COSMOLOGY & CONSCIOUSNESS

MIND & MATTER

Exchanges between Buddhist Scholars and Indian and Western Scientists.
Cosmology & Consciousness - MIND & MATTER

(Exchanges between Buddhist Scholars and Indian and Western Scientist).

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Editor’s Preface

Human consciousness not only conceives of this Universe, but also observes its nature. Human consciousness looks out into the cosmos and tries to make sense of the Universe we inhabit. Our theories about the physics of the Universe were created by our brains and minds. And it is incredible that single individuals, through thinking, can invent a theory that describes the whole Universe. Yet, as we explore the outer limits of the Universe, can our thinking also lead us to examine our own capacity to understand? Are there some profound connections between the inner dynamics of our mind and the outer structure of what we call physical reality, including perhaps the large-scale nature of the Universe, and the smallest scales of the quantum? The purpose of this conference was to humbly explore these intersections through dialogue and informal exchanges. Another purpose was to support a new generation of monastic scholars who are eager to continue the tradition of dialogue that His Holiness the Dalai Lama embarked on over 25 years ago when he started having conversations with scientists through the Mind and Life Institute.

In 1999, expanding beyond dialogue, His Holiness the Dalai Lama provided a vision and directive for the exiled Tibetan monastic community in India to more fully engage in science, and to initiate science training that would eventually support new learning at the frontiers of science and Buddhism. Since 2001, the Science for Monks program has organized annual workshops and training opportunities to introduce science to Buddhist monastics and to train select groups
of monastics to be teachers and science leaders. This three-day public conference brought Buddhist scholars and Indian and Western scientists into dialogue on topics of mutual interest and broadly promoted an awareness of spiritual values and scientific investigation. For the Buddhist, it is not enough to find these connections; the primary motivation is to discover ways to improve life and consciousness in the Universe. Improvement is primary to the Buddhist perspective.

The partners in organizing this conference were the Library of Tibetan Works and Archives (in Dharamsala, India) and the Exploratorium (in San Francisco, USA). The conference was in many ways the result of over a decade of work by the LTWA and the Science for Monks program.

The conference was made possible by a grant from the John Templeton Foundation, and through the ongoing support of the Sager Family Foundation.

The conference was preceded by a four-week workshop, also funded by the John Templeton Foundation, where 18 monastic graduates explored a range of topics with Western instructors that included cosmology, astronomy, particle physics, chemistry, cell biology, neuroanatomy, and contemplative neuroscience. The monastic graduates, who came from 12 institutions of Tibetan Buddhism across India, have completed the highest level of training afforded by their institutions, and serve as teachers and administrative leaders within their communities. One of the goals of the workshop was to prepare the monastic graduates to participate in the conference dialogue and to lead the planning of the five panel sessions.

The monastics are in the habit of asking philosophical questions and focusing intently on them. They are experienced in considering questions of mind, perception, existence, and they have a wide interest in topics related to science. Therefore, the conference included bold and broad themes that would foster participation by monastics with varied interests, letting
them jump into the conversation readily. The monastics lead the thinking in directions that often challenged the way we answer the question: “What is nature?” Hoping to clarify and extend connections between Buddhist philosophy and science, the conference included the following themes.

DAY 1

Life and Consciousness in the Universe:

Astrobiological and Buddhist perspectives on life and mind in the Universe. Under what conditions, and where, might life and consciousness flourish? Is there a connection between cosmology and consciousness and how do these investigations impact our sense of place in the world we inhabit?

DAY 2

Nature of Mind and Consciousness:

How do concepts from the cognitive sciences and neurobiology interface with concepts from Buddhism and other contemplative traditions? What are the relationships between mind, consciousness, and the brain? What are the various perspectives on the survival of consciousness after death?

Limits of Knowledge and Knowing:

What are the possible limits to theories of the very large and the very small? Can the current scientific paradigm facilitate a deep understanding of consciousness?
DAY 3

Mind, Awareness, and Behavior:

What are the relationships between the physical brain, the mind, behavior, and our emotions? We examine cognitive science and Buddhist notions of mind, happiness, and peace.

Serving Humanity:

How can Buddhism and science best serve humanity—providing both knowledge and happiness? We explore the role of ethics in Buddhism and science.

This publication is based on the transcripts of the conference presentations and dialogue that took place in the main assembly hall of the Tibetan Children’s Village, Dharamsala, from December 16th to 18th, 2011.

In editing the transcripts for this publication, we have tried to carry forward the flavor of the conference, the informal exchanges, and the frank interactions. While polishing, we hope that the vibrancy of these interactions, and the unique perspective of the speakers, has been maintained. Only in a very few places, when needed to clarify the ongoing discussion, has new content been added post-conference. In many places, however, moments of the conference have been omitted to create brevity and clarity in the exchanges, and to drive the conversation forward.

As the monastic graduates generally speak English as a third or fourth language, many spoke in Tibetan through an interpreter. Karma Thupten of the LTWA Science Department provided on-stage interpreting during the discussion and panel sessions for all three
days of the conference. The Keynote Address of His Holiness the Dalai Lama was delivered in Tibetan and transcribed and translated into English by LTWA staff.

We would like to thank everyone at the LTWA and the Exploratorium who worked extremely hard in organizing this important conference and contributing to its success. We would also like to thank the staff of the LTWA Science Department for their great efforts and skills in interpreting and translating, and to Patricia Wood, a volunteer at the LTWA, for her excellent work as editorial assistant.

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KEYNOTE ADDRESS

His Holiness the XIV Dalai Lama

My warm greetings to the distinguished scholars gathered here today. I congratulate you all for making this dialogue between Buddhist science and modern science possible. I consider this the result of your long-term endeavors. I would sincerely like to thank our sponsors, who are helping us in both direct and indirect ways, and the conference organizers and participants.

We have been in exile for more than 50 years. Buddha’s teachings have flourished in the world for around 2,600 years. As a Buddhist practitioner, I consider these highly learned Nalanda scholars, whose imagery, including that of Nagarjuna, you can see around the stage, as buddhas and masters. I usually address them as scholars. I often tell people that Nagarjuna and the other masters were Nalanda scholars. There were also many saints, some of whom studied at Nalanda University and after completing their studies spent the remainder of their lives in hermitages. Many of the disciples of the highly learned masters received direct lineage transmission from their respective masters and followed the path to liberation simply by single pointedly meditating on their experiential realizations. This tradition was practiced almost 2,000 years ago.
We first embarked on our dialogue with scientists 25 years ago. I have been deeply interested in science since childhood. Despite my poor English, I used to read English science books as a child. I also had the opportunity to meet scientists. So a seed was planted in my mind at a very young age. It was 40 years ago, just after ten years in exile, when I first expressed my hope and intention of engaging in dialogue with scientists. Many people advised me against doing so—they saw it as a great danger for Buddhism. They told me that science destroys religion. They told me, in English, that science is the killer of religion. “How could that be?” I wondered. The Buddha himself said, “Just as people test the purity of gold by burning it in fire, by cutting it, by examining it on a touchstone, so exactly should you, Bhikshus and learned scholars, accept my words after subjecting them to a critical test, and not out of reverence for me.” So there is room for investigation, even in relation to the Buddha’s own teachings. The Buddha himself permits this. Scholars, such as Nagarjuna, followed this advice and put reasoning and logic above the literal meaning of the Buddha’s teachings. They did not take the Buddha’s words as fact.

Scientists do experiments and if there is something upon which they all agree it becomes their position. In Buddhism, there is now a tradition of taking a philosophical position and then trying to defend it. This was not the original method. Observation and experiment should precede philosophical disposition about what is truth. Buddhist and scientific methods of investigating reality are the same. In Buddhism, this reality refers to emptiness. Whether we are referring to a particular phenomenon, or phenomena in general, all are subject to observation and experiment. This applies to Buddhism in general and the Nalanda tradition in particular. When facts are proven, a position is established. As a Buddhist practitioner, and someone who follows the process of logic laid down by the Nalanda scholars, I value the scientific method. If something stated in a Buddhist text contradicts empirical evidence, then, as logical thinking followers of the Buddha, we should discard it. For instance, I don’t believe in the idea of Mount Meru and the four continents around it as described in
the Abhidharma. I talk about a spherical world and have full faith in it. If scientists disprove something that Buddhists believe, we should revise our position accordingly. Once, in Germany, a journalist asked me what my response would be if scientists came to the conclusion that there is no life after death. I said that scientists had not reached any such conclusion. It’s all about not knowing. Even in our texts it is clearly stated that finding non-existence and not finding something are completely different. If something is proven by empirical evidence we should accept it. This was the basis upon which our relationship with scientists was built.

