning of all the great mystical metaphysicians from his day to that of Hegel and his modern disciples. Reality, he says, is uncreated, indestructible, unchanging, indivisible . . ." If this is not a description of Brahman, what is?

Ramánuja and others gave a theistic interpretation of Vedánta. They maintained that the *jívátman* (individual soul) and Brahman are not, as Shankara had said, identical; indeed that even after the ultimate cosmic merger, jívátmans would preserve their identity. The jívátman was not like a cup of water getting homogenized in the ocean, but rather like sand particles that even in the depths of the sea remain but sand particles. There are, in the worldview of Ramánuja, three basic realities: God (*íshvara*), soul (*chit*), and matter (*achit*), the last two being dependent on the first. Conscious souls and inanimate matter qualify ishvara. Ramanuja's school is known by the term *vishistadvaita* (qualified monism). It is again a complex system of thought, involving detailed discussions on epistemology, metaphysics, and practical paths to follow for salvation.

As noted above, the third influential thinker in the world of medieval metaphysics was Madhva, who insisted on the irreducible distinctiveness of the jívátmans from the

paramátman. He regarded the physical world, not as máyá, but as being all too real, and quite distinct from the Supreme Principle. His system introduced the interesting concept of *sákshi* (witness), an internal light in each individual that declares if something is true or false. It is a sort of epistemological conscience that transcends material proofs and logical reasoning. It could lead to a priori knowledge. Madhva's is known as the *dvaita* (dualist) school.

These different systems of thought gathered around themselves adherents who became pious devotees and/or able scholastics, forming separate sects whose members would not even intermarry.

**Conception and Personhood**

From the merger of a microscopic sperm and egg in the darkness of the fallopian tube arises an entity that gradually acquires self-awareness and an identity all its own. This embodied consciousness reflects and rejoices, creates and communicates, and engages in many activities for a brief time span. Then, after a final breath, its nonphysical attributes vanish from the visible world. No thinking mind can be unimpressed by this remarkable phenomenon. As far as we know, it is unlike anything else in the universe. If anything is mystery, human consciousness is.

Four centuries of modern science have thrown much light on the physical basis of this uncommon wonder which may have parallels in other pockets in a universe studded with billions of stars and planetary systems. Someday we may explain consciousness in terms of neurons, microtubules, or other matter-based principles. But as of now, consciousness continues to be a fantastic anomaly in the mindless morass of matter-energy.

Each one of us carries within a totality that is more than the sum of our body's material substrate. Many of the atoms and molecules that make up our anatomy at this hour were not part of us a moment ago. Millions of microorganisms rapidly thrive and perish in our saliva and alimentary canal. With all that, there is a subtle self that has been illumining every one of us, something that etches the identity of a separate existence even within a hugely interconnected whole. This self has been with us since the first utterance of *I* and *me*, and it will be part of us until the dusk of life when, gradually or suddenly, our individual memories will falter and fade away for good.

We cannot deny the biochemical basis in the persistence of personhood. Someday, silicon configurations in plastic casings may acquire feelings and emotions, mimicking the heaves and exhilarations of the human heart. Computers create music today; they may be enjoying it tomorrow. From the perspective of science nature appears to be no more than a tangible manifestation of matter and energy. However, the laws of nature which organize and sustain it cannot be located here or there or anywhere: they pervade the entire span of spread-out space and ceaseless time. From the Indic perspective, consciousness is implicit in these laws, for it is the intangible principle that breathes order in the universe and life into inert matter.

The Copernican revolution displaced our earth from the center of the universe. Science has been enormously successful in exploring the entire physical span of the universe from the far-from-visible microcosm to faint and farthermost specks in the vast expanse. Science may be right in regarding consciousness as just another among the countless occurrences that have come to pass in the stretch of time since the first creative bang.

We will be missing the point, however, if we do not see the role of consciousness in the unfolding of cosmic history. Science has displaced our habitat from center stage, but not dethroned human consciousness from the center of the perceived world. Like invisible air and earth-binding gravity, we take it for granted because it is with us all the time. Consciousness deserves more than passing mention in any serious commentary on the universe, for it is consciousness that has lit up the universe with beauty and color and infused it with meaning and understanding.

**A Spark from the Cosmic Consciousness**

In ages past, Indic visionaries probed into the roots of consciousness, and they came up with some fascinating views on it. They arrived at the startling conclusion that human consciousness is but a pale echo of something far more magnificent. This is expressed through the pithy aphorism, *tat tvam asi*: thou art that. The Hindu vision is that every conscious entity is a spark from an underlying effulgence, and can flash a radiance as only its source can.

This capacity for awareness and experience, for logical analysis and joyful interaction is an intangible component in the fleeting persistence of *Homo sapiens*. This is the essence of what we call the human spirit. Just as there is more to a flower than soil and its tree branch; so in the Hindu view, the spirit is more than its neural network, heartbeat, and vital breath, though these are what create and sustain it.

If there is splendor in the perceived world and pattern in its functioning and if it can all result in the grand experiences of life and thought, then even prior to the advent of humans, there must have been an experiencing principle of a vastly superior order. This cosmic experiencer spans the full range in space and time. Just as the expanse of water in the seas is scattered on land in ponds and puddles and cups and carafes, all-pervading *Brahman* finds expression in countless life forms. We are miniature lights, one and all. We have emanated from that primordial splendor, like photons from a galactic core, destined for the terrestrial experience for a brief span on the eternal time line, only to finally re-merge with that from which we sprang.

Is this poetic imagery, scientific hypothesis, or perhaps the ultimate Truth? One may not know for certain. If it be poetry, let us remember that poetry and prayer are for the human spirit what the telescope and the microscope are for human eyes. Lenses enable us to discern entities beyond our normal cognition, and profound poetry is a response of the spirit to that which is not fathomed through logic and reason. Poetry brings home to us, indeed it forces us to reckon, the world of experience not in terms

of sense data and charts and proofs, but in subtle and holistic ways. It reveals meaning and majesty in the universe, which lie in a realm beyond the plane of rigid rationality. Poetry is mystic experience verbalized.

The Hindu spiritual vision thus paints individual consciousness on a cosmic canvas. It recognizes the transience of all of us as separate entities, yet incorporates us into the infinity that encompasses all. It does not rule out the possibility of other manifestations of *Brahman*, sublime and subtle, carbon or silicon based, elsewhere amidst the stellar billions. It recognizes the role of matter and the limits of the mind, but sees subtle spirit at the core of it all. It does not speak of rewards and punishments in anthropocentric terms, nor of a He-God communicating in local languages. Yet it regards the religious expressions of humanity as echoes of the Universal Spirit, even as volcanic outbursts reveal submerged forces of far greater magnitude.

Ignoring for a moment the tenets of mechanistic-materialist science and reflecting in the realm of poetic visions, it is fair to say that there is something sublime in regarding every conscious being as a spark from a cosmic Whole. It is an elevating thought to be told that we are part of that from which the universe sprang, and in that grand vision, every fellow human becomes yet another spark from the same source. When such a worldview is internalized, what an outpouring of caring and compassion, love, and respect would exude toward others!

It is no less interesting in this context to reflect upon the conclusion of the physical sciences that say we are ultimately made up of carbon atoms and the atoms of other heavier elements synthesized in the core of supernovas. This discovery prompted Carl Sagan to pronounce, both poetically and literally, that we are made of stardust. But even more precisely, all the matter making our bodies emerged from the primordial Big Bang of which present day cosmologists speak. This, no doubt, is our physical makeup. In the Indic vision, aside from the material component of the universe, there is also a spiritual substratum that emerged through modes we are unable to fully fathom, from that same pristine creative principle.

**Non-Vedic Schools**

In India, as in every culture where free thought finds expression in challenging authority, there were many who questioned Vedic infallibility. There arose thinkers who saw no sense in systematic sacrifices of animals in the name of poetic gods, who looked upon declarations of an afterlife as no more than fancy speculations, and in whose view souls and spirits were mere creations of imagination. Over the ages, millions might have secretly held such views, but only a few dared to express them openly and face the consequences. Some succeeded in propagating their perspectives, winning numerous followers, and eventually became the fount of another set of revelations; while others only managed to get condemned, and perhaps even snubbed into final silence.

Thus Gautama Buddha was an open rebel against Vedic practices. He laid more stress on ethical behavior than on obsessive concern for the hereafter. He preached the

gospel of compassion and refrained from lecturing on heaven and hell. He felt deeply for the pains of others and searched for the secret sources of sorrow and suffering. He taught that the way to eliminate emotional pain (*dukkha-nirodha-marga*) was by following an eightfold path consisting of right understanding, right thought, right speech, right action, right livelihood, right endeavor, right mindfulness, and right concentration. None of these referred to any gods or rituals. Yet they furnished the foundation for one of the great religions of the world: Buddhism. But the prophet who preached against gods and spirits eventually became a god himself in the minds of the masses. Apotheosis has been the fate of some atheistic prophets.

The Chárvaka school was purely materialistic in its convictions. All that mattered was matter itself. True, there was consciousness, the Chárvakas conceded, but this was no more than another manifestation of matter. Jivátman and paramátman were all gibberish, they maintained. A person dies, and that is the end of it: no spirit and no reentry into another body. Rituals to the departed serve no purpose but to feed the priests.

A natural consequence of this philosophy was a hedonistic ethics: As long as we live, let us make the best of it. Pleasure should be the ultimate goal of every enterprise. Every unenjoyed moment is a wasted moment. Those who preach that we should renounce the world because of pain and suffering want to "throw out the baby with the bathwater." There is pain and suffering in life, but there is also a thorn in every rose. Does it mean we should ignore the rose? Should grain be discarded because husk comes with it? Madvácharya summarized the philosophy of Chárvaka whom he described as "the crest-gem of the atheistic school, the follower of the doctrine of Brihaspati," and remarked with great wisdom, "The efforts of Chárvaka are indeed hard to be eradicated, for the majority of living beings hold by the current refrain—

> While life is yours, live joyously;
> None can escape Death's searching eye:
> When once this frame of ours they burn,
> How shall it ever again return?

These ideas may seem to be alien to the normal modes of Hindu thinking, yet they were as Hindu as any other. Indeed, all through Indian history, thinkers with such views have come up now and again. But they often moved counter to the common current. They were exceptions rather than the rule, seldom permitted to become part of the mainstream. Such radical thinkers either broke away or were subdued; they either established new religions or became brief chapters, if not footnotes, in books on Indian philosophy.

In this context we should draw attention to a scholarly reappraisal of Indian materialism by Debiprasad Chattopadhyaya. He convincingly argues in his book *Lokayata* that the followers of the Chárvaka school had their own rituals and that they were related in some fundamental ways with Tántric philosophy.

We may picture Chárvaka—if such a one existed—as a highly original thinker who could not possibly accept what must have seemed to him a whole lot of mumbo jumbo in Vedic rituals and who dared to speak out against the system. The Mahabharata refers to an individual by this name. There he is described as a demonic individual (*rakshasa*) who befriended the evil Duryodhana. In one scene he appears as a Brahmin who accuses the just and righteous Yudhishtira, when the latter returned triumphantly to the capital, of having killed his own kith and kin. The all-knowing Brahmins exposed him and, by their spiritual fires, reduced him to inconsequential ash.

Intellectual and spiritual rebels have but two fates: they are eventually deified or destroyed. It is entirely possible that Chárvaka was but a symbol, a name for a whole group of people who did not take the routine rites and rituals seriously, for whom feast and frolic were more meaningful than prayer or pilgrimage. Quite probably, they also poked fun at the pious postures of penitents and pundits. The personage of Chárvaka has even less substantiality than that of the great names associated with the other great systems of Hindu philosophy, for there is hardly any writing that is directly attributed to the man. (There is at least one historical fiction—Charvaka Charitra—on the life of this great Indic philosopher.) Yet it is not inconceivable that some acute thinker may have led a major materialistic movement in ancient India.

Every great civilization has had its Chárvakas: adamant skeptics who speak out against established authorities, against ideas and practices that to them seem inane. For example, Wang Chong in first century China questioned the existence of ghosts and spirits and made fun of omen-mongering.

**Indic Insights and Quantum Mechanics**

Quantum mechanics is an esoteric chapter of modern physics that has its origins in the early decades of the twentieth century. Its primary field of interest is the microcosm: the world of atoms and molecules, electrons and protons, and such other entities that make up the substratum of the physical universe. It was a crowning achievement of a methodology that hinged primarily on observational data and a theoretical framework that was rich in sophisticated mathematics. Quantum mechanics not only served as a floodlight for entities and processes in the deep-down material microworld, it also gave rise to some fantastic inventions and technologies that have transformed the modern world in incredible ways.

No less remarkable is the fact that quantum mechanics uncovered for human understanding some altogether new facets of physical reality. The emergence of quantum mechanics instigated fascinating fundamental questions as to the ultimate nature of reality, and led to deep inquiries into the roots of human knowledge and the relevance of an objective world. Thus while die-hard physicists continued with their theoretical and experimental investigations of the physics of the phenomenal world, philosophers and philosophically inclined physicists began to raise epistemological

questions and build worldviews that spilled over from technical physics into the arena of human knowledge, philosophy, and metaphysics more generally.

In this context, certain ancient worldviews enunciated by classical Indian philosophers become not just interesting, but very *á propos* too. In particular, from the perspective of one school of Vedánta, the strange results of quantum mechanics are not as strange as they may seem. At this point it is important to emphasize that the Vedantic worldview emerged from the reflections of profound thinkers and had little or nothing at all to do with the methodology of modern physics. That the final conclusions of the two led to some parallel visions is not unlike the arrival of two travelers to the same spot, one by taking an ocean liner and the other an airplane. In which case we might say that scientific insights and spiritual convictions bear fascinating parallels, but may not be interchangeable. It is important to recognize the underlying differences as well as the apparent parallels in incorporating quantum mechanics into Vedantic thought or vice versa.

To begin with, Vedánta clearly distinguishes the observing consciousness (purusha) from the observed entity (prakriti). This duality is at the basis of the Indic worldview at the level of the intellectual grasp of the world, but it dissolves into a cosmic oneness at the highest level of spiritual merger. The role of the observer in the scientific investigation of the world took on a new dimension in quantum mechanics: the observer and observed are fused in an inextricable way in the very process of observation. Moreover, this fusion dissolves the subject-object separation and indeed it serves as the touchstone for knowledge acquisition. In the Vedantic view, framed as it is in a spiritual context, the interaction between purusha and prakriti takes on a special role when the purusha tears open the veil of separation with prakriti. When that is achieved the purusha attains supreme knowledge. Thus the notion of an epistemology resting on the deep interaction between the inquiring subject and the inquired into object is intrinsic to both Vedánta and quantum physics.

Or again, classical karma—the idea that what one experiences is the inevitable fruit of past actions—may be described as pure determinism. However, the idea that what we do now alters our future state corresponds to the quantum rule whereby the process of observation alters the course of evolution of the observed system. In other words, the process of measurement in quantum mechanics would be like the action one currently performs: it affects the outcome in the future. What one will experience is potential: it consists of several possibilities. A particular action would then be like a measurement that results in the collapse of the wave function, reducing it to just one possibility.

Or again, let us for a moment consider the question of causality. In the framework of quantum mechanics, one is obliged to alter this principle in the microcosm. For example, whereas one can predict the statistical probability of nuclear decay, one cannot, even in principle, predict which particular nucleus in a sample will next undergo decay. From the Indic philosophical perspective, aside from a cause (*kárana*) and an action (*kriyá*), there is also an agent (*kartá*) who initiates the action. Thus if we assume a *kartá* for nuclear

decay, the phenomenon becomes better understood: except that the causative agent (*kartá*) in this case is intractable. One simply has to assume its existence in the context.

Finally, consider the notion of entanglement. In quantum mechanics this refers to the inextricable intertwining of the wave functions of correlated quantum entities. In the macroworld this may be looked upon as the interweaving of the many causative factors that keep the phenomenal world functioning. In the Vedántic framework one speaks of the individual consciousnesses being integrated into the cosmic consciousness. More exactly, it is the realization of this ultimate unity of all that is said to constitute supreme knowledge. In other words, the Hindu philosophical perspective affirms a cosmic entanglement of which we are normally unaware, but whose recognition constitutes complete knowledge.

It should be mentioned in this context that volumes have been written on the interrelationships, parallels, and concordance between Vedánta and modern physics by a variety of authors and thinkers: scientists, physicists, philosophers, metaphysicians, general commentators, and more. From prestigious physicists like Erwin Schödinger and David Bohm, to popularizers like Fritjof Capra and Gary Zukav, to Hindu commentators like Chandrasekharayya and Jitatmánanda, numerous writers have reflected on the subject—adding interesting materials to the debates and discussions, if not to physics or to spiritual vision. The goal of such reflections is to provide newer insights into the framework of our understanding rather than new information about the physical world.

Having said all of this, I should point out that it is important not to take such parallels too far. Indeed, many serious physicists have criticized authors who either directly claim or indirectly imply that the two systems—ancient philosophical/spiritual insights and modern physics—reveal the same truths about the world. I am inclined to agree with such cautions. The way I see it, the intricacies of the experienced world may be approached from a variety of perspectives, each offering different kinds of fruits. Now and again there could be striking similarities between some of the fruits, as between oranges and grapefruit. We may enjoy both, but it would be a mistake to think that both are the same.

**Máyá and Transformation**

The notion of máyá is central in Hindu philosophy, but in other garbs it has also found its way into Western philosophy. From Parmenides of ancient Greece, to George Berkeley in the eighteenth century, to Francis Herbert Bradley who wrote on *Appearance and Reality* at the end of the nineteenth century, the term has been variously translated and interpreted. It has been described as illusion, as the veil that separates us from the absolute truth, as the garb that hides the nature of reality, and so on. In the spiritual realm the goal is to pierce through the veil that distorts and misrepresents the ultimate nature of reality so as to obtain an experience of ultimate knowledge, which entails the state of pure bliss.

The notion of máyá is a profound insight for it says essentially that things are not what they seem to be: this also turns out to be one of the greatest discoveries of modern science. Whether it is sunrise and sunset, the waxing and waning of the moon, the rainbow or the blueness of the sky, the uniqueness of the human species or the flatness of the earth and its centrality in the cosmos, we have come to realize that much of what impresses as truth on the basis of common sense experience and superficial observation turns out to be false: máyá. It is only through the careful and painstaking methodology of science that we have uncovered the truth, or certainly, the deeper layers of reality. In this sense, the máyá doctrine simply says that reality is altogether different from how it strikes us at the first level.

Moreover, from the perspective of Vedántic thinkers, the intrinsic feature of what we normally regard as reality is its transitory nature, its impermanence. The impermanence implies incessant transformation. This again is a major discovery of modern science: that the phenomenal world is essentially the continuous change of matter and energy from and into their various forms. Nothing, not even the proton, is here to stay ad infinitum.

**Dharma**

No discussion of Hindu philosophy, culture, or religion would be complete without a mention of the concept of *dharma*. I have already mentioned it in previous pages. Dharma is a unique concept that ties together a variety of aspects of human knowledge and culture: ethics, religion, cosmic law and order, harmony, and values. It pervades every domain of the Hindu world: art and poetry, epics and literature, prayer and studies, individual responsibility and societal classification.

The word *dharma* has been translated variously as religion, duty, righteous behavior, and more. Dharma in the sense of duty is illustrated amply in the epic Ramayana. Here we see how a king has to send his own son in exile for upholding a promise he had given to his queen many years earlier, how the prince cheerfully goes into exile to uphold the dharma of his father, how the princess Sita follows her husband to the forest to uphold her dharma as a wife, and so on. It also shows how the *adharmic* behavior of Ravana in ravishing Sita cost him his kingdom and his life.

The Mahabharata is replete with stories and conversations around the theme of dharma. Indeed the epic revolves around the conflict between two clans of brothers, one adhering strictly to dharma and the other transgressing it at every opportunity. The very first word in the Bhagavad Gita is dharma, referring to the locale of the great war as the field of dharma. The Gita speaks of the harm that would come to society if the basic stability ensuing from assigned social responsibilities (*varnáshramadharma*) were to be removed. Here Krishna expounds on each person's allotted duty in society and in a context and aptitude (*svadharma*). It is more important to follow this, be cautions, than to take on the dharma of another person (*para-dharma*).

The term *dharma* meaning religion is sometimes used for Christianity, Buddhism, etc. In this sense Hinduism is self-described as *Sanátana Dharm* or Eternal Dharma or *Religio Perennis.* Indeed, in the tradition one makes a distinction between this and *yuga-dharma*, a set of ethical rules applicable to each different yuga. Traditionalists have their own interpretation of the term, but I find this to be a profound insight into the nature of rules and regulations. Some are inexorable and should never be changed, while others are time and context dependent. Thus, for example, truthfulness, honesty, and respect for life may be listed as parts of *sanátana dharma*, while table manners, social etiquette, modes of greeting, and how much one should tip a waiter in a restaurant may be regarded as elements of yuga dharma as these depend on place and historical period.

Etymologically speaking, the word dharma refers to that which supports or sustains. We may therefore look upon dharma as those codes of behavior, attitudes of mind, and cherished values that keep us in peace and harmony with the world around us.

There are three levels at which we function in the world: the spiritual, the intellectual, and the interactive. The spiritual life calls for self-control (*damá*), purity of mind and body (*shaucam*), and control of the senses (*indriya nigraha).* The intellectual dimension of life calls for adherence to reason and logic (*dhí*), pursuit of knowledge (*vidyá*), and quest for truth (*satyam*). Finally, in the interactive mode, there must be forgiving of the faults and shortcomings of others (*kshamá*), non-coveting of what belongs to others (*asteyam*), and not being angry with others (*akrodha*). Above all, we need to persevere to cultivate these. So it has been said in a pithy formulation attributed to Manu that these are the ten principles of dharma.

*dhritih kshyamá dama asteyam shaucham indriya nigrahah*
*dhí vidyá satyam akrodho dashakam dharma-lakshanam*.

In other words, if these virtues are cultivated one can live in peace with oneself and with others. It is to be noted in this listing that logic, reason, and pursuit of knowledge are also included as dhármic qualities, a fact that is seldom stressed, or even pointed out, in religious expositions on dharma.

The Taittiríya Upanishad (I.11.1) has a beautiful invocation which speaks to us of the great value that was placed on truth and dharma in the classical Hindu world:

*satyam vada—dharmam chara—svádhyáyán má . . .*

Speak the truth.—Follow the path of dharma.
Neglect not Vedic recitation (self-study).
After fetching for the teacher a pleasing prize (fee).
Sever not the link with lineage.
Never ignore truth.—Never ignore dharma.

Neglect not health.—Neglect not prosperity.
Neglect not self-study or the teaching (of truth).
Neglect not your responsibilities to the gods and ancestors.

What is especially noteworthy about the dharma concept is that at its core it is nontheistic and nonsectarian and is not anchored to any particular religion. Though it rests on the proposition that there is a cosmic order that sustains the world and the universe, there is little that is metaphysical about it. Thus the dharma framework may be adopted by anyone, irrespective of one's religious affiliation or theological beliefs. In this sense it is ethically panhuman, just as scientific knowledge is epistemically so.

**Rama as Personification of Dharma**

In the Indic tradition, the epic hero Rama personifies dharma at its best, but he reminds us that we humans can never be perfect dhármic beings. Valmiki's *Ramayana* speaks of Rama as "one with all the noble qualities . . . He has full self-control, he is with glory, is resolute, and free from attachments. He is intelligent and wise, eloquent and illustrious, a powerful destroyer of evil. His shoulders are broad, his arms powerful, his chin is sturdy, and his neck graceful. His chest is broad, his collar strong, and he wields a mighty bow. With a handsome face and well-shaped forehead, he has a charming gait too. He has a soft complexion and big endearing eyes. He keeps his word, he cares for his people. He protects all that is good. He defends dharma. He is versed in the Vedas and science, and in archery. His knowledge is deep, his memory sharp, and his wit is quick. He is revered and respected everywhere. He is pious, noble, and of keen mind. The righteous always seek him just as rivers long for the boundless sea. His knowledge is deep as the ocean. In sheer firmness, he is like the stupendous Himalayas. When in anger, he may burst forth like cosmic fire (*kâlâgni*). Yet, he is patient as Mother Earth . . ."

What can one add to this portrayal of the epic hero? We can only sing the glories of this ideal prince. Rama becomes relevant because we can't imagine an intangible faceless God out there somewhere in regions beyond. We need a divinity that is visualizable, in name and in image, conceptual or real, to elevate our spirits to lofty levels, to give meaning to existence, to concretize our ideals. If such an *avataric* divinity deviates ever so slightly from perfection, he is even closer, for he is like one of us. That is why the Rama of Valmiki slips here and there: stubborn in his obedience to his father, but at the cost of pain and anguish to countless people, indiscriminately exterminating all evil-doers, but harsh to Sita when tossed by jealousy. Rama, the divine, is human now and again.

Rama always adheres to Truth. By this we mean that he is committed to all that is good and noble, to fairness and justice, that he is always upright, honest, and sincere. His devotion to his father is equaled only by his father's love for him. But even more powerful is his devotion to *dharma*. Rama reminds his brother that "dharma is primary.

My father's command is paramount because it rests on dharma (Valmiki, II.21.41)." He refused to blame anyone when misfortune came his way, he simply said it was so ordained. When others get emotional, angry, and annoyed, Rama keeps his calm, patience, and equanimity.

Rama is surely one of the best known and most revered of all heroes in history. More people have uttered and written his name more often than that of any other. Few have been worshiped with such devotion over so many centuries. No other name is invoked as a greeting mode. Yet, scholars are still arguing about whether this personage even walked on terrestrial soil.

Rama is divinity incarnate on the religious plane; on the mythological plane, he is a symbol of goodness that subdues evil; and he is an extraordinary role model on the ethical plane. His adherence to truth is exceptional. His respect for parents surpasses anything in history. Hindus sing the glory of this Lord of the Raghu dynasty, Raja Ram, who protects those who have fallen, who is forever associated with that of his beloved Sita in a moving Hindu hymn that resonates with every Hindu heart. The ideals formulated in a culture serve to enhance its image and self-image.

**Concluding Remarks**

If the totality of Indian philosophies are comprised in countless aphorisms and erudite classical commentaries, far more voluminous are the works that discuss these from the modern perspective. Many scholars have written extensively on the meanings and methods, the details and differences, on the divisions and subdivisions of these many systems of Indian philosophy.

To penetrate into the depths of their metaphysical intricacies one needs to devote a lifetime of study. The intellectual output of a robust civilization over a period of more than three millennia is full of insights, concordances, and controversies. These form a highly specialized field of extended inquiry. To appreciate the *Weltanschauung* of these philosophies, one needs to have some understanding of Hindu religion, for religion and philosophy are blended into a powerful amalgam in the Indian context. Philosophy was not a purely intellectual inquiry in classical India, not just a pastime for the leisure class. Rather it was the consequence of a deeper search, the search not only for meaning and purpose in human existence, but also for literally merging with the cosmic wholeness. Much of Indian philosophy arose from trying not so much to explain as to explore human consciousness: this magnificent flicker in the cold cosmos of which even we of this advanced scientific age know but little on final analysis. To experience the subtle impacts of Hindu philosophy on everyday life and thinking, one must grow up in the framework of the Hindu world. For as I mentioned earlier, more perhaps than anywhere else, highly technical philosophical insights have touched and moved the masses in India. The peasant in the fields and the housewife in the village speak and think of life as illusion, of salvation and union with the divine, in terms no different than those used by pundits and philosophers in universities. The intrinsic

Hindu worldview on fundamental matters of life and death are related as much to the Hindu vision of spirituality as to the major philosophical systems of the country.

There are two ways of looking upon the vast corpus of Indian philosophical writings. The first is to regard them as yet another interesting body of speculative thought about the world and human consciousness. From this perspective, Indian philosophy may strike us as rich in the variety of problems it explores, impressive in its scope. It may strike us as creatively imaginative in its analogies and hypotheses, tantalizing in its picturesque worldviews. The output of Indian philosophers has been staggeringly voluminous and their modes confusingly classificatory. The goal of the various schools is invariably the same: liberation of the jívátman from the doctrinally proclaimed cycle of birth and death. Few who have even scratched the surface of the grand ideas of Indian philosophy can deny that the thinkers who originated them were mighty intellects who were altogether convinced of whatever they were declaring.

This leads us to the second view. From this second perspective, even with its mutually opposing positions as to the identity or the distinctions between *jívátman* and *paramátman* and other conflicting and logically questionable metaphysical assertions, Indian philosophy has at its core certain profound insights into the ultimate nature of the world and the human experience. The basic theses of Indian philosophy do not simply subtend speculative systems, any more than Maxwell's theory of electromagnetism is mere mathematics. Rather, the proponents of Indian philosophy were telling us something that is not only meaningful but revelatory about the ultimate nature of consciousness and the cosmos. They were not building a system of thought so much as unveiling a not-so-apparent dimension of Reality. Their assertions and aphorisms were not just doodles on the mental plane; they arose rather from experiential certitudes resulting from sustained tinkering with the subtlest centers of the inscrutable Self. Their words and wisdom are to be taken, therefore, not as grand imaginative poetry, but as findings and discoveries about the physical universe—exactly as twentieth century science, after persistently probing into the heart of matter and energy, after countless hours of search and reflection, has erected its own views of fundamental reality.

If this were so, if spiritual probing via yogic exercises does lead to insights about the ultimate nature of physical reality, while scientific peelings of the layers of matter via experimental ingenuities and mathematical formalisms also lead to the deep-down details of that same reality, then one would expect the two lines of quest to merge.

This, in the view of some, is what is happening in our own times. For it turns out that the philosophical quagmire into which quantum physics has been sliding during the past few decades turns topsy-turvy our common-sense pictures of a solid substantial world of cause and law, of rigid particles and conserved quantities, of smooth-flowing time and three-dimensional space. As we delve deeper into the recesses of atoms and nuclei, funny things appear to happen: mathematical clouds of probability take over, electrons seem to know, information seems to be transmitted instantaneously, everything is interconnected, and a good many more strange things are taking place. In the depths of black holes and in the singularities of quarks, space and time and

physical laws themselves get warped and dissolved. Now we begin to wonder if those *rishis* of India had not after all tumbled upon some profound truths about the perceived world, which because of their very nature, could not be adequately expressed even in Sanskrit. They were perhaps quite right in insisting that in the stark denuded aspect, stripped of mute matter and measuring mind, there is a level of reality that only pure consciousness can experience, and only experience, not convey. Could it be that now at long last, after countless tortuous turns of reason and experimentation, of mathematics and microscopes, science is slowly beginning to get a glimmer of what the sages were speaking about?

Quite a few modern investigators are persuaded by this possibility. That is why in our own times some eminent physicists and philosophers of the quantum world, some commentators and speculative thinkers, are drawn more and more toward ancient wisdom. It would seem, as Alex Comfort suggested, that there is much to be gained if the yogic quest on the one hand (stripped of its obscurantism) and no-nonsense empirical science on the other (stripped of its rationalistic straitjacket and model-building prejudices about what can and what cannot be) combine forces in unscrambling the deeper mysteries of the world of experience.