Five or ten years into this relationship, the interest of scientists began to grow. Their interest was not just driven by amusement or entertainment. In the past, people visited Tibet for entertainment. When they saw dances and rituals, they saw them simply as entertainment. It didn’t occur to them that they might learn something. I had an acquaintance from Norway who had been working in a number of villages in Uganda, Africa, to help the local people to preserve their culture. One day he came to visit me in Dharamsala and brought along a Ugandan friend. I told the Norwegian that every country and region has its own culture and traditions, and that it was very good of him to help out in Uganda. But, while the Norwegian may have admired the cultural and religious activities of the Ugandan villagers, I wondered whether it occurred to him that he might learn something from their beliefs and practices. Similarly, early visitors to Tibet saw Buddhism as entertainment: not even in their dreams did they imagine that there might be something virtuous to be gained from it.

I am speaking frankly; there is no point in being reticent. We lost our country due to our fondness for reticence. We should know the facts and accept the facts. In the past, many Westerners said that Buddhism in Tibet was not the real Buddhism. They referred to it as Lamaism. We can’t blame them: in our society there was little value for people who seriously studied the texts composed by the Nalanda scholars. The so-called lamas and tulku—who travelled on horses and mules accompanied by bearers, lived in labrangs (residences
with attendants), and sat on high thrones—were seen by Tibetans as extraordinary. They looked forward to their visits, had faith in them and took initiations from them. The real Buddhist scholars remained in monasteries studying and teaching texts and did not get the respect they deserved. Few of those who sat on high thrones were very good scholars. They were grateful for the teachings of the Buddha and, while I genuinely admire and respect them, I have to acknowledge that many of them transmitted empowerments and performed rituals without understanding their meanings. The great fifth Dalai Lama always said that he came to know things by learning. That’s true, we know through learning: it’s difficult to acquire knowledge without learning. It is possible that a few individuals have a sudden realization of knowledge and wisdom, but this is rare. Many lamas had little to say from their high thrones. I am a little better. When I was a child, my tutor had a whip of yellow silk that he kept nearby to frighten me. I was quite intelligent and perhaps because of that I was lazy. I would spend most of my time playing, imagining that everything would be fine. That was why my tutor kept a whip by his side and often wore a stern expression rather than a smile. When I think of him now, I am very grateful. Even though I have not undergone years of monastic studies, like ordinary simple monks, I have studied a bit. Our social system in old Tibet focused on surface appearance rather than knowledge. The Buddha Dharma is something special that we Tibetans have. Unfortunately, there has been a reduced quality in its practice and it has become like a traditional performing art. This is very sad. When foreign visitors to Tibet saw the surface appearance—including the fact that many lamas had wives and children—and compared this with Buddhist practices in Sri Lanka, Thailand, and Burma, they coined the term Lamaism.

In the late 1980s I attended a conference in San Francisco with some scientists. There was a very famous scientist there, who, judging by her expression, was thinking, “What can scientists possibly discuss with a religious person?” When the discussion started she posed a few questions. As the discussion continued we did not talk about a creator or an independently existing self. Instead, we talked about dependent
origination of cause and effect. Her expression changed and she told me that the Buddhist view was unique. When we discussed consciousness her interest grew and she asked me about the Buddhist position on many aspects of science. Her questions continued, even during the tea break. Scientists do not see Buddhism as entertainment; their hope is to find inspiration and new explanations. They expect to get something positive and helpful from the exchange. The number of scientists who are interested in exploring the Buddhist viewpoint is growing, as is their confidence in our exchanges.

I have paid attention to science not solely for my personal learning, but to make a connection between Tibetan students—lay and monastic—and scientists. In the early days, there was quite a bit of wariness among some of our geshe scholars and abbots in regard to the potential ill effects on religious faith. At the time, Achok Rinpoche was working in the Library. As I was visiting South India, he asked me to stress the importance of learning about modern science to the abbots there in the hope that I might weaken their resistance. Our monastic leaders have since been supportive and interest has grown among new and prospective students.

One of our goals is to produce science teachers from within our own community. We have established a partnership with Emory University, which is now in its 5th year, to develop science curricula in the Tibetan language. This will enable us to teach science in Tibetan and gradually produce our own teachers. We initially studied Buddhism with the help of masters, interpreters and translators from India; later we were able to lead in our own way. Similarly, we have been learning science from Western and Indian scholars but in time will produce our own teachers.

In terms of consciousness, all parts of the world—East, West, South, and North—that have good levels of education and quite good economic conditions are beginning to pay attention to the need to bring happiness and peace to the human mind. There is no peace; although there is economic progress something is missing. There
are also mischievous people among the highly educated: even with education and skills, the untamed mind can be destructive. In terms of physical health, it is not sufficient to take medicine to look after the workings of the biological body. If there is happiness and peace of mind there will be balance within the body—without peace there will be physical unease. Even with the same illness the patient with peace of mind recovers faster, as medical science is beginning to discover.

When we talk about peace of mind we do not mean that the mind remains motionless and inattentive. When we go on vacation and do nothing we forget about our problems and our minds are temporarily at peace. But real peace of mind is not dependent on our circumstances. There is a way to sustain peace of mind in the midst of adversity. Feelings of happiness and suffering based on mental consciousness have more energy and force than feelings of happiness and suffering based on sense consciousness. One way to lower suffering and increase happiness is through mind training based on mental consciousness.

Happiness of mind cannot be achieved through taking medicine or through dependence on technology. Since happiness of mind comes through training the mind, one should understand the theories of mind. Until recently, Western scientists focused their research on outer physical objects rather than upon themselves. They are now paying attention to theories of mind. In general, when we speak of consciousness we are referring to the energy of the brain. A number of leading neuroscientists are now looking at causes that lead to changes in the brain.

We see changes in the brain when there is training of the mind. These changes are now of great interest to scientists. Generally, all Indian religious traditions have profound theories of mind as encapsulated in the concepts of vipassana (calm abiding) and shamatha (special insight). When we speak of faith, there is little need of explanation; believing in God is enough. In the Indian traditions, training the mind is primarily done through the combined practice
of vipassana and shamatha meditation. Through this practice one changes his or her conceptual mind by using the wisdom gained through single pointed meditation to analyze phenomena. In Buddhist traditions there is also extensive reference to vipassana and shamatha practice and in Tantric teachings there are detailed presentations of grosser and subtle mental states. Countries like Burma and Thailand have well-developed explanations of the theory of mind, but these come from the Pali tradition and do not include the great works of the renowned Nalanda scholars. These days I say, only half in jest, that Tibetan Buddhism is one of the greatest treasures of the world. I do not say this in a boastful way. For more than 50 years I have had the opportunity to meet, discuss and debate with many great scholars and intellectuals and through these experiences have learnt that Tibetan Buddhism, with both its Sutra and Tantric traditions, is the most complete teaching of the Buddha. There is nothing like it on this planet. Today, many scientists are showing an interest in Buddhist mind training methods and detailed descriptions of the mind as these are closely related to psychological health and neuroscience. I think that we Tibetans have a resource that we can use to serve others well.

Within Buddhism, especially in the Nalanda tradition, the analytical approach to each and every phenomenon is based on logic so the analyzer needs to be highly intelligent. When you do analysis, it should follow a logic that can lead to a definite conclusion: if the logic is like a strainer that cannot hold water you may come up with a vague explanation but you won’t be able to reach a conclusion. To reach a conclusion, it’s extremely important to see the applicability of the reasoning. If not, we end up, in desperation, putting forth unclear explanations from this point of view, and that point of view, and nothing is proven. Of course, there are other cases, such as the basis of designation of a phenomenon, which are not findable through searching. If this is explained as findable in an epistemological text then, of course, it is wrong because in reality it is not findable. Here the process of search is based on how things appear to us. Things appear to us as having true existence. When we say that the object of
designation is not findable it is in the sense that things appear to us as having true existence but such an existence is not there.

Logical analysis is essential. Recently, at a conference on neuroscience, one of the scientists referred to the debating method that we Tibetan Buddhists use in teaching logic. He asked whether this method had been applied in studies other than Buddhism. I told him that we were trying to introduce it into our lay school system. During our early years in exile, one of our great scholars who was teaching at our lay school in Mussoorie, and who was later murdered by Shug-dhen party members, taught the debating method to school children. At that time we had quite a number of school students practicing the method, not only in the Mussoorie Tibetan school but also in Shimla and Dalhousie Tibetan schools. Unfortunately, the practice fell by the wayside. In schools these days our religious teachers only teach students how to recite prayers and do practices associated with religious festival. Here, too, we have been careless. If we had maintained the debating method, our students would have done much better academically. We really need to put effort into reintroducing the method into our schools.

When I talk about the contribution that Buddhism can make to modern science I am referring to science related disciplines, such as physics and psychology, which are an integral part of Buddhist scholarship. These disciplines are of universal interest and are taught in schools and universities around the world. At the beginning of this year, we began compiling material relating to physics and psychology from 300 volumes of Tibetan Buddhist texts. This work is nearing completion. Our goal is that this material will contribute to scientific knowledge at the international level. Just as Tibet’s early Buddhist scholars made a distinction between the five major and five minor subjects of knowledge, we need to distinguish between science related disciplines and other disciplines that form part of Buddhist scholarship.
There is a lot to be done and much of this is our responsibility. At the very basic level we need great teachers and translators. We often complain that the Chinese are destroying our culture and language, but here, in a free country, the standard of Tibetan—especially reading and writing—is very poor, as is acknowledged by teachers in our Tibetan schools. Books and papers written in Tibetan are produced throughout Tibet, and particularly in the Domey area. That we are not able to produce the same here, in a free land, is very sad. We need to put effort into this. We also need to translate scientific material from Sanskrit into Tibetan and to make the science of mind that is discussed in Buddhist texts available in major world languages such as English, Mandarin, and Hindi. We also need to produce well-educated people with good values. In our schools, most of the Tibetan students are Buddhist. They need to know that Buddhism is not only about praying and reciting texts; it is also a science of the mind. We need to train the mind and to do that we need wisdom. When I speak of compassion, and the need to promote compassion, I am referring to a quality—a product—of wisdom. Compassion is one type of consciousness and one needs to know its nature, its causes and conditions. Just as one needs a map to travel from place to place, we need a map to highlight the nature, causes and conditions of compassion. The discipline of psychology provides that map.

In closing, may I say that I very much appreciate the years of effort that the conference organizers and participants have put into fostering our knowledge of modern science and exploring the connections with science related disciplines in Buddhism—particularly the science of mind. Your work is of great significance and contributes to the promotion of inner value, compassion and warm-heartedness.

I think that human affection—human compassion—is the seed of inner peace, inner strength. Human compassion is not a Buddhist value; it is a universal secular value. All major traditions speak of the importance of love, compassion, and forgiveness.
One of the most profound questions humans can ask about their relationship to the cosmos is whether or not we are alone as sentient beings on a habitable planet. In the past decade, astronomers have shown that planets form readily around Sun-like stars, and about 100 million habitable planets are anticipated in the Milky Way galaxy. It’s not yet known if any of them host life, but unless the events on Earth that led to life and to intelligence were a series of flukes, we are unlikely to be alone. The modern search for life and intelligence is described, along with possible outcomes, and implications for our self-image and our relationship to the larger Universe.

Chris Impey: It is a great pleasure to be at this conference, and of course a great honor that His Holiness opened the conference. In short, he is what could be called the “ultimate act” to follow. But I will do my best to hold your attention by talking about exciting new results in the cosmic context for life.

I think, although I have no evidence yet, that the Universe contains comedy and tragedy. I think the Universe contains suffering
and compassion. And I think that these things happen on worlds other than our own. That is my conjecture: science is on the verge of discovering life elsewhere. That is the story I want to tell today.

The fact that biology exists in the Universe is remarkable, because life is in the middle of a range of sizes that spans 42 orders of magnitude, from the sub-atomic nucleus, to the largest structures containing thousands of galaxies. What’s remarkable is that entities like us, at the middle of that range of scales, can hold both ends of the scale within our heads. The unity of the cosmos is symbolized by the Ouroboros—an ancient symbol found in cultures across the world—the snake that eats its tail. His Holiness has said that both science and the teachings of the Buddha tell us of the fundamental unity of all things. And that is amply borne out by science in the 21st century, and especially in my field, cosmology.

The Universe is a complex place, and it is remarkable that we can understand it at all. I use grains of sand both literally and as metaphors, because each grain of sand under a microscope is a tiny geological world, and yet in our study of the Universe we have to contemplate billions of these worlds. The complexity we see around us seems like magic, but it is not; it is the result of natural forces acting over cosmic time. The complex is actually simple, but the simple can be complex too. To describe something as simple as a pile of sand where you add grains to the top requires chaos theory and complex mathematics. One of the features of our complex Universe is that the parts are not always simply describable in terms of the whole. Emergence is the idea that the whole is more than the sum of its parts, that humans, for example, are more than just the chemicals we’re made of. Here’s an example: if you have a glass of water, it is obviously wet, it is transparent, it will dissolve things, and it is polar in its chemical properties. But a single water molecule cannot be wet, cannot be transparent, and cannot be a solvent. At what point does water become water? A brain can think, can be self-aware, can know death, and can create. But the components of which it’s made can do none of these things. At what point does a brain become a brain?
And I submit the two other aspects that I am talking about are in this same category. The idea of life itself—at what point does something become living? And perhaps the Universe itself—at what point does something become what we call a Universe? To talk about something that has not yet been discovered, which is what life beyond Earth is, we have to use our imaginations, as we do in all forms of science. Scientists and artists and others have been doing this for hundreds of years. In the case of Isaac Newton, he imagined orbits and space travel three centuries before it was possible with technology. Even though we have no close up views of other worlds in space, space artists have been visualizing them for a century. In thinking about biology in other locations, we have to think outside the box, we have to go beyond Darwin and we simply don’t know what that looks like.

Imagine that the Universe is composed of things that are, and things that are not, of things that happen, and things that don’t happen, and our job as scientists is to find out which is which. The interesting point, both in physics and other forms of science, is that there are things that are possible that do not break any law of nature, which don’t actually happen. It’s a larger set of possibilities, and we don’t know the boundaries of that set. A bigger problem—I’d rather call it an opportunity—is the imagination. It is not machines or robots or automata doing this work, it’s people. Our imaginations are bigger than the worlds we imagine, and so we might imagine things in the Universe that are really there, but probably we cannot imagine all the things that exist. We can imagine things that are possible and do happen, and things that are possible but don’t. We can even imagine things that are impossible, and there’s nothing wrong with that.

How do we know the boundaries between these different sets? Let’s start with the basic ingredients. The simple answer is that the Universe was made for life. By far the most abundant elements are hydrogen and helium, and they were there at the beginning. The next most abundant elements—carbon, nitrogen and oxygen—are just those elements that a biologist or chemist would say are essential for life. They’re quite abundant, one part in a few thousand. These
elements are forged in stars and ejected into space by the death of those same stars.

The story of stars is our story, because we are made of stardust. For almost 13 billion years stars have been living and dying, and their stories are intertwined with our stories because they are made of the same elements from which we are made. In the sense that there has been successively more carbon, more nitrogen, more oxygen made by stars over cosmic time, the Universe has been getting more hospitable for life as time goes by.

What are the simplest things we can say about biology? With biology we have one example to study, and yet we are now wondering about hypothetical biologies. Things can look complicated and not be alive, and things can look simple and be alive. Biologists do not agree on the definition of life, and so as an astronomer, I feel quite comfortable in my ignorance. We can say life has order, that it organizes the chaos of the surrounding environment. Life uses energy, sometimes the direct manifested energy of the Sun; other times it lives further down the chain of life using other forms of life’s energy. Life is interconnected in a profound way, in a hierarchy extending from the entire eco-system of the Earth, to individual organisms, down to the sub-parts of cells and the molecules that provide its functions. It has been known for a long time that a simple reductionist strategy in understanding biological systems fails, because behaviors are emergent and can’t be understood purely in terms of their components.

What do we need to have life? Most scientists would agree that water is special. We need water. It’s not a difficult requirement; water is the third most abundant molecule in the Universe. Not only are carbon, nitrogen and oxygen abundant but water, the medium in which life began and on which life still depends, is available everywhere. Carbon is special, and is the second most abundant element made in stars, and with carbon as the basis for chemistry, the possibilities are essentially infinite. Biology has a tool kit with as many tools as it wants. Did it have to make life that looks like us, or that works this way? Absolutely
not, there are other possibilities if we’re imaginative enough to think of them, and the Universe may indeed encompass some of these possibilities. It’s hard to believe when you stare at or consider the difference between an elephant and a fungus and a butterfly, that these are all profoundly the same thing, examples of the same genetic code. All life on Earth is literally unified. The traditional tree of life was very comforting for our insecurities, because it placed us at the top of the tree, as the natural and perhaps inevitable result of evolution and natural selection over billions of years. In this view, we seem special, and it makes us feel good, but the truth is a little less comforting.