# VII. Classical Texts: Interpreting the Upanishads and the Gita Today

> [The Upanishad's] central principle that there is one supreme reality that manifests itself in the universe is not asserted as a dogma. It is the ultimate truth at which it is possible for human understanding to arrive.
>
> —S. Radhakrishnan

**Introduction to the Gita**

In terms of its impact on the minds of millions, the Bhagavad Gita is perhaps the most important dialogue in history. The dialogue occurs in the epic Mahabharata. It is between Krishna, the fount of Divine wisdom, and Arjuna, the brilliant hero of the Pandava brothers. It takes place on the eve of the battle between the Kaurava and the Pandava families, who are cousins. The battle became inevitable since Duryodhana, the oldest Kaurava, was intransigent, in spite of pleas from Krishna. In a remarkably dramatic—not to say science-fictional—way, we read that Sanjaya, King Dhritirashtra's trusted counselor, was able to see what was transpiring on the battlefield though both he and the king were miles away in the palace. This was possible because Sanjaya was endowed with the capacity to hear and see what was happening at great distances. It is a sad contrast: On the one hand there is Dhritarashtra who cannot see at all, on the other hand, there is Sanjaya who can see distant events miraculously.

That the Gita occurs smack within the Mahabharata suggests that the book is an integral part of Hindu culture. That is to say, its full import cannot be understood—or understood only superficially—by those who are unfamiliar with the Hindu cultural and sacred historical framework. Not only is the language Sanskrit, the sacred idiom of eternal dharma (Hinduism), the terms and metaphysics are very much part of Hindu worldviews. There are references in the Gita to varnáshrama, the Vedas, aum; to Brighu, Váyu, Yama, Agni, Prajápati, and Brahmá; to mantra, Janaka and more. Thus the epic context and the literal textual verses are quintessentially Hindu. To absorb and appreciate these to the full, familiarity with the Hindu worldview is a *sine qua non*.

To the outsider, however versed in Sanskirt and the lore, the Gita will be just another ancient literary or philosophical work.

At the same time that it is thoroughly embedded in a particular culture, the Gita also expounds some transcultural and transcendental truths. What can be more universal in the human experience than war and conflict, confusion and compassion? Interspersed in all the abstract philosophy permeating the work are insights that are meaningful and relevant to one and all and for all times. This would imply that the universal message of the Gita can be understood by non-Hindus as well—that its wisdom can be appreciated by people of other faiths and cultures. The Gita is more universal than Hinduism or India, for it mirrors the human predicament at all times. That is why people as diverse as Al Beruni, Warren Hastings, and countless more from different places have acknowledged the enrichment they have derived from reading the Gita. For example, Henry David Thoreau wrote:

> In the morning I bathe my intellect in the stupendous and cosmogonal philosophy of the Bhagavad-Gita, in comparison with which our modern world and its literature seem puny and trivial.

For Hermann Hesse:

> The marvel of the Bhagavad-Gita is its truly beautiful revelation of life's wisdom which enables philosophy to blossom into religion.

And Albert Einstein was moved to say:

> When I read the Bhagavad-Gita and reflect about how God created this universe everything else seems so superfluous.

That the Gita takes place on the battlefield suggests that deep philosophical questions are not matters for armchair speculation. Questions about the nature of the self and the goal of human activity are more than matters for classroom discussions or esoteric problems restricted to academic ivory towers. Rather, they are human questions, relating to the human condition. Their significance must be related to the harsh problems of life and death. They must be perennially borne in mind through all of life's ups and downs; they must enlighten us in our decisions at every heartbeat of existence, in the rough and tumble of life as in the quiet of the countryside.

The discharge of one's duty becomes difficult when there are conflicts between duty and personal desires and interests. Yet if such a situation arises, the Gita insists we need to sacrifice our own needs and do what is incumbent upon us. In the context of civilized society, the law of the land should take precedence over political convenience. In the case of individuals, the moral law should take precedence over personal interests. This is the central theme. We are reminded of a character in a play by Pierre Corneille

(*Le vieil Horace*, act 2, scene 5) who says: *Faites votre devoir, et laissez faire aux dieux.* Do your duty, and leave the rest to the gods.

The Bhagavad Gita is glorious music. When we hear it chanted in its serene rhythm and we immerse ourselves in its melody, we experience an inner peace such as only the loftiest expressions of the human spirit can afford. When one is listening to Mozart's *Exultate, Jubilate*, who is thinking of the meaning? The piously simple and the profoundly sensitive are moved.

The Gita combines poetry and philosophy, music and religious solace. It kindles subtle thoughts; it also calls for decisive actions. It consoles the bereaved and cheers up the dejected. It thrills the soul and illumines the mind. It presents a vision of the human condition that is lofty and universal. No other work has accomplished so much for over a millennium of human history. Many thinkers, great and modest, lay and religious, have been touched by this work.

**Some Lessons from the Gita**

Arjuna is a robust man with a keen intellect. Yet he is baffled by the confusions of right and wrong, of war and peace. This is to remind us that no matter how intelligent we are, no matter how much knowledge we have or how many books we read, ultimate questions as to righteous and unrighteous actions do not have easy answers. Moral problems are not as easily solved as problems in arithmetic and algebra. Questions relating to war and peace are complex, as are the conflicts of everyday life. Who can assert categorically what is right and what is wrong, what is punishable, and what should be forgiven? Events in the world where we may play a major or a minor part may have deeper significance than what we are able to imagine. Their grander purpose in the scheme of things may not always be clear to our imperfect understandings. The mind may grasp and order things, and it can explain what causes what. However, logic alone cannot say what is ultimately good and what is bad. Mathematical decision theory can reveal what will be the outcome of particular courses of actions and with what probability, but it can never tell us what the morally right action is.

The Gita instructs us that in everything we do, we must remember the link between the individual and the universal. There is more to being human than engaging oneself only in self-centered actions having little relevance in the cosmic scheme of things. If anything, they blur our vision of the grander goals of life and civilization. The notion that we do this and we do that, as if we are in full control of the world, is a paltry view of what life is all about. It arises from ingrained ignorance, just as the geocentric picture of the cosmos, however convincing to the superficial observer of the skies, is a grossly mistaken appraisal of how the universe actually is. When we begin to recognize that there is something loftier to life than the satisfaction of the senses, our actions begin to take on greater meaning and significance.

This recognition comes from an understanding of the ultimate nature of the self, which is the intangible center of our innermost experience. The self in the embodied

state goes through the cycle of terrestrial life many times over before merging with the Absolute. And even when the body ages, grows decrepit, and dies, the self continues to exist forever; for it is unaffected by the constituents of the physical world.

Having realized this fundamental truth, we must work in the framework of our inborn talents (*svadharma*) and abilities. Only in such a self-discovery will one find true fulfillment, not in actions motivated by imitation or envy. This is how I interpret the injunction not to follow *paradharma*. We all have our respective roles to play in society, our different duties to perform, and we are better off not trying to do what is beyond our capacities. The religious mode is to discharge these duties with a sense of commitment and to dedicate our actions to a higher Spirit that undergirds the world.

The performance of one's duty alone, however, will not suffice unless it is done with the proper attitude. Our actions must be in the spirit of consecrating them to the world at large, rather than for purely selfish purposes. It is with a spirit of sacrifice that we must play our part in life. This is best accomplished if one can develop an abiding love of God. In other words, the deeply felt *bhakti* mode is most conducive to spiritual life. For spiritual progress, one needs to adopt a frame of mind that does not crave for physical gratification.

The Gita does not propound any one philosophical system as the correct one. It presents a variety of paths and views, some of them seemingly incompatible. At one point Arjuna himself pleads with Krishna to show him just one way by which he may attain the highest good. Krishna expounds many spiritual modes: ritualism and meditation are extolled, action and detachment are both recommended, pursuit of knowledge and pious devotion are equally praised. If anything, the Gita reveals that there are various ways to find fulfillment in life, for no one path is appropriate for one and all. That is also a central theme in Hindu spirituality.

**Perspectives on the Gita**

The Bhagavad Gita has been approached from a variety of perspectives, and volumes have been written by scholars on the various interpretations of the Gita. To many traditional Hindus, the Gita is the voice of God, revelations of ultimate divine knowledge to mortals *via* Arjuna. The verses of the Gita are regarded as capsules of esoteric wisdom: the spoken syllables of the Lord in human aspect. Tilak entitled his book on the Gita as "the secrets of the Gita." Krishna himself asserts this in his dialogue with Arjuna (XVIII.63):

> Thus, knowledge more secret than all secrets
> Has been imparted to you by Me.

Some have heard the voice of Krishna directly. Sri Aurobindo once had a mystical experience which he described thus:

> It seemed to me that He spoke to me again and said, "The bonds you had not the strength to break, I have broken for you, because it is not my will nor was it ever my intention that that should continue. I have had another thing for you to do and it is for that I have brought you here, to teach you what you could not learn for yourself and to train you for my work.
>
> Then He placed the Gita in my hands. His strength entered into me and I was able to do the sadhana of the Gita. I was not only to understand intellectually but to realise what Sri Krishna demanded of Arjuna and what He demands of those who aspire to do His work, to be free from repulsion and desire, to do work for Him without the demand for fruit, to renounce self-will and become a passive and faithful instrument in His hands, to have an equal heart for high and low, friend and opponent, success and failure, yet not to do His work negligently. I realised what the Hindu religion meant . . .

Bhaktivedanta Swami Prabhupada considered the Gita to be the words of God which ought to be accepted literally and without questioning. He felt that the Gita contains all that is worthy of knowing. Had not Krishna Himself declared this (VII-2)?

> I will declare to you in full, this wisdom together with knowledge
> By which there shall remain nothing more to be known.

The Swamiji went further and declared that scholarly dissection and intellectual analysis of the Gita are uncalled for and also impertinent, not to say blasphemous. More exactly, those who do not belong to the Krishna consciousness tradition, he went on to declare, have no right to interpret the Gita. Their "unauthorized interpretations . . . are so many stumbling blocks in the path of spiritual understanding." The reason for his position is that "the deluded interpreters do not surrender unto the lotus feet of Srí Krishna, nor do they teach others to follow this principle."

This is the *bhakti* approach. It may not appeal to all, but its strength and satisfaction lies in that it can afford inner peace to spiritual aspirants. This is a valid time-honored mode with parallels in all religious traditions. From this perspective, inconsistencies or contradictions within the Gita, if such are perceived, arise from one's inability to understand the deeper esoteric meanings which, in turn, is due to one's low level of spiritual evolution. Even if one respects this view, not everyone buys it, as the expression goes. However, if such a view is enforced by religious authorities, there can be more persecution and pain than knowledge and liberation in any culture. This should be evident to anyone who has studied the history of religions.

Associated with, but not identical to, this approach is the view of the book as scripture. Swami Tapasyananda described the Gita as a scripture for all humankind. But in this context, it is good to recall what Sri Aurobindo said with great insight:

> . . . the letter of the Scripture binds and confuses us, as the apostle of Christianity warned his disciples when he said that the letter killeth and it is the spirit that saves; and there is a point beyond which the utility of the Scripture itself ceases. The real source of the knowledge is the Lord in the heart . . .

For ages, the Gita has been regarded as one of the three pillars of Hindu canonical works, the Brahma-sútras and the Upanishads being the other two. Mahadevan put it this way:

> The Upanishads, the Bhagavad-gita, and the Brahma-sútra (are) together referred to as the *prasthána-traya*, the triple canon of Vedanta. Since the Upanishads are the summits of the Veda (shruti-shiras) and therefore are parts of it, they are described as shruti-prasthána (prasthána means foundation). The Bhagavad-gíta comes next only to the Upanishads . . . As this text forms part of the Mahábhárata which is a smriti (remembered, i.e., secondary text based on the Veda) it is called smriti-prasthána. The third of the canonical texts is the Brahma-sútra which is regarded as the nyáya-prasthána, because it sets forth the teachings of Vedanta in a logical order.

Because it is regarded as a scripture, in the Hindu world it replaces the Bible as a book on which one takes an oath. For the same reason, pious reading of the Gita is a religious exercise that is conducive to one's spiritual evolution. Lord Krishna states this explicitly (XVIII-71):

> He who hears this (the Gita) with faith, who does not just argue, he too, liberated, shall attain the higher region attained through meritorious deeds.

Mahatma Gandhi vouched for this when he wrote:

> When disappointment stares me in the face and all alone I see not one ray of light, I go back to the Bhagavad-Gita. I find a verse here and a verse there, and I immediately begin to smile in the midst of overwhelming tragedies—and my life has been full of external tragedies—and if they have left no visible or indelible scar on me, I owe it all to the teaching of Bhagavad-Gita.

The Gita enunciates many basic Hindu doctrines, such as the nature of the soul and reincarnation. It also lists the virtues and vices of human beings and righteous and unrighteous conduct. It is a guiding light in a variety of contexts, a source of insight into the nature of life and death, and of human action and experience. It speaks

about human qualities and responsibilities and prescribes steps by which one would ultimately achieve liberation. Though it is regarded by some as an essentially Vaishnava treatise, for many Hindus in today's world the Gita symbolizes the essence of Hindu spirituality.

Then again, the Gita may also be looked upon as a popular work on certain classical Indian philosophical systems, presented in the form of a dialogue so as to make the exposition more interesting and understandable. From the point of view of the history of ideas, these may be regarded as theories about the nature of body and soul, of food and the phenomenal world. The discussions are all cast in the framework of a spiritual worldview of matter and spirit, of life and death. There are references to the five elements, to the concepts of mind and matter, and to the world beyond. The verses reveal to us how Indian thinkers of past centuries thought and discoursed upon matters of perennial significance. In other words, the Gita is not only propounding the perennial philosophy, it also serves as an invaluable source book for the thought currents and the sciences of past generations.

The Gita has also been looked upon as an allegorical poem on the predicaments governing life. This view has been expressed by many thinkers and saints, of whom Sri Aurobindo is a prime example. In Swami Yogananda's analysis, we find one of the most lucid and penetrating insights in this regard. He clarified the idea that the Bhagavad Gita is "an allegory of the inner conflict between man's base materialistic instincts and his innate yearning to attain the blissful spiritual consciousness of the oneness with the Divine."

In life's journey, there are conflicts between good and evil. In the Gita, the Kauravas represent human weaknesses and attachment to material things, which outnumber the higher qualities represented by the Pandavas. Though temporarily subdued, the good qualities will ultimately triumph. Krishna is the enlightened Mind that wields the horses representing the directions along which the mind wanders. Kurukshetra is the human heart and mind where the battle rages day in and day out. The Gita tells us how to attain tranquility amidst all the stress and turmoil of mundane existence.

**Commentaries and Translations**

The Bhagavad Gita has provoked more scholarly commentaries and analyses, more discussions on its contents and significance than probably any other Hindu work. In the classical world, eminent thinkers and saints like Adi Sankararacharya, Ramanujacharya, Madhvachara, Vallabhacharya, and Nimbarkacharya wrote commentaries on the work. Since the nineteenth century, B. G. Tilak, Sri Aurobindo, Mahatma Gandhi, Vinobha Bhave, Swami Sivananda, and scores of others have commented and continue to comment on the Gita in English.

Lay, scholarly, and saintly people have interpreted the masterpiece from different visions. Swami Chidbhavananda put forth an excellent simile. He compared the Gita to a mirror, each person seeing in it a little bit of his or her own reflection. In the

exposition of the great Shankaracharya, the *karma* that Krishna speaks of refers to Vedic rituals, activities one ought to engage in with meticulous attention in order to achieve spiritual progress. Centuries later, when energy was a central theme in nineteenth century physics, karma came to be interpreted differently. Tilak saw in the Gita the philosophy of *energism*: action rooted in knowledge and leading to liberation—selfless action, no doubt—yet day-to-day action for a noble purpose rather than routine rituals. The yoga of the Gita is an exercise, Tilak suggested, a *modus operandi* for the effective performance of action. *Jñana* and *bhakti* are there, but it is action in the real world that is important. Ashok Kumar Malhotra, in his book on the Gita, explores the interpretation of the Gita by three major thinkers of the tradition: Tilak, Gandhi, and Radhakrishnan.

For Gandhi, the Kurukshetra War in the Gita is supreme symbolism and poetic imagery and surely not a call for killing. It is a metaphor for the eternal conflict between good and evil. He felt that each person could see his own meanings in the Gita, irrespective of what literal translations might suggest. He justified his nonviolence in terms of the Gita, for in his view the war that Krishna was urging Arjuna to wage was not a physical war with weapons and bloodshed, but an ethical and spiritual struggle. The Gita was a personal experience for Gandhi, inspiring in him a commitment to right action.

On the other hand, political revolutionaries during the British Raj, such as Veer Savarkar, sought inspiration from the Gita to take up violent arms against alien rule. Damodar Chapekar had a copy of the Gita with him when he assassinated a British official in the 1890s.

Vinobha Bhave's interpretations were linguistic. From the meanings of words he constructed the meanings of whole passages. He analyzed the syntax and word combinations of the verses to draw his interpretation. He was convinced that there are subtle meanings in the Gita verses that are not evident to the superficial reader.

Even if some of these interpretations are mutually irreconcilable, the value of the Gita lies in that many insights may be drawn from it. Its messages may be adapted from age to age and from context to context. Like a great work of art, it is satisfying to people in different ways from different perspectives. Each serious student can find appropriate quotes from the work and interpret them suitably to justify or vindicate his or her own position.

No one knows where the original manuscripts of the Mahabharata and of the Gita are, or what happened to them. However, at least 125 early manuscripts of the *Bhishma-parvan*—Book Five of the Mahabharata, which contains the Gita—are known to scholars. The earliest published version of the Gita in Devanagri script goes back only to the seventeenth century.

Today we have translations of the Bhagavad Gita in more than seventy different languages of the world, several times in the same language. Thus there are at least 70 Tamil, 150 Telugu, 132 Marathi, 384 Bengali and 300 Hindi versions of the work. There are some 25 French, 28 German, and more than 270 English translations of

the Gita. Aside from the major languages of the world, the Gita has also been rendered in such not so widely known languages as Santali, Serbo-Croatian, Finnish, Ho-Mundari, and even in Esperanto. It was reported in 1983 that there were in all some 1,891 translations of the Gita in seventy-five different languages. It is of interest to note that Old Javanese and Arabic were the first languages into which the Gita was translated, and this was in the eleventh century, even before the first Indian language translations. The Marathi translation appeared at the close of the thirteenth century, and the Braj Bhasha translation appeared in the early fourteenth century.

Every reader may have his or her own favorite verse or verses from the Gita. Perhaps the most frequently quoted verse is the one that expresses historical optimism. It says in effect that as and when injustice and inequities come to dominate, a selfless leader will emerge to harness the positive potential of the people and subdue and eliminate the harmful elements (IV-7):

*yadá yadá hi dharmasya glánir bhavati bhárata:*
*abhyutthánam adharmasya tadá átmánam srjám aham:*

As and when dharma (justice/morality) goes astray, O Bharata,
And unrighteousness dominates, then I arise (to save the society).

**Krishna**

Krishna is a major divine personage in the Hindu pantheon. He is worshipped in Hindu temples, his life and deeds are narrated in classical Sanskrit literature. He is a central figure in the epic Mahábhárata, in a sacred history called Shrimad Bhágavatam, and in a work entitled Harivamsha. His name literally means Black.

Tradition tells us that King Ugrasena had a son, Kamsa, and a daughter, Devaki. Kamsa became a tyrant who imprisoned his own father. Devaki married Vásudeva. A sage had predicted that Kamsa would be filled by Devaki's son. So the tyrant imprisoned Devaki and her husband, and killed every newborn child of his sister. The seventh child was miraculously transferred elsewhere. When the eighth child Krishna was born at midnight, he was stealthily taken away across a river and left with the wife of a cowherd named Nanda. (We are reminded of the Pharaoh who had all newborn Hebrew male children killed, and how Jochebed stealthily saved her son Moses.) The wife was called Yashoda. Nanda and Yashoda fled to a place called Gokula with the child and it was there on the meadows of the herd-forest, Vrindâvana, that the boy was reared in the company of cowherds and milkmaids, or gopis.

When he played his magic flute, the gopis would throng around Krishna and dance with joy. Each one of them would want to hold his hand. To satisfy them all, Krishna would transform himself into a thousand Krishnas. Sometimes he would steal their garments when they were still wading in water, and hide them up on the tree whence he

would watch them. The symbolism is that the gopis are the individual souls, the cowherds are their physical bodies, and Krishna is the Supreme Soul who is beckoning them.

In Hindu theophany all the worshipped gods are representations of the divine. All representations are finite, hence never perfect. In the Hindu world there are no simple answers of yes or no to complex questions, but much maybe and in between. Answers to profound mysteries are not true or false, but why not both. Truth about the Ultimate is not a single flash but a multifaceted gem.

Krishna has become a major focal point of worship in the Hindu world. In the tradition, he is what the hero is to history: to be remembered and revered; what the library is to the scholar: a vast storehouse of knowledge; what nature is to the poet: an inspiration for song and dance; what colorful toys are for children: an instrument for mirth and merriment; what the beloved is to the lover: the instigator of intense joy.

**The Upanishads**

The Upanishads contain the central core of traditional Hinduism. Scholars say that many of these writings were composed during the period between 800 BCE and 200 CE and that there are over 150 pieces of writing that were once referred to as the Upanishads. Irrespective of whether these are profound reflective affirmations or mystical certitudes or recognitions beyond the perceptual, the writings that compose the Upanishads are certainly among the most ancient works wherein the human spirit matured from mere wonderment and piety to a more sophisticated stage. Max Müller was quite right when he said in the first volume of his *Sacred Books of the East*:

> To watch in the Sacred Books of the East the dawn of the religious consciousness of man, must always remain one of the most inspiring and hallowing sights in the whole history of the world.

In the eighth century CE, Shankaracharya listed 108 authentic Upanishads. He also wrote learned commentaries on twelve of these, which have come to be known as the *Principal Upanishads*. These twelve are read and discussed more often than the others. They bear the following names: *Aitareya, Brihadaranyaka, Chandogya, Isha, Kaivalya, Katha, Kena, Mandukya, Mundaka, Prasna, Svetasvatara, Taittiriya*.

Hindus are generally anchored to the Vedas as the fount of the religion. However, the quintessence of Hindu beliefs and doctrines are actually found more so in the Upanishads than in the Vedas. The law of karma, transmigration of the soul, the esoteric significance of *aum*, the notion that we are all sparks of the undergirding cosmic principle: all of these find full expression and explanation in the Upanishads, rather than in the Vedas.

The formats of the Upanishads range from simple prose to didactic dialogues and subtle poetry, and they cover a broad spectrum of topics. The texts embody sublime thoughts and profound reflections pertaining to human existence, its origins, and its

relation to cosmic mystery. They speak of God and the spirit, of the world and of Being, not in poetic and pictorial ways nor as problems or puzzles, but as revelations of the Infinite.

Most importantly, the Upanishads tell us that we are more than the gross matter that constitutes our physical body. Though we are subject to the limitations of space and time and restricted by the constraints of causality, yet, say the Upanishads, there is something in us that transcends all of this. They remind us in no uncertain terms of our links to the eternal. To ignore our cosmic connection would be as pathetic as the plight of the vagabond who roams the roads in poverty and disease when, in fact, he is a billionaire's son.

Such ideas are expressed in different ways in several contexts. Perhaps the most potent of all is the terse aphorism in the Chándogya (VI.8.7) where, as I noted earlier, we come upon the great saying, *tat tvam asi*: "that thou art." This phrase means that each one of us is no other than a part of the grand cosmic consciousness. This is perhaps the most lofty appraisal of the human condition in the history of thought. It recognizes our finitude, but paints our fleeting existence on a cosmic canvas. This is not picturesque mythology nor a promise of heaven or threat of hell. Rather, it is a magnificent vision that raises human consciousness to a sublime level. When this great saying (*mahávákya*) is fully assimilated, every human being is recognized as a spark from the same Divine. As Ramakrishna Puligandla put it, "the Upanishadic seers first realized the profound truth (of the identity of the infinite, but material Brahman and the finite, but spiritual Âtman) through their own—direct, existential, and hence authentic—non-dual mystical experience, transcending the senses and the intellect."

Another formulation of this fundamental insight about human existence is *aham brahmásmi*: I am Brahman, which occurs in the Brhadáranyaka Upanishad. This strikes me as a cosmic vision of Martin Buber's *Ich und Du* (I and You) where the *Du* refers to Brahman, for it says *Ich bin Du* (I am Thou).

Many people know how to say or quote this great truth. However, most of us have difficulty internalizing it, if only because that is not easy to do. To repeat a great saying, however often and however fervently, is not the same as living up to it. When we truly regard fellow members of the human race in this light, we are transported to a higher level of perception. From there, how can we classify people on the basis of caste and creed, as *dvijas* and dalits, as Christians, Jews, Hindus, Muslims, and Buddhists?

In the nineteenth century, Arthur Schopenhauer, who understood the philosophical depth of Upanishadic thinkers on the intellectual plane, exclaimed famously in the preface to one of his major works:

> Oh, how thoroughly is the mind here washed clean of all early engrafted Jewish superstitions, and of all philosophy that cringes before those superstitions! In the whole world there is no study, except that of the originals, so beneficial and so elevating as that of the Oupnekhat. It has been the solace of my life, it will be the solace of my death!

However, as pointed out by Bertrand Russell in A History of Western Philosophy, Schopenhauer, this great admirer of Upanishadic wisdom "habitually dined well at a restaurant; he had many trivial love-affairs, which were sensual but not passionate; he was exceedingly quarrelsome and unusually avaricious . . ."

In a peculiar way, Schopenhauer represented what so many of us do, whether Hindus or Christians, Muslims, Buddhists, or whatever. We are profuse in singing the glories of our religion and heritage, in paying homage to our prophets and sage-poets, and announcing to the world what great wisdom lies in the philosophy and spirituality of our culture. When it comes to practice, however, we go about our chores and challenges with a business-as-usual mind-set, small and self-centered in our different ways, deeply prejudiced to the core, and all too often susceptible to anger and pettiness. Reading the grand ideas and listening to the eloquent sermonizers can sometimes delude us into believing that we are ourselves as evolved as the thoughts we entertain in our minds. It is difficult to reconcile the divide between practice and proclamation; it is poor consolation that this dichotomy is not peculiar to Hindus.

**Prayer for Light and Nature of Perfection**

People who grow up in the Hindu tradition hear many sacred stanzas: the *shlokas* and *mantras* of the tradition. Once these were uttered only by the initiated at appropriate times and occasions. Today, though there are still controversies about privileges as regards the sacred thread, practically any Hindu may learn and recite the canonical prayers. This is thanks in large part to the voice recording and reproducing devices of modern technology. However, not all may be familiar with the sources of the prayers, which have acquired considerable sanctity over time. Consider, for example, the following:

> *asatomá sad gamaya; tamasomá jyotir gamaya; mrityormá amritam gamaya.*
>
> From the unreal, lead me to the real; from darkness, lead me to light; from death, lead me to non-death.

This is a magnificent expression of the human spirit recognizing its state of ignorance and finitude and longing for knowledge and ultimacy. Few Hindus who have grown up in the tradition have not heard this inspiring invocation. This prayer is from the Yajus verses in the *Brihadáranyaka Upanishad*, which is regarded as the oldest of all extant Upanishads. The lines are in fact from the last part of the *Shatapatha Bráhmana*. It is prescribed that while the priest is reciting mantras during a sacrifice, one who is performing the sacrifice should be chanting this. In our own times, this has become one of the most widely chanted *shlokas* in the Hindu world, recited by one and all in temples and sometimes prior to dinner in homes.

In this Upanishad it is explained that unreal and darkness mean death; real and light mean immortality. The prayer is to seek release from death and attain immortality. I prefer to interpret *asad,* or the unreal, as an illusory understanding of the true nature of reality—what happens when the ephemeral is taken for the eternal and the perishable for the never-decaying. The prayer is to enable us to understand the deeper aspects of this passing world of experience, for in that recognition we become wiser and more balanced in our perspectives. We are reminded of Tennyson's line here: "The prayer was 'Light—more Light—while Time shall last;'" and also the line in Luke which says: "To give light to them that sit in darkness." However, I take *tamas* or darkness to mean ignorance, not just of the nature of physical reality but of moral rightness as well. The light that one seeks here is not physical light to see things, but enlightenment: a vision of life and society that respects others, that is caring and compassionate, that is guided by reason and understanding, not by unthinking adherence to outworn practices, but by a recognition of deeper truths. Finally, the plea to be taken from death to immortality means asking to be released from the cycle of birth and death so that one may merge with the Cosmic Whole.

The wisdom of sacred texts is not in their literal meanings, but in the commentaries of keen thinkers and in the meaningful interpretations that are relevant in this day and age. Here is where tensions arise between traditional theology and evolving worldviews. In most dynamic cultures, both of these forces are at work. What is interesting in the Hindu world is that many sacred verses have an intrinsic spiritual appeal that gives fulfillment to the faithful even when one does not fully understand the message they convey.

Another oft-repeated Upanishadic prayer is:

> *púrnam adah púrNam idam, púrnát púrnam udatcyate*
> *púrnasya púrnam ádáya, púrnam eva vashishyate*
>
> Complete is that; Complete is this. Out of the Complete, the Complete emerges. From the Complete, (when) the Complete is taken, The Complete still remains.

Recall that I mentioned this in the context of ancient Hindu mathematical insights. Priests recite this on auspicious occasions, and worshipers recite it collectively after the *árati* in temples. These lines form the opening reflection of Ísá Upanishad, also known as Ísávásya Upanishad. This prayer also occurs in Brihadáranyaka Upanishad.

The shloka sounds like the exclamation of one who has had a mystical experience, a person who has recognized perfection (*púrnam*) everywhere. In that experience, the mystic sees the entire cosmos as a manifestation of Fullness, Completeness, Perfection. Though this vast universe has emerged from the boundless Supreme, the latter remains unaffected by it.

**Resolution, Invocation, and Prayer**

Most Upanishads are offshoots of Vedic literature and are linked to the Áranyakas and the Bráhmanas. Thus for example, the invocatory prayer in the Taittiríya Upanishad pays homage to the Vedic deities Mitra, Varuna, Áryamán, Indra, Brihaspati, Vishnu, and Brahmá. It declares Váyu (Pneuma, Air) to be the perceptible Brahman, recognizing that air is the most fundamental element for the sustenance of life. The invocation has the format of a determination, a resolution:

*ritam vadishyámi; satyam vadishyámi;*
*tan mám avatu; tad vaktáram avatu;*
*avatu mám, avatu vaktáram . . .*

I will speak about what is right; I will speak the truth.
May that protect me! May that protect the speaker!
Let that protect me! Let that protect the speaker! . . .

We note here the insight that ultimately what matters in life are right conduct and truthfulness. Our highest ideals should be adherence to ethical principles and to truth. This will keep us safe and sound in life, no matter what. In history, there are forward and backward steps on two planes: the conduct plane and the knowledge plane. Positive steps along the conduct plane is what enlightenment is all about—right action, whether by individuals or by societies or by nations. Positive steps on the knowledge plane lead us to coherent and rational understandings of the world. We acquire this knowledge from dispassionate inquiry, and knowledge thus acquired about the physical world is what we call science. Its pursuit can be tainted by emotional factors and ancient misconceptions. When one rids oneself of such constraining factors, the resulting apprehension of truth would be clear and mind-freeing.

Uttering this prayer daily is a method of reminding ourselves of these values on a regular basis. This can help even those who do not attach much importance to routine rituals, to visiting temples, or fasting on appropriate days. We are reminded of something that John Locke wrote in a letter: "To love truth for truth's sake is the principal part of human perfection in this world, and the seed-plot of all other virtues."

Consider another *shloka* that too is a widely used invocation:

s*a ha náv avatu—saha nau bhunaktu*
*saha víryam karavávahai*
*tejasvi náv adhítam astu*
*má vidvishávahai*

May He protect us! May He be pleased with us!
May we labor together with vigor!

May our studies bring us enlightenment!
May there be no discord among us!

This is a prayer that a master and pupil are supposed to offer together so that the *us* stands for both of them. However, it is usually chanted by groups. Taken literally, one would not recite it when one is alone in a worship mode.

This invocation starts with the customary appeal for security, which is a motivation for most prayers, but it quickly expresses the wish that the Divine be pleased with us. This is a poetic way of saying that we need to act responsibly, righteously, and in compassionate ways. Ethical principles are to be defined, not by what we think, but by universal standards. This is implied by the statement that the Divine must be pleased by our actions. The prayer reminds us of the work we must do. The idea of working together reflects a sense of community, of working for the common good. Furthermore, the prayer distinguishes between the acquisition of knowledge and the wisdom that must accompany it. All the knowledge in the world will be useless if it is not nourished by enlightenment. Finally, the prayer seeks peace and harmony in the world.

**Levels of Consciousness and Aum**

The Mándúkya Upanishad relates the cosmic sound of *aum* with the states of consciousness. Phonetically the sound *aum* may be analyzed into three constituent sounds: A-U-M. Vaishvánara or the waking state corresponds to the *A* sound; *taijasa* or the dream state to the *U* sound, and *prájña* or deep sleep to the *M* sound. And the sacred syllable, taken as a whole, represents the fourth state of *turiya*. It stands for ultimate realization, for supreme spiritual knowledge, for the transcendental experience of cosmic consciousness.(I.9-12). This is why *aum* is invoked on all spiritually significant occasions in the tradition.

Aum is the most universally recognizable sound associated with Indic traditions: a prolonged sonorous invocation that is as much Buddhist as it is Hindu. Its representation as a written symbol resembling the number three with a curly appendage, a crescent, and a dot is as much a signature of Hinduism as the Star of David is for Judaism or the Cross for Christianity. No one knows the origin of this ancient sacred Vedic sound that has been reverberating in the Hindu world for ages.

The Upanishads speak about this mystical invocation. The Chándogya Upanishad begins by saying that we should meditate on *aum* (I.1-10). It also says that this is a syllable of assent, of agreement. It may be noted that in ancient Tamil, one used to agree to things by repeating aum twice: *aum-aum*, which later become *ámám* (the word for "yes" in modern Tamil). In the same Upanishad we read that this sound emerged from Prajápati, the progenitor of humankind. "As the leaves are all held together by the stalk," it says, "in the same way all spoken words are held together by *aum*."

Other Upanishads also speak about *aum*. The Taittiríya Upanishad says that *aum* is Brahman (I.8.1). The Shetáshvatara Upanishad says that using the body to chant *aum*

is like using a stick to rub against a surface to generate fire, in this case, the fire of the Divine (I.14).

Finally, the Mándúkya Upanishad also says that all the past, the present, and the future are enshrined in *aum* (I.1). In other words, *aum* is a capsule-sound of what was, is, and will be—a transformation, as it were, of temporal eternity into an audible vibration. As much as for their spiritual loftiness, it is in such poetic, profound, and provocative conceptual sweeps that Upanishadic insights become most interesting.

**Dialogue on a Grand Mystery**

As we live through life we learn many things, and our knowledge is steadily increasing. But there are matters about which we know absolutely nothing. There are questions that stand out impressively as questions, but with no definite answers. One such question pertains to death. It is a grand mystery hanging as a backdrop in life. There is a famous passage in the Kathopanishad where this mystery is presented as a story (I.1). Vajashrava performs a sacrifice, offering all his possessions to the gods. His son Nachiketas asks the father, "To whom will you offer me?" Vajashrava is upset and says he would offer the son to the God of Death. Whereupon Nachiketas goes to the abode of Yamá (God of Death), waits there for three days, and confronts the Death God. Realizing that the young brahmin had been waiting for three days, Yamá promises him three boons to compensate.

Nachiketas wants his father not to be so ill-disposed toward him, and he wishes to return home. This is granted. Then he seeks the secret of the altar of a particular fire sacrifice that leads men directly to heaven. This too is revealed to him. Finally, for his third boon, Nachiketas asks: "According to some, a person continues to exist after death, but others do not believe this. I wish to know what happens to a person when he dies."

To this, Yamá says: "Ask for cattle and horses, for elephants and gold. Ask for progeny that will live a hundred years. Ask for lands and possessions, kingdoms and power, beautiful damsels and perennial pleasures, but do not ask for the secret of Death." This insightful passage declares in simple terms that while there are no limits to human knowledge and achievements, we can never know what will happen to the individual after the last breath is heaved. However, the human spirit is not satisfied when boundaries are drawn on its quest. Nachiketas does not accept Yamá's answer, and he persists, refusing to take any other boon. The implication is that ultimate knowledge about the hereafter is of such significance that it is preferable to every conceivable possession or experience.

Finally, instead of answering the question directly, Yamá explains to Nachiketas that our actions could be for achieving one of two things: fleeting satisfaction or what is intrinsically good. Work for attaining passing pleasures, and you will get nowhere. Work toward the greater good, and you are on the right track to immortality. Yamá goes on to say that the foolish and the short-sighted imagine this world to be the only and

the total reality. They think that the world will dissolve from their field of experience when they die. This is because they do not understand the true nature of the *átman*. For this, one must have a master who has himself realized the Truth—for higher spiritual understanding cannot be attained by mere reading and reasoning.

In order to fully grasp the significance of the truths implicit in the sacred texts, one needs an enlightened master: a guru. This is a crucial idea in the tradition. It is through a guru that occult meanings become clear to the seeker. Those who read and study on their own can learn much in many fields, but not in the spiritual. Here, intellectual knowledge is inadequate and may even be unsatisfying.

For example, the non-spiritual reader may find this story to be interesting, but not quite revelatory about the mystery of death itself. However, a guru might explain that the episode does give an answer to the question: Nachiketas's return to his father symbolically refers to reincarnation, for rebirth is essentially a return to where we came from before reaching the realm of the dead. The reference in the story to the sacrificial fire that enables one to go directly to heaven is meant to show that by leading a proper life, one obtains liberation. In other words, both rebirth and *moksha* are possible for one who dies.

Yamá also explains to Nachiketas the importance of the mystical mantra *aum,* the apprehension of which reveals the nature of Brahman. He states that the átman is smaller than the smallest imaginable unit and grander than all of physical space. Yamá compares the physical body to a chariot, our reasoning to the charioteer, and the mind to the reins. The senses are the horses that take the charioteer here and there. As the good charioteer controls the horses with the reins, and does not let them drag him where they will, our reasoning mind should control our senses and not let us go astray. Nachiketas learns many spiritual truths from Yamá and becomes immortal, having attained the knowledge of Brahman. We may note in passing that the mind-chariot imagery is to be seen in many contexts in Indic reflections, but also elsewhere. We read it in Plato's Phaedrus where Reason is the charioteer reining in two winged horses, one white and one black.

Though Nachiketas is a student in this exchange, in the Upanishadic tradition he is regarded as a teacher of esoteric wisdom. Shankaracharya called him an *acharya* of *brahmavidya*, comparing him to a bridge that helps us cross the waters of samsára. This is because of his earnestness, sincerity, and determination in the quest for higher truths. One normally considers these as characteristics of a student. We are reminded that they should be of a teacher no less.

**Empiricism in the Upanishads**

The route to ideas, knowledge, and convictions about the world is through three paths: revelation, speculation, and observation. Traditional religious scriptures offer us revealed knowledge. Thus the truths proclaimed in the Vedas, the Bible, and the Qur'an are taken as truths by the adherents of the respective religions. Faith is fundamental in

the acceptance of revealed knowledge. Philosophers engage in insightful speculations, which are in turn discussed and debated by other analytical thinkers. Such are the legacies of Plato and Kant, Shankara and Ramanuja, for example (although some Hindus would claim that unlike Plato and Kant and other non-Hindu thinkers, the insights of Shankara and Ramanuja are no less spiritual revelations). Intuition plays a role in the elaboration of speculative knowledge. Finally, we have modern scientific methodology in which empiricism is fundamental. Here nothing is accepted as valid unless it is supported by extensive observation, experimentation, and verification. This is the hallmark of science.

In the Western tradition, Aristotle insisted that everything we know about the world comes from what we observe. However, it was not until the seventeenth century that this came to be adopted in a systematic way as a criterion in the acquisition of knowledge about the world. Thus in modern science, observation and verification are crucial, though these are not the only modes of grasping valid knowledge. Intuition and insight also play important roles.

It was long believed that Indian thinkers, like their counterparts in other cultures, relied primarily on revelation and speculation in forming their worldviews. To a large extent, this is at least the impression one gets from reading many ancient Hindu writings and their interpretations by most Hindu scholars. However, there is a passage in the Chándogya Upanishad (VI.7), dating back to the sixth century BCE or earlier, which talks about a sage who understood very well the significance of empirical knowledge.

This Upanishad speaks about ritual chants and the primordial significance of the sun, of breath and food, of the genesis of Vedic hymns, and much more. In the midst of all this, we encounter a personage by the name of Uddálaka Áruni. His son Shvetaketu returns home after twelve years of intense study under a guru. The youth now displays the conceit of a fresh graduate who thinks he has learned everything. The father detects this and tells him that with all his guru-given knowledge, Shvetaketu had not learned about the essence of perceived reality. I interpret this part of the story to mean that the traditional wisdom one learns from gurus is often only superficial knowledge, which the one lacking in depth of understanding repeats parrotlike. (There is too much of this in religious contexts.)

Uddálaka then attempts to teach his son about the ultimate. He explains that beyond the bowl's form, the clay is its essence. Beyond the golden jewelry, there is gold in its essence. Beyond rain and grain there is water, which is the essence. From the minutest of seed arises the mammoth tree. Recognizing the hidden truth behind appearances is true enlightenment. Uddálaka asks his son to sprinkle salt in some water. The next day the son returns, and he can see no salt in the water, but he is able to taste it. We cannot see or touch the salt in the water, but we can experience it. So it is with Brahman, explains the father.

Then Uddálaka tells Shvetaketu that a person is made up of sixteen entities. He asks him not to eat solid food for fifteen days. His breath, which consists of water,

will not be affected, he says. The son does just that and returns, only to discover that he cannot recall any of the Vedic chants he had learnt. Then the sage asks the young man to eat for fifteen days and return. The son obeys, and now he is able to recall the chants. The father explains:

> Just as, in a huge lighted fire, if a single ember small as a firefly is left, and it can be made to blaze by enclosing it in a heap of straw, the little fire that was left in you, when covered with food, blazed again. So you remember the Vedas now. The mind consists of food, the breath consists of water, and speech of heat.

Uddálaka Áruni proved to his son what he had stated. This episode is extremely important for its unusual empirical methodology. In no contemporary writing elsewhere does one find such a dramatic illustration of the observational verification of a theory. Because the episode is buried in a mountain of metaphysical musings in a work that is regarded as of primarily spiritual significance, its scientific relevance had escaped detection until a few decades ago.

It was European scholars like J. D. Bernal, Herman Jacobi, and Walter Ruben who drew attention to the materialistic, naturalistic, scientific spirit that is hidden among the heaps of spiritualism that has dominated Upanishadic discourses for ages. More importantly, their analysis gives an entire new twist to the history of science. During the nineteenth and twentieth centuries, it had been generally believed that Thales of Miletus (624-546 BCE) was the first ancient philosopher to put forth naturalistic explanations. Debiprasad Chattopadhyaya, a twentieth century scholar and historian of Indic science, drew attention to the scientific import of passages from the Upanishads which had been too long understood to be no more than articulations of the mystic quest. In this matter, thinkers like Shankara and Ramanuja reinforced the quest for the supernatural and moksha as primary to human existence, which was not helpful for the sprouting of naturalistic science in the culture. Chattopadhyaya argued that the exchange between father and son in the Chandogya Upanishad entitles Uddálaka, rather than Thales of Miletus, to be reckoned as the first scientific thinker in history. Uddálaka Áruni, he said, "did in fact boldly knock at the gates of natural science to be opened," for which effort he deserves to be called "the first rational natural scientist in the history of the Indian subcontinent, if not in global history."

**How Many Gods?**

One reads in the Puranas and in the Mahabharata that there are eight Vasus: Prithví (Earth), Agni (Fire), Antariksha (Intermediary Space), Váyu (Air, Life Breath), Dyaus (Sky), Súrya (Sun), Nakshatra (Stars), Soma (Moon); eleven Rudras; twelve Ádityas, Indra (Thunderbolt), and Prajápati (Lord of Progeny). They add up to thirty-three.

Each of these is regarded as a manifestation of the Divine. But ultimately, they are all manifestations of the same single Divine principle.

This view is elaborated in the Brihadáranyaka Upanishad in the following conversation between the sage Viddagdha Shakalya (VS) and Yájñavalkya (Y) (III.9.1-26).

VS: *kati deváh*, Yájñavalkya? (How many gods are there, Y)?
Y: As many as are mentioned in the invocatory hymns of the scriptures, which is three hundred and three, and three thousand and three (*trayas ca trí ca shatá, trayas ca trí ca sahasreti*).
VS: Yes, but how many Gods are really there, Y?
Y: Thirty-three
VS: Yes, but how many Gods are really there, Y?
Y: Six.
VS: Yes, but how many Gods are really there, Y?
Y: Three.
VS: Yes, but how many Gods are really there, Y?
Y: Two.
VS: Yes, but how many Gods are really there, Y?
Y: One and a half.
VS: Yes, but how many Gods are really there, Y?
Y: One (*eka iti*.)
VS: Yes, but which are those three hundred and three and three thousand and three (which you mentioned earlier)?

At this point Yájñavalkya goes on to say that those are all manifestations of the thirty-three primary gods of the Vedic framework, and then he explains who are the Rudras, the Ádityas, etc.

What is perhaps most interesting in this dialogue is that when Yájñavalkya comes up with large numbers in answer to Shakalya's question; though the answer is based on Vedic statements, the latter does not to take him seriously. This suggests that it is not always wise to take what we read in the scriptures literally. The persistent questioning by Shakalya means that one needs to probe more deeply in order to fully understand the core meaning of a sacred text.

The final answer that there is but one God is as true as the initial one that there are more than three thousand gods because the one God is manifest in countless different forms—in air and water, on earth and sky, in the sun and moon and stars—with countless different names. This is also a way of saying that God is omnipresent, that is, the Divine is implicit in every aspect of the perceived universe. This vision of a unity behind the multiplicity is at the core of the Hindu vision of the Divine. God, in the Hindu framework, is too grand and magnificent to be declared as One and just left at that. To say that the Divine has only one Prophet is even more restrictive of the capacity of the

Divine for self-expression. If anything, manifestations of God, whether as minute atoms or as mammoth stars, as mindless animals or as thinking humans, as poets or prophets, have to be vast in numbers, because God is also omnimorphic (has all forms).

Thus it is quite true to say that in the Hindu framework, there are millions of gods. It is equally true to say that there is only one God. The Divine is like music. There is but one music, but it finds countless expressions. It is through a particular song or sonata that we experience music. So it is that we get a glimpse of God through every form or name. A corollary of this vision, intrinsic to the Hindu religious approach as nowhere else, is expressed in the following Tamil verse, translated by Charles Grover (*The Folksongs of Southern India*):

> Into the bosom of the one great sea
> Flow streams that come from hills on every side.
> Their names are various as their springs.
> And thus in every land do men bow down
> To one great God, though known by many names.
> This mighty Being we would worship now.

**Some Greek Parallels**

Worldviews in places far apart have often overlapped. There are similarities between Norse and Roman gods, between Babylonian religion and the Judaic tradition, between Hindu deities and the Greek pantheon. It is known that there were mutual interactions and influences among ancient peoples, but questions as to who influenced whom and where an idea first arose are still matters of controversy, often colored by nationalistic pride and sensitivity. I have seldom been interested in such matters because, on final analysis, we all belong to *Homo sapiens*, trying to figure out what it is all about.

Wisdom is not the monopoly of any one people, any more than intelligence is the characteristic of any one race or caste. So just as we had our *rishsis* and *kavis*, the Greeks had their *hoi sophoí* (the wise ones) and *hoi poietaí* (the poets). Thales of Miletus was the foremost of the Seven Wise Men (*sapta rishi*) of Greece. According to Diogenes Laertius, Thales believed that "water constituted the principle of all things." This reminds us of the idea expressed in the Upanishads that water is Brahman. This is only one example of the parallels between some Upanishadic visions and those of some ancient Greek thinkers.

Anaximander spoke of an immaterial *apeiron* as the *arche* (beginning) of everything. His book, *On the Nature of Things,* begins with the statement: "That from which all things are born is also the cause of their coming to an end . . ." He imagined that in the beginning, a seed of hot and cold was separated from the boundless *apeiron*, whence emerged a huge sphere of flame around the air, like the bark of a tree. There are similar cosmologies of *agni* in the Upanishads also.

Anaximenes talked of *pneuma*: air as the ultimate substance. Pneuma refers to something more than the physical air we experience. It is the life principle and corresponds to

the *chih* of the Chinese and the *prána* of the Upanishads. It says in the Kaushítaki-Bráhmana Upanishad (II.2), *práno brahmeti*: The breathing spirit is the Creator.

Heraclitus of Ephesos saw fire at the root of all changes. This reminds us of the passage in the Brihdáranyaka Upanishad where it says that Agni is in the sun, in the rain-bearing cloud, on earth, indeed that men and women are also fire. Heraclitus also theorized that everything was characterized by the coexistence of opposite tensions normally in a state of balance. When one of the forces gets the upper hand, the balance is upset, and the break in the equilibrium causes change. This is similar to the three-guna theory in Hindu thought.

Parmenides, the greatest Eleatic philosopher, wrote famously *hen ta panta:* all things are one. This sums up the *advaitic* worldview, but then why do we observe changes? Parmenides explains this by saying that these observed changes are not real. They appear to be so because of our inability to recognize the unchanging principle beneath it all. For him, the universe was a large, unchanging, unmoving body that remains the same forever and forever. The changing universe is an illusion in the minds of those who have not realized the Ultimate Reality. This Ultimate Reality is again not unlike the Upanishadic *Brahman*. The Shvetáshvatara Upanishad also reminds us that the phenomenal world of change (*prakriti*) is an illusion (*máyá*) (IV.10).

Empedocles of Acragas was a physician, philosopher, poet, and physical theorist. He believed that he had been a bird and a fish, even a shrub, in previous incarnations. He was not the only Greek thinker to subscribe to reincarnation. According to one interpretation of his writings, he propounded the notion that the world passes through four successive stages that repeat themselves. In the first stage, love reigns supreme. All the elements were fused together. In the second stage, strife gradually enters the scene and begins its disruption. In the third stage, strife takes over completely, and the elements are separated out. In the fourth and final stage, love reenters: little by little, the elements come back together. This was his idea of the *cosmic cycle*. Parallels with the Hindu concept of the *yugas* are inescapable. One can go on and on.

Clearly, the visions of the Upanishadic seers were shared by others. Many scholars suspect that the Greeks got it all from the Hindus, others that it was the other way round. This divergence of views will never be settled, except within particular traditions. The urge to see unity behind multiplicity, commonality beneath diversity, is an ancient urge that inspires the human spirit in its quest for meaning in existence and purpose in life. The sages and seers of the ancient world, like scientists in our own times, knew no boundaries of nation or religion. They expressed in the language of their times the deepest insights they came upon whether through reflection, intuition, meditation, or hearsay. Ideas must certainly have seeped from region to region, culture to culture, and undergone local variations. It is therefore not at all surprising that we find parallels between Upanishadic visions and the writings of Greek philosophers.

**The Spiritual Content of the Upanishads**

Everything I have said above is based on my own partial vision of sacred texts that have deeper esoteric significance. Spiritually evolved souls have repeatedly told us that the inner meanings of these and other sacred works of the tradition cannot be fully grasped through analytical means. Those who have gone into greater depths from spiritual perspectives have considered the truths differently. For example, Sri Aurobindo characterized the Upanishads as "the treasure-house of the deepest eternal Knowledge without beginning or end which is the root and foundation of the eternal dharma." He wrote that in the Upanishads:

> We find the same knowledge in the Suktas of the four Vedas but covered over with metaphors which give an exoteric meaning to the hymns like that of the descriptive image of the ideal man. The Upanishads unveil for us the supreme Knowledge, the naked limbs of the real man. The poets of the Rig Veda, the Rishis, expressed spiritual knowledge in divinely inspired words and rhythms; the Rishis of the Upanishads had direct vision of the true form of that Knowledge and expressed it in a few profound words.

Sri Aurobindo also affirmed that aside from the doctrine of Monism:

> All the philosophical thoughts and doctrines that have come into being in Europe and Asia—Rationalism, Realism, Nihilism, the Darwinian theory of evolution, the Positivism of Comte, the philosophy of Hegel, Kant, Spinoza and Schopenhauer, Utilitarianism, Hedonism, all were seen and expressed by the Rishis endowed with the *direct vision*. But what has been elsewhere partially glimpsed, proclaimed as the integral truth—in spite of its being only a fragment of the Truth—and given a distorted description with a mixture of truth and falsehood, has been recorded in its fullness and right perspective, in a pure and unmistakable manner.

However, not everyone can attain the level of comprehension that arises from deep spiritual experience. Fortunately, these great thoughts and insights of the tradition can also be approached from other less spiritually profound perspectives, and they too add to our personal enrichment—even if mere scholarly exegesis might seem too shallow an approach for the spiritually elevated few.

## VIII. Mythic Inklings of Future Science

> Yes, our ancestors imagined all such bizzare and interesting things but alas the apropriate technology was not available at contemporary times and we are still awaiting to see many of the predictions made by our scripture writers to see the light of the day.
>
> —Arvind Mishra

### Introduction

India has a rich mythological tradition; and the myths of India, as of the rest of the world, have messages that go beyond their story content. Besides being often inspirational, these stories are relevant to the human condition. They also have what may strike modern readers as a fantasy dimension: grand elephants and strange creatures, saintly and wicked beings with supernatural powers, celestial demons swallowing the sun and the moon. These tropes are fascinating in themselves, but they often contain esoteric knowledge of no less than the nature of existence. There is, therefore, a vast body of hermeneutical scholarship on the epics and the purana of the Hindu world.

In modern terminology, one refers to the myths of a people as their sacred history. It is appropriate to be respectful to classical writings that have acquired sanctity in any religious tradition. Whether it is Moses encountering God and receiving the Commandments, the virgin birth of Christ, or the Prophet's receiving revelations from an Archangel, these have become parts of the sacred history of peoples. However, what one religious group regards as sacred history often impresses those not of the tradition as mythology.

Irrespective of what term we use and what personal opinions one may have, I will be concerned here with the anecdotes as such and not with whether they actually occurred or are only legends. There is, as of now, no archeological evidence for the claims of reality for what strike many as essentially breakthroughs in human imagination. Some contend that absence of evidence is not proof of nonexistence. But neither is claim of existence proof thereof. It is simply a fact of modern times, incredible as it may seem to outsiders, that there are a great many people in all religious traditions who have no difficulty in subscribing to the reality of personages and anecdotes in one's sacred history.

Be that as it may, what is interesting is that some descriptions and details in Hindu sacred history which seemed incredibly outlandish, fantastic, and physically impossible as recently as a century and odd ago are no longer so. In our own times some of the things mentioned in the tales and tidbits of the distant past have been actualized one way or another.

Some of the stories we read look like the records of an extraordinarily advanced age that has been lost forever beyond any trace of survival. This is the basis on which one may argue that ancient Indian civilization was technologically far more sophisticated than conventional archeology and historical paradigms will have us believe. On the other hand, the ancient stories may also be regarded as no different from the writings of science-fiction writers of our own times. After all, the imaginative flights of creative writers can take us to undreamt of realms of reality. Icarus constructed wings and tried to fly to the sun, Prometheus outwitted the gods and made them eat bones instead of meat, and King Midas turned everything into gold by a mere touch. We do not regard these are historical facts, and given that there is no longer an ancient Greek religion, these are not even sacred history. In the nineteenth century, Jules Verne wrote about journeys to the center of the earth, to the bottom of the sea, and even to the moon. These can hardly be taken as proofs that such voyages actually took place.

In any event, whether the stories and statements we find in the Ramayana, the Mahabharata, and various puranas tell us about the material achievements of ancient Hindu technology or they reflect the rich imagination of ancient writers will always be debated, depending on one's criteria for truth claims and on whether one regards the ancient writings as literature or history. What is undeniable is that many of the most incredible narratives in some ancient Hindu writings have uncanny resemblances to what modern science has been able to achieve. Some of the situations mentioned there are remarkably prescient; even myths are all that they actually are.

### The Churning of the Ocean (*Samudramanthanam*)

One of the major episodes in Hindu sacred history is known as *Samudramanthanam,* which is translated as the *Churning of the Ocean*.[1] In this story of grand proportions, the good and the evil forces of the universe—*devas* and *asuras*, as they are called—exert their combined efforts to churn the entire cosmic ocean. The ocean is said to have been filled with milk, and both parties were all too eager to extract from it the elixir of immortality (*amrita*) for themselves. The spindle for this collaborative effort was a mammoth mountain called Mandhara. A serpent of global dimensions served as the churning rope. Initially, a terrible poison oozed out in large quantities. Upon pleas from one of the deities, the supreme Lord Shiva willingly gulped down this poison,

[1] There is a magnificent sculpture of Samudramanthanam at the Suvarnabhumi airport in Bangkok, Thailand.

causing a bluish tinge on his throat. This is why the Lord Shiva is pictured in iconic images with a blue neck.

A whole range of wonderful entities emerged from the Churning. They included precious gems, the moon, a divine conch and bow, a magical elephant, a seven-headed horse called Ucchaishravas, and the blessed cow Kamadhenu, which was a cornucopia. Certain divine personages also emerged from this primordial mix. They included Varuna, the goddess of inebriating liquor; Dhanvantari, the father of all medicine; and Lakshmi, the goddess of abundance. Finally, there was also amrita, the ambrosia of Hindu lore, for which the project had been initiated.

The story is fascinating in itself, but like most sacred stories it carries deeper meanings. The forces of good and evil in the universe point to our own human capacities for good and evil. The ocean of milk symbolizes our own minds. The mountain Mandhara represents concentration. The churning rope is the process that enables concentration. Lord Shiva represents asceticism at its highest. The poison refers to the pain associated with intense penitential spiritual disciplines, which only the ascetic can withstand. The bounties that emerged from the churning refer to the untold benefits that can accrue from the spiritual pursuit. Lakshmi and amrita represent all that one can wish for. That the devas and the asuras were both exerting effort to achieve the bounties shows that both the good and evil sides in us strive for power. Thus one may peer beneath the mythic story to uncover truths about the psychological forces at work in the human mind.

The episode may also be viewed as pointing to a number of other truths about human existence. For instance, the task of churning the ocean was accomplished by the cooperation of the good and evil forces. In every major human endeavor, both good and bad elements are involved. In the story, the ocean is the source of enormous bounty; as in our natural world, it is source of wealth and nourishment and even the origin of life itself. As to the moon coming from the sea, I recall that in the last quarter of the nineteenth-century George Howard Darwin, son of the famous biologist Charles Darwin, put forth the theory that the moon was pulled off of the earth by the sun's gravity. Osmond Fisher went on to suggest that the void left by this splinter was filled with water and became the Pacific Ocean. It may be mentioned in passing that in the village of Besakih on the island of Bali in Indonesia, these is an eleventh century temple consecrating this event. This is just one instance of how Indic sacred history spread to South East Asia in classical times, just as Indic philosophical thought spread to Europe from the eighteenth century on.

**Weapons**

In our more idealistic moments we laud and proclaim peace. We also sometimes think that ours is an age of conflict and warfare, while previous eras were relatively peaceful. It is a fact of human history, however, that battles and violence have been present at all times and in all regions. An important feature of most ancient epics is that they all mention raging wars. After all, a central theme in practically all religions is that

there exists a perennial tug of war between the forces of good and evil. It is therefore not surprising that all through the ages, every dynamic civilization has sought to perfect its arsenal for warfare. Consequently, we find that in many ancient Indian works, there are references to conflicts and battles as well as descriptions of some fantastic weaponry. There were theories of warfare. Wars were classified as *dharma-yuddha* (righteous war) in which one fought for a principle and *kúta-yuddha* (false pretense war) where the goal was sheer conquest and self-aggrandisement.

As to weaponry, the Ramayana tells us that the sage Vishvamitra presented to the hero Rama weapons that came in various forms and shapes: Some were like a thunderbolt, long and slender, and shone blindingly bright; another was shaped like a noose; and one had the form of a horse's head. One weapon was meant for the release of pure heat. Still another was a simple sword. There are also references to weapons with which one could stupefy an enemy, put him to sleep, or humiliate him, cause him to be infatuated, and so on. This last category may represent an ancient mode of psychological warfare, not through pamphlets and propaganda but by direct intrusion into the mind of the enemy, and sounds very futuristic. Some interpreters have been tempted to regard some of the ancient weapons as actual missiles and lasers.

Or again, consider the following stanza (my translation from the original Tamil):

> Devices that a hundred slew,
> Threw people down and beat them too,
> Demons one with eyes could follow,
> Elephants, snakes that could humans swallow.
> Death-like vultures causing pains,
> Man-made tigers, lances, chains.
> Bows and arrows auto-released,
> Machine-horses, swords that never ceased,
> Stone-hurling gadgets, so it's said,
> And statues spitting flames in red,
> Hot balls of iron, storks and owls,
> Head-crushing rays, molten metals from bowls . . .

These lines (verses 101-104) are from what is regarded as the oldest (extant) Tamil epic. It is known as *Cheevaka-chintámani*. This work is the first of the five major epics of the Tamil world. The story was written in poetic format by a Jain monk. The theme is anything but what we would expect a monk to be meditating on, for it is a narrative of the naughty deeds of a married prince by the name of Cheevakan. The adventurous youth was in effect what sixteenth- and seventeenth-century Western literature celebrated as the women-chasing Don Juan. Cheevakan seduces women with great facility. The author paints the amorous exploits of the hero in picturesque poetry. One critic went so far as to say that this is perhaps the only book in all of Tamil literature that deserves to be banned. In the end, of course, Cheevakan renounces the world of pleasure in favor of loftier

goals. St. Augustine is said to have prayed: "God, give me chastity, but not yet." It is fair to say that this prayer was answered for the hero of *Cheevaka-chintámani.*

Literary critics have not thought much of this work mainly because it lacks an interesting plot and is weak in character development. Yet the book seems to have been popular in its time. Even in those days and even within the framework of Indic culture, a story with lots of sex had great appeal. In fact, there is a story to the effect that the Chola king was so fascinated by this Jaina epic, that there was the danger of his turning Jain himself.

In any event, what is impressive in the passage above is the science-fictional nature of the weapons described. How the author's imagination drew pictures of machines of mass murder—human-gobbling elephants, automatically firing missiles, vats of molten metals, and such—is a reflection of the creative genius of poetic minds, rather than, as some would be tempted to claim, proof of high-grade weapons technology in those times.

Normal thinkers engage in ideas and weave intricate images. In the Indian context, it is impressive that poets could go into detailed descriptions of specialized weaponry. It is difficult to resist the conclusion that many lethal arms must have been fairly common in those times. The inventive genius of the people had been amply applied in the field of warfare also.