The modern tree of life is based on mapping DNA or RNA, the genetic material itself, and showing how it evolved over those same 4 billion years with gradual deviations. This is a powerful method because it doesn’t depend on saying that something looks like something else. You cannot use the species method with bacteria, for example, and most life on Earth is bacterial. The modern tree of life looks very strange; most of the branches on the tree are unfamiliar. Off in the top right, you see plants and animals, but these are small parts of the tree of life in terms of the real estate of genetic information. All the apes, primates, including us, are the tiniest little twigs on the tree of life, a tree that is almost overwhelmingly composed of microscopic organisms. That’s good for our sense of humbleness, I think.

We are all brothers in a very deep sense. If you think of marriage within the family, you might think the family you’ve married into and maybe the children born are half yours and half the other family. Our overlap with other species is much more profound than that; we share half or more of our DNA with yeast and wheat—yeast and wheat are our brothers too. Life on earth is incredible in its degree of diversity based on small percentages of the genetic material. This unity of course is very familiar in the Buddhist tradition where the connectedness of all living things is a foundation idea, but it’s the foundation idea of modern biology as well. To go beyond this, I could also say that any two of you in the room, say any two of the Tibetans
in the room, have more variations between your two sets of DNA than one of you and an African tribesman, or an Inuit fisherman, or someone who lives in Paris. This is remarkable. The genetic variation between two people, unrelated, living in the same village, is five or six times more than any two people plucked at random from the planet. And we make such a fuss of the tiny little genetic diversity that does exist between individuals.

Life on Earth has found its way into places far more inhospitable than those familiar to us. Some of you may find this room a little cold, but that is because we are frail and weak. Life on Earth can be in places where it rains once in a century. Don’t feel bad about being cold, but life elsewhere can exist below the freezing point of water. It does this because it invented anti-freeze so the cells don’t break. Life on earth exists in the deep darkness and near the super-heated water of volcanic vents under the ocean, independent of the Sun, so if you’ve heard someone say life needs a star, that’s not true. Life just needs energy of some form. Life can exist with the radiation equivalent to standing 100 meters from an atomic bomb exploding, and it does quite well with that. Such microbes do this by repairing their genetic material hundreds or thousands of times faster than we do. Life can be found in the equivalent of battery acid or drain cleaning fluid. Life can be found 10, 20, 30 miles underground in complete darkness, living off the tepid glow of radioactive material in the rock itself. This is the range of life on one planet, our planet. What might be the range of life on other planets that we’ve only just discovered? We don’t know.

Microbes maybe don’t seem interesting enough to spend much time talking about, but remember that we live on a microbial world; it’s their world, not ours. When we are gone, they will be quite happy to take it over again. Indeed, there are more microbes in your gut than individual cells in the human body. We represent the end of an outcome of 4 billion years of evolution, with branching points and random influences. It would be very hard to look at life on the early Earth and predict us, especially the last part of the story that led us to develop from the apes, and before that from small mammals that we
might not even recognize as very intelligent. Is this a fluke? How likely or unlikely are we, and has anything like us evolved on other planets? The thing that we think might mark us out from other creatures is our intelligence. But even there, it pays to have a little humility, or curiosity perhaps, about other modes of intelligence. Among different species of animals there is a relationship between the mass of the body and the mass of the brain, a very simplistic view of intelligence, of course. In these terms we do not have the largest brains on Earth. We are near the upper edge, but nothing special. There are social insects, whose behaviors are quite complex, whose engineering works rival ours in some senses. The point is not whether an ant or termite is intelligent, but that evolution doesn’t stand still. There are many more species of insects than there are primates or animals. Evolution will take them into directions that we can only just imagine. What will be the result of the cooperative behaviors they exhibit after many more years of evolution? Or what might social insects have done, or figured out how to do, on other worlds?

What about the octopus? This creature exists in a three-dimensional maze that is confusing even to experienced human divers. This creature has nine brains, one at the center of its body, and eight at the periphery. This creature’s skin is a video display device with a billion pixels. This creature has very complex behavior, and it has some quite clever tricks. The octopus is a cephalopod that diverged from our lineage in the tree of life 300 million years ago. I think of this as the alien among us, who lives on Earth, with whom we cannot communicate. We have no idea if this creature has feelings or suffers pain. We don’t know the nature of its intelligence or its mind. While we go out to look for life in the Universe, we should remember what and whom we share the planet with. We should remember the aliens among us.

We are a very egocentric species. For better or worse, this is our planet. We are the masters, no question, but we don’t know a lot about the creatures we share it with, and when we talk about intelligence and sentience, and suffering and pain, and emotional states, there
is an enormous amount we don’t know. As an astronomer, I would speculate that perhaps in 50 years we’ll find a planet with life on it. Maybe there is some amazing creature on that planet, just a little bit like an elephant. You know, if we found such a thing, it would be the most amazing discovery. We’d think it was wonderful. We’d do everything we could to understand, study, and preserve these strange creatures, far away. But we already have the elephants, and we already have the dolphins, they are right here, and who knows what goes on inside their heads. For another type of extraterrestrial perspective, let me just point out how recent our supremacy is: the brain size of humans mostly evolved in the last few hundred thousand years. The brains of dolphins and toothed whales evolved over 40 or 50 million years’ history, and this is in terms of brain to body mass ratio. What you see is that if aliens have come to the Earth for most of the last 50 million years, and wondered where the brainy creatures were, they would have gone into the oceans. Just in the last million years have we eclipsed the marine mammals. Indeed, our time on top may be short. It’s a transient place in the history of the Earth. Impermanence is not just a feature of individuals, but of species as well.

Exobiology is the search for and study of life beyond earth. If we were to find life elsewhere, it would be a revolution equal to the Copernican revolution, which showed we were not the center of the Universe. Since the time of Copernicus, we have found that we are but one star among many, in one galaxy among many. We are not even made of the stuff that the Universe is made of, which is primarily dark matter, the dark energy. The discovery of other life forms would be yet another level of displacement of our centrality in the scheme of things. But I don’t think it would be a surprise, and I don’t think it will be unwelcome. In this subject we are still in a high state of ignorance. Most of the microbial world is not understood, and I have already told you how amazing some of their capabilities are. We have just poked around the Solar System, studied a few places. These are expensive and difficult missions. We have just begun to find habitable worlds beyond our Solar System. It’s a brand new field of research. In terms
of searching for intelligent signals, from aliens elsewhere, the search has already begun. For 50 years astronomers have been searching for signals from intelligent aliens. They have heard nothing, a result that’s been called the “Great Silence.” But the Universe is so large that we cannot yet conclude that we are alone.

We tend to make assumptions because in science sometimes you have to make assumptions in order to progress. But if all we look for is life situated on planets using carbon chemistry, with DNA, or something like it, as a replicating molecule, then we may have missed most of what’s out there. I have already mentioned that life doesn’t need a star. It’s not even obvious that it needs a planet and it might not need carbon. Last, in that outer sphere of ignorance, life might be unrecognizable to us. We have just begun to look outside. This is an image of our home, a famous image made with the Voyager spacecraft looking back toward the Earth from a billion miles away. The pale blue dot is seen here against the rings of Saturn, and we want to know how special it is.

There are places not far from home that are interesting for biology. This is the icy surface of Europa, one of the moons of Jupiter. This moon has a kilometer thick icy crust covering tens of kilometers of deep water; the entire moon is a water world. We have designs that could land a probe on the ice pack, melt through it, and search for life. Not funded, but it’s an interesting thing to do. Earth is not the only place in the Solar System covered by water.

This world looks Earth-like. You see clouds, a shoreline, and a river delta. This is Titan, a large moon of Saturn. Titan has an atmosphere, made of the stuff we breathe, nitrogen, and twice as thick. But because it’s a frigid world, where the chemistry is based on ethane and methane, if there is life here it would be unlike anything on Earth. Life 2.0.
The closest target for astronomers is of course Mars. Mars has disappointed us, because after decades of speculation and science fiction, we learned 35 years ago that it is a desert, with a thin atmosphere, flooded with ultraviolet rays and cosmic rays that would seem to sterilize the surface. But we have had tantalizing evidence that the arid Mars surface may hide a water world underneath. The water evaporates into space, but we have evidence that Mars can be wet from time to time. And where there is water, there might be life.

Astronomers have finally started to find distant worlds, the first only 18 years ago. For centuries we wondered if there were planets around other stars. Now we know there are. Imagine a familiar part of the sky, the constellation of Cancer, and one of the brightest stars in this constellation, some 20 light years away. We can’t visit it with spacecraft, but we can with our telescopes. Going through the Solar System, across the light years, we found a system of four planets, mostly large like Uranus and Neptune. But this Solar System is very far from home, the first, it turns out, of many. How have astronomers done this? By a clever trick, the planet itself is invisible. Earth as seen from afar would be a billion times fainter than the Sun, Jupiter a hundred million times fainter. We cannot see the planet by reflected light. Instead, we see the planet by the wobble it exerts on its parent star by the force of gravity. So we look for the wobbling star, and infer the planet. If the orbit is like this, we have an additional possibility, which is to observe the slight dimming of the star as the planet crosses its face. Both of these effects have now been observed over a hundred times, and that’s how we know there are planets around other stars. We also know, in this case from theory, that these are going to be “water worlds,” many of them. Some will be baked dry like Mercury; some will be frigid worlds as in the outer Solar System. But a substantial number of Earth-like worlds should exist according to theory and computer simulation.

Here is the state of this exciting field just 15 years after it started: each red dot in the graph is a planetary system. In many cases, multiple planets have been found. This line shows you how the detection has
improved in the last few years from Jupiter towards Earth-like planets. We are approaching the detectability of Earth-like planets. NASA’s Kepler Satellite is going to fill in that space. Finding an Earth-like planet is exciting, but how would we know if it’s alive? It is, after all, likely to be tens of light years away, maybe hundreds. This is how we will find out: we will take that feeble reflected light from the planet, and spread it into a spectrum, and look for the indicators of life indirectly. You can see the spectra of Mars, Venus, and the Earth. They all show carbon dioxide, but Earth alone shows a very strong signature of oxygen, ozone, and water. The oxygen is the tracer of life on this planet. If the biosphere shut off overnight, if every living creature died, the 20% of oxygen in the atmosphere would disappear in less than a million years, a blink of an eye geologically. It is sustained only by the biosphere. Reversing that, we want to look for oxygen and ozone and other gases as indirect traces of life. The Earth-like planets we find won’t exactly be like our Earth. They will be subtly and interestingly different. And I have to break one piece of bad news to you: finding another Earth will not relieve us of our obligation to look after this one because the next nearest Earth will be tens maybe a hundred of light years away with no way to go there if we mess up this planet. We could, however, potentially communicate with other beings on those worlds if they exist. Let me now get to the last part of my talk, the frontier of the subject.

Microbes are interesting, but there is a sense of companionship that we are looking for here. We want to know if we are alone, or not, and what that means. Here is the perspective on the number of worlds in the Universe we think might host life based on current research. The number of grains of sand you might hold in your hand is the number of stars that have been inspected for planets. The number about which we have enough information to show they might be habitable in terms of our form of biology may be less than a hundred, or the number of grains of sand that would stick to your finger. Projecting into the Milky Way, the number of habitable worlds is the number of grains of sand in a sand box, each one potentially hosting
biology, each one potentially hosting sentient creatures with hopes, dreams, fears, longings, unknown to us. These grains of sands are representatives of just our galaxy. In the Universe there are a hundred billion galaxies. The number of habitable worlds in the Universe is the number of grains of sand on a long beach. How significant is our life then if a modest fraction of these worlds are alive? The number is a billion habitable worlds in the Milky Way, a hundred million of which are roughly Earth-like. The complete census is a billion billion in the Universe. What odds would you place now on us being special or unique?

The bounty of astrobiology is not just about space—it’s about time. Life on Earth started about 4 billion years ago, but the Universe had 8 billion years before Earth even formed to be doing biological experiments. In other words, there could be creatures that got to our stage of evolution and then went on a few billion more years. What would that be like? We don’t know, and I don’t even think it’s possible to visualize that many inhabitable worlds. If we spent just five seconds looking at each habitable world in the Milky Way—just one galaxy—it would take 10,000 years of inspection. Space travel is in its infancy; for now we will just have to use our imaginations.

In advance of finding life anywhere else, and without knowing whether that life would be intelligent, astronomers are trying to communicate by sending messages into space. These attempts at communication might seem feeble, and they are more symbolic than anything else. This plaque or picture is attached to the first spacecraft to leave the Solar System. It’s our message in a bottle, now 12 billion miles from Earth. But even as fast as its feet can carry it beyond the edge of the Solar System, it will be a hundred thousand years before it approaches another star.

We have even sent a record into space with 110 of the world’s languages represented, with our music, with images of us. It represents us, but again it may not be a realistic attempt at communication, especially when the aliens are likely to have unknown function and
unknown form. Other attempts involve radio telescopes, which are efficient ways to send information across the gulf of interstellar space. Experiments have improved dramatically because of Moore’s law, the advances in electronics, and the ingenuity of the people who conduct these experiments, but we have heard nothing. Now they are listening rather than sending, and they are not discouraged because the capability is improving so rapidly. To put a number on that, if there were civilizations on any of the nearest hundred million stars the lasers or radio telescope technology that we have now are sensitive enough to detect them.

What are the forms of alien life? I have no idea. I do not think they have been represented in science fiction, and I am pretty sure they are not represented on TV or in the movies that I have seen. I think they are maybe stranger than we can imagine. It’s motivating, however, to look for such creatures and to wonder what we might learn from them. The physicist Enrico Fermi posed a very interesting question 60 years ago. Recognizing that our technology is young and that we are unlikely to be the first intelligent civilization in the Universe, he asked: “Where are they?” Going further, a very modest extrapolation of our technology will let us travel beyond our Earth, either physically or with our robotic eyes and ears. In fact, Fermi also knew, even then, how many likely sites for life there would be. The question is where are they? It is well posed and one answer is that we are indeed alone, truly alone, which would be an amazing outcome in our vast Universe so seemingly full of biological potential. We might hope to learn from such species, if we find them. Do they share our fears and dreams? Are there civilizations that have compassion, but no suffering? What happens out there in the multitudes of the planets? We still need to get over ourselves a little more, remembering that the aliens may relate to us as we are to bacteria, or they may not be interested. Or they may think of us in a slightly different way, one less comfortable. Perhaps to them we are food. Going there is not yet on the cards; our space program is in its infant stages. Having been part of teaching the first cohort of monks in the leadership program, I know whom I would
choose as our next cohort of astronauts, remembering that space is hazardous and things can go wrong when you are an astronaut. I would like to see monk astronauts if we are serious about space travel.

I think we will get there eventually. If we look at the history of transportation, we might project that in a century so we will be able to travel to the stars. Whether it is with robots, or by ourselves, we will find out the answer. If there is companionship there, we will find out. It may take a while, but again, if anyone got to this stage before us, they could, in a very short time, just a few million years, travel the galaxy. These would be the ancients of the galaxy, the wise ones who have been there, who have been everywhere.

In the end, having posed a few questions, as in all good science, more questions are raised than are answered. In a Universe with ten thousand billion billion stars, and an enormous number of habitable planets, it is therefore very likely, given the raw ingredients, that a myriad of life forms may exist. We do seem special in some ways and we should treasure that. But we are not special in any cosmic sense. And astronomy, of course, has not yet been able to answer the question that underlies all these considerations, a question that lies beyond the domain of science: Why are we here?
Discussion

Rajesh Kasturingan: You were saying how difficult it is to map out the potential signs of life, or the elements that might make up life. With the use of modern technology, couldn’t we do a massive data mining of the various spectra and automatize some of the search—so what Google does for web searches, couldn’t we do the same thing in searching for life on other planets?

Chris Impey: That’s a good question. Yes, but only at the level of finding planets. With zero planets detected before 1995—and now approaching 1,000—we are harvesting planets easily. Indeed, the citizen scientist, or the public, can even get involved in these efforts. The trouble is that the next step of the game of finding life signs on a planet is very much harder. Analyzing the spectra of planets’ atmospheres is ultimately harder than detecting a planet in the first place. If I may use an analogy: if the Earth is the size of a soccer ball, you are looking for something that’s the size of a soccer ball and a 100,000 miles away, and it is also next to a light source that is a billion times brighter than the soccer ball. So it’s very hard for telescopes to isolate the spectrum from a planet that is in such close proximity to the star, and we are still five or ten years away from finding a facility that can attempt it. In a sense, that’s why the radio astronomers searching directly for intelligent life feel they have a slight advantage. Though they spend a lot of time looking at noise, any potential signal they might observe is likely to stand out above the noise and wouldn’t be obscured by the parent star.
Monastic Graduate: I have two questions and they are interrelated. Scientists have made many great achievements and one of these achievements is finding other planets. My first question is: Since there are so many things that we need to learn about our planet, so many problems here at home, why are scientists so interested in looking for another planet, or other planets, in other solar systems and in other parts of the Universe? My second question is: If somehow we happen to find a planet with life on it, do we have any plans, or do scientists have any plans, to help sentient beings on those other planets and how will we, the people on Earth, benefit from that kind of discovery?