The science of weaponry was known in the classical Hindu world as *dhanurveda*. There were also theoretical analyses of the nature and variety of weapons. For example, the *Agnipurna* lists five categories of weapons:

(a) *yantramukta*: these were weapons hurled by instruments;
(b) *páimukta*: these were manually hurled instruments;
(c) *muktasandhárita*: were weapons thrown and brought back; a kind of boomerang;
(d) *amukta:* were weapons that are not thrown at all;
(e) *báhuyuddha*: referred to bodily weapons: arms, legs, teeth, and so on.

Such references clearly indicate that many matters besides self-realization and spiritual liberation interested Indian poets and thinkers.

**Flying Machines**

There are references to flying machines in Indic lore. In the Ramayana, one speaks of a flowered aerial vehicle: *Pushpaka Vimána*, which belonged to Kubera. We are told how it came to the service of the hero Rama, who rode in it throughout the length and breadth of the country to see if everything was right. We also read that as he flew in this aircraft adorned with gold, he saw the gods in other similar vehicles. According to one version of the epic:

> The Pushpaka Car, that resembles the sun and belongs to my brother, was brought to Sri Lanka by the powerful Ravana; that aerial and excellent car, going everywhere at will, is ready for thee. That car, resembling a bright cloud in the sky, is in the city. "Speedily bring the aerial car for me," ordered Rama. Thereupon the car promptly arrived, adorned with gold, having fine upper rooms, banners, and bejeweled windows, and giving forth a melodious sound, having huge apartments and excellent seats. Beholding the car coming by force of will Rama attained to an excess of astonishment. And the king got in, and the excellent car, at the command of Rama, rose up into the higher atmosphere. And in that car, coursing at will, Rama greatly delighted.

In the Tamil epic *Cheevaka-chintámani* again, we read about a king who dispatches his wife in a sophisticated aerial vehicle, which is shaped and adorned like a peacock. The vehicle, carrying the wife who was with child, lands in a crematorium where the baby *Cheevaka-chintámani* is born, an epic hero in the Tamil tradition.

There is another episode in the Ramayana in which Lakshmana, the brother of the hero Rama, is wounded on a battlefield in Sri Lanka. Nothing less than an extraordinary medicinal herb called Sanjivani can bring him back to health. But the herb is on the slopes of a distant mountain (Dronagiri) in Northern India. So the all-powerful Hanuman is dispatched there to fetch it. Hanuman takes off like a gigantic plane and flies to the destination. However, not sure of exactly which herb was required, Hanuman sliced a whole hill and carried it back to Sri Lanka. On the way back, however, he is shot with an arrow by a king who imagines Hanuman to be some mischievous demon. Hanuman is wounded, lands to the ground, explains who he is, and is able to resume his flight.

What is remarkable in this episode is that very similar things happen in today's warfare. Replace Hanuman by a giant aircraft and the hill, by huge tanks and other equipment, and we are smack in the modern world. Even the arrow shot at Hanuman reminds us of the antiaircraft devices one uses in our own times.

**Test-Tube Babies**

Technically, a test-tube baby results from the fertilization of an egg and a sperm in a petri dish after which the fused entity is transferred into the womb of the mother. This biotechnological achievement became possible only in the twentieth century. Interestingly, the concept seems to have been known to thinkers in ancient India; at least a very similar idea is expressed in some ancient Indian writings. Thus there is a hymn in the Rig Veda (XVI) whose reports bear a striking resemblance to the birth of a test-tube baby.

> Consecrated for the sacrifice, propitiated by praises, they Mitra, and Varuna, poured a common effusion into the water-jar, from the midst of which

> Mana (Agastya) uprose, and from which also, they say, Vashistha was born. Pratrits, Agastya comes to you; welcome him with devoted minds, and he in the foremost station directs the reciter of the prayer, the chanter of the hymn, the grinder of the stone, and repeats (what is to be repeated).

It says, in effect, that when the Vedic gods Mitra and Varuna saw the beautiful nymph Urvasi, they shed their seeds. One of these fell into a jar, and it was from there that the sage Agastya was born. There may be an esoteric meaning attached to this hymn. What is interesting, however, is the idea that a fetus grew in a jar from which it become a full individual. In the ancient worldview, the full person was contained in the semen of the father, the mother's womb served merely to shelter and to nourish the fetus during the incubation period.

Again, consider the following: In the Mahabharata we read about two rival families, the Pandavas and the Kauravas. The latter are one hundred in number. Here is how the hundred brothers were born along with one sister. While Queen Gandhára was carrying an overdue embryo, she heard that her husband's brother's wife had given birth to a son, which would make him eligible for royal succession. In her anger

> . . . she struck her womb with great violence . . . As a result there came out of her womb . . . a hard mass of flesh. When she was about to throw it away, a wise sage instructed her: "Let a hundred pots full of clarified butter be brought instantly, and let them be placed at a concealed spot. In the meantime, let cool water be sprinkled over this ball of flesh . . ." That ball of flesh, then, sprinkled over with water, became divided into a hundred and one parts about the size of a thumb. These were then placed in pots with clarified butter that had been placed at a concealed spot and watched.

Then, in due course, the hundred brothers and one sister were born, and they came to be called Kauravas and Dushala, respectively.

From the perspective of the world such as we understand it, the details of the event may strike most people as too much of a stretch of imagination. However, the description of embryos being nurtured in jars, which provided nourishment to them while they were maturing, bears a remarkable resemblance to incubators. This would have been unthinkable before the twentieth century.

**Body Transplants**

There are two types of replacement of body parts: First, there are parts like hands, arms, and legs, which are not vital organs. Then, there are transplants of vital organs, such as liver, kidney, and heart. The one instance where one can conceive of a combination of the two is transplanting the entire head, which is both an external appendage and the storehouse of the most important organ in the body, the brain. Thus head replacement

would be the most sophisticated organ transplant one can imagine. We find an instance of this in the story of Ganesha who is one of the primary representations of the Divine in the Hindu pantheon. Every worshipping Hindu, irrespective of sectarian theistic affiliations, pays homage to Ganesha.

In this context let us recall the mythopoetic significance of Ganesha. His name signifies that he is the chief of the *ganas,* which are godlings in the service of the Supreme. It literally means *god of the ganas*. The Sanskrit root *gan* is related to counting, and *ganaha* is a mathematical set. Its extended meaning includes every aspect of the world, all categories in terms of which we comprehend the universe. Thus Ganesha becomes the Lord of all categories. This is equivalent to the mathematical concept of the *set of all sets*. Ganesha, by definition, is the supreme entity governing our intellectual grasp of all experience, the basis of all the fundamental principles through which we reckon the world.

In spiritual-poetic vision, Ganesha becomes a god with the face of an elephant with a single tusk, a potbelly, two legs, and four arms. One interpretation of this is that the icon reflects the connection between the human world and the divine realm. The manlike body represents the small human plane. The much-larger elephantine face stands for the grand Divine. His twisted trunk is to remind us that the path to transcendental truths is never straight or direct. Ganesha's favorite food is made up of a sweet core of candied coconut pulp covered with a layer made of white insipid flour. The bland outer shell is said to represent the gross physical body, the sweet inside stands for the resplendent soul. External reality is for observation and description. Its intrinsic nature is a source of enjoyment and ecstasy.

There is an eerie charm in Ganesha's imagery that touches every Hindu heart and infuses one with a sense of confidence that all hindrances on the path of a project will be erased. So Ganesha is invariably invoked at the commencement of any project, great or small: be it the day's business in a small store, arrangements for a wedding, the opening page of a book, foundations for a new building, or whatever.

His elephantine face exudes a majesty that is overpowering, but also a peace that is universal. Ganesha is portrayed in a thousand art forms and sculpture. He has a presence in every Hindu home and place of worship. He is the fount of much strength and caring.

There are a number of meaningful concepts implicit in the Ganesha principle: the notion of the set of all sets, psychological techniques (a principle to set people in an optimistic frame of mind before the beginning of a task), the relative proportions of the human and the Cosmic, and a vision of the nature of reality which includes externalities as well as satisfactions that arise from probes into the interior. A consequence of the transformation of culture from the mythic-magical to the rationalist-scientific is the loss of perspectives that once enriched and reassured us.

In the sacred history, there are several accounts to explain how Ganesha received his head. According to the one we read in *Brahma Vaivarta Purana*, the planetary deity Shani (the deific aspect of the planet Saturn) was among the guests at Ganesha's birth. Now Shani's wife had cast a spell on him on that day because he had ignored her. Because of this, Shani kept staring at the ground instead of looking at the infant for

fear of harming it by his cursed look. Upon the mother Parvati's insistence, however, he looked directly at the child; whereupon the baby's head was burnt and turned to ash. Parvati lifted up her headless infant and began to wail. When this happened, the Supreme Being Vishnu, who was among the guests, flew off in search of a substitute head. He found on the bank of a river a sleeping elephant. He severed the beast's head, brought it to Parvati's abode, and affixed it to the body of Ganesha.

Considered from a history of ideas perspective, this legend of Ganesha may be regarded as one of the earliest examples of organ transplant, and it includes both the external appendage and the internal organ. Beyond the spiritual and religious significance of the framework, what is interesting here is that here again ancient Hindus had a vision that has scientific technological relevance in our own times. Indeed, in the legend of Ganesha we see that the thinkers envisioned a possibility (organ transplant) that has proved to be not impossible.

**Data Collection and Storage**

Computers are among the marvels of modern technology. They are able to perform so many complex functions because of their impressive capacity to store and retrieve enormous quantities of data. Now consider a computer that records and retrieves at the appropriate time every single thought, word, and deed of every single human. Suppose further that such a computer can also classify these in every case into a positive and negative column; that is, it can also evaluate the data. That would be one of the most super supercomputers imaginable.

Ancient Hindus imagined such a computer and gave it a form and name. It was called Chitragupta, which has been translated as Mindfold-Secret. We read in the Padma Purana that Chitragupta sprang from the Supreme Being and was human in appearance. He was endowed with a huge blank book called *agra sandháni* and a writing instrument. He was instructed to record every good and bad deed of every human being.

We note here the idea that data can be stored for future use. Aside from its value as statistical information, details on people's action can also serve to reward or punish them. From this perspective, the notion of Chitragupta may be seen as a kind of a cosmic police state where there is a chief who is assigned the task of maintaining detailed records on everyone. The role of Chitragupta was to keep a separate dossier on every planetary citizen, the sort of thing that the FBI, the CIA, and their equivalents do in modern times.

The recording of human good deeds and misdeeds for the purposes of reward or punishment is not unlike the Judeo-Christian belief in the Day of Judgment. Chitragupta's role is not dissimilar from the role of Saint Peter in this regard. What is particular to the Hindu world is that the one assigned to keep careful track of our several activities is not a historical personage, for in that case it would be difficult to imagine who could have performed this task in ages before his birth and role assignment—a problem that arises with Saint Peter guarding the Pearly Gates. It would seem more reasonable to treat this as a concept rather than as a role played by a specific individual in human history.

There are many other Puranas where stories about Chitragupta are told. According to one of them (*Yamá Samhita*), Dharmarája, the lord of justice, complained to the Creator that he could not keep track of the thoughts and deeds of countless humans to give them the appropriate rewards and punishments. In response to this the Creator went into meditation and extracted from his body the personage of Chitragupta. Chitragupta was regarded as more than a bookkeeper. He was also a wise instructor who taught people that it was in their interest to be virtuous.

In the Mahabharata (*Anusana Parva*) we read descriptions of hell that rival Dante's *Inferno* and the ones described in other religions. Those who are thrown into hell are not only condemned to hunger and thirst, but also to rot there and burn in pain. They simply cannot get out. But, says Chitragupta, it is easy to avoid that, and he prescribes two simple virtues: One is to give water and the other is to give light. This is a very meaningful statement. It says in effect that the highest forms of meritorious deeds are providing for the hungry and the thirsty and removing darkness. Our body needs water for physical sustenance, and our intellect needs light for spiritual sustenance; any help we can render unto others in these contexts is the best we can do to attain salvation.

In the mingling of myth and history, a date has been assigned as Chitragupta's birthday. It is celebrated to this day.

**Clones and Procreation**

In modern genetic technology reproductive cloning is the process by which an animal is created with the identical nuclear DNA of a given animal. Somatic cell nuclear transfer is the process by which this is done. The first such mammal to be born through this process was the famous sheep Dolly in 1997. Thus cloning involves the production of creatures that are in many ways identical. In Puranic literature one hears of a certain Daksha who is said to have been the son of the creator God Brahma. Daksha was asked by the Supreme to procreate and bring forth living creatures. He promptly produced ten thousand sons who were called *Haryashvas*. All these sons were perfectly identical. These may be regarded as the first recorded (imagined) instance of clones. All of these sons became ascetics, which meant that there would be no future generation of them. Then this process happened again. The third time, Daksha initiated physical procreation, and his wife Ashiní gave birth to sixty daughters. Of these, thirteen were married to a divine personage named Káshyapa. And the many children who were born of Káshyapa and his thirteen wives started the human race. In this view, therefore, every human being in the world is a progeny of Káshyapa and Daksha's thirteen daughters.

The legend is more complex than this, but the procreation methods described herein can be paralleled with those of biological evolution. Biological evolution first propagated species through asexual reproduction; the feature of sexual reproduction, that is common for the human species, is only a later biological innovation. The point of interest is not whether there was or could have been a Daksha, but that the concepts that emerged in the Hindu world in its sacred historical contexts have their parallels in

modern science. Up until the twentieth century few would have thought of Daksha's sons as clones.

**Distant Vision**

The Bhagavad Gita is known for the wisdom that Krishna imparted to Arjuna in Kurukshetra where the armies of two families had gathered for a climactic battle. What may not be as widely known is that the Gita dialogue was relayed to the blind king Dhritarashtra by his minister Sanjaya who was nowhere near the field where the action and dialogue were taking place. He was miles away in the palace with the king.

In the Mahabharata, Sanjaya received the faculty of distant vision especially for performing the task of reporting what was going on in the battlefield. Conceptually, this was the equivalent of a TV system being set up for transmitting a particular event. Sanjaya was watching the action unraveling as if on a television screen and hearing the dialogue also. In fact, it was more than that. He was endowed with full knowledge of history and geography, which enabled him to recount to the king details of the topography of the entire country and narrate everything that was going on in Kurukshetra, where the Gita was spoken and the battle was raging.

As recently as a century ago, such a possibility would have been deemed pure fantasy. But remarkably, the author of the Mahabharata could well envision it. His vision of human potential was truly penetrating, for today distance seeing and distance hearing have become very much a reality through physical means. Moreover, the narration of Sanjaya of the Battle of Kurukhsetra is the first recorded instance, historical or sacred historical, of direct reporting, almost journalistic in its details and objectivity, of events, verbal exchanges, death tolls—and all from a battle scene.

However, it is important to note one fundamental difference. In the Sanjaya context, unlike in the modern world, no physical equipment was involved in the process. It was a special capacity for extra sensory perception acquired by an individual. In current technology, devices external to the human body enable this. As a result, everyone with normal vision and hearing ability can be a beneficiary of this device. In the ancient view, however, that capacity was given only to a chosen few. This must be emphasized because this reflects two fundamentally different worldviews: The ancient worldview was based on the idea that the human body is itself capable of enhancing its normal faculties through spiritual and other means. In the modern worldview, knowledge of the forces and principles governing the physical world enable humankind to construct and invent devices that can extend and enhance our perceptions. However, it is entirely possible that with the development of chip technology, someday we may be able to implant devices in the human brain which will enable everyone to do exactly what Sanjaya did. Futurologists are talking about telepresence: a technology by which one can see in a contact lens three dimensional images of persons miles away, and hear their voices too, as if they are right there in the room where we are.

## Teleportation

Teleportation refers to the transfer of something from one point of space to another without that entity being physically moved from place to place. The term was coined in 1931 to suggest that it might be possible for bodies to physically transport themselves instantaneously from one region of space to another far away region. Soon the idea was incorporated into science fiction and became popular through the Star Trek series in which human teleportation occurs. During the 1990s, some physicists argued that it should be possible to accomplish photon teleportation: that is to say, to move a photon from one region to another without the photon itself traveling from point to point.

Here too, Indic thinkers had imagined the possibility centuries ago. Consider the story of Usha and Chitralekha, which appears in *Srimad Bhágavatam*. The beautiful Princess Usha, single and longing for love, had the experience of a handsome youth in her dream one night. The dream was interrupted; and she woke up and exclaimed, "Oh, beloved one, where are you?" She confided the dream to her close friend Chitralekha. The friend said she would find who the young man was and get him to her. But how was she to recognize him? She began to draw a series of faces and asked Usha if any of them resembled the man of her dream. After seeing many sketches, Usha finally came upon a drawing of Aniruddha, a grandson of Lord Krishna. That night, Chitralekha transported herself to Dwaraka where she found Aniruddha who was in deep sleep. She then brought him instantly to Sonitapura where Usha lived.

Two aspects of today's world are implicit in this story. First there is the idea that one can identify an unknown person through sketches, a matter that is routinely done in criminal investigations in our own times. Then, of course, there is the notion of teleportation, though not in the technical sense of the term.

It may be mentioned in passing that in the framework of modern science, human teleportation is impossible, at least on the basis of current physics. It is important to distinguish between photonic teleportation, which is achievable in principle, and the teleportation of objects and human beings. For in physics, the teleportation of Chitralekha would call for the annihilation of every molecule and atom in her body and their reconstitution in precisely the exact same configuration at a distant point. As of now this is no more than a science-fictional dream. However, the Chitralekha story conjures up the possibility of such instantaneous transportation.

While this type of teleportation only occurs in the mythic lore of the tradition, an even more remarkable instance of it was reportedly performed by some historical personages. According to traditional lore, the great philosopher-saint Shankaracharya actually accomplished the transportation of his inner being (soul/consciousness) into the body of another human being. It is known as *parakáya pravesha* (out-of-body presence). It is claimed by some that other yogis have achieved this feat as well. Whether in the ancient or modern context, the line separating rigorous science from belief in the extraordinary has often been tenuous in the Indic framework.

### Earthly Matter from Heavenly Stars: *Ákásh Gangá*

In Hindu lore there is an interesting account of how the sacred river Ganga, which has its origins in the Himalayan range, came about. In the Ramayana, the sage Vishvamitra explains that the river "rose from the skies and finally came down to earth in the form of a terrestrial stream that has the power to rid us of worldly sins." In Sanskrit, this life-giving river is called *Ákásh Gangá* or the Celestial Ganges. In this vision, its original, pristine presence in the universe may still be seen in the heavens in what is known in English as the Milky Way.

This is perhaps the first instance in history where we find a description of a material something reaching earth from the stellar realm. The extra-atmospheric origin of meteors was not discovered until the eighteenth century, and it was only in the twentieth century that we became aware of the ceaseless shower of cosmic rays that reach us primarily from the sun, but also from sources beyond our solar system.

At first blush, it may seem somewhat strange to imagine a river coming down here below from the heavens above. Of course, we know that this is a physically impossible feat. However, what is important is the implication that a life-giving principle here on earth had its origins in the celestial realm. This too is a notion that would have been pure fantasy a century ago. Today, however, we know it to be the case that the atoms in our bodies and indeed in the entire solar system had their origin in the core of superheavy stars that exploded in supernovas. The intuitive awareness that material aspects of the earth had extraterrestrial origins is another instance of the many prescient insights we find in ancient Hindu writings, albeit in mythical language.

An altogether different version of the idea that material bodies on earth originated in outer space is expressed in the panspermia hypothesis. Proposed in the early decades of the twentieth century, this hypothesis speculates that life on earth arose from life-bearing spores from interstellar space that happened to land here and then sprouted and evolved. This is an idea that would not have been given any scientific respectability until the twentieth century. Now, however, though not universally accepted, it is regarded as scientifically possible. The point is, though there is no scientific basis whatever for the Ákásh Gangá view, it may be seen to embody ideas that are not altogether unscientific. In other words, though poetical metaphors are indeed what many of these ancient writings were, they also prove deeply insightful as plausible scientific hypotheses.

### Genetic Chaos

Today, genetic engineering has accomplished some remarkable things. However, there is also a general fear that it has the potential for doing much harm. Some have projected that strange birth defects and grotesque species variations could result from our tinkering with genes that have evolved in nature. Thus, in one report, "Genetically

modified *rape*, a plant used extensively for its oil, transferred its herbicide resistance to nearby wild *brassicas*, creating *superweeds*."

In the Mahabharata we read a frightening description of a world where there is total genetic chaos:

> Donkeys are taking birth in cows . . . Trees in forests are exhibiting unseasonable flowers and fruits. Women, quick with child, and even those who are not so, are giving birth to monsters. Carnivorous beasts, mingling with similar birds, are feeding together. Ill-omened beasts, some having three horns, some with four eyes, some with five heads, some with two sexual organs, some with two heads, some with two tails, some having fierce teeth, are being born, and with mouths wide open are uttering unholy cries. Horses with three legs, furnished with crests, having four teeth, are also being born.

The list goes on and on, including such things as, "Every barley-stalk has five ears, and every paddy-stalk has a hundred," and "the best creatures on earth upon whom life depends, namely cows, when milked after the calf have suck, yield only blood."

It is difficult to know what to make of such passages except to surmise that perhaps some terrible bio-chaos had occurred in the region at one time. Indeed in the same chapter there are also references to planetary and astral anomalies such as three lunations twice meeting together in the course of the same lunar fortnight and the dimming of the stars in the constellation Big Bear. The dimming of stars would have seemed impossible to ancient astronomers. Today we know that the luminosity of one of the stars in Ursa Major (VY Ursa Majoris) fluctuates. We also know of other pulsating stars, but back then these were mere fantasies.

Such references make one wonder whether the known history of civilizations is really complete, whether perhaps there might have been phases of human history of which we may have completely lost track. Reading some of those narratives from our radically transformed perspectives, constrained by the current paradigms of science, they do seem strange and fantastical. Yet it is not persuasive to say that everything we read in ancient epics is purely creative writing. The reading of mythology as records of a world that has somehow disappeared altogether, except as vague remembrances enshrined in legends of ages past, could turn out to be closer to the truth than now seems the case.

**Satellite Communication and Other Modes**

During the nineteenth century, if someone had proposed that it would be possible to communicate a message from one point on earth to another with the aid of something up in the skies, the very idea would have been laughed out of court. In fact, by the close of the nineteenth century, some eminent theoretical physicists argued that

trans-Atlantic wireless communication would be impossible because the waves would not bend with the curvature of the earth. They were not stupid. They just did not know about the existence of a reflecting ionospere.

Consider, however, what the Sanskrit poet Kalidasa wrote in his play *Meghadútam*: *The Cloud Messenger* in the eighth century CE. In this romantic story, a character is exiled from a kingdom as punishment for neglecting his official duties. He is thus separated from his dear wife. Lonely in his exile, he longs for his beloved. One day, at the commencement of the rainy season, he sees a cloud high above. It occurs to him that perhaps he could send a message to his wife through that cloud. He addresses the cloud as a shelter to the distressed and pleads with it to carry his lovelorn thoughts to the one he misses most. A lover talking to a cloud to convey his feelings may be poetically charming, but the idea of sending a message via an inanimate entity seems a little far-fetched. Surely to his contemporaries and to many in future generations since, the idea was no more than a fine example of a creative poet's fertile imagination.

Yet in a way, this too was a prescient vision. In the modern age we accomplish something very similar in our telecommunication systems. In 1958, Project SCORE (Signal Communications Orbit Relay Equipment) was used by President Dwight Eisenhower to convey his Christmas greetings to the world at large. In 1960 the Echo satellite reflected radio waves which served as a passive instrument for communication. We may not address a cloud up there directly, but our voices are transduced into microwaves that bounce off artificial satellites which are orbiting even beyond the clouds.

Aside from this literary reference there are many legends in Puranic lore where telepathy and other modes of communication are mentioned as practices in which certain people engaged. To this day, there are people who are convinced that when one has acquired certain spiritual powers, one can communicate with others in distant parts of the world without the use of the common physical media. Thus far such claims are more in the making than in the proving. Even though telepathy and ESP have gained a degree of respectability for some, they are still classed by most scientists in the same category as haunted houses, clairvoyance, and astrology. However, there are some serious computer scientists who believe it is possible to connect human brains via computer technology. There are sufficient instances of reported paranormal phenomena which, though only anecdotal at this time, may some day be explained in the scientific framework.

**Concluding Thoughts**

There are many more references in Hindu lore that have incredible parallels with technological breakthroughs of modern science. There are two very different ways in which these have been interpreted in our own times. In the first, it is claimed that the stories refer to historical events and are literally true. In other words, these are regarded as records of the scientific achievements of an ancient civilization that flourished several thousand years ago. In this view, much of India's past scientific achievements

were either destroyed or subdued by foreign invaders, some of whom even stole the native scientific treasures. According to proponents of this perspective, some of those ancient sciences and the associated worldviews need to be recalled and reaffirmed by the current generation. A more realistic proposal would be that the subtler aspects of occult science, such as clairvoyance, extra-sensory perception, and parapsychology must be explored by current science.

As discussed earlier, there are quite a few references to highly advanced technology in the epics. There are also texts, believed to date to antiquity, which have been interpreted as works on ships and airplanes. Some of the descriptions of ancient weapons have been interpreted as laser weapons and guided missiles. It was even argued by one scholar, in a paper presented at an international conference, that based on the gruesome accounts of the Kurukshetra war, nuclear weapons were possibly involved in that epic confrontation. These might appear to be bold, not to say grossly exaggerated, extrapolations from a modern point of view; but they are quite convincing to those who seek more satisfaction than information in their historical quest.

The second view is quite the opposite. It grants that the stories in the ancient writings are fascinating, but it rejects the claim that they represent historical actualities. Other mythologies in other traditions have similar science-fictional stories. The proponents of this view point out that there is no substantial relic or evidence of any kind that reveals any material instance of these sophisticated technologies. It is not unlike the story of the Italian and Indian archaeologists: When the Italian said that they had found some copper wires in Roman ruins, leading to the conclusion that in ancient Italy there was telegraphy, the Indian replied that Indian archeologists did not find any copper wires in their digs, showing that in ancient India there was wireless telegraphy!

Poetic visions often transcend the limitations of present physical realities and imagine possibilities that may seem unachievable, even unreasonable, to people of a certain age. However, by other means perhaps, these visions may come well within the realm of the real in a future generation. That many Indic thinkers constructed such situations is a tribute to their keen minds and their capacity for sophisticated thinking, for which they deserve all our commendation and admiration. However, to say that they were talking about a real cow that gave limitless food to its master or of an actual incident in which a stretch of cloth worn by a woman kept extending indefinitely when some miscreants tried to disrobe her, may not be convincing on one plane of apprehending reality; but they do have deeper meanings on a different plane.

So we have what are essentially two mutually irreconcilable perspectives. Not all may be persuaded that the mythical anecdotes indeed occurred. And it is unlikely that this controversy will be resolved in the near future, if only because it is so closely associated with cultural claims. The most one can hope for is the recognition that matters of cultural and traditional import can be approached from different perspectives. But what is interesting is the fact that a great many instances of modern science and technology find expression in different garbs or in indirect ways, in various Hindu epics and sacred history.

# IX. Global Science and Modern India

> I can assert without fear of contradiction that the quality of the Indian mind is equal to the quality of any Teutonic, Nordic or Anglo-Saxon mind . . . We have developed an inferiority complex. I think what is needed in India today is the destruction of that (complex). We need . . . a spirit that will carry us to our rightful place under the sun, a spirit which will recognize that we, as inheritors of a proud civilization, are entitled to a rightful place on this planet . . . It was poverty and the poor laboratories that gave me the determination to do the very best I could.
>
> —A. P. J. Abdul Kalam, *Indomitable Spirit*

**Indic Insights in Europe**

In modern times, Indic wisdom began to impact the Western intellectual tradition in the latter half of the eighteenth and early nineteenth centuries. It was a time when many thinkers in Europe were becoming disenchanted with the crass rationality and order and structure instigated by growing successes in physics and astronomy, and even in music and poetry, as well as the stringent empiricism imposed by a cold and calculating science. That science was chopping away the fullness of experience into its ultimate irreducible bits and unweaving the multicolored splendor of the rainbow into imperceptible water droplets in air and Snell's law of refraction. There was a near-rebellion against a science that tended to regard the human being as, in the phrase of Julien Offray de La Mettrie, *l'homme machine*: a man-machine which was little more than a complex mechanical blob ruled by the inexorable laws of physics and chemistry. This was the period when the Romantic movement was emerging in European culture.

When European thinkers encountered Hindu perspectives on nature, soul, and reality, they were genuinely fascinated and deeply struck by the Indic vision's grasp of the integrated whole. It is not difficult to detect echoes of Hindu worldviews in the writings of the German philosophers of that period. The keenest among them reacted very positively to Sanskrit writings. Goethe wrote exuberantly that "Kalidasa understood

in the fifth century what Europe did not learn until the nineteenth century . . . that the world was not made for man, and that man reaches his full stature only as he realizes the dignity and worth of life that is not human . . .” Schopenhauer gave high praise to the Upanishads: “In the whole world . . . there is no study . . . so beneficial and as elevating as that of the Upanishads. They are products of the highest wisdom.”

The leaders of the *Sturm und Drang* of German literature and music were familiar with the Hindu views on life and values, which had more to do with the intensity of *bhakti* than the impeccability of logic. Indic insights into the nature of consciousness and its recognition of the constraints of knowledge gained through sensory perceptions alone impressed many German thinkers. Most of the pioneers of German idealism such as Immanuel Kant, Johann Gottlieb Fichte, Friedrich Schelling, and Georg Wilhelm Friedrich Hegel were acquainted with the Sanskrit literature that had recently been brought into their country. The philosopher Johann Gottfried von Herder who wrote a treatise on the origin of languages expressed the view that “mankind’s origins can be traced to India, where the human mind got the first shapes of wisdom and virtue with a simplicity, strength and sublimity which has - frankly spoken - nothing, nothing at all equivalent in our philosophical, cold European world.” Schelling thought Hindu writings were superior to the Bible. Kant’s notion of a perceived reality and a noumenon beyond is very much like máyá and Brahman of Hindu thought. Not everyone acknowledged explicitly the impact of that literature on their own thinking, and some, like Hegel, gave Hindu philosophy an inferior status only in the history of ideas. Yet, Hindu pantheism played a role in the emergence of *Naturphilosophie,* whose goal was to comprehend the world in its totality. The role that Naturphilosophie played in the development of nineteenth century scientific worldviews has been recognized by scholars, but the impact Hindu visions had on its genesis has not been as well investigated.

These reactions spread to France and the English-speaking world also. Emerson referred to the Bhagavad Gita as “the first of books; it was as if an empire spoke to us, nothing small or unworthy, but large, serene, consistent, the voice of an old intelligence which in another age and climate had pondered and thus disposed of the same questions which exercise us.” Henry David Thoreau referred to the Ganges and Indra, while Hermann Melville mentioned the Matsya Avatara. William Blake formulated the Vedantic thesis in *A Memorable Fancy* when he wrote, “If the doors of perception were cleansed everything would appear to man as it is Infinite.”