Chris Impey: In response to your first question, part of the answer is very simple; it’s just pure curiosity that causes us to look beyond ourselves and our immediate situation. I guess the analogy I would use is the way humans spread across the earth 50 to 100 thousand years ago, starting with less than a million humans coming from Africa within a very short time, and hundreds of generations spreading across Asia, through the Americas and to the southern tip of South America. They didn’t have to; it would have been more comfortable, if they had cared about comfort, to stay where they were. For example, on the way from Siberia to Patagonia, they passed through southern California; why didn’t they just stay there? I think you know. We are curious, and that curiosity is built into our DNA, and some part of it we express outwards. Another answer, the scientifically practical answer, is that sometimes it’s easier to look out than look in. The deepest hole we have ever dug in the Earth is no deeper than the thickness of the skin on an apple. It’s very hard to do, so even learning about our own planet directly can be harder than looking out with a telescope. Then a third, more philosophical, reason we do it when we have so many problems at home, and why it’s not a bad thing, is that it speaks to our cosmic situation. It tells us more about ourselves, if we are alone, unique, or part of a tapestry of life that also exists elsewhere in the Universe.
That gets us to the second question. Because it’s such a new science not as much thought has been given to how we will behave, or what we will do, if we discover intelligent life. But some thought has been given to ethical issues of life beyond Earth, for example, and this may surprise people. NASA has given a lot of thought to exploring the Solar System and not contaminating it. Every mission that goes to Mars, now and in the future, will be designed not to contaminate Mars, and to clean up after the mission, leaving no debris. Of course, enormous protection is planned if we ever bring a Mars rock back to the Earth in case the microbes that it might contain would hurt us, so there is the idea of protection. Within the space community there is a tension between two ideas. The first idea is that space is there for us to take—that just as civilizations on the Earth traveled around the Earth and made empires, so we will take asteroids, take other planets. There is also a movement in the space community that wishes not to alter anything, to never alter a world you find, to just look at it and learn without changing it, not just Mars, but everywhere else as well. The ideas are now forming of how to protect and preserve and learn. Then, of course, there is a hope that we might learn something really substantial if we ever found a certain intelligent life form. It would be something really important for us. It’s unlikely they would know exactly what we know, or feel what we feel. Fear should not govern us in this. It would be bad for us to be afraid. Stephen Hawking has famously said that we shouldn’t tell them we are here with radio and telescopes, because they might come and destroy us. I don’t agree with him.

**Monastic Graduate:** When you talk about evolution on this planet, and living beings evolving from a single cell to large mammals, which organisms have evolved the smallest and largest brain sizes? And is there more to intelligence than just brain mass?

**Chris Impey:** I am not a neuroscientist, but there are large marine mammals, for example whales, that have bigger brains. But brain function is not simply related to size. Brains have evolved over more than half a billion years. More interesting to me is that there could
be other architectures of brains that we really don't know how to measure, and so size could be a completely unreliable measure of brain capacity or sophistication.

**Geshe Jangchup Choeden:** I appreciated your presentation—very beautiful. Astrobiology is quite a young field of science so from that point of view I think it could be very difficult to be sure that there is life out there. You presented Fermi’s question. He appears to believe that there is life out there. The question is, where? It’s not like asking is there any life out there? That’s a very different question. What is the logic behind Fermi’s position?

**Chris Impey:** You raise an important point. I will generalize, but I have talked to enough scientists to know that there is truth in the generalization. Life scientists tend to be much more pessimistic about the possibility of life elsewhere than physical scientists and astronomers. I think that is simply because life scientists look at the many conditions that apparently had to be satisfied, the twists and turns in the path of evolution, the fact that life on Earth was simple for a very long time, and took a long time to become complex and intelligent, and even then, intelligence exists in only a small number of species out of millions and millions. They would consider it unlikely. But there are also people who look at the other side of the coin. The astronomers say the ingredients are everywhere, the conditions are everywhere, on one planet life radiates to every possible evolutionary niche and some that are hard to imagine. Thus, if you give it another environment, it will just do something different. But there is no way to win that argument. Science is empirical; you have to see, you have to go and look. There are reasonable arguments on both sides. I recognize the strength of each side, and that to me is the reason one is compelled to look, however hard it is. As for knowing for sure, you’re right, evidence for a habitable planet is in our hands now, and out of the known 1,000 exoplanets about 50 are habitable. We have habitable planets, in a traditional sense. Some are within two times of the mass of Earth, but saying they are habitable and saying they are inhabited is much harder. The experiment will take like 10 to 20 years, but I think
it will happen because there is much motivation to do it.

**David Presti** (Moderator): There are a large number of very interesting questions from the audience, and we will try to get to them now. Several of the questions speak in a very interesting way to interface, to the connections between mind and cosmology that are relevant to the topic of astrobiology. We may defer those questions until later today, and ask a simpler one now. As you mentioned in the beginning of your talk, even biologists disagree on how to define life. To the best extent possible, how would you define a living entity, and are there any scientific studies that are trying to create life, or the basis of life, in the laboratory, and doing that with elements that are not the standards, such as carbon, oxygen and nitrogen?

**Chris Impey:** In the 1940s Erwin Schrodinger wrote a book called *What is Life?* He used the informational, thermodynamic argument that life is something that can harness order from the chaos of the natural environment. It organizes, and essentially stores information, and propagates, and the last ingredient is evolution—a mechanism to evolve the information. If you just call it information that liberates you, because DNA and the genetic information of human organisms and all creatures on earth is one genetic code. However, there are many possible genetic codes, and there are other ways to code information other than macromolecules. The theorists of the subject, theoretical biologists, a small breed, actually try to imagine very different bases for life. The more extreme view is that life doesn’t need biology at all, that you could have information organized in other ways, perhaps physically through electric or magnetic fields, and other means. This sounds like science fiction, but science fiction is based on science too. There is much speculation because we start with the thing we know but we don’t want to get stuck there.

In terms of the second question, the question is whether we can tell the story of how we got here. It’s very important to be able to tell that story scientifically. The answer is not yet, because the story is lost in the mists of time. Can we trace the pathway from molecules with 20
or 30 atoms, which exist naturally on the early Earth, to a developed, living cell? The answer is no, not in the lab. Scientists did experiments in the 1950s, and they have been updated, but they have never reached anything like a replicating molecule. A series of lab experiments in the last two decades have basically taken pieces of the puzzle, and if there is a linear path between big molecules and a simple cell, we have paved with lab experiments 20% of that road, maybe 30%. It’s been shown, for example, how molecules can become more complex naturally, on clay surfaces, which is a template for reproduction. It has been shown how oily material and water naturally form proto-cells much smaller than present day cells, and that those cells will concentrate chemicals, increase the rate of reactions and naturally subdivide. But bridging the gap from simple molecules to a chemical form of natural selection is actually a very hard task, and may never be done in the lab. All these events took place on the surface of the earth 4 billion years ago, and there is essentially zero evidence remaining because it’s almost impossible to find rocks that old; the ones you do find are tortured by volcanism, heat and pressure. There is no trace of what happened; this is an historical science, not an empirical science in the normal way.

David Presti (Moderator): A composite question from the audience. If there are indeed many potentially inhabitable worlds even in our own galaxy, and if there have been billions of years of evolutionary time available before the formation of life on the earth, there may have been time for many advanced civilizations to develop and explore the Universe. Is it possible then that many of the phenomena that are often attributed to extraterrestrials here on Earth could in fact be true? And do astrobiologists and cosmologists interested in extraterrestrial life take those kinds of reports seriously?

Chris Impey: These are important questions because in popular culture and media there is widespread storytelling involving UFOs or alien visitation. The ironic situation is that while most astronomers might believe on statistical grounds that there are likely to be intelligent civilizations somewhere in the galaxy, they equally believe they haven’t visited Earth. But, with so many individual reports that would need to
be refuted, I could not discuss this in the next few minutes, or even the next few hours.