All this is well-known, but one point which has never been stated explicitly needs to be recalled in this context. The West did not discover India in an unhappy, confrontational context. Enlightened Western thinkers recognized India’s intellectual and philosophical greatness without having to become defensive about their own culture. They did not have to impress Hindus that they too had had great thinkers in ancient Greece and Rome, if only because few people in India were reading at the time what Western writers were writing. They bore no grudge against Indic civilization whose lofty ideas they recognized, valued, and even internalized. Many of them were fascinated and thrilled by what to them were new and insightful approaches to life, existence, and the human condition.

## East Discovers West: Indian Encounter with Modern Science

During the British occupation of India, Indians of the middle and late nineteenth and early twentieth centuries encountered the post-Copernican science that had been initiated by Galileo, Newton, and other scientific giants of what A. N. Whitehead called the century of genius. As a result, when India confronted Western culture, which had barged in with enormous advantages in material strength and craftiness, the responses to Western civilization and associated modern scientific perspectives were not excitement and exhilaration but resentment and anger. Indian reactions to Western technology and science were of two kinds. One was to argue that India had a technology during ancient times that rivaled what the West had in the nineteenth century. Ironically, many who took this position were not even aware that great mathematics, astronomy, practical chemistry, and physical theories had been developed in classical India. It was only after years of research instigated by Western scholars and later pursued and extended by generations of Indian scholars that modern Indians became fully aware of their own scientific heritage.

Another reaction to Western science was to affirm India's spiritual strength vis-à-vis the materially stronger intruders. Hindu intellectuals played, if not overplayed, the spirituality card to emphasize their intrinsic superiority in this domain. In the Ramayana, there is an episode in which the materially mighty king Vishvamitra tried to ravish a magical cow from the spiritually evolved Rishi Vasishtha, but to no avail. After a series of futile attempts and embarrassing failures, the wise Vishvamitra conceded in humility that the material and military power of the *kshatria* was not worth a penny compared to the Brahminical spiritual strength. He famously declared, "*Dhik kshatriya balam! Brahma tejo balam, balam!* Fie unto the warrior's might. True strength lies in spirituality alone!" The invaders from the West did not say anything that profound. Instead, they ignored, if not belittled, Indian spirituality and successfully went on with their goal of gaining economic control and political domination over India. In this, they succeeded very well.

Many Indians were awestruck by the practical fruits of Western technology. This stark reality began to sow doubt in the minds of some Indians as to the value and relevance of spirituality in a world ruled by a might that seemed to have emerged from a different intellectual framework. That doubt persists to this day.

At the same time, Indian thinkers who studied modern science systematically began to realize that there was more to it than gunpowder and gadgets. The serious students of science understood that modern science is based on meticulous experiments with ingenious instruments, subtle and fertile concepts, sophisticated mathematics carefully developed, testable hypotheses which may be discarded if unsatisfactory, falsifiable theories, and above all, that it is independent of religious scriptures and not under the control of religious authority. They also realized that the scientific enterprise had no more affiliation with colonialism and imperialism than Hindu spiritual visions had with casteism and superstition. This recognition led most Indian scientists of the early twentieth century to a deeper understanding and appreciation of both science and Indian spirituality. In such an awakened context, there was no need to be defensive

about one's own culture, no urge to engage in *palaeoaltry* (worship of the ancient). Nor did they feel embarrassed about adopting modern science—a practice that discovers reliable knowledge which transcends race, religion, and nationality.

Indians who were formed in the English-medium colleges and universities, which had been instigated by Macaulay's arguments, not only absorbed the framework of modern science, but they also began contributing to it in significant ways. The resilience of a civilization arises as much from its intrinsic qualities as from its openness to receive input from the outside world and its ability to build on that input internally. This principle is amply illustrated in the embrace of modern science by enlightened Indian thinkers.

But this enlightened outlook of Indian scientists during the first half of the twentieth century has been challenged, if not assaulted, by thinkers who have taken inspiration from Western postmodernists who write against science. Though working scientists in India are generally unperturbed by such thinkers' dissertations, this is still unfortunate because it undermines scientific thinking in India.

Now I would like to look into this matter specifically with respect to some eminent scientists of the twentieth century. The average reader about India, whether Indian or outsider, is usually unaware of why these illustrious scientists are honored in the community of world scientists. The sage-poets of India had said that the one Ultimate Truth is spoken of in many ways by the learned. This also applies to how thoughtful persons regard their traditions and philosophies. The greatness of India lies as much in the freedom she has given her children in entertaining divergent views as in the views themselves.[2]

**Jagdish Chandra Bose (1858-1937)**

The first Indian to make a mark in international science in modern times was Jagdish Chandra Bose. He was the first and only Asian to be invited to the International Congress of Physics held in Paris in 1900. He presented a paper on the similarity of responses in inorganic and living matter. The thesis of this paper was revolutionary in that it regarded the transition from inorganic to organic as a continuum rather than as a quantum leap from one kind of matter (nonliving) to another (living): an idea that is implicit in the theory of the chemical evolution of life. He developed these ideas into a book entitled *Responses in the Living and Non-living*.

Bose did not simply dream up his ideas. He was a first-rate experimentalist: the first in the Indian tradition to devise ingenious instruments for observing, detecting, and measuring. These are indispensable elements for modern science. Bose was fascinated by plants; and he was convinced, contrary to the prevailing opinion, that plants had a sophisticated response-mechanism which was very much like our nervous system. His research led to publications with such titles as "Plant Response as a Means of Physiological Investigations" and "Nervous Mechanism of Plants." He did many

[2] Much of the following is based on my book: *Glimpses of Indian Scientists.*

significant experiments on root pressure and capillary action in sap. His book, *Response Plant*, contains many of the fruits of his labor. It was received very favorably by the international scientific community. In a review of the book in the journal, *Nature*, we read, "A biologically equipped reader will experience dazzled admiration for the logically progressive way in which the author builds up, not in words, but actually on a complete functioning plant, from three simple conceptions."

Though his interest in plant physiology was deep, Bose was first and foremost a physicist. In fact, it was his interest in electromagnetic phenomena that led him to a systematic study of plant behavior. In this transition, he unwittingly laid the foundations for a new field of science: biophysics.

Bose performed experiments on the reflection, refraction, and polarization of very short electromagnetic waves. His results were published in 1895. He explored the possibility of wireless telegraphy—a field that revolutionized human civilization. One of the first wireless devices was demonstrated at the town hall in Calcutta long before it happened in other places.

Bose's biographer, Subrata Dasgupta, points out that Rabindranath Tagore spread Bose's fame in India. The poet was inspired by the enthusiastic comments of the Irish Indophile, Margaret Noble. It has been said that this led to what is regarded by some as "exaggerated claims on behalf of Bose." Nevertheless, Bose's achievement in the transmission of radio waves deserves a more prominent place in the history of science than is normally accorded to it.

Upon his return to India from England in 1897, Bose became a professor of physics at the Presidency College in Calcutta. Soon after his retirement in 1915, he founded a scientific research center which he named *Bijñan Mandir*—meaning "Temple of Science" in Bengali—for Bose regarded the study of natural phenomena (science) as equivalent to the worship of God. Erasmus Darwin, the grandfather of Charles Darwin, had written a poem in 1802 entitled "The Temple of Nature" and Louis Pasteur had used a similar term for a research laboratory.

The Bose Institute, as it came to be called, was inaugurated on November 30, 1917, on the occasion of its founder's fifty-ninth birthday. Its goal was not only the advancement of science, but also the diffusion of scientific knowledge. Bose saw an emerging synthesis between physics and biology. "The investigations to be carried out in the Institute," he said, "are for the fuller and further investigations of the many and ever opening problems of the nascent science which includes both Life and non-Life." Bose envisioned an institute where scholars from all over the world would come and work in a spirit of internationalism. He said, "I am attempting to carry out the traditions of my country which, so far back as 25 centuries ago, welcomed scholars from different parts of the world within the precincts of the ancient seats of learning at Nalanda and Taxila."

Bose had a deep devotion for his country and abiding love for its traditions, but as one touched by modern science, he could not reconcile himself to simply repeating what his ancestors had said and done, however splendid they might have been. He called on his people to look forward, to explore the world, and to see how they could

build a new world without sacrificing the one they had inherited. "We have still a great and mighty future before us," he reminded his countrymen, and added that we should not just "brag of what our ancestors have done but . . . carry out in the future something as great, if not greater, than they."

**Prafulla Chandra Ray (1861-1944)**

As noted earlier, the element mercury—the only metal that is in the liquid state at ordinary temperatures—played a central role in ancient Hindu alchemy. Interestingly, the first great chemist of the modern era became one of the foremost authorities on mercury compounds, both mercurous and mercuric. His name was Prafulla Chandra Ray.

Ray came from a village school in what is now Bangladesh. Just as Mohanja-daro, the seat of the ancient civilization in the Indian subcontinent is no longer part of India, the birthplaces of many great scientists and writers of old Bengal are now in Bangladesh.

Ray was patriotic in an enlightened way. He expressed his patriotism symbolically by casting off his suit and tie upon his return from England in 1888 and by adopting simple and graceful Bengali attire. He understood the intrinsic value of modern science and its relevance for the welfare of the people. Ray's life, as that of many Hindus, showed that English education need not necessarily make one what is now derisively called a *Macaulayite*. It can also transform one into a better-informed and more enlightened person with respect to India's culture and history.

Ray had received a doctoral degree from the University of Edinburgh in analytical chemistry, working on amorphous mixtures and the nature of molecular combinations. He had some difficulty finding a suitable position upon his return home, but he eventually became the first Indian professor of chemistry in India. He did so well in this capacity that the government gave him enough funds to have his own research laboratory—again the first in India. He continued with his explorations of mercuric salts and tried to discover a new element; Mendeleev's periodic table still had some gaps. Though many of his papers on the mercury compounds were published in the *Journal of the Asiatic Society*, they received attention from the prestigious British journal, *Nature,* which alerted its readers to Ray's work.

Ray was also interested in organic chemistry because it is related to the food we eat. He knew that food adulteration was common practice among the local merchants. Adding water to milk may not be serious, but when ghee (clarified butter) and mustard oil were contaminated with undesirable ingredients, it could be quite dangerous to health. So Ray undertook meticulous chemical analysis of the purest ghee and mustard oil in his laboratory and compared these with what was available in the market, with shocking revelations of high levels of adulteration.

Ray felt science should be more than a labor of love for knowledge. It is cultivated by forming future scientists, and it needs to be used for the benefit of one's countrymen and of humanity. So Ray trained students and came to be called the founder of the Indian Chemical School.

Like Antonine Lavoisier and Nicholas Leblanc in eighteenth century France, Ray wanted to put his knowledge of chemistry to practical use. So with only modest capital, he established chemical companies like Bengal Chemical and Pharmaceutical Works, Bengal Pottery Works, Calcutta Soap Works, and Bengal Canning and Condiment Works. Besides manufacturing articles, these provided jobs for thousands of people. His industrial undertakings brought him lots of money too, but he gave it all to charities and scholarships. Thus this great ascetic-scientist spent much of his talents and resources for the benefit of his people.

Ray happened to see Marcellin Berthelot's *Les Origines de l'alchemie* (1885) and was inspired to write a few papers about it. He shared them with the eminent French chemist who encouraged him to write a full treatise on the subject. Thus it was that Ray's two volume classic on the *History of Hindu Chemistry* emerged, based on objective analysis of a plethora of extant Sanskrit works. Ray traced the development of chemistry in India into four distinct periods: ancient times (1500 BCE-800 CE), a transitional period (800-1100), the Tantric period (1100-1300), and finally the period of iatrochemistry (1300-1550). This was historical scholarship at its best, a careful search into the past without nationalistic flag-waving or moaning about Western scholars.

Ray received many well-deserved honors in his lifetime. He was a genuine scholar, great philanthropist, and a man of uncommon simplicity. People like Ray combine what is best in India's rich tradition with what is good from other cultures. Such was this great rishi of modern India—dedicated to the pursuit of science and silently serving his countrymen. Such are the ones who, one hopes, will be leading India as she marches on into the unknown future.

**Srinivasa Ramanujan (1887-1920)**

Once in a while, a genius appears in the firmament of world history like a blazing comet, shines brightly and disappears, leaving behind a trail that cannot be forgotten by future generations. Such were Michelangelo and Mozart, and such was the mathematician Ramanujan, except that Ramanujan's creations are beyond popular reach. Ramanujan lived for only thirty-two years, but he left behind mathematical results of supreme significance, evoking awe and admiration in those who can decipher the theorems that issued forth from his head like multicolored scarves from a magician's hat.

Ramanujan was born in a modest family in a small South Indian town. He was drawn to the magnificent world of numbers and proofs at an early age. The book, *Synopsis of Elementary Results in Pure Mathematics,* by G. S. Carr, added to his love for the subject. He took peculiar delight reciting pi (π) and the square root of two in long across strings of decimal places. But he was not good in English and flunked the required courses because he could not handle English orthography and syntax.

Ramanujan was married at the age of twenty-one and became a quill-driving clerk—much like Einstein at the Swiss patent office a few years earlier. He dabbled in higher mathematics in his spare time. At twenty-three, he published a paper on some

properties of Bernoulli numbers. He showed his results to a certain Ramachandra Rao who was unable to figure out Ramanujan's abstruse symbols and theorems. But Rao had the wisdom to direct the young man to G. H. Hardy, the famous Cambridge mathematician.

This led to a correspondence with Hardy to whom Ramanujan sent more than one hundred significant results without proof. Reacting to some of Ramanujan's results, Hardy wrote:

> I had never seen in the least anything like them before. A single look at them is enough to show that they could only be written down by a mathematician of the highest class. They must be true because, if they were not true, no one could have the imagination to invent them.

Indeed, Hardy ranked Ramanujan higher in mathematical creativity than David Hilbert, the greatest mathematical giant of the period. Hardy invited the young Hindu to Cambridge. But orthodoxy and Ramanujan's mother wouldn't let the Brahmin youth to cross the polluting seas. It is said that a goddess brought the mother a vision of her son shining in an assembly of Westerners, and this goddess commanded the lady not to stand in the way of her son's sailing overseas, so she let him sail to Cambridge. Instances like this must reveal to modern West-baiting Indians how much India has changed in the past one hundred years as a result of her contact with the West in positive ways too.

In Cambridge, Ramanujan came into the mathematical mainstream and realized, sadly, that some of his insights were not entirely new. Other extraordinary minds like Leonhard Euler and Carl Gustav Jacobi had come upon them much earlier, but Ramanujan continued to make new discoveries and contributions to such esoteric fields as *highly composite numbers* and *elliptic functions*.

No narration of Ramanujan's life would be complete without the 1729 story. The only math one needs to know for this is that when a number is multiplied thrice by itself, we get its cube. Thus, for example, $2^3$ is 2 x 2 x 2 = 8, and $7^3$ is 7 x 7 x 7 = 343. The sum of two cubes is the number we get by adding two cubes. Thus $3^3 + 5^3 = 27 + 125 = 152$. Now here is the story: Once, Hardy casually remarked that the number which they happened to see on the license plate of a cab was a dull number: 1729. "Not at all," replied Ramanujan instantly, "It's the smallest number that can be expressed as the sum of two cubes in two different ways: $1729 = 10^3 + 9^3 = 12^3 + 1^3$." Such split-second recognition of the property of a randomly seen number was but a mild example of Ramanujan's unusual mathematical intuition.

We have more facts about Ramanujan's life than we do for any other Indian mathematician. Thanks to probing biographers, we know about his wife and mother and grandmother, his father and teacher and brother, their relationship with him, the pressure they put on him, their sympathies for him, and such. We know details about his last year when he was dying of tuberculosis, his continuing creativity, about his jealous mother, frightened wife, and his brother who sought financial aid from Hardy after Ramanujan died.

All that occurred a century ago in a world that was very different from ours. The great mathematician was stubbornly orthodox in his ways and wishes, imbued, as he was, with local fears and what some would regard as superstitions, often referring to a village goddess as the source of his insights. In that world, astrologers predicted his imminent death and advised his wife to leave him for a while for his recovery as per the dictates of stars, and relatives would not attend his cremation because he had not been cleansed of the impurity caused by his travel abroad. Such worldviews are still not uncommon in India.

Speaking of Ramanujan, Nitin Ingle perceptively remarked:

> . . . at reason's limit does something else take over? Do we here flirt with spiritual or supernatural forces outside our understanding? It is an unlikely, anachronistic, even heretical notion today, with science and Western rationalism everywhere triumphant. But there is scant reason to doubt that Ramanujan himself thought so. South Indians of otherwise presumably rationalist bent . . . recall him as wholly at ease in the spiritual to which his mother and grandmother had introduced him as a child . . .

**Chandrasekhar Venkata (C. V.) Raman (1888-1970)**

C. V. Raman is probably the best known Indian name in science because he discovered a phenomenon that is of enormous interest in both physics and chemistry. He distinguished himself as a brilliant student and received his bachelor's and master's degrees before he was nineteen. In the first part of the twentieth century, Indians used to go abroad for advanced studies in science. As Raman was not physically well to undertake a long voyage, he passed a government service exam, joined the Indian Audit and Accounts Service, and worked as an accountant for a decade. During this time, Raman did not ignore his first love, namely physics. While posted in Calcutta, he researched in his spare time at the Indian Association for the Cultivation of Science. He published results in international scientific journals, which won him recognition. In 1917, he was offered a teaching position at Calcutta University. He taught ably and continued with his research in acoustics and optics.

In the Hindu tradition, Vishnu is portrayed in blue because it is the color of the sky which represents the infinite beyond. But not many Hindus before Raman wondered about the blue of the sky or of the ocean. In 1921, Raman attended a scientific congress at Oxford on behalf of Calcutta University. On his way on board the ship, he was struck by the blueness of the Mediterranean. The blue sky had been explained by the British physicist Lord Rayleigh in the nineteenth century as resulting from the scattering of light. Rayleigh also said that the ocean was blue because of the reflection of the sky on the water. Raman was not convinced. He decided to investigate the matter further upon his return to India in terms of molecular light scattering.

During that visit to England, Raman was invited to lecture at the Royal Society on the theory of stringed instruments. His work in this field was so well received that the

prestigious *Handbuch der Physik* invited him in 1926 to contribute an article on the physics of musical instruments for its series. He was the first non-German to receive that honor.

Raman and his collaborators relentlessly explored light scattering for five intensive years. Their investigations culminated in the discovery of the famous effect that bears his name. The *Raman Effect* refers to the scattering of certain wavelengths when an incident beam of light strikes specific targets. Its importance lies in that it further confirmed the then-emerging field of quantum physics. Furthermore, it enables us to explore the molecular structure of many substances. Another young physicist, K. S. Krishnan, collaborated in this discovery, which was reported in a series of papers in 1928, notably in the international scientific journal, *Nature*.

The discovery of Raman scattering made headlines in the community of physicists. The British government knighted Raman the following year, thus making him Sir C. V. In 1930, Raman was awarded the Nobel Prize for physics. Two Soviet physicists had also made the discovery independently, but their results were published a few weeks later. As a result, they lost the prize, and this led to some unpleasantness. Russian books still refer to what is elsewhere known as *Raman Effect* as *Effect Landberg-Mandelstam.*

Raman went to Bangalore in 1933 to lead the *Indian Institute of Science*, and here he founded the *Indian Academy of Science*. Raman was a superb experimentalist—and a classical one at that. In the 1920s and 1930s while quantum mechanics and nuclear physics were taking mainstream physics by storm, Raman was relatively shielded from the conceptual and mathematical framework of these new vibrant domains of theoretical physics.

The Raman Research Institute was born in 1948. But Raman had professional rivals because science, when affiliated with institutions, is intertwined with politics and power. Some tried to oust him from his directorship. Raman's biographer, G. Venkataraman, has chronicled all the squabbles, backbiting, and awkward confrontations that colored Raman's years in Bangalore.

Raman was fascinated by light and sound, by the mathematics of music, and the magic of color. He studied the physics of *mridangam* (a South Indian drum) and the optics of avian plumage. He probed into the mysteries of sparkling gems and of pleasing rhythms. He acquired more than three hundred diamonds—not to adorn his wife—but to probe into their properties, like diamagnetism susceptibility, luminescence, UV absorption, and such. He trained more than five hundred physicists in India.

Raman was an English-educated South Indian and Brahmin intellectual of the times, wearing tie, *kudumi* (pigtail) and turban, dignified in demeanor and with a sense of humor, absorbing whatever is best in the West while avoiding its superficialities, never forgetting the roots of his own tradition, eager for science, yet sensitive to Hindu cosmic worldviews. He was a physicist in thinking and poetic in expression, authoritarian and outspoken yet gentle and kind at heart, a robust lover of life but a strict vegetarian and teetotaler.

**Satyendranath Bose (1894-1974)**

Light is one of the most common elements in the field of our everyday experience. In many ways it is still a mystery. And yet during the past few centuries, thanks to the efforts of physicists, we have come to know many aspects of light which are not obvious; for example, it is made up of electromagnetic waves, it travels faster than any physical body ever can, it has a corpuscular nature called the photon, and more. Satyendranath Bose (no relative of J. C. Bose) is among the physicists who have unveiled light's properties.

S. N. Bose showed his brilliance in mathematics from a very early age. Like many classical scientists, he too had deep interest in poetry, in English as well as in Bengali poets. It is said that Bose memorized long passages from Tennyson when still very young. At the Presidency College in Calcutta, he was the brightest in a galaxy of brilliant students which included Meghnad Saha.

Recognizing the importance of scientific publications in European languages in those days, Bose studied, aside from physics and mathematics, French and German. This proved to be very valuable when a professor allowed Bose and his friend Meghnad Saha to use his books on advanced physics, some of which were in German. Thanks to these, Bose became well versed in the then-current topics in physics such as the quantum theory of Max Planck, the relativity theory of Albert Einstein, and the atomic model of Niels Bohr and Arnold Sommerfeld. As much to master the material as to do a service to the scientific world, Bose and Saha translated Einstein's papers on relativity into English. A couple of young Bengalis translating German papers into English was a great example of the international character of modern science. It happened decades before the cultural apartheid which advocates of postmodern and postcolonial ethnoscience are trying to impose on universal science.

Bose began to work on related problems and published a paper entitled "A Deduction of Rydberg's Law from the Quantum Theory of Spectral Emission." Because of professional political rivalries, conditions at Calcutta University were becoming somewhat uncongenial for Bose, so he left for Dacca (now Dhaka) in 1921 to teach physics at a newly established university. Although resources, especially laboratory equipment and library facilities, were not as great in Dacca as in Calcutta, Bose continued his theoretical research. Genius often works under available conditions instead of fruitlessly complaining about the surroundings or the paucity of resources.

In 1924, Bose wrote his famous paper entitled "Planck's Law and the Light Quantum Hypothesis," which he sent to Einstein for comment and possible publication. Einstein recognized its merit right away, translated it into German, and had it published in the prestigious *Zeitschrift für Physik*, with the following significant comment: "In my opinion, Bose's derivation of the Planck formula signifies an important development. The method considered here yields also the quantum theory of ideal gases . . ." This classic paper led to the recognition that the photon and other particles obey a particular type of statistic and led to the term *boson* to describe such particles.

Bose traveled to Europe and met some of the illustrious physicists of the golden era of quantum physics. Upon his return to Dacca, he became full professor, and in this capacity, aside from teaching and doing research, he also guided many young physicists in their investigations. In 1945, Bose returned to Calcutta where he occupied a prestigious chair for over a decade. During this period, he traveled to Europe regularly to attend conferences, take part in meetings, and renew acquaintances. At the same time, he also worked on some aspects of Einstein's unified field theory, which was an attempt to blend gravitation and electromagnetism into a single theory.

In 1956, Bose moved on to Santiniketan as vice chancellor of the university that had been established by Rabindranath Tagore. It is said that his efforts to infuse more science in its curriculum were not very successful. He returned to Calcutta after barely three years.

Satyen Bose was a versatile person. Besides theoretical physics, he also worked on experimental science and in chemistry. He had an abiding interest in music. One of his biographers notes that "Bose was capable, with equal ease, to talk about research on edible mushrooms with a botanist, or discuss the pre-Revolution conditions in France, or read the history of the French Revolution in the original." He translated French stories into Bengali. He was dedicated to teaching science in the vernacular.

Bose received many honors, such as honorary doctorates, the *Padma Bhusan*—a high honor bestowed by the Government of India—and fellowship in the Royal Society. He was a scholar in the best sense of the word, a lover of art and literature, a creator in science, a true representative of whatever is best in the Indian love of learning. His name will always be associated with one of the most subtle properties of light.

**Meghnad Saha (1893-1956)**

In the nineteenth century, physicists developed a technique for identifying the chemical elements present in a distant source by carefully examining the light emanating from it through a spectroscope. This method of analysis opens up the possibility of knowing the composition of stars and of our own sun. It was undoubtedly a most important scientific breakthrough. This was the first time that human beings could recognize the materials in stars and planets.

Gradually, one came to expect the presence of certain elements in the sun on the basis of the nature of the emitted light. This was based on an understanding of the properties of the atoms of various substances. But not all the expected elements seemed to be present in the sun. In particular, rubidium and cesium were conspicuously absent in the sun's chromospheres. This remained a mystery until Meghnad Saha solved the puzzle.

When Saha was assigned to teach a course on thermodynamics, it occurred to him that perhaps one could combine thermodynamics and the then emerging quantum mechanics to a study of matter in stars where the temperatures are extremely high. Thus his interest turned to astrophysics. In this context, he undertook a systematic study of twenty-five years of the *Monthly Notices of the Royal Astronomical Society.* While engaged in this, an insightful idea occurred to him. In chemistry, one talks about

the dissociation of molecules at high temperatures. That is to say, molecules break up into their component atoms. In atomic physics, one speaks of ionization. That is, atoms are stripped of their electrons at very high temperatures. Saha worked out a theory based on this analogy. His theory gave a measure of the ionization in a hot gas as a function of temperature and electron pressure.

All this becomes relevant in the study of the spectra of light from the sun and stars. This topic is of great importance in understanding the nature and composition of stellar bodies. Saha's important results on this subject were published in a classic paper entitled "On Ionization in the Solar Chromosphere" in the prestigious *Philosophical Magazine* in 1920. The problems considered in this paper were of enormous importance, and Niels Bohr had suggested them to some of the brightest physicists of the time. Some leading German physicists did experiments to confirm Saha's theory. This gave further boost to the theory.

In 1919, when Saha went to Europe for two years, he spent five months at the Imperial College in London where he had discussed his ideas with the leading astrophysicists William A. Fowler and Edward Arthur Milne. He then traveled in Europe, where he interacted with the giants of the time like Max Planck, Arnold Sommerfeld, and Albert Einstein. These meetings inspired him to establish scientific research institutions in India.

Natural phenomena are explained in terms of laws, principles, and equations in physics. We have Newton's law of gravitation, the principle of matter-energy conservation, and Bernoulli's equation for fluid flow. Other famous equations are Euler's equations (rotational dynamics), Maxwell's equations (electromagnetism), and Boltzmann's equation (thermodynamics). In astrophysics, we have Saha's equation. Saha is immortalized in physics through his equation.

Upon his return to India, Saha became professor of physics at Calcutta University. Because he did not find sufficient support for his work here, he moved to Allahabad, where he spent the next fifteen years. During this period, he developed great interest in ionospheric physics. As a scientific activist, Saha played a role in the Indian Science Congress, established the United Provinces Academy of Sciences, which became the National Academy of Sciences, and initiated the Indian Science News Association and the National Institute of Science. He started the journal, *Science & Culture,* which has published numerous articles on science in its social context.

During India's freedom struggle, Saha was among those who devoted their full attention to science and did not spend much time and energy fighting the British. Saha was not particularly sympathetic to the *khadi* movement in which Gandhi and his followers called for a boycott of British goods in favor of developing cottage industries. Saha and others feared this would slow down India's industrial progress.

After independence, Saha turned his attention to social and educational issues. He now worked hard to rid his people of ancient superstitions and time-honored astrology, though not very successfully. Under his leadership, an *Institute of Nuclear Physics* was established in Calcutta in 1950, which is now named after him. In 1953, Prime Minister Jawaharlal Nehru asked Saha to chair the Calendar Reform Committee to bring about uniformity among the thirty different calendars then used in India. Saha also served as a Member of the Indian Parliament for some time.

**Subrahmanian Chandrasekhar (1910-1995)**

When the ancients gazed at the constellations and imagined therein patterns like the scorpion and the swan, little did they suspect that someday astrophysics would provide clues as to where the material of our own physical bodies derived. After millennia of astronomy primarily concerned with the motions of planets and the periodic return of celestials, we learned to detect the composition of stars and the physical processes leading to their brilliance.

In the first decades of the twentieth century, scientists recognized what goes on in the deepest interiors of stars. Two of the pioneers in this were Walter Sidney Adams, who unraveled incredibly high densities of matter in the core of white dwarfs, and Arthur Stanley Eddington, who worked out a mathematical model revealing how stars eventually attain the so-called white-dwarf stage. Both these discoveries were made in the 1920s.

Questions still remained, such as how did the complex matter in the world around us, including our own bodies, arise? In which fantastic furnaces were the atoms of calcium, iron, and phosphorus formed? Today, any course in astronomy will tell us that matter in our solar system was created in the interior of certain massive stars, which became so hot and compressed that the sheer crush glued the protons and neutrons together and cooked up the heavier elements of the periodic table. This sounds simple and reasonable, but the thought and work, analysis, and exploration that led to this recognition was considerable.

A major step in reaching this understanding was taken by a nineteen-year-old who was sailing from Bombay to Europe in August 1930. The youth was Subrahmanyan Chandrasekhar. When Chandra applied relativistic physics to the problem that Fowler had attacked, he found something totally unexpected: there is an upper limit to the mass of a star that can eventually degenerate into a white dwarf! This discovery of what is now called the *Chandrasekhar limit* is crucial in explaining how supernovas arise and for unraveling how heavy elements are synthesized in their cores and spewed into space. Such matter condenses over eons into second-generation stars and planetary systems. It was not easy to bring this idea to the attention of the astrophysical establishment at whose pinnacle sat Eddington, who was regarded as one of the two people who had understood Einstein's relativity theory. The Upanishadic seers had said that our consciousness is a spark of the Cosmic Whole. Chandrasekhar's theory showed how our physical bodies arise from stellar dust.

More exactly, elements as heavy as iron are synthesized in the core of stars. Heavier ones are formed in the depths of supernovae. Chandra's work on white dwarfs using relativistic degeneracy is a major landmark in astrophysics. He is also recognized for his outstanding work on a variety of other topics, including radiative transfer, hydromagnetic stability, and perturbations on black-hole space-time.

Sometimes, in their eagerness to hold on to their own theories, scientists stoop to levels that are unbecoming. Such was the reaction of Eddington to the ideas of Chandra, a man almost thirty years his junior. So intense was Eddington's irritation that

he criticized Chandra's ideas beyond decorum in what seems like an unfortunate misuse of the prestige he enjoyed. Yet Eddington and Chandra remained friends for decades.

From 1936 to 1952, Chandra was the leading theoretical astronomer at the Yerkes observatory in Wisconsin, USA. There he did research, initiated projects, guided graduate students, and taught courses ranging from basic astrophysics and photometry to stellar interiors, stellar dynamics, galactic structure, and such. Until 1980, he was associated with the physics department of the University of Chicago.

Chandrasekhar took over the editorial reins of the prestigious *Astrophysical Journal*. As editor, he served his discipline with distinction. His high standards for accepting and rejecting papers occasionally provoked the displeasure, even the wrath, of some astrophysicists.

Most offers of academic position that Chandrasekhar received from India did not appeal to him. A time came when he and his wife had to make up their minds as to whether they were Indians or Americans by citizenship. This was a difficult decision, as it is for many first generation immigrants. In the end, they decided to take the oath of loyalty to the flag of the United States of America. After all, the melting pot was gradually becoming a tossed salad of various cultures and races.

The fact that coming from a non-Western culture he distinguished himself so eminently in the Western world makes Chandra's life story all the more interesting. His Hindu tradition exposed him to the epics, and his Brahminical affiliation molded his values in positive ways, which included the practice of vegetarianism. Yet he admitted to being an atheist. A physicist of his standing from some other faiths might not have gotten away with this in those days.

Chandrasekhar was made Fellow of the Royal Society and elected to the National Academy of Sciences; he received the *Padma Vibhushan* from the Indian government and many more honors. At the age of seventy-three, he received the Nobel Prize for physics. The Chandra X-ray Observatory, named in his honor, is one of a fleet of orbiting observatories enabling scientists to comprehend the structure and evolution of the universe better.

**Scientific Saptarshi**

As the Greeks had their Seven Wise Men (*hoi hepta sophoi*), in the Hindu tradition one had the *Saptarshi* (seven rishis). The seven eminent scientists sketched above may well be called the *Vijñána Saptarshi* of modern India. Just as there were many rishis beyond the esteemed seven, there have also been many scientists other than the ones listed above. But the Scientific Saptarshi were the pioneers who set the stage and the standard for science in India. Note that one was steeped in Vedánta, another in the history of Hindu chemistry, yet another was a pure mathematician—a genius whose mind soared in the realm of numbers and theorems—while another delved into the nature of *jyoti* (light) in the theoretical domain, and another in the practical. Two directed their interests to the status of stars, present and in the future.

Now I will turn my attention to three more physicists of the modern era as instances of how the newly evolved tradition of modern science has progressed in India.

**Homi Jehangir Bhabha (1909-1966)**

Today, India is among the nations that have reached a sophisticated level in the field of nuclear physics and atomic energy. Much credit for this is due to Pandit Jawaharlal Nehru, India's first prime minister. He had a deep understanding of the importance of modern science in today's world. The dedication of Homi Jehangir Bhabha also played a major role in the development of nuclear energy in India.

Homi Bhabha was born in a Parsee family in Bombay where he studied at Cathedral High School. He went to Cambridge in 1927 to become a mechanical engineer, but his interests turned to physics, and he studied at the Cavendish Laboratory, which was then under the direction of Ernest Rutherford. He received his doctoral degree in physics in 1935. Bhabha traveled to several research centers in Europe and met eminent physicists like Enrico Fermi, Wolfgang Pauli, and Niels Bohr.

In Cambridge, Bhabha was fortunate to do physics during an exciting period. His tutor in mathematics was Paul Dirac, one of the giants of twentieth-century theoretical physics. Bhabha's own work began with a paper on the absorption of high-energy gamma radiation by matter. The mathematical expression which he derived for the probability of positrons being scattered by electrons is now known as the Bhabha Scattering Formula. With Walter Heitler, he explored the mathematical aspects of cascade showers in cosmic rays. These are high-energy elementary particles discovered in the upper layers of the earth's atmosphere and are believed to have originated in the distant recesses of the cosmos.

In 1938, Bhabha suggested an experimental confirmation of Einstein's time dilation formula by studying the decay of muons in cosmic rays. This was a matter of great significance as the special theory of relativity, though mathematically elegant and conceptually beautiful, was still in need of experimental verifications; very fast-moving particles are not common. Bhabha's work in nuclear physics was also important. One of the mysteries of the atomic nucleus was that it contains particles (protons) carrying the same kind of (positive) electric charges, and yet it is extremely stable. One would expect the positive charges to repel one another. This problem led to the theory of *strong interaction*: a new kind of force that exists within the nucleus. In the mid-1930s, the Japanese physicist Hideki Yukawa developed a theory of nuclear forces, according to which nuclear forces result from the exchange of subnuclear entities. Bhabha suggested *meson* as the name for these particles which were previously known as *Yukawa particles*. It has been said that Bhabba's work during this period was significant enough to assure him a place in science history.

In 1939, when Bhabha was on vacation in India, World War II broke out. He took a job at the Indian Institute of Science in Bangalore where he came under the influence of C. V. Raman. In 1944, he suggested to a Parsee industrialist the idea of founding a research institution where only advanced physics would be taught and explored. The

result was the *Tata Institute of Fundamental Research,* which was first established in Bangalore and then moved to Bombay in 1945. Bhabha was also involved with the establishment of the Indian Atomic Energy Commission (1948), which was to become the Department of Atomic Energy in 1954. As he was a well-recognized and highly respected scientist in the international arena, he could accomplish a great deal in these projects. The personal esteem he enjoyed among Western physicists made it easier for countries like France and England to enter into nuclear collaboration with India.

Bhabha chaired many committees and headed many organizations. He served as president of the First International Conference on the Peaceful Uses of Atomic Energy (1955) and as governor of the International Atomic Energy Agency in Vienna. He was a member of the organizing committee of the Twelfth Pugwash Conference that was held at Udaipur in 1964 on the theme "Current Problems of Disarmament and World Security." It was appropriate at the time that an eminent Indian scientist played a role in the cause of peace in a world threatened by nuclear weapons. The eminent Polish physicist, Leopold Infeld, noted in his *Quest: An Autobiography* that "Homi Bhabha played an honorable role" in the discharge of his responsibilities to the international forum.

Bhabha was an Indian physicist and world citizen, but he was more than that. His love of culture extended to art and music, for though he was a lover and practitioner of science, he was no less a lover of life who indulged in whatever was best for the mind and the spirit. He played the piano and developed a taste for Western classical music. He was known to transmit his enthusiasm to those who came in touch with him. He was also a painter on canvases. His premature death in an airplane crash in 1966 was a grievous loss for India and for science.

**Ennackal Chandy George Sudarshan (b. 1931)**

Ultimately, the physical world consists of matter and energy that continuously transform. What causes these transformations? Physicists have traced all changes in the physical world to four *fundamental forces* or *interactions*. These are known as gravitational, electromagnetic, weak, and strong. One goal of physics is to reduce these to a single fundamental force, that is to say, to develop a mathematical theory that derives all the four from a single source.

For example, the theory of gravitation arose from an effort to explain the motion of the planets round the sun, of the moon round the earth, and the fall of an apple from a tree—all due to a single force. Or again, one tried to explain the attraction of a needle to a bar magnet and the flow of an electric current through a wire as due to one and the same force. This is known as the electromagnetic force.

E. C. G. Sudarshan is among the scientists who tried to synthesize the weak and the electromagnetic fields. His mathematically sophisticated result in this so-called electroweak theory is of paramount importance in twentieth-century physics.

Soon after completing his undergraduate studies in Madras, Sudarshan became one of the privileged few in India's newly emerging cadre of elite scientists at the

famous *Tata Institute of Fundamental Research* (TIFR) in Bombay. He interacted with and learned from some of the leaders in theoretical physics who visited the place. While still in his early twenties, Sudarshan developed mathematical techniques to estimate the masses of cosmic ray particles from experimental data. He critically examined John von Neumann's work on the foundations of quantum mechanics.

Among the visiting physicists to TIFR who were impressed by young Sudarshan was Robert Marshak, who invited him to the University of Rochester for doctoral work. Given the politics in bureaucratic setups, Sudarshan could not accept the offer right away, but he managed to go a couple of years later. His doctoral work served as a springboard for an important formula in elementary particle physics known as the *mass formula*.

In the course of his doctoral research, Sudarshan also made his fundamental discovery in the theory of the *weak interaction* mentioned above. He had a golden opportunity to present this work at a conference in 1957 that was convened by his advisor, Marshak. It was deemed inappropriate for a graduate student to present his work there, since that meeting was attended by many senior physicists of the time, including Nobel laureates. Later that summer, Sudarshan discussed his crucial idea with some other theoretical physicists of repute. His own insights, enriched by Marshak's, were presented finally in a conference in Italy; but before the proceedings of that conference were published, more or less the same results had appeared in print with some additional points, authored by Richard Feynman and Murray Gell-Mann.

In the course of his long and productive career, Sudarshan published innumerable papers and books. His first book, co-authored with Marshak, was an *Introduction to Elementary Particle Physics* (1961). This is one of the earliest books on the subject. It was promptly translated into French, German, and Russian. Sudarshan also put forward a theory that permitted the existence of faster-than-light particles called *tachyons*.

His work on the quantum interpretation of the coherence of light was so fundamental that another physicist, Roy J. Glauber, who explored it further received the Nobel Prize for it. Indeed, many physicists have wondered why Sudarshan was not recognized with the Nobel medal for two major contributions to physics.

In our own times, few Indian professors and practitioners of science have much attraction for the philosophies of their tradition. They are content and creative in their technical fields, and like scientists elsewhere, they would rather not venture into other domains. There are many good scientists in the Hindu world who go to temples and do their prayers and *puja,* sing heartfelt *bhajans,* and periodically renew their sacred threads; but generally speaking, they keep all this quite separate from their sciences. Likewise, modern scientists keep away from metaphysics. For many of them, religion is a matter involving rites and rituals, which may be enriching and meaningful but have little to do with science—whether theoretical or experimental.

However, Sudarshan, who is a scientist of stature in the world of physics, is also a thinker who has delved into Vedánta and Indian philosophy. He moves with ease among scientists and lay people alike, exchanges technical ideas with fellow scientists,

converses knowledgeably with philosophers, and has rubbed shoulders, metaphorically speaking, with sages and saintly men. He is also blessed with a sparkling wit.

His mother tongue is Malayalam. He was born in a Christian family, but he embraced Hinduism. He has been recognized in the world of science and also honored by the organizers of the *International Vedanta Conference*. He has written technical treatises in his field and also a most penetrating book called *Doubt and Certainty,* which probes into the nature of scientific knowledge.

Sudarshan has received many prestigious awards, from the C. V. Raman Award and the Bose Medal to the first prize from the Third World Academy of Science, the Padma Vibhushan, and the Dirac Medal.

**Vasudev Mangesh Kenkre**

Scientists in India come from every region. In the first stages of modern science—they were primarily from Bengal and Tamil Nadu, where the British established the first English-based universities—but today we have scientists from Kerala to Kashmir and everywhere in between. Therefore, I will conclude this series on Indian scientists—of whom there are many more than have been mentioned—with a note on a physicist from the Konkan tradition in Goa. Thus this scientist has a Portuguese-Indian background. He still recalls "the tall doors and long classrooms of the college buildings which were but the vacated edifices of the Liceu Nacional Afonso de Albuquerque, the beautiful trees in the quadrangle, and the dashing spiraling steps that dropped down to the Corte d'Oiteiro." He remembers having studied under teachers bearing such names as Antão, Vaz, and Lawande Jr. The name of this physicist is Vasudev M. Kenkre.

Kenkre's early passion was poetry and literature, and this has not left him even now. But a juvenile distaste for mathematics was transformed magically, drawing him to the hard sciences. He graduated with a degree in electrical engineering from IIT (Bombay), and then went on to do theoretical physics at the State University of New York, Stony Brook. After receiving his doctoral degree in statistical mechanics, Kenkre began to delve into condensed matter physics. Over the years, his fertile mind has drawn him to a very wide range of topics, always probing them with uncanny mathematical skill. In an age of extreme specialization when, as the cliché goes, a specialist knows more and more about less and less until he knows everything about nothing, Kenkre has been digging deeper and deeper into more and more subjects and knows a good deal about many things.

A mere listing of the fields in which Kenkre has worked and published papers could cause the head of the nonscientist to reel. It would be like reciting the 108 Upanishads to someone utterly unacquainted with Sanskrit or Hindu thought. His writings have dealt with such topics as nonequilibrium statistical mechanics, solid state physics, sensitized luminescence, and exciton-electron dynamics in molecular solids. He has explored cross-disciplinary fields such as photosynthesis and worked on unconventional topics of interdisciplinary interest like the statistical mechanics of granular materials and the

theory of sintering of ceramics under microwaves. He has worked on self-trapping, solitons, and nonlinear phenomena, the theory of scanning tunneling microscopy, nuclear magnetic resonance in confined geometries, transport of charges, excitons, and polarons, energy transfer and dynamic disorder in molecular aggregates, vibrational relaxation in liquids, fractals, master equation and random walk techniques, nanostructures, formation/tunneling of Bose-Einstein condensates, flow and stress distribution of granular materials, ecological systems, growth phenomena, and laser damage. Not many scientists in the forefront of any field have worked on so many different topics as Kenkre.

Traditionally, statistical mechanical methods are used to study atoms colliding with one another and transferring their atomic states. Kenkre has used these methods to study disease-bearing mice encountering other mice on the landscape and transferring infection (e.g., the Hanta virus). He uses nonlinear science and transport theory to investigate the motion and aggregation of animals (mice, birds, mosquitoes).

Perhaps, because of his early Portuguese connection, Kenkre was instrumental in founding *The Consortium of the Americas for Interdisciplinary Science*. This institution equally serves the cause of intercontinental science, for it provides a forum for scientists from both Latin America and North America to interact and collaborate. India could be proud that one of her sons helped found an institution that serves international scientific cooperation in a distant world.

Kenkre is a poet and philosopher too, and an enlightened thinker above all. He reflects on the difference between serious disagreements in the arena of science and conflicts in religious contexts with a touch of sadness:

> I am a physicist by profession. We are always engaged in conflicts about the way we think about the structure of a nucleus or the origin of a spectral line. Being human, we are unreasonably and egoistically attached to our convictions. We argue with passion. We rave and rant. But to defend or promulgate our beliefs, we never kill. And yet, the moment we divest ourselves of our scientists' hats and replace them with our religious trappings, calling ourselves a Hindu, a Muslim, a Jew, or a Christian, we become maniacal, homicidal. I have always been mystified by how this transformation occurs.

Not many thinkers speak out so frankly on this sorry state.

Another attribute of Kenkre, the physicist, is that he is an exceptionally good teacher and lecturer with great command of language, and great wit and humor too. Even while talking on a serious subject, he can inject an appropriate, lighthearted aside. One may notice this even in some of his scientific papers.

**Thoughts on Indian scientists and science history**

Ethnocentrism has been a characteristic of most great civilizations. Greeks, Chinese, Hindus, and Arabs all imagined themselves in their respective glory days to be unique in

some ways and perhaps superior to others. So during the first few centuries of modern science, many European thinkers imagined that they were the first to discover the scientific mode and that others had done little, if anything, in the field of scientific research.

At the same time, starting with the European Enlightenment in the eighteenth century, scholars began to probe into humanity's cultural legacies. From the untiring quest of such scholars, much of ancient history, from Greek and Egyptian to Chinese, Hindu, Arab, and Mayan science came to be uncovered from their long-forgotten relics. This is still a slow process.

The quest for the forgotten past has continued, not only through archeology, which unearths and reconstructs lost civilizations, but also by deciphering ancient scripts and translating fading manuscripts on leaves, parchments, and such.

The achievements in thought and deed of the people of India in science and technology were considerable. For the ancients not only invented wheels and pulleys, built towns and cities, constructed huge structures and buildings that have lasted for centuries, but they also initiated writing and counting, formulated laws and ethics, and reflected on the origin of the universe. We are descended not only from apes but also from sages and poets, architects and sculptors.

It is clear from the preceding pages that Indian scientists have been making significant contributions to modern science for more than a century now. In earlier centuries, European scientists traveled to Asia and Africa and South America, carrying instruments ranging from pendulums to telescopes to do their investigations. Today, scientists and engineers from India are in many countries, doing research in fundamental science and medicine and participating in engineering projects. Their work is published, cited, and explored further by the global scientific community. They have been recognized in the international arena in various ways, and their numbers are growing in every field. They serve to exemplify the truly international aspect of modern science.

Even while Indians were fighting for their independence and the world was engaged in a global war, a Council of Scientific and Industrial Research (CSIR) was established in India in 1942. This has grown to considerable proportions since independence. Today, India has numerous scientific laboratories and centers where research is routinely conducted on a whole range of problems, from the highly theoretical to the relevantly practical. Here work is being done by experts in fields from biotechnology, oceanography, and nuclear physics, to space exploration, environmental science, and more.

The government has been investing huge amounts of money in establishing universities, institutes of technology, and graduate programs which turn out thousands of young people with advanced degrees in science and engineering every year. When all the brain power of India is turned on to full capacity, the output can be fantastic. With all that, traditional worldviews and allegiance to the enriching aspects of traditions have not diminished.

# X. Science in Context: Debates within Transnational Civilizations

*Puranamityeva na sadhu sarvam, na chapikavyam navamityavadyam*
*Not everything old is good, nor is everything new bad.*

—Kalidasa

**On the History of History**

History, in the modern sense of the term, is fairly recent in humanity's long saga of cultural experiences. Tractable human history may at best go as far back as ten thousand years, during which period many painful and praiseworthy things have occurred, not all worth remembering. For many millennia, even after the invention of language and writing, careful accounts of what people in various regions of the world did were not always maintained as carefully, systematically, and faithfully as one would wish. Innumerable records, both explicit and indirect, of the past must have been lost. Many ancient authors did write histories and biographies with varying degrees of reliability. Some of these have survived and have helped us in the reconstruction of the past with the help of critical sciences. Sciences like archeology, radioactive dating, philological analysis, and genetics have also been enormously valuable here.

In the case of India, many precious biographical details about the spiritual, intellectual, scientific, and literary giants who made Indic culture what it is were either never written down or have been totally lost. Instead, antiquity and propensity for mythic visions have transformed many of those personages into semidivine characters with fantastic birth modes. So we have no reliable information on the lives and travels of the great rishis who composed the Vedas, of the authors of the epics and the puranas, like Valmiki, Vyasa, and Markadeya, of poets and thinkers like Tiruvalluvar and Tirumoolar, of Charaka and Sushruta, and countless others.

The enterprise of delving systematically into ancient history to bring it back to life began to emerge as a specialized discipline in the eighteenth century and soon gathered momentum. Most histories—national, global, modern, ancient, medieval, etc.—based on careful examinations of past writings and relics have thus come to be written in modern times. What distinguishes modern historiography from ancient ones is that now scholars venture into alien regions and write histories of other cultures and peoples, not just their own. While this has enriched the body of historical scholarship, it has had one serious drawback. Such histories are often tainted by unconscious biases, unintentional distortions, and unwitting errors. In a different way, the same may be said of attempts to write the history of one's own people; except that in this case, the biases and exaggerations tend to be on the positive side.

It is no secret that Western historians have often devalued the contributions of the non-West to science. However, in this context one must also recognize that Western scholars were the ones who brought to the world arena ancient science history. Interest in Chinese astronomy was initiated by European Jesuits like Antoine Gaubil in the seventeenth century. In 1821—thanks to Jean François Champollion and Thomas Young—Egyptian hieroglyphics were decoded. The foundations of Egyptology were put on firmer ground by James Henry Breasted. Goerg Grotefend's deciphering of cuneiform texts and Henry Rawilson's work on Behistun inscriptions considerably increased our knowledge of ancient Mesopotamian civilization. The Code of Hammurabi and the Ashokan pillars are among the countless treasures of the ancient world that have been resuscitated and now preserved in museums and elsewhere by the pioneering work of Western scholars.

In the later part of the eighteenth century and more so in the nineteenth, Orientalists explored the intellectual legacies of India, paving the way for Indology, the scientific study of all things in the subcontinent. By the end of the nineteenth century, it was realized that ancient Hindu thought was not confined to mythology and metaphysics, but extended to mathematics and the exact sciences as well. The decipherment of the Bákshali manuscripts by Augustus Hoernle revealed a host of arithmetical and algebraic problems in which Hindu mathematicians had been engaged. The names and works of Charaka and Sushruta were brought to the attention of the world in the nineteenth century by Horace Hayman Wilson and John Forbes Royle ("An Essay on the Antiquity of Hindoo Medicine"). Hendrik Kern did the same for Áryabhata I. The French chemist Marcellin Berthelot wrote a treatise on ancient Hindu chemistry. In the nineteenth century also, Jean-Baptiste Biot published his histories of Egyptian, Indian, and Chinese astronomy. There are many more. These contributions by Western scholars are barely known to the public at large and rarely even mentioned in the legitimate critiques of Western scholarship on the non-West. Not all the assessments of the Western scholars may have been correct, but their efforts provided the foundations for the multicultural visions of the sciences of the human family in different times and places.

**Ethnocentric Histories and Cultural Reaffirmation**

As biological entities we have species identity. But as a consequence of cultural differentiation and creativity, we have also developed ethnic and linguistic identities. This has resulted in the abundant richness of human culture in art and music, in poetry and philosophy, in dances and foods. Unfortunately, however, cultural and religious differences have also been at the root of mutual aggressions and convictions of one's own superiority. We have now reached a state in human history when, by and large, such feelings and expressions have been exiled from public arena, at least in some regions of the world, though the Internet-jungle abounds in these within closed groups.

A major achievement of the last century was consciousness raising at various levels, ranging from the evil implicit in racism and gender inequality to a proclamation of human rights for all the citizens of the world and respect for all religions and cultures. As a result, for example, there are powerful movements to eradicate caste discrimination in the Indian context, growing revulsion for the stoning of adulteresses in the Islamic world and using derogatory language toward people of African heritage in Euro-American countries. In the enlightened framework of our own times, every culture is to be respected for its intrinsic values and merits, and none is to be looked upon in derogatory terms. While self-criticism is fine, there are limits to the criticism of others. In the second half of the twentieth century, scholars came to realize that many previously written histories were by and large ethnocentric and often sectarian and political. Historians began to recognize that the nineteenth century *national* histories were for the most part *nationalistic* histories whose implicit goal was to glorify the conquests and achievements of one's own people, sometimes denigrating others at the same time. As Patrick Geary put it strongly in *The Myth of Nations*, perhaps with some exaggeration, such histories turned one's "understanding of the past into a toxic waste dump, filled with the poison of ethnic nationalism, and the poison has seeped deep into popular consciousness." This reveals how difficult it is to write cool-headedly even about history.

In the present age of rapid globalization, all cultures and civilizations are seeking to reaffirm their individuality and integrity after more than two centuries of European colonialism. The West should never forget that colonialism included political oppression, economic exploitation, and cultural marginalization of the non-West. In the post-World War II period, after the dismantling of European colonies, erstwhile colonized peoples sought to assert their dishonored dignity and celebrate their cultural integrity. The languages that dominated scholarship in history, science, and advanced learning were primarily English and French—the languages of the colonial oppressors—and they still largely are. Eurocentrism continued to color commentaries on indigenous non-Western cultures and languages. Sinocentric, Islamocentric, Nippocentric, and Indocentric histories are also there in various other languages; but these are generally not easily accessible to people beyond specific linguistic and cultural boundaries. Therefore these non-Western ethnocentric histories are relatively

immune to attacks and protests that books in English or French are exposed to, because they do not command worldwide readership. At the same time, the injustice in the continued domination of English and French, the elite cooptation by these cultures, and the ethnocentric bubble that the majority of people inhabit are not helpful in the new world that is being shaped.

The reaffirmation of ancient cultures is important and welcome in the newly awakened world. In this context, it is important to study and recognize the discoveries and inventions of Indic civilization and give it its due place of honor in the history of humanity's heritage. In the fields of medicine (Ayurveda, for example), psychology (yoga and meditation), and overall values that have impact on other people (tolerance and multiple paths for spiritual fulfillment), such recognition can lead to positive results. But it is not likely that emphasis on Bengali physics or Gujarati chemistry or Hindu metaphysics can take us too far in such positive sciences.

**Errors in Appraising Science History**

In our efforts to recapture the past in the context of the present, especially regarding science, it is easy to fall prey to three kinds of errors which could arise in our evaluation of scientific achievements.

The first is *temporal* error. It consists of the impression that in scientific understanding our present generation is somehow superior to all previous ones. This idea of sixteenth-century European exceptionalism in science was common among the original thinkers of the time, at the dawn of modern science. To Francis Bacon, for example, the ancients were all immature. Medieval thinkers had been wasting their time, he wrote, with "the borrowed light" from Aristotle. René Descartes declared there was little to be gained from a study of the ancients who had been consistently wrong on all matters scientific. It is very difficult to avoid this error which arises from the conviction that we have at last discovered the truth that had been hidden from the clouded minds of distant generations.

In our discussions on Indic science we have seen that though the details of the results arrived at by ancient Hindus are not quite the same as of modern science, the thinkers in the Indian past were no less keen, certainly not any the less in their intelligence or creativity within the informational framework in which they lived. In matters relating to the human mind and in the application of their worldviews to everyday life to achieve the practical goal of obtaining inner peace and harmony, they had indeed been enormously successful.

The second kind of error is *cultural error*. It attributes the capacity for investigative knowledge (science) to particular cultures. At one time, the Chinese thought they alone did science, Hindus thought likewise of themselves, as did the Greeks and the Arabs in their turn. Practically all ethnic groups still feel this way with respect to religious truths: that their religious tradition alone gives us the Truth about the beyond. This is a universal cultural error with potential for many negative attitudes and behavior. Not so

long ago, some European thinkers seriously believed that science was not just a Western achievement, but indeed a unique Western capability. This scientific exceptionalism of the West is not unlike the spirituality exceptionalism of Hindus who believe that theirs is the chosen culture for spirituality. At one time many European thinkers were quite sure that no science existed before Galilean-Newtonian successes. This view is still there when one uses the epithet *Western* for *modern* science: a trap into which many non-Western cultural patriots also fall when they talk about the superiority of Vedántic worldview over Western science, for example.

Even within Western culture, some used to hold that clear rational thinking (*l'esprit cartésien*) was an essentially French *forte*, others that empirical skill is primarily British, yet others that true science requires the keen mind of the Aryan (Germanic) race. Such prejudices are likely to persist until non-Western peoples make significantly more substantial contributions to modern science than they have done thus far. This should happen in the course of the present century, especially since countries like China, Japan, South Korea, and India are investing considerably in scientific research, and many scientists from those regions have moved into the West where they have become truly members of the international scientific community.

Finally, we are all susceptible to what I call *nostalgic error*. This is of more recent vintage. It is the belief that some ancients were already aware of the latest findings of current science. It is based on the conviction that the sages and holy books of one's own religion articulated truths revealed by higher powers to extraordinary individuals who were thus made aware of the results of current science. This conviction prompts many in the non-West to keep resurrecting the worldviews of their distant ancestors, not so much for unraveling the wisdom, interesting perspectives, and thoughtful reflections they embody—which are many—nor to savor and appreciate the penetrating philosophical systems and meaningful metaphysical visions that have breathed life and joy into civilizations that have grown over the centuries, but to prove to the rest of the world that their ancestors had uncovered currently known scientific results millennia ago which they had expressed in symbolic modes.

My discussions in these pages, while recalling and respecting the many great truths in an extended sense recognized by the keen minds of India, are not meant to prove that the ancient systems contained modern scientific truths. I believe it is possible, indeed important, to celebrate the achievements of past generations without claiming them to be the same as some of the discoveries of modern science.

**Our Ancestors and Modern Science**

The achievements in thought and deed of ancient civilizations were impressive and of far-reaching impact. But the science we are engaged in today is different from the science of past ages in many important ways. In content, methodology, and framework, it is not the same as ancient science. Most importantly, modern science is essentially universal, resting on what many thinkers over the centuries have described as *Universal*

*Reason*—a concept that has been reiterated in recent years by William Grassie and others. The dismissal of universal values and universal truths in postmodernist thought is among its more negative doctrines. Ancient science was rich, insightful, and meaningful in its time. But every ancient science was a function of culture, creed, and reason. It varied from region to region, from people to people. The expressions of ancient science were by and large human-centered. They regarded the world in terms of the human presence in it, they sought explanations that were analogies to the human experience, and invariably they had affiliations to specific religious traditions. None of this is to diminish their value in so far as they served the people, but it would be intellectually naïve to hold on to ancient worldviews as a matter of cultural pride. We live in a very different and interconnected world, inevitably marching toward a global society which has been made possible largely because of the physics and technology of the past few centuries.

Science is much more than a body of useful information. It is the effort of the human mind to interpret the world. The paths by which we have reached our current evolving knowledge are as relevant and interesting as the knowledge itself. Then, too, an awareness of the sheer changeability of scientific worldviews can guard us from the illusion that we have finally arrived at all the right answers. One effect of the study of the history of science could be to shield us from excessive self-congratulation in the context of our current scientific achievements.

**Postmodern Attitudes to Science**

Until India's political independence from the British, most Indian scholars and intellectuals went along with the Western approach to the history of science in which one sees modern science as a gradual development from medieval thought, stirred by discoveries of ancient worldviews and achievements. But they also realized that modern science was a significant break from ancient methodologies for the acquisition of knowledge and acceptance of ideas. They recognized that modern science has led to countless essentially new results and worldviews absent in ancient times.

But things have changed from yester-century views of science, not so much among Indian scientists, as from a growing number of new scholars. Inspired by postmodern Western thinkers who challenge the hegemony of science in the realm of human inquiry within Western philosophy and also as reaction to the cultural marginalization suffered by the non-West in the colonial era, two new movements have gained strength in India. Incidentally, these have sympathizers, supporters, and instigators in the West also. In some ways the two new theses oppose; in other ways they complement each other.

The first of these recognizes that the scientific spirit has always been there in the Hindu world, and that what impeded the growth of the scientific spirit in India was superstition. "The world is fettered by the chain forged by superstition and ignorance. I have come to snap asunder that chain and to set slaves at liberty," wrote the dynamic

and pioneering thinker Swami Dayananda Saraswati in the nineteenth century. But this great thinker was also subject to what I described above as nostalgic error. He was the inspiration behind the school which contends that ancient Hindus had come upon modern scientific results by modes which are as yet beyond the comprehension or reach of the West, indeed of all so-called moderns.

An extreme version of this view states that the Vedas and other sacred writings contain everything there is to be known, both spiritual and scientific. One eminent religious teacher stated that "the authority of the Vedas is unchallengeable and stands without any question of doubt. And whatever is stated in the Vedas must be accepted completely, otherwise one challenges the authority of the Vedas." This may be a perfectly valid position to take in the context of spiritual inquiries, but it goes against the very foundation of the scientific spirit.

Today some Hindu apologists write books to the effect that the quark model is implicit in a Vedic hymn. Enthusiasts in other traditions engage in similar nostalgic exercises asserting that contemporary science is merely rediscovering the truths enshrined in their scriptures. At least one Jewish scholar claims that the Book of Genesis contains a coded version of the theory of relativity. Some Muslims try to validate the Holy Qur'an by arguing that it contains nuggets of modern physics. Such claims by the faithful of traditional religions do not explain why those insights did not lead to anything like what modern science has been able to accomplish, let alone to the technological inventions that have ensued from modern scientific knowledge. But one does not pose such inconvenient questions; indeed it is inappropriate to do so. It is no surprise that all the protagonists of traditional religious worldviews (Hindu, Christian, Muslim, etc.) are of one mind when it comes to decrying and rejecting Darwinian evolution.