In general, extraordinary claims require extraordinary evidence. If scientists claim to find microbial life in another world, those claims will be scrutinized at a very high standard before they are believed. For claims that intelligent aliens visited the Earth to be validated, they require the highest standard of critical review. Because there is a complete lack of physical evidence that could be analyzed in independent labs, this presents a fatal flaw for the UFO cases, fatal. Photographs are not significant evidence. Eyewitness reports are famously fraudulent, even if they were not made with the intention to mislead. I won’t and can’t discard all of the anecdotal evidence, but as a scientist you have to put all your effort where the most benefit lies and where the most fruitful exercise is for the scientists involved.

Another answer, and maybe the most likely one, is that we are very isolated in time and space. The great distances between worlds in time and space are difficult chasms to overcome with technology, even technology that far surpasses ours. The energy requirements are bounded by robust laws of physics. The isolation aspect could be significant, and may indeed be the case.

Another answer is simply because they don’t care. For example, dolphins and orcas, I believe are intelligent, are sentient, have emotional states. There is evidence that elephants are aware they have mortality. But these creatures, as far as we know, even if they evolve, will not develop telescopes and spacecraft, and that’s not a fault of their own. If other planets have such creatures, we don’t know about them.

There is even a cultural layer, the business of very active exploration in the history of the world, from colonization to exploration of space, which in our culture has its genesis in a bitter super-power rivalry between the United States and the Soviet Union. Lots of weapons were created. This landscape of projective exploration, and often conquest, is a very Western mode of operating, and maybe if these
activities had been more informed by Buddhist philosophy in the mid-20th century none of that would have happened. We wouldn’t have the space program, we would have tried to take care of business on Earth, and maybe other creatures elsewhere are doing the same thing and therefore we don’t know they are there.
If we don’t understand the role of life and consciousness in the Universe, we may end up doing more harm than good. What is life and what is consciousness? When do life and consciousness begin? Where and how do they thrive? Is it possible to improve life and consciousness? If so, how? These are tough questions. Different contemplative traditions and fields of science have tried to define the terms “life” and “consciousness” but are yet to reach consensus. How did life and consciousness evolve in the Universe? Did the great thinkers ponder this question and fail to find clear-cut, and universally acceptable answers? Many of the contemplative traditions of India developed a strong culture of studying life and consciousness, primarily to achieve a common human goal—happiness. It appears that mainstream communities of scientists have focused on a search for life beyond planet Earth, while ignoring the study of consciousness. Many Western psychologists, inspired by Eastern culture, have tried to address the importance of the study of mind and consciousness but research in this field is still limited. From a Buddhist point of view, the Universe is just one whole township built up by blocks of consciousness and matter, and consciousness plays an exceptionally greater and more important role than matter in achieving the common human goal of happiness.
Geshe Jangchup Choeden: Good afternoon brothers and sisters. It’s a great pleasure to be here with you all, especially in the presence of His Holiness. The topic that I’ve been invited to discuss is life and consciousness in the Universe. Professor Chris Impey gave a precise and informative presentation this morning about the probability of life in the Universe, and the definition of life according to the field of astrobiology, along with his personal views.

The first important thing we need to note about life and consciousness is that we are discussing life and consciousness within this present Universe; the Universe in which we are dwelling. From this point of view, it is interesting to talk about the Universe itself. How the Universe came into existence is a question that human beings have pondered for a long time, perhaps since the beginning of human community. Different spiritual traditions and all the religions have tried to answer this question and in the past century and a half new answers have replaced the old.

As I am representing the Buddhist community, I will give a Buddhist perspective on how we look at the Universe and how it came into existence. Of the various views of cosmology presented in Buddhist literature, I will primarily rely on those given in the Abhidharma (special topics of knowledge) and specifically the Abhidharmakosha.

According to Buddhist cosmology the Universe came into existence as a result of karma. How this occurred is not clearly explained. Buddhist literature provides an explanation of how the Universe came into existence, but it is not as clear as the Big Bang theory.

Here we need to reflect on the meaning of the term “Universe” as

1 The Tibetan term *jig-rtan* is composed of two syllables/words: *jig* meaning “disintegration” and *rtan*, which means “support” or “contingent.” Together they mean “disintegrating support,” which can be interpreted as the “disintegration of the container being contingent upon the illusory notions of the contained.” Another description of the Universe is “one that acts as a support system for sentient beings’ death and impermanence.”
used in Western cosmology. Is there an equivalent term in Buddhism? I’m not sure there is. When we speak about the “Universe” in the Tibetan language we use the term *Jig rtran gyi kham*. Unlike terms such as “planet Earth,” “Solar System,” “Milky Way galaxy,” and “Universe”—which each refer to something of a different size—*Jig rtran gyi kham* has a number of connotations.¹ This may lead to ambiguity when Western scientists and Buddhist scholars discuss the “Universe.”

When we learn in the Abhidharma how *Jig rtran gyi kham* came into existence, we also learn about time span. According to the Abhidharma it takes 80 intermediate eons² to complete one whole cycle, which includes an era of emergence, an era of existence, an era of ceasing, and an era of absence of the Universe. These four eras are required to complete a whole cycle, just as the completion of a year requires four seasons. This is the traditional explanation as presented in the Abhidharma. I don’t claim it to be true.—

The next question is: Who created the Universe? This is a recurring question in the general community. Some spiritual traditions claim that the Universe is a design and that it was designed. If so, who designed it? Some of these traditions claim there was a creator who created the Universe and they provide explicit details of how this occurred.

Of the various scientific theories on the beginning of the Universe, the commonly accepted one is the theory of the Big Bang. This theory has prevailed for the past 100 or 150 years and is now commonly accepted in the scientific community; ironically it is taking the shape of a religious dogma. Experiments validate the theory as being accurate and precise. As I’m not an expert I’ll leave that to the cosmologists, astronomers and physicists who may address this topic later on. The Big Bang is one way of looking at how the Universe came into existence.

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¹ This is the traditional explanation as presented in the Abhidharma.
² 80 intermediate eons equals one great eon.
Of the various theories in Buddhism, the most common is that following completion of the era of absence of the Universe, very subtle particles gradually formed into the coarse Universe. A time span of twenty intermediate eons, one medium *kalpa*, is required for completion of the emergence of the Universe, which some Buddhist scholars have calculated to be 300 billion years.\(^3\) I can’t verify the accuracy of this time span; when I studied this theory, I didn’t learn how to prove it through experiment. Scientists are required to prove their theories through experiment so they have far more empirical data.

The next question we are looking into is how life and consciousness evolved in the Universe. This is a very tough question. According to the Abhidharma, life and consciousness recycle continually one after the other. Therefore, logically, there is no beginning point. From this perspective, the commonly accepted theory of natural selection does not completely explain the beginning of life and consciousness. The theory of natural selection is an important part of the science of evolution. However, it focuses on explaining the origin of living matter rather than addressing the origin of consciousness. I believe this is the wrong approach.

The Abhidharma and other Buddhist scriptures teach us that life has existed eternally; instead of explaining how it begins, emphasis is put on explaining how it continues through recycling. This theory applies to consciousness too. The Abhidharma does not tell us how and where life started; if life has existed without a beginning point the question is irrelevant. This is the Buddhist point of view on the beginning of life in general and it applies similarly to consciousness. This view is easily understood by those who reject the idea that the Universe and beings were designed by a creator.

As His Holiness reminded us this morning, the most important

\(^3\) Each of the four stages takes 20 intermediate eons, approximately 300 billion years each, or in total, 1.2 trillion years.
thing is human happiness and this is deeply related to consciousness or the mind. Therefore, according to Buddhism, it is very important to study and understand consciousness: How does it occur? How is it sustained? How can it be modified? How can it be controlled? How can it be improved? These are vast and important fields of study in Buddhist academia. So, too, the way in which life is sustained and recycled.

Buddhist teachings explain the recycling process of life through the law of karma and result. To understand the recycling process and continuity of life, we first need to answer the question, “What is life?” My friend Professor Impey has just explained the definition of life according to astrobiology. From the scientific perspective, the definition of life is surprisingly difficult to agree upon. Everyone agrees on the attributes of growth and reproduction, and that is one way of explaining life. Another definition that Chris put forward is the idea of life as flow of matter and energy, and that makes perfect sense.

Buddhism offers other definitions. Among the Abhidharma texts, the most widely studied and accepted in the Tibetan Buddhist community are the Abhidharmakosha and the Abhidharmasamuchaya. According to the Abhidharmasamuchaya, the primary function of life is to act as a support for consciousness and heat. This definition of life is the one most commonly accepted by Tibetan Buddhist scholars. On the other hand, the Abhidharmathasangho divides the life force into two: one belongs to the category of consciousness and is listed as a main mental factor; the other belongs to the category of form and is counted as the 6th sense organ.