The other school subscribes to the Paul Feyerabend thesis to the effect that rationally derived knowledge is not the only valid kind of knowledge. It goes on to argue that quest for so-called objective knowledge could even be unhealthy for society. Antiscience reflections have been there all through history. While the anti science philosophers enjoy the freedom to talk and publish their great ideas in lectures, articles, and books and take full advantage of the technology made available to them by the objectivity-obsessed, methodology-bound scientific enterprise, beyond providing fodder for fellow philosophers to comment upon or contradict their anti science theses, they have generally contributed little of noticeable consequence for the advancement of human knowledge about the world in which we live. But they have aided semi-scientifically literate thinkers the world over who are eager to dethrone science from its success-ridden appeal and power. Some postmodernists not only challenge the claims of science to the effect that its methodology leads to coherent and consistent interpretations of phenomena, but also argue that modern science was a carefully constructed ruse whose hidden goal was/is to subdue and conquer the non-Western world. This postmodernist naïveté that science is a clever concoction of colonizing Europe for exploiting Africa and Asia is reinforced by postcolonial thinkers in the non-West as well as in the West. The denigration of "Western science" and the

promotion of various ethno-sciences have turned out to be a soothing, though by no means fruitful, ideological tool in postcolonial societies trying to reassert themselves, besides providing fodder for papers presented in conferences.

A number of Indian writers have joined the chorus whose refrain is that modern science is only one of many equivalent modes of uncovering the nature of things. Other modes, such as were preached by ancient thinkers or revealed to Hindu rishis and to Jewish and Muslim prophets, are said to be equally capable of unraveling the secrets of the physical world.

In this context, some liberal Western intellectuals adopt a patronizing posture by arguing that respect must be shown to the non-West by allowing it to continue with its own versions of science, which is in content no different from the science that prevailed in medieval and ancient Europe. In a paper read at an international conference, the speaker said that the views of certain Pacific islanders to the effect that their island had been created by their God as a special gift to them was being dismantled by Western intruders who were teaching the natives about plate tectonics. This, she said, was an instance of the imperialist arrogance that has always been a trait of Western Man. What is objectionable in this broad-minded and well-intentioned assertion is that these postmodern and postcolonial thinkers appropriate the modern scientific worldview and the capacity for practicing modern science to their own (Western) culture and relegate the premodern ones forever to non-Western ones. It is amazing and unfortunate that many non-Western thinkers fall for this. This is somewhat like a Hindu in the twelfth century who, while using the decimal system for himself, praises the Romans for their fascinating number system which uses the letters of the alphabet and urges them to continue with the same. The fact of the matter is that the decimal system is Hindu only in its geographical-cultural origin, not in its appeal or applicability. So is modern science: Whether she is Hindu or Arab, Chinese or Nigerian, once introduced to it, a scientist becomes a member of a panhuman community. At the intellectual and inquiring level of science, there is more in common between an Arab and a Norwegian physicist or between an Indonesian and Texan chemist than there is between a twenty-first century Frenchman and his peasant compatriot or twelfth-century ancestor.

These two forces—one claiming or proclaiming that the results and worldviews of the so-called Western science had already been discovered by ancient Hindus, Christians, Buddhists, Muslims, or whoever, and the other rejecting Western science as no more than a cultural construct—are mutually incompatible. For if the findings of modern science are simply local constructs with no universal content or validity, how could these have been independently discovered millennia ago in altogether different cultures? Therefore, the groups are not always sympathetic to each other.

A careful reading of the two theses reveals, as often happens when radical extremist positions are examined, that there are grains of truth in both. It cannot be denied that when one studies the philosophical and metaphysical treatises of ancient India, fascinating and profound insights emerge. As we have seen, many of these have interesting similarities with some of the findings of modern fundamental physics, especially those relating to the subject-object interface and

to the interconnectedness of entities in the universe. It is intriguing that at least some interpretations of quantum physics seem to resonate with certain Upanishadic aphorisms, and some number patterns in Vedic hymns and altar construction do correspond to periodicities in the skies.

Likewise, there is no question but that the West had engaged in systematic exploitation and oppression of the non-West ever since its age of exploration began as other invaders had done in earlier eras. It is also true that there are other modes by which different kinds of experiential insights may be gathered. But from all this to conclude that investigations in mathematics, explorations in astronomy, formulation of the theory of evolution, studying the neuron, discoveries in genetics and geophysics, probes into the atomic nucleus, trying to verify the existence of the Higgs boson, and other pursuits of modern science are just schemes by the hegemonic West to perpetuate its hold on its colonies is a bit much, not to say absurd, to many thoughtful people, whether in the West or in the non-West.

Those who share the view that science is a transnational enterprise of validity and value that could benefit all humankind reject the notion that the scientific enterprise is a conspiracy intended to exploit. More seriously, they would be concerned about such a myopic vision of science because, if adopted, it would keep the non-West forever in a state of relative backwardness in the field of creative and productive science, if not in technological advances which call for only faithful imitation and monetary investment. Fortunately, those who condemn modern science, inspired as they are by Western postmodern philosophies, have no more than voicing-their-opinion status in emerging countries. They are not at the helm of affairs in universities and research centers in Asia. That is why these countries have been making significant advances in science in recent decades, in spite of the twisted views on modern science entertained by some of their thinkers.

As noted above, a generation or two ago, the thesis of the nonuniversality of modern science did not exist in India. If such had been proposed, many Indian scientists would have laughed it out of court. But not so today where the chorus is "anything goes or should go." There are at least two reasons for this. One is that, as in the West, the vast majority of productive Indian scientists, both at home and abroad, are too engrossed in their various specialized disciplines to argue with philosophers, historians, and cultural chauvinists who venture to comment on science with but little experience in *doing* science. But the silence of the scientists can be dangerous because retrograde anti-modern-science noises are becoming more and more loud. If allowed to grow unchallenged, they have the potential for impeding India's scientific advancement. They have greater appeal because all too often they are also psychologically satisfying. The second reason why scientists in the non-West prefer to hold their tongue on these matters is that any challenge to the comforting ideas denigrating "Western science" would be branded as a defense of Western hegemony and as a servile support of the enslaving West, which has not only exploited us materially and economically, but continues to do so culturally by poisoning our

minds with notions of Western superiority. So it is not surprising that active scientists tend to keep quiet on these issues.

**Prophets Facing Forward**

In the very last year of the twentieth century, Hindu traditionalists, backed by the then-in-power Indian government, began to demand that astrology be made part of the science curriculum in India, giving it the fancy name of *Jyotir Vijñana*. Knowingly or unknowingly, they had their conservative counterparts in the United States, where scientifically ill-informed Christians were making a move to introduce creationism in disguise as part of biology courses in the country. Indian scientists were furious when traditionalists tried to instate astrology on par with astronomy in the curriculum. The matter went through the courts; and eventually the supreme court of the modern nation of India, much to its credit, rejected the petition and described the move as "a giant leap backwards, undermining whatever scientific credibility the country has achieved so far." This bodes well for science in India in the twenty-first century.

Meera Nanda is one of many articulate Hindu intellectuals who speak out against culture-instigated commentaries on science. She is among the modern Hindu thinkers to recognize the dangers in these movements. In a book entitled *Prophets Facing Backward*, she wrote:

> Any erosion of the dividing line between science and myth, between reasoned, evidence-based public knowledge and the spiritual knowledge accessible to yogic adepts, is bound to lead to a growth of obscurantism dressed up as science. It is time secular and self-proclaimed leftist intellectuals called off their romance with irrationalism and romanticism. It is time to draw clear boundaries between science and myth, and between the Left and the Right.

In her enthusiasm for the scientific worldview, as well as in her fears, legitimate or exaggerated, that Hindu thinkers are passionately reasserting their cultural heritage, Nanda sometimes overstates her case, transforming a commendable advocacy of modern science into invectives against traditionalists. She fails to see that Neo-Hindu movements have been instigated by what is often justifiably perceived as threats to Hindu security within India. In any event, whether one agrees with her views or not, it is good that different perspectives are heard and permitted in India, for great civilizations are known to have stagnated and become warped and rotted when dissenting voices are silenced and stifled.

Or again, Jayant Narlikar, a modern Indian astronomer of considerable international stature, wrote boldly in a popular daily, after mentioning the eighteenth-century European expeditions to countries in different latitudes,

> What makes me rather uneasy is the fact that history has no mention of any local Indian astronomer taking part in such studies. The reason may be well and truly simple: there was none. Why? As for total or partial eclipses, there may have been a religious ban on watching transits. Or there may have been no awareness of the forthcoming event. Or more simply, the urge to go and watch something unusual in the sky was not there. The first of these reasons indicate the prevailing superstitions; the second one shows a lack of competence in astronomy, while the third and the most serious of them was indicator of a state of mind that lacked the basic scientific curiosity. Indeed, why otherwise no native observer felt the need to come out of the house in broad daylight to observe an event that had attracted foreigners despite hazards and uncertainties of travel over thousands of miles? (Deccan Herald, 24 November 2010)

Perhaps more scientists need to speak out in this tone.

It is important to mention here that several organizations have been established in India that foster skepticism, humanism, atheism, rationalism, and—above all—respect for modern science. Their goal, like that of the ancient Chárvakas, is to rid India of the countless superstitions and unscientific beliefs that still numb the minds of millions in the emerging country which holds all the promise for becoming a world leader in the twenty-first century. In 1997, a number of them gathered at a conference and formed the Indian Rationalist Association. It will be a long process, but there is reason to believe that these organizations will eventually have a positive impact and transform Indian society into a scientifically informed society, rid of unscientific and pseudoscientific intoxicants. One can hope that this will be done while still maintaining India's spiritually elevating, culturally meaningful, and aesthetically rich heritage. The adoption of rationally sound views and enlightened values need not imply a total repudiation of time-hallowed values and reverence for Mystery, as I have tried to argue in this book. There is more to being fully human than devotion to the scientific framework alone, and less to being fully human if one is indifferent or impervious to the worldviews of modern science.

**Multiculturalism**

Multiculturalism is a stage of humanity's historical awakening in which the peoples of the world are coming to recognize that all the cultures and civilizations of the human family, of the present as of the past, have their intrinsic value and beauty. From the sands of Mesopotamia, which was one of the cradles of human civilization, to the spiritual empire of India which probed into the mysteries of human consciousness; from the Chinese sense of harmony with the world and the imposing majesty of the pyramids to the once-vibrant richness of Mayan and Aztec civilizations, there is a

magnificent range of thoughts and accomplishments, of insights and frameworks which have breathed life and feeling in a wide spectrum of human cultures. Through these expressions, the human spirit forged many particular ways of recognizing and reckoning the world, giving meaning to human existence and achieving an impressive variety of material and moral ends. There is glory in the myriad expressions of art and music, of poetry and philosophy, of myth and creativity.

Even as every biological species must be saved from extinction, every language and tradition which has evolved over the centuries and millennia deserves to be nurtured and respected. Each one of them needs to be studied and understood, preserved, and protected for the further enrichment of one and all. Multiculturalism may thus be looked upon as a call to recognize the variety and splendor in humanity's heritage.

The genesis of modern multiculturalism, however, has a negative side. Multiculturalism arose in the aftermath of the gradual removal, after more than three centuries, of the dominance of Western nations in the affairs of the world. Aside from erasing some ancient cultures, in every region of the world where "Western man" made his appearance since the close of the fifteenth century, he exploited natural resources, subjugated the peoples, introduced his newfound technology, and consciously or unwittingly initiated them into his worldviews. His victims are angered by his subjugation, hate him for his exploitation, benefit from his technology, and do not know whether to thank or condemn him for the worldviews he ushered in.

When Westerners intruded into their lands, the peoples of Asia, Africa, and the New World were not without language or culture. Over the centuries they had created art and music, propounded philosophy and poetry, contrived crafts and inventions, which, though not as well known beyond their own borders, were no less mature and significant than their coeval European counterparts. They had also evolved their own science and technology, as the West had done in its pre-Galilean-Newtonian phase. Not simply ancient Greeks, but Egyptians, Babylonians, Chinese, Hindus, Mayans, Arabs, Africans, and Aztecs, all had inquired in the nature of things; and all had formulated their own theories about life and the material world. Furthermore colonizing nations benefited immensely from the importation of agriculture and farming tools. Imagine Europe without corn, rice, potatoes, squash, tomatoes, and innumerable spices.

If the freedom movements in the colonies of Asia and Africa were provoked by the physical violations of Westerners into the rest of the world, the demand for multiculturalism was a rebellion against their intellectual arrogance. Thus, commendable as the concept is, its genesis was under unhappy circumstances. Moreover, one utterly unexpected result of the emergence of multiculturalism is this: the victims of Western intrusions are recuperating from the jolts they received and are affirming their national and ethnic identities. At the same time, Western nations, by virtue of their post-World War II multiethnic immigration and demography, are gradually losing their own time-honored cultural specialness. Large sections in France and Holland, England and Germany, the United States and Canada, for example, are no longer peopled by men and women who identify themselves emotionally and

ethnically with the cultural roots of those nations. The implications of this have not yet worked out fully. I recall a Lebanese American lady once ask rhetorically in a TV interview, "Why should I celebrate Thanksgiving Day?" There was a time when French children used to be taught *"Nos ancêtres les Gaulois"* (Our ancestor, the Gauls). One cannot teach this anymore to millions of children in France who do not identify with the vast majority of the people. Today the phrase is just the name of a restaurant in the heart of Paris. Likewise, in India there are citizens who protest the singing of "Vande Mataram" and resent the nation being called Bharat.

As with microorganisms in the human body, when alien cultures seep into a culture and become part of it, they may become symbiotic, contributing to the health and wellbeing of the culture where they have found a new home; or they may become parasitical, working toward the destruction of the body into which they have come. One can never tell what the future holds. But this very uncertainty is causing a malaise that has potential for explosion.

**Foundations of Ancient Civilizations**

The material foundations of ancient civilizations were craftsmanship and ingenious devices. These ranged from plowshares and windmills to carpets and sculptures. Their intellectual foundations were primarily religion, philosophy, poetry, and mythology, which gave rise to lofty thoughts, deep insights, sublime works of creativity, and meaningful legends. Their norms and values derived from sacred texts. The Vedas and the Bhagavad Gita, the Ten Commandments and the Sermon on the Mount, the Holy Qur'an and the Hadith are the roots of the ethical frameworks that inform traditional societies. It would be hard to deny the role that religions have played in shaping culture, civilization, and worldviews.

On the other hand, the material basis of modern civilization is sophisticated technology, deriving from ever-advancing physics, chemistry, biology, and mathematics. What this means is that if any nation wishes to be part of the modern world, no matter what its philosophers say about the questionable nature of scientific knowledge and no matter what its religious leaders proclaim about the road to reality and salvation, the nation simply has to take modern science seriously and instruct its schoolchildren and university graduates on the results of modern science. Paying homage to ancient visions may be fine for cultural reasons and religious enrichment; but no nation—Hindu or Islamic, Jewish or Buddhist or whatever—can afford to ignore modern science as a subject to be seriously taught to at least a section of its citizens.

It is equally true that if the intellectual foundations of most modern nations have to be closely linked to the modern scientific worldviews, its values and norms need to pay attention to the Enlightenment that flowed almost as a corollary from modern science. To appreciate its importance, let us recall that in the ancient world most ethical systems had to do with individual behavior toward fellow members in a community or society. One seldom spoke of attitudes toward members of other groups in positive

ways. The Vedic prayer for the happiness of all people on earth (*loká samastá sukhino bhavantu*) is unique in this context. A major element in post-Enlightenment values relates to how one group should deal with other groups. Associated with this are such ideas as human rights, gender equality, respect for other groups, freedom to express one's views on any topic including the government in power, freedom of the press, and the like. Some of the current tensions in the word arise from differences as to whether and to what extent such values should be regarded as universal. What is plaguing the world is not a clash of civilizations, but a clash of worldviews.

This clash of worldviews has two components. One relates to the interpretation of natural phenomena and the other to convictions relating to the existence of domains beyond matter-energy and the physico-chemical. As to the first, there is no question but that modern science has been triumphant at the explanatory level and that it far surpasses anything that traditional views have been able to achieve. Ours will certainly be a more awakened world if and when religious people of all traditions concede that modern science is more reliable than ancient religions in the matter of explaining the physical world. On the other hand, when it comes to spirituality, human-centered meanings, experiential ecstasies, and awe in the presence of the unfathomable mystery of human existence, the adamant stance of materialist scientists, if not of science itself, is hardly satisfactory to the vast majority of people. Such scientists tend to derisively repudiate everything religious, explain away love, self-sacrifice, and compassion in terms of evolutionary psychology, and reduce visions of transcendence to alterations in brain chemistry. It is important for the scientific establishment to understand traditions as deeply etched cultural genealogy, and grasp the religious thirst for connecting with the cosmos as trans-rational dimensions of being fully human. It is only through mutual appreciation of divergent worldviews that one can avert an eruption of their clash into something more ominous than what we have seen before, and transform them instead into mutually enriching and harmonious perspectives for humanity at large.

Modern civilization is not better than ancient ones on any absolute standard, any more than that the ancient ones were intrinsically superior. But many of the insights and material elements of the modern world were formulated only in recent human history. Even with the much narrower visions they had about nation, race, and creed than we are privileged to have in our own times, the early thinkers of the Enlightenment sowed the seeds for some of the happy and wholesome elements in today's world.

**Predicament of Non-West**

In this context, non-Western peoples face a serious predicament: Accepting modern science and its offshoots of technology, and liberal secularism seems at the face of it to be equivalent to embracing Western values. But rejecting them altogether is neither possible nor realistic and would grievously affect their status in the modern world. Even anti-Western cultural patriots in many nations have to rely on telephones

and airplanes, vaccines and pipelines, e-mails and computers, and a lot more of Western vintage if they wish to survive and compete in the modern world.

At the same time, there has been in Western societies a gradual awakening that the West has committed outrageous moral transgressions and embarrassing intellectual errors in the past few centuries. The moral transgressions lay in ruthless appropriation of lands and minerals that properly belonged to others and the infliction of political domination over them. The intellectual blunders related to attitudes arising from the belief that the subjugated peoples were without culture or civilization. Thanks to sensitive and enlightened scholars, the cultural superiority assumed by Europeans of earlier centuries has been revealed to be baseless.

We are reminded here of the famous Roman censor Marcus Porcius Cato (234 BCE-149 BCE) the first author of a history of Rome. Like many leaders of the Hindu renaissance, he staunchly defended traditional Roman virtues. He felt that Greek culture was invading Rome, and in his view it was "morally degenerate," not unlike how spiritual Indian thinkers consider the materialistic West. His antipathy went so far as to expel Greek philosophers from Rome. And just as Hindu Anglophobes continue to speak English, Cato himself used Greek words and concepts in his speeches and writings. With all that, or perhaps because of that, Latin literature was much indebted to him for its efflorescence. So, too, it is entirely possible that anti-English Indians may be a useful catalyst for the further development of Indian languages and, paradoxically, also Indian science.

**The Dimensions of Culture**

It is true that modern science and modern enlightenment arose in the European cultural matrix, just as writing first began in Sumeria, gunpowder in China, the notion of zero in India, coffee in Ethiopia, etc. However, as I have noted a few times before, it seems to be rather difficult for some to realize that science and enlightenment values are ultimately no more European or Western than *zero* is intrinsically Hindu. The identification of modern science and Enlightenment with Western culture is one of major conceptual blunders of our times. The other side of this anachronistic perception is that spirituality is unique to India, as if there had been no Christian mystics or Jewish Kabala or Islamic Sufis. Such dichotomies may have been appropriate in the nineteenth century, but not any more.

It is possible that such parochial perceptions will be erased from the collective psyche of humanity in the course of the present century. The explanatory dimensions of premodern scientific cultures—and that includes medieval Europe and ancient Greece—must be preserved as part of humanity's heritage rather than for accommodating them into the framework of modern science. It must be remembered, especially by non-Western intellectuals, that within Western culture also, demands to hold on to premodern scientific models of the world still persist in many quarters. Such longings for the past need to be replaced in the interest of a better-informed

humankind. Indeed, it is fair to say that if the ancient philosophers of various cultures were to reincarnate in the modern world, they would be the first to call for revisions of their former views; for they were not rote repeaters of what their own ancestors had said, but keen, original, and intelligent thinkers themselves. The author of the Book of Genesis would probably revise the text as: "God said 'Let there be electromagnetic waves, and there were electromagnetic waves.'" And the author of a Purana would probably reformulate the Brahmánda idea in terms of the Big Bang.

Therefore it is worth repeating that the explanatory dimension of science transcends national, racial, and religious boundaries. The ancient myths and visionary accounts of cosmogenesis and anthropogenesis of all cultures must be retold and enjoyed, not for their literal truth content, but for their poetry and symbolism, and also because they remind us of how our distant ancestors pictured the world. But they are anachronistic if taken as part of the belief system in the modern world. Better-informed sections of humanity have little choice but to accept the explanatory structures provided by modern science because they are consistent, coherent, rational, and useful.

The moral dimension of culture usually springs from various religious traditions. It maintains order and sustains societies. Most of all, in the modern world the ethical dimension should include responsible behavior toward the world at large, both human and ecological. Unfortunately, sometimes it also includes elements which, like dusty and worn-out furniture, are no longer useful, appropriate, or desirable. These elements need to be urgently cleaned up or discarded. The goal of all ethics is to tame our aggressive tendencies and control our animal instincts. The moral dimension must bring out the best in us as human beings by encouraging compassion, caring, and respect for fellow human beings, injunction which are part of many traditional religions. Indeed, many ethical insights of ancient cultures deserve to be preserved, not only because they carry the weight of traditions, but also because they embody the wisdom of the ages. At the same time, traditional practices and beliefs that are at odds with the best values and epistemic framework of the modern age must be appropriately modified.

The aesthetic dimension of culture infuses civilization with charm and color, beauty, splendor, and delight. Every generation takes pride in its cultural heritage. Indeed, this is what distinguishes it as a unique flower in the bouquet that is humanity's collective cultural garden. The aesthetic dimension includes the best in art, music, dance, poetry, architecture, and such. These differences must be preserved because they represent the best creative expressions of the human family. Each new generation contributes to the culture that has been handed down to it; the aesthetic dimension is, as noted earlier, like a magnificent mansion to which one continually adds new rooms and furniture. It is this dimension of cultures that must be nourished, cultivated, and shared by all of us. Fusion in these may be good up to a point, but one would hope that the historical uniqueness of cultures will not be blurred into a seamless homogenization of cultures that is being created by multicultural enthusiasts, who sometimes blend the rich variety into amorphous and rootless blobs.

Those who embrace the explanatory modes provoked by modern science may be called the *moderns*. Those who cling on to the premodern scientific explanatory modes may be called the *traditionals*. Those who have been awakened to the broader values of equality, justice, humanity, etc., are the *enlightened* ones. Those who reject the moral elements emerging from the enlightenment, such as human rights, gender equality, tolerance of opposing ideas, rejection of racism and caste-hierarchy, etc., may well be called *reactionaries*. Finally, those who value, enjoy, and appreciate the aesthetic dimensions of their own culture, in music, art, literature, dance, festivals, food, etc., and of some others too are the truly *cultured* people of the modern world.

In every society there are moderns and traditionals, enlightened and cultured people as well as reactionaries and uncultured ones. One may hope that, with sufficient education and awakening, all the peoples of the world will eventually incorporate the explanatory framework of science and the moral framework of religion, which do not belong to East or West, North or South.

**Concluding Thoughts**

India is a land with an incredible variety of flora and fauna, a lush tropical world that has fostered the growth of countless birds and animals and insects. Its landscape is variegated with plains and valleys, mountainous slopes and lofty peaks, lakes and rivers, rain forests and deserts too. Perhaps all this is symbolic of the range of thoughts and cultural expressions that have emerged from its people. The vast majority of its inhabitants identify themselves as Hindus; but as Sri Aurobindo reminded us, Hinduism "set itself no sectarian limits; it claimed no universal adhesion, asserted no sole infallible dogma, set up no single narrow path or gate of salvation; it was less a creed or cult than a continuously enlarging tradition of the Godward endeavor of the human spirit." Herein lies its intrinsic strength. Just as democracy and secularism are worth adopting by modern nations, the Hindu religious framework could serve as a model for religions, and help overcome the *I-alone-have-all-the-truths* doctrine, which has often led to religious intolerance and persecution, forced conversions, even murder and mayhem in the name of God Almighty.

In this context, the world should know that India is the source of one of the most civilizing concepts in all of human history: *ahimsa* or non-injury to other beings. Nowhere else did the human mind even think of not harming fellow creatures on the planet. It is an ethical and spiritual awakening of the highest order, wherein lie implicit the notions of universal peace and the scrupulous avoidance of war. Like the idea of human rights for all, this may be mere idealism, and yet it seems to be the only door open for a world plunged in the dungeon of hate, violence, and mutual hurt. The idea of vegetarianism emerging from ahimsa is also unique to India: a healthy and compassionate alimentary principle for which the world must be grateful to Jaina thinkers.

The seeds planted by Swami Vivekananda in his famous address at the first Parliament of World Religions are blossoming into many interfaith groups being formed in the United States and elsewhere, whose mission is to instill mutual respect among religions. This indeed is a central tenet of traditional Hinduism. In this backdrop, a good many Hindus in India are frustrated and fearful that their culture seems to be swept away in their own land. They see indications that forces of ill will, both from within India and from the outside, are actively engaged in harming the cultural, national, and religious integrity of India. This provokes many into unfriendly words and attitudes toward sister religions, reminding us of what Pierre Laserre wrote in his *Cinquante ans de pensée française* (1922). I give my translation (using motherland for patrie):

> Patriotism is the core of our life. Nationalism is a reaction, a crisis of health when the idea and the feeling of motherland are put in danger. For the negation of the motherland threatens to kill it; while an exaggerated application of the patriotic point of view, if it takes away the enjoyment of certain benefits of the spirit, at least saves the fundamental condition without which we would lose all the benefits of the spirit right away, beginning with our own language.

One hopes that the faithful of other religions will respect legitimate Hindu concerns and that Hindus will not abandon the greatest strength of their tradition, which is to respect all faiths. This may well be the only path open for peace in our pluralistic world.

The freedom of thought and expression in Indic culture gave rise to a tremendous range of worldviews and values, many of which were sublime. As Swami Vivekananda put it, "From the high spiritual flights of the Vedanta philosophy . . . to the low ideas of idolatry with its multifarious mythology, the agnosticism of the Buddhists and the atheism of the Jains, each and all have a place in (India's) religion."

Art and music, movies and celebrations abound in India as they always have over the ages. Schools, colleges, and universities are also growing in number and scope. Millions and millions of young minds are molded there. If this is done, not just for pride and patriotism, but equally for the advancement of science, for social justice, and for the welfare of humanity, then their full potential will be constructively actualized. When that happens, as with America, a stupendous creative power will be unleashed as well as the capacity and the responsibility for charting the course of human destiny.

Arnold Toynbee, a foremost twentieth-century historian, wrote half a century ago *(One World and India*):

> The vast literature, the magnificent opulence, the majestic sciences, the great realized souls, the soul touching music, the awe inspiring gods. It is already becoming clearer that a chapter which has a western beginning will

> have to have an Indian ending if it is not to end in the self destruction of the human race. At this supremely dangerous moment in history the only way of salvation for mankind is the Indian way.

At a time when intercultural and interreligious conflicts are taking on seismic modes, we can only pray that Toynbee's vision of India will continue to be accurate.

One result of the shock and awe that civilization experienced on September 11, 2001 was that the Western world realized that it is important to foster better understandings among the religions of humanity. So interfaith movements came to be formed. It was not realized in this healthy and welcome movement that its seeds have been there in the ancient Hindu tenet of *polyodosism* (multiple paths) that is implicit in the Vedic aphorism: Truth is one; learned people call it by different names (*ekam sutt, viprá bahudhá vadanti*). It would be worth dinning this mantra in the ears of every child that is initiated into any religious tradition and every religious enthusiast. Many Hindu children are taught to recite:

> As waters falling from the skies return to the self-same sea,
> Prostrations to God by different names go back to the same Divinity.

This is not a naïve postmodernist declaration of the moral equivalence of all systems. Rather, it is the recognition that when it comes to visions and tributes of God, no one system can claim superiority over others, and that the conviction that those who do not subscribe to one specific view of God or the hereafter will be condemned to eternal damnation is both simplistic and doctrinally dangerous.

Because the world was not rocked by terror from the Hindu world, it did not even occur to the bridge builders that we have a powerful paradigm for religious tolerance enshrined in that ancient Hindu view. In certain Western interfaith dialogues the Hindu voice is glaringly absent. There are at least three reasons for this: One is the urgency to establish an *entente cordiale* with the world of Islam—a *sine qua non* for world peace today; another is a cultural reluctance to accept religious perspectives that don't flow from the Abrahamic traditions; and the third is the relative unawareness on the part of organizers of such events of the Hindu insight that respects the divine representations of all the religions.

Thanks to the concerted efforts of a number of scholars, Islam has now come to be regarded in mainstream Western mind as a religion of peace: a positive paradigm shift from perceptions of a generation or two ago. So, fortunately, informed people in the West don't dwell on the Sharia which recommends that sinning women be stoned to death and that apostates must be executed, but rather emphasize Islam's many positive aspects.

But since there has not been any such effective project from Hindu activists, not many outsiders know much about Hindu worldviews beyond the sacred cow, the spicy curry, and the cruel casteism.

It is important for the world to know something about this ancient and yet very modern culture. The people of India are engaged in a renewed vibrancy and are looking forward to a future that could outshine the past. In the process of building that future, of turning the dreams of an *India-shining* into the realm of reality, the thinkers and leaders of the tradition must recognize, as must those of all emerging nations, that there are things that one can learn from others. Even while guarding what is precious in one's own, every country can cooperate with others in building a global quilt where no nation will dominate over another, where no religion can claim a privileged status, and all cultures—in so far as they add to humanity's aesthetic treasures and spiritual integrity—deserve recognition and respect. India has the vision to contribute toward reaching that as yet distant goal.

## Selected Bibliography


Andalusi, S. a id ibn A. hmad, Sema an I. Salem, and Alok Kumar. *Science in the Medieval World: "Book of the Categories of Nations"*. Austin: University of Texas Press, 1991.

Aryabhata, Kripa Shankar Shukla, K. V. Sarma, Somesvara, Bhaskara, and Suryadeva. *Aryabhatiya of Aryabhata*. 3 vols. New Delhi: Indian National Science Academy, 1976.

Auroux, Sylvain. *History of the Language Sciences: An International Handbook on the Evolution of the Study of Language from the Beginnings to the Present = Geschichte Der Sprachwissenschaften: Ein Internationales Handbuch Zur Entwicklung Der Sprachforschung Von Den Anfängen Bis Zur Gegenwart = Histoire Des Sciences Du Langage: Manuel International Sur L'évolution De L'étude Du Langage Des Origines À Nos Jours*, Handbücher Zur Sprach—Und Kommunikationswissenschaft Bd. 18. Berlin ; New York: Walter de Gruyter, 2000.

Baber, Zaheer. *The Science of Empire: Scientific Knowledge, Civilization, and Colonial Rule in India*, Suny Series in Science, Technology, and Society. Albany: State University of New York Press, 1996.

Bacon, Francis, Peter Urbach, and John Gibson. *Novum Organum ; with Other Parts of the Great Instauration*, Paul Carus Student Editions V. 3. Chicago: Open Court, 1994.

Ball, V. *Jungle Life in India: Or, the Journeys and Journals of an Indian Geologist*. London,: T. De La Rue, 1880.

Bappu, M. K. V., S. K. Biswas, D. C. V. Mallik, and C. V. Vishveshwara. *Cosmic Perspectives: Essays Dedicated to the Memory of M.K.V. Bappu*. Cambridge England ; New York: Cambridge University Press, 1989.