To discuss the existence and emergence of consciousness we also need to define and understand consciousness. I have no idea what consciousness really means to scientists. Buddhism explains consciousness as something characterized by clarity in its nature, and having the function of knowing. According to Buddhist philosophy, these characteristics are indispensable to consciousness.
Up to this point we have discussed life and consciousness and their definitions. Now we look again into whether there is a beginning point of life and consciousness. As I mentioned earlier, according to Buddhism, life and consciousness, in general, had no beginning point. The Abhidharma, however, tells us that life began evolving on Earth as long as 19 eons ago.

How did life begin to evolve on Earth at that time? According to the Abhidharma, life moved down to Earth from higher realms where it had existed continuously during the era of the ceasing and absence of the Universe. Life remained in the higher realms without destruction. According to the Abhidharma the higher levels of existence are free from destruction and are not included in the meaning of the term *jig rtan gyi kham*.

After the completion of the emergence of the Universe, when the Earth was young and just ready to host beings, a private being from the higher realms descended to Earth due to the power of previous karma. Over time, due to karma, more beings descended and these were the first points of the evolution of beings on Earth. This process of evolution continued step by step all the way down to the final stage of the era of the emergence of the Universe, which lasts for a total of 20 intermediate eons. Once the era of the emergence of the Universe is over, the era of existence begins, then the era of ceasing, and finally the era of absence, the empty era.

Once the Universe is completely destroyed with its debris swept away by strong winds, the era of absence (the empty era) begins. It, too, lasts for 20 intermediate eons and there is nothing except empty and open space holding the scattered particles. As mentioned earlier, the four eras of emergence, existence, ceasing and absence each last for 20 intermediate eons.

According to Buddhist texts, amoeba did not move step by step towards emerging into a new form of intelligence that finally ends up in producing human beings. Instead, beings of a much early period
were physically and spiritually more advanced than modern human beings. The first beings that descended from the higher realms had bodies made of light and could astral travel at will. This is the Buddhist view of evolution.

The next question I must address is: Where and how do life and consciousness thrive? Under what conditions do they flourish? According to scientists, and as mentioned in Chris’s book, *The Living Cosmos*, they require nourishment such as air and water, and may also need carbon or amino acids. However, there are many unanswered questions. According to the Abhidharma, four types of nourishments are necessary: food, contact, volition, and concentration. Carbon could be a necessity for a limited variety of life—the Abhidharma doesn’t mention carbon, as it wasn’t recognized in those days, at least not with its present name. Many of the questions raised by scientists are new to Buddhism. When we say nourishment, we are referring to different varieties of nourishment. The nourishment that contains mass, taste, and liquid are necessary for the survival of a special variety of life, but not for all types of life. Contact is a different kind of nourishment that is necessary for different varieties of life. Volition and concentration are types of nourishment that are needed specifically for the sustenance of consciousness.

As I explained earlier, from the Buddhist point of view life is primarily supported by consciousness. If we look at life from this point of view it makes sense, because Buddhist scriptures count food, contact, volition, and concentration as nourishment required for the sustenance of life. Scientists, who have a different definition of life, would not see this type of nourishment as acceptable in terms of sustaining life.

Now let’s find out if it is possible to improve life and consciousness and, if so, how? Scientists say it is possible to improve life and consciousness through methods ranging from medicine, business, and education through to technology etc. Buddhists say it is possible, too, but mainly through the spiritual methods outlined in great detail in
the Dharma, such as training in the Noble Eightfold Path and the Six Perfections. Learning about life and consciousness is important. As long as improvement remains a primary goal, spirituality is indispensable. Spirituality is different to science. Buddhist spirituality provides detailed methods of how to improve life and consciousness, how to make consciousness grow calm, stable, efficient and powerful. Improvement occurs when people are trained properly and dedicate themselves to the practices for extended periods of time. Specifically, when someone trains in mental concentration and insight meditation the employment of these techniques improves consciousness and elevates it to higher level and makes one’s life more peaceful, satisfactory and happy.

Now let’s look at another question: Is it possible to produce new life and new consciousness? Here, science probably says “yes” for life, but I’m not sure what the response is with respect to new consciousness. This is a question that makes me eagerly await the presentations of our scientist friends. Buddhism is very clear on this. Buddhism says “no”—there is no chance to produce a new life without the involvement of an existing life. Life existing at present is continued from a source life of the past; it is a long term recycling process. There is no chance at all to produce a fresh new consciousness without a source consciousness from the past. I remember David raised the question of whether it is possible to produce new life and consciousness with Chris earlier.

There are clearly huge differences in how scientists and Buddhists explain life. I think this is due to the way in which each defines life. According to Buddhism, it is not necessary to have any kind of form, or matter, to sustain life and have consciousness. Consciousness is able to sustain itself without any support of matter. This is completely different to the way in which scientists view life and consciousness. Scientific approaches are based primarily on day-to-day experience, detectability of matter through machines, and contemporary human interaction with the external world. Buddhism explains the Universe from a much wider perspective that creates huge differences between these two traditions. There could be specific findings of scientists that
concur with Buddhist studies of life and consciousness, and specific Buddhist theories of life and consciousness that scientists may assert through experimental studies. As the authentic scientific approach is unbiased, focused, research based, and impartial, it is appropriate to agree with science and scientists on particular findings.

Discussion

Monastic Graduate: In science we talk about the Big Bang as the beginning of the Universe, and in Buddhist traditions we talk about the emergence, existence, ceasing and finally the absence of the Universe, where there is a specific cycle for the beginning and the end of the Universe. When we bring these two traditions together, what are the diverging points and converging points between the two?

Geshe Jangchup Choeden: The long time span required for the emergence, existence, ceasing and absence of Universe as referred to in the Abhidharma is a key point of divergence. If Buddhists were to renounce this, I believe we would find many points of convergence with the Big Bang theory. But for Buddhists, discussion of and research on the birth of the Universe is not as important as it is to cosmologists, so Buddhist scholars have provided very limited research material on this topic. I hope that will change in the future.

David Presti (Moderator): I like the definition of life as a center of support for consciousness, and these are very interesting questions to consider. A discussion I have often had with monks over the years is where do you draw the boundaries around where consciousness is possible? For instance, consider a sentient being, perhaps a fly, and a plant. Is a plant a sentient being? I am wondering what you, or the Abhidharma, might have to say about what is possible. Can bacteria be conscious under these definitions?
**Geshe Jangchup Choeden:** I don’t know if bacteria have intelligence or not. If bacteria have the ability to think, then I can accept that bacteria have consciousness and are sentient. Generally, we don’t accept the idea that plants can think, and anything that cannot think is not seen as a sentient being. Thus, it all depends on whether bacteria can think or not.

**David Presti (Moderator):** What do you mean by “think?”

**Geshe Jangchup Choeden:** I mean whether bacteria can plan and, based on that planning, move to consume things and undertake some of the functions carried out by intelligent beings.

**Monastic Graduate:** From the Buddhist point of view, when we talk about consciousness we talk about a very subtle consciousness, and along with that we talk about subtle wind energy, the mount of subtle consciousness. If we combine these subtle wind energies, is it possible to produce a grosser level of wind energy that can be detected?

**Geshe Jangchup Choeden:** Different schools of thought in Buddhism recognize different theories. This explanation of subtle consciousness is generally found only in specific parts of the Tibetan Buddhist tradition. According to Tibetan Buddhism, it is very difficult to say whether the mount of subtle consciousness, which is known as subtle wind energy, can evolve to become coarse matter. Firstly, I haven’t seen an explanation of such development in any text. Secondly, I think it is difficult to hold the view that subtlest wind can evolve to a level of coarse wind. Although the Abhidharma provides an explanation of the different levels of subtleness of mind, it doesn’t get close to the subtlest level of mind that is explained in the highest yoga tantra.

**David Presti (Moderator):** Thank you. The topics we are learning about are so huge and bring up so many questions that ten minutes is not enough. There were many fine questions from the audience that we were reviewing over the tea break and we
will try to address as many of these as we can during the panel discussion later this afternoon. Now we will move on to the second presentation of the afternoon.
**THE NEW ANTHROPOCENTRISM**

Rajesh Kasturirangan, Ph.D.

The end of anthropocentrism is one of the signature achievements of science. Starting with Copernicus, we have progressively shifted the center of the Universe away from human beings. Now we are just another species in yet another planet in yet another Solar System in yet another galaxy (not yet another Universe, though that might happen too). Human