Behanan, Kovoor Thomas. *Yoga, a Scientific Evaluation*. New York,: Dover Publications, 1964.

Bell, Eric Temple. *The Development of Mathematics*. 2d ed. New York, London,: McGraw-Hill book company, inc., 1945.

*Bhagavad-Gita*. Pasadena, Calif.: Theosophical University Press, 1978.

Bharathi, K. S. "The Political Thought of Radhakrishnan." In *Encyclopaedia of Eminent Thinkers*. New Delhi: Concept Pub. Co., 1998.

Bidyaranya, and Avadhesh Narayan Singh. *History of Hindu Mathematics, a Source Book*. Bombay, New York,: Asia Pub. House, 1962.

Billington, Ray. *Understanding Eastern Philosophy*. London ; New York: Routledge, 1997.

Blampied, W. A. "Satyendra Nath Bose." In *Dictionary of Scientific Biography*, edited by Charles Coulston Gillispie, Frederic Lawrence Holmes and American Council of Learned Societies., v. <1-18 in 10 >. New York: Scribner, 1970-1990.

Bohm, David, and B. J. Hiley. *The Undivided Universe: An Ontological Interpretation of Quantum Theory*. London ; New York: Routledge, 1993.

Bose, D. M., S. N. Sen, B. V. Subbarayappa, and Indian National Science Academy. *A Concise History of Science in India*. 2nd ed. Hyderabad: Universities Press (India), 2009.

Bose, Jagadis Chandra. *Sir Jagadish Chander Bose, His Life, Discoveries and Writings*. 1st ed. Madras,: G. A. Natesan & co., 1921.

Bower, Hamilton, A. F. Rudolf Hoernle, and Archaeological Survey of India. *The Bower Manuscript: Facsimile Leaves, Nagari Transcript, Romanised Transliteration, and English translation with Notes*. New Delhi: Sharada Rani, 1983.

Boyer, Carl B., and Uta C. Merzbach. *A History of Mathematics*. 2nd ed. New York: John Wiley & Sons, 1989.

Bryant, Edwin F. *The Quest for the Origins of Vedic Culture: The Indo-Aryan Migration Debate*. New York ; Oxford: Oxford University Press, 2001.

Burgess, Ebenezer. *Surya-Siddhanta: A Text Book of Hindu Astronomy (1858)*. Belle Fourche: Kessinger Publishing Co, 1998.

Busia, and Kofi. "Kofibusia.Com." http://www.kofibusia.com/patanjali/patanjali.php.

Busia, Kofi (Ed.). *Iyengar: The Yoga Master*. Boston and London: Shambhala, 2007.

Capra, Fritjof. *The Tao of Physics: [an Exploration of the Parallels between Modern Physics and Eastern Mysticism]*. London: Wildwood House, 1975.

Chakrabarti, Dilip K. *Colonial Indology: Sociopolitics of the Ancient Indian Past*. New Delhi: Munshiram Manoharlal Publishers Pvt. Ltd., 1997.

Chakraborty, Alpana. "Mind Body Dualism: A Philosophical Investigation." In *Contemporary Researches in Hindu Philosophy & Religion:* DK Print World, 1996.

Chandrasekharayya, U. *Vedanta and Modern Physics*. Bangalore: Lokashikshana Trust, 2006.

Chatterjee, Abhas. *The Concept of Hindu Nation*. New Delhi: Voice of India, 1995.

Clarke, J. J. *Oriental Enlightenment: The Encounter between Asian and Western Thought*. London ; New York: Routledge, 1997.

Cowell, Edward B., and A. E. (trans) Gough. *The Sarva-Darshana-Sangraha of Madhavacharya*. New Delhi: Motilala Banarsidass Publ, 1996.

Cremo, M. A. "Puranic Time and the Archeological Record." In *Time and Archaeology*, edited by Tim Murray, vii, 172 p. London ; New York: Routledge, 1999.

D'Espagnat, B. *The Search for Reality*. New York: Springer-Verlag, 1981.

Dala, Ajit K., and Giriswar Misra. "The Core and Context of Indian Psychology." *Psychology and developing societies* 22 (2010): 121.

Danino, Michel, and Sujata Nahar. *The Invasion That Never Was*. 1st ed. Delhi: Mother's Institute of Research & Mira Aditi, Mysore, India, 1996.

Darling, David J. *Teleportation: The Impossible Leap*. Hoboken, N.J.: Wiley, 2005.

Dasgupta, Subrata. *Jagadis Chandra Bose, and the Indian Response to Western Science*. New Delhi ; New York: Oxford University Press, 1999.

Dasgupta, Surendranath, and Surama Dasgupta. *A History of Indian Philosophy*. Cambridge,: University Press, 1922.

_____. *A History of Indian Philosophy*. Cambridge: C.U.P., 1932.

Davis, Richard H. *Ritual in an Oscillating Universe: Worshiping Siva in Medieval India*. Princeton, N.J.: Princeton University Press, 1991.

De Crespigny, Rafe. *A Biographical Dictionary of Later Han to the Three Kingdoms (23-220 Ad)*, Handbook of Oriental Studies. Section Four, China. Leiden ; Boston: Brill, 2007.

Deshpande, N. A. *The Padma-Purana*. 1st ed, Ancient Indian Tradition and Mythology Series. Delhi: Motilal Banarsidass, 1988.

Dharampal. *Indian Science and Technology in the Eighteenth Century; Some Contemporary European Accounts*. Delhi,: Impex India, 1971.

_____. *The Beautiful Tree: Indigenous Indian Education in the Eighteenth Century*. New Delhi: Biblia Impex, 1983.

Duquette, Jonathan. "Towards a Philosophical Reconstruction of the Dialogue between Modern Physics and Advaita Vedanta: An Inquiry into the Concepts Fo Akasha, Vacuum and Reality." Université de Montreal, 2011.

Edgerton, Franklin. *Vikrama's Adventures; or, the Thirty-Two Tales of the Throne, a Collection of Stories About King Vikrama, as Told by the Thirty-Two Statuettes That Supported His Throne, Edited in Four Different Recensions of the Sanskrit Original (Vikrama-Charita or Sinhasana-Dvatrinçaka)*, Harvard Oriental Series V. 26-27. Cambridge, Mass.,: Harvard University Press, 1926.

Eknath, Easwaran. *The Bhagavad Gita for Daily Living: Commentary, Translation, and Sanskrit Text*. Berkeley, Calif.: Blue Mountain Center of Meditation, 1975.

Eknath, Easwaran, and Michael N. Nagler. *The Upanishads*. 2nd ed, The Classics of Indian Spirituality. Tomales, CA: Nilgiri Press, 2007.

Elfering, Kurt. "The Area of a Triangle and Volume of a Pyramid as Well as the Area of a Circle and Surface of the Hemisphere in the Mathematics of Aryabhata I." *Indian journal of history of science* 12, no. 2 (1977).

Elphinstone, Mountstuart. *The History of India*. 2 vols. London: J. Murray, 1841.

Elst, Koenraad. *Who Is a Hindu?: Hindu Revivalist Views of Animism, Buddhism, Sikhism, and Other Offshoots of Hinduism*. New Delhi: Voice of India, 2002.

Feuerstein, Georg. *Yoga: The Technology of Ecstasy*. 1st ed. Los Angeles: J.P. Tarcher, 1989.

Feuerstein, Georg, Subhash Kak, and David Frawley. *In Search of the Cradle of Civilization: New Light on Ancient India*. 2nd ed. Wheaton, Ill.: Quest Books, 2001.

Flew, Antony. *A Dictionary of Philosophy*. New York: St. Martin's Press, 1979.

Flood, Gavin D. *An Introduction to Hinduism*. New York, NY: Cambridge University Press, 1996.

Fort, Charles. *Lo!* New York: Cosimo Classics, 2004.

Framarin, Christopher G. *Desire and Motivation in Indian Philosophy*, Routledge Hindu Studies Series. London ; New York: Routledge, 2009.

Frauwallner, Erich. *Erich Frauwallner's Posthumous Essays*. New Delhi: Aditya Prakashan, 1994.

Ganguli, Kisari Mohan. *The Mahabharata of Krsishna-Dwaipayana Vyasa*. 3d improved ed. 12 vols. New Delhi: Munshiram Manoharlal Publishers, 1972.

Goswami, Amit, Richard E. Reed, and Maggie Goswami. *The Self-Aware Universe: How Consciousness Creates the Material World*. New York: Putnam's Sons, 1993.

Grassie, William. *The New Sciences of Religion: Exploring Spirituality from the Outside in and Bottom Up*. New York: Palgrave Macmillan, 2010.

Gupta, Jyotirmoy, and Meghnad Saha. *M.N. Saha in Historical Perspective*. Calcutta: Thema, 1994.

Hall, A. Rupert, and Isaac Newton. *Philosophers at War: The Quarrel between Newton and Leibniz*. Cambridge Eng. ; New York: Cambridge University Press, 1980.

Halsted, George Bruce. *On the Foundation and Technic of Arithmetic*. Chicago,: The Open Court Publishing Company, 1912.

Hardy, G. H., and Srinivasa Ramanujan Aiyangar. *Ramanujan: Twelve Lectures on Subjects Suggested by His Life and Work*. New York: Chelsea Publishing Company, 1940.

Hiriyanna, Mysore. *Outlines of Indian Philosophy*. London: G. Allen & Unwin Ltd, 1932.

Hoernle, A. F. Rudolf. *Studies in the Medicine of Ancient India. Part I, Osteology or the Bones of the Human Body*. Oxford: Clarendon Press, 1907.

Hoyle, Fred. *The Intelligent Universe*. 1st American ed. New York: Holt, Rinehart, and Winston, 1984.

Huizinga, Johan. *Homo Ludens; a Study of the Play-Element in Culture*, Humanitas, Beacon Reprints in Humanities. Boston,: Beacon Press, 1955.

Husken, Alexandra, and Antje Dietz-Pfeilstetter. "Pollen-Mediated Intraspecific Gene Flow from Herbicide Resistant Oilseed Rape." *Transgenic research* 16, no. 5 (2007).

Ifrah, Georges. *From One to Zero: A Universal History of Numbers*. New York: Viking, 1985.

Ifrah, Georges, and David Bellos. *The Universal History of Numbers: From Prehistory to the Invention of the Computer*. New York: Wiley, 2000.

Joseph, George Gheverghese. *The Crest of the Peacock: The Non-European Roots of Mathematics*. New ed. Princeton, N.J.: Princeton University Press, 2000.

_____. *A Passage to Infinity: Medieval Indian Mathematics from Kerala and Its Impact*. Delhi ; London: SAGE, 2009.

Joshi, M. C., S. K. Gupta, and Shankar and Goyal, Eds. *The Delhi Iron Pillar: Its Art, Mettalurgy and Inscriptions*. Meerut: Kusumanjali Publications, 1996.

Kak, Subhash. *The Astronomical Code of the Rgveda*. New Delhi: Munshiram Manoharlal Publishers, 2000.

Kakar, Sudhir, and John M. Ross. *The Indian Psyche: Comprising, the Inner World; Shamans, Mystics and Doctors ; Tales of Love, Sex and Danger (with John M. Ross)*. Delhi: Oxford University Press, 1996.

Kalyanaraman, S. *Sarasvati*. Bangalore: Babasaheb (Umakant Keshav) Apte Samarak Samiti, 2000.

Kanigel, Robert. *The Man Who Knew Infinity: A Life of the Genius, Ramanujan*. New York, Toronto: C. Scribner's; Collier Macmillan Canada; Maxwell Macmillan International, 1991.

Kaplan, Robert. *The Nothing That Is: A Natural History of Zero*. Oxford ; New York: Oxford University Press, 2000.

Katz, Victor J., and Annette Imhausen. *The Mathematics of Egypt, Mesopotamia, China, India, and Islam: A Sourcebook*. Princeton: Princeton University Press, 2007.

Keith, Arthur Berriedale. *Indian Logic and Atomism*. Oxford: The Clarendon press, 1921.

Kelvin, Lord. "On the Age of the Sun's Heat." *Macmillan's magazine*, March 5, 1862, 375.

Kenkre, V. M. "V. M. Kenkre." University of New Mexico, http://panda.unm.edu/Kenkre.

Kenoyer, Jonathan M. *Ancient Cities of the Indus Valley Civilization*. 1st ed. Karachi, Islamabad: Oxford University Press ; American Institute of Pakistan Studies, 1998.

King, Richard. *Indian Philosophy: An Introduction to Hindu and Buddhist Thought*. Edinburgh: Edinburgh University Press, 1999.

Kipling, Rudyard. *The Ballad of East and West*. New York: Alex Grosset.

Kline, Morris. *Mathematical Thought from Ancient to Modern Times*. New York,: Oxford University Press, 1972.

Klostermaier, Klaus K. *A Survey of Hinduism*. Albany, N.Y.: State University of New York Press, 1989.

Krishnamurti, Bhadriraju. *The Dravidian Languages*, Cambridge Language Surveys. Cambridge ; New York: Cambridge University Press, 2003.

Kutumbiah, P. *Ancient Indian Medicine*. Bombay,: Orient Longmans, 1962.

Lemaitre, Georges. "The Beginning of the World from the Point of View of Quantum Theory." *Nature magazine*, 1931.

Madhavan, C. Muralim. In *International Forum for India's Heritage*. Coimbatore, August 2006. *Mahabharata*. "Anusasana Parva."

*Mahabharata, Abridged. Adi Parva and Sabha Parva*. Vol. 37. Bangalore City,: Printed at the Pangalore Press, 1956.

Maharishi, Sri Ramana. "Be as You Are: The Teachings of Sri Ramana Maharishi." http://www.beasyouare.info/beasyouare.html.

Mahavir. *Panini as Grammarian: With Special Reference to Compound Formations*. 1st ed. Delhi: Bharatiya Vidya Prakashan, 1978.

Malhotra, Ashok Kumar. *Transcreation of the Bhagavad Gita*, Library of Liberal Arts. Upper Saddle River, N.J.: Prentice Hall, 1999.

Mani, Vettam *Puranic Encyclopedia*. New Delhi: Motilal Banarsidass, 1975.

Masson-Oursel, Paul, Helena Willman-Grabowska, and Philippe Stern. *Ancient India and Indian Civilization*, The History of Civilization. New York,: Barnes & Noble, 1967.

Matilal, Bimal Krishna, and Jonardon Ganeri. *Epistemology, Logic, and Grammar in Indian Philosophical Analysis*. New ed. Delhi; Oxford: Oxford University Press, 2005.

Mazer, Arthur. *The Ellipse: A Historical and Mathematical Journey*. Oxford: Wiley, 2010.

Minor, Robert Neil. *Modern Indian Interpreters of the Bhagavadgita*, Suny Series in Religious Studies. Albany: State University of New York Press, 1986.

Mishra, Umesha. *Conception of Matter, According to Nyaya-Vaiçesika*. Allahabad; Benares City, U.P., India: U. Mishra ; Selling agent, Braj Bhusan Das & Co., 1936.

Misra, R. S. *Philosophical Foundations of Hinduism: The Vedas, the Upanishads, and the Bhagavadgita: A Reinterpretation and Critical Appraisal*. New Delhi: Munshiram Manoharlal Publishers, 2002.

Mohanty, J. N. *Classical Indian Philosophy*. Lanham, Md.: Rowman & Littlefield Publishers, 2000.

Montucla, Jean Etienne. *Histoire Des Mathématiques, Dans Laquelle on Rend Compte De Leurs Progrès Depuis Leur Origine Jusq'à Nos Jours; Où L'on Expose Le Tableau & Le Développement Des Principales Découvertes, Les Contestations Qu'elles Ont Fait Naître, & Les Principaux Traits De La Vie Des Mathématiciens Les Plus Célebres*. Paris,: Ch. Ant. Jombert, 1758.

Mukhyananda, Swami. *Vedanta in the Context of Modern Science*. Mumbai: Bharatiya Vidya Bhavan, 1997.

Müller, F. Max. *A History of Ancient Sanskrit Literature: So Far as It Illustrates the Primitive Religion of the Brahmans*. London: Williams and Norgate, 1859.

_____. *India: What Can It Teach Us? A Course of Lectures Delivered before the University of Cambridge*. London,: Longmans, Green, 1883.

_____. *The Upanishads*, The Sacred Books of the East. Oxford [Oxfordshire]: Clarendon Press, 1900.

Nagarajan, K. S. *Bhaskara's Leelavathi:* The Aryan Path, 1949.

Narayan, Kirin. *Storytellers, Saints, and Scoundrels: Folk Narrative in Hindu Religious Teaching*, Publication of the American Folklore Society, New Series. Philadelphia: University of Pennsylvania Press, 1989.

Neill, Stephen. *A History of Christianity in India, 1707-1858*. Cambridge Cambridgeshire ; New York: Cambridge University Press, 1985.

O'Malley, L. S. S., and Royal Institute of International Affairs. *Modern India and the West; a Study of the Interaction of Their Civilizations*. London, New York etc.: Oxford U.P., 1968.

Olcott, Henry S. *Theosophy; Religion and Occult Science:* Kessinger Publishing, 1993.

Olivelle, Patrick. *Upani*Sads*, The World's Classics. Oxford; New York: Oxford University Press, 1996.

Panini, and Srisa Chandra Vasu. *The Ashtádhyáyí of Pánini*. Allahabad,: Indian Press, 1891.

_____. *The Ashtadhyayi of Panini*. Delhi: Motilal Barnarsidass, 1962.

Pence, Gregory E. *Who's Afraid of Human Cloning?* Lanham Md.: Rowman & Littlefield, 1998.

Penrose, Roger. *Cycles of Time: An Extraordinary New View of the Universe*. London: Bodley Head, 2010.

Phadke, N. H. *Lilavati of Bhaskaracarya: A Treatise of Mathematics of Vedic Tradition with Rationale in Terms of Modern Mathematics Largely Based on N. H. Phadke's Marathi Tr. Of Lilavati*. Translated by English Trans. Krishnaji Shankara et al. Delhi: Eastern book Corp., 2006.

Plofker, Kim. "Mathematics in India." In *The Mathematics of Egypt, Mesopotamia, China, India, and Islam: A Sourcebook*, edited by Victor J. Katz and Annette Imhausen, xiv, 685 p. Princeton: Princeton University Press, 2007.

Polo, Marco, and Henry Yule. *The Book of Ser Marco Polo, the Venetian*. 3d ed. London,: J. Murray, 1903.

Prabhupada, A. C. Bhaktivedanta Swami. *Srimad Bhagavatam: With the Original Sanskrit Text, Its Roman Transliteration, Synonyms, translation and Elaborate Purports*. Los Angeles, Calif.: Bhaktivedanta Book Trust, 1987.

Prabhupada, A. C. Bhaktivedanta Swami, and Goswami Hridayananda. *Srimad-Bhagavatam: With a Short Life Sketch of Lord Sri Caitanya Mahaprabhu, the Ideal Preacher of Bhagavata-Dharma, and the Original Sanskrit Text, Its Roman Transliteration, Synonyms, translation and Elaborate Purports*. New York: Bhaktivedanta Book Trust, 1972.

Radhakrishnan, S. *The Hindu View of Life; Upton Lectures Delivered at Manchester College, Oxford, 1926*. London, New York,: G. Allen & Unwin; The Macmillan company, 1927.

_____. *The Bhagavadgita, with an Introductory Essay, Sanskrit Text [Transliterated]*. New York,: Harper, 1948.

_____. *The Principal Upanisads*. 1st pbk. ed, Humanities Paperback Library. Atlantic Highlands, NJ: Humanities Press, 1992.

Ramabni, Suresh. *Srinivasa Ramanujan*, National Biography Series. New Delhi,: National Book Trust, India; chief stockists in India: India Book House, Bombay, 1972.

Ramamurty, A. *Vedanta and Its Philosophical Development*, Contemporary Researches in Hindu Philosophy & Religion. New Delhi: D.K. Printworld, 2006.

Raman, Varadaraja V. Balakanda: Ramayana as Literature and Cultural History. Bombay: Popular Prakashan, 1998.

Raman, Varadaraja V. *Glimpses of Ancient Science and Scientists*. Philadelphia, PA: Xlibris, 1999.

_____. *Nuggets from the Gita*. Bombay: Bharatiya Vidya Bhavan, 1999.

_____. *Scientific Perspectives.* Philadelphia: Xlibris, 1999.

_____. *Truth and Tension in Science and Religion*. Center Ossipee, N.H.: Beech River Books, 2009.

_____. *Variety In Science History*. Philadelphia: Xlibris, 2000.

_____. *Variety in Religion and Science*. New York: iUniverse, 2005.

Ramaswamy, Krishnan, Antonio T. De Nicolás, and Aditi Banerjee. *Invading the Sacred: An Analysis of Hinduism Studies in America*. New Delhi: Rupa & Co., 2007.

Ramaswamy, Sumathi. *The Lost Land of Lemuria: Fabulous Geographies, Catastrophic Histories*. Berkeley: University of California Press, 2004.

Ranade, Ramchandra Dattatraya. *A Constructive Survey of Upanishadic Philosophy, Being a Systematic Introduction to Indian Metaphysics*. Poona: Oriental Book Agency, 1926.

Rao, K. Ramakrishna. "Perception, Cognition, and Consciousness in Classical Hindu Psychology." *Journal of consciousness studies: controversies in science & the humanities* (2005).

Rao, S. Balachandra. *Tradition, Science, and Society:* Navakarnataka Publications, 1998.

Rao, T. R. N. "The Panini-Backus Form in Syntax of Formal Languages." http://www.infinityfoundation.com/mandala/t_es/t_es_rao-t_syntax.htm.

Ray, Prafulla Chandra. *A History of Hindu Chemistry from the Earliest Times to the Middle of the Sixteenth Century, A. D., with Sanskrit, Texts, Variants, translation and Illustrations*. London, Oxford,: Williams and Norgate, 1902.

*Rig-Veda Sanhita: A Collection of Ancient Hindu Hymns of the Rig-Veda: The Oldest Authority on the Religious and Social Institutions of the Hindus*, edited by H. H. Wilson, Edward B. Cowell and William Frederick Webster, "Hiranyagarbha Sukta." X. 121. New Delhi: Cosmo Publications, 1977.

*Rig-Veda Sanhita: A Collection of Ancient Hindu Hymns of the Rig-Veda: The Oldest Authority on the Religious and Social Institutions of the Hindus*, edited by H. H. Wilson, Edward B. Cowell and William Frederick Webster, X. 34.13. New Delhi: Cosmo Publications, 1977.

*Rig-Veda Sanhita: A Collection of Ancient Hindu Hymns of the Rig-Veda: The Oldest Authority on the Religious and Social Institutions of the Hindus*, edited by H. H. Wilson, Edward B. Cowell and William Frederick Webster, X. 32.2. New Delhi: Cosmo Publications, 1977.

*Rig-Veda Sanhita: A Collection of Ancient Hindu Hymns of the Rig-Veda: The Oldest Authority on the Religious and Social Institutions of the Hindus*, edited by H. H. Wilson, Edward B. Cowell and William Frederick Webster, Book VIII Hymn 21. New Delhi: Cosmo Publications, 1977.

Robin, Mel. *A Handbook for Yogasana Teachers: The Incorporation of Neuroscience, Physiology, and Anatomy into the Practice*. Tucson, Ariz.: Wheatmark, 2009.

Robinson, Andrew. *The Last Man Who Knew Everything: Thomas Young, the Anonymous Polymath Who Proved Newton Wrong, Explained How We See, Cured the Sick, and Deciphered the Rosetta Stone, among Other Feats of Genius*. New York: Pi Press, 2006.

Robinson, Catherine A. *Interpretations of the Bhagavad-Gita and Images of the Hindu Tradition: The Song of the Lord*. London ; New York: Routledge, 2006.

Royal Asiatic society of Great Britain and Ireland London. [from old catalog]. *Transactions of the Royal Asiatic Society of Great Britain and Ireland*. London,: The Society, 1827.

Sastri, Bapudeva. "Bhaskara's Knowledge of the Differential Calculus." *Journal of the Asiatic Society of Bengal: a comprehensive index 1832-2006* 27 (1858).

Sastry, V. Subrahmanya. *Brihat Samhita of Varahamihira*. Varanasi: Chowkhamba Vidyabhawan, 1977.

Satchidananda, and Patañjali. *The Yoga Sutras of Patanjali*. Yogaville, Va.: Integral Yoga Publications, 1990.

Sax, William Sturman. *The Gods at Play: Lila in South Asia*. New York: Oxford University Press, 1995.

Schopenhauer, Arthur. *The World as Will and Representation*. New York,: Dover Publications, 1966.

Schrödinger, Erwin. *What Is Life? The Physical Aspect of the Living Cell*. Cambridge Eng.; New York,: The University press; The Macmillan company, 1945.

Sen Gupta, J. *Profulla Chandra Ray*. New Delhi: National Book Trust, 1972.

Sen, S. N., and A. K. Bag. *The Sulbasutras*. New Delhi: Indian National Science Academy, 1983.

Sen, S. N. (ed.). *Professor Meghnad Saha: His Life, Work and Philosophy*. Calcutta: Kalipada Mukherjee at Eka Press, 1954.

Sewell, Robert. "The Siddhanta-Siromani." *Epigraphia Indica* 15 (1919): 159-245.

Shah, Jethalal Govardhandas. *Shri Vallabhacharya: His Philosophy and Religion*. [1st ed. Nadiad,: Pushtimargiya Pustakalaya, 1969.

Sharma, Arvind. *A Hindu Perspective on the Philosophy of Religion*. New York: St. Martin's Press, 1991.

_____. *Sleep as a State of Consciousness in Advaita Vedanta*. Albany: State University of New York Press, 2004.

Sharma, P. V., and Indian National Science Academy. *History of Medicine in India, from Antiquity to 1000 A.D*. New Delhi: Indian National Science Academy, 1992.

Sharma, Ramkaran, and Bhagwan Das. *Charaka Samhita (& Vols): Text in Sanskrit with English Translation*. Varanasi: Chowkamba Sanskrit Series Office, 2004.

Shukla, Kripa Shankar. *Aryabhata: Indian Mathematician and Astronomer*. New Delhi: Indian National Science Academy, 1976.

Singh, Jagjit. *Some Eminent Indian Scientists*. 3d ed. New Delhi Publications Division, Ministry of Information and Broadcasting, Govt. of India, 1977.

Singh, K. Suresh. *Tribal Society in India: An Anthropo-Historical Perspective*. 1st ed. New Delhi: Manohar, 1985.

Sinha, Jadunath. *A History of Indian Philosophy*. Calcutta: Central Book Agency, 1952.

Sivananda, Swami. "Kundalini Yoga." Divine Life Society, http://www.dlshq.org.

Strachey, E. *Observations on the Mathematical Science of the Hindoos, with Extracts from Persian Translations of the Leelawutee and Beej Gunnit*. Calcutta: 1805, 1805.

Sudarshan, E. C. George. "E. C. George Sudarshan." University of Texas at Austin, http://www.ph.utexas.edu/person/sudarshan_e_c_george.

Trautmann, Thomas R. *The Aryan Debate*, Oxford in India Readings. Debates in Indian History and Society. New Delhi: Oxford University Press, 2005.

Valmiki, and Anant Pai. *The Ramayana*. Vol. Canto 25, Amar Chitra Katha. Bombay: India Book House, 1989.

Varahamihira, O. Neugebauer, and David Edwin Pingree. *The Pañcasiddhantika*, Det Kongelige Danske Videnskabernes Selskab. Historisk-Filosofiske Skrifter. Copenhagen,: Munksgaard, 1970.

Venkataraman, G. *Journey into Light: Life and Science of C.V. Raman*. Bangalore: Indian Academy of Sciences, 1988.

*Vishnu Purána: A System of Hindu Mythology and Tradition*. 3d ed. Calcutta Punthi Pustak, 1961, 1979 printing.

Vivekananda. *Lectures from Colombo to Almora*. [5th ed. Almora,: Advaita Ashrama, 1947.

Vivekananda, and Ramakrishna Vedanta Centre. *Thoughts on the Gita*. Calcutta; Bourne End: Advaita Ashrama ; Ramakrishna Vedanta Centre, 1981.

Wali, K. C. *Chandra: A Biography of S. Chandrasekhar*. Chicago ; London: University of Chicago Press, 1991.

Weinberg, Steven. *Dreams of a Final Theory*. 1st ed. New York: Pantheon Books, 1992.

Wheeler, Mortimer. *The Indus Civilization*. [Ed. 2] ed, Cambridge History of India. Supplementary Volume. Cambridge: University Press, 1960.

Whish, Charles. "On the Hindu Quadrature of the Circle and the Infinite Series of the Proportion of the Circumference to the Diameter Exhibited in the Four Sastras, the Tantra Sahgraham, Yucti Bhasha, Carana Padhati and Sadratnamala." *Transactions of the Royal Asiatic society of Great Britain and Ireland* 3, no. 3 (1834): 509-23.

Wilson, H. H., Edward B. Cowell, and William Frederick Webster. *Rig-Veda Sanhita: A Collection of Ancient Hindu Hymns of the Rig-Veda: The Oldest Authority on the Religious and Social Institutions of the Hindus*. 7 vols. New Delhi: Cosmo Publications, 1977.

Wriggins, Sally Hovey. *The Silk Road Journey with Xuanzang*. Boulder, Colo.: Westview Press, 2004.

Wujastyk, D. *The Roots of Ayurveda: Selections from Sankskrit Medical Writings*. Rev. ed, Penguin Classics. London ; New York: Penguin Books, 2003.

Yogananda, Paramahansa. Autobiography of a Yogi. 13th ed. Los Angeles: Self-Realization Fellowship (SRF), 1998.

Zaehner, R. C. *The Bhagavad-Gita, with a Commentary Based on the Original Sources*. Oxford,: Clarendon P., 1969.

Zukav, Gary. *The Dancing Wu Li Masters: An Overview of the New Physics*. 1st ed. New York: Morrow, 1979.

Zvelebil, Kamil. *Companion Studies to the History of Tamil Literature*, Handbuch Der Orientalistik. Zweite Abteilung, Indien. Leiden ; New York: Brill, 1992.

## Varadaraja V. Raman

Varadaraja Venkata Raman was born of Tamil parents in Calcutta. Aside from Tamil, Bengali, Hindi, and English, which he spoke in his early years, and Sanskrit and Latin, which he studied at school, Raman learned some European languages as well. After receiving his degrees in physics and mathematics from Calcutta University, he did doctoral work in theoretical physics at the University of Paris. He was associated with UNESCO during his career as an educator, and he is currently emeritus professor of physics and humanities at the Rochester Institute of Technology.

Raman has authored papers on the historical and philosophical aspects of physics and science, as well as on India's cultural heritage. His books include *Scientific Perspectives, Glimpses of Ancient Science and Scientists* (1984), *Nuggets from the Gita* (1997), *Varieties in Science History* (2000), and *Truth and Tension in Science and Religion* (2009). He is an associate editor of the *Encyclopedia of Hinduism Project* (2010), a recipient of the Raja Rao Award from Jawaharlal Nehru University, the IRAS (Institute for Religion in an Age of Science) Scholar's Award, and the Interfaith Services Award from the Center for Interfaith Studies and Dialogue. He is an elected member of ISSR (International Society for Science and Religion, Cambridge, United Kingdom) and a Metanexus Senior Fellow. He chaired the academic board of the Metanexus Institute (Philadelphia, USA) and is a regular contributor to its online magazine.

# Index

**B**



**C**

**D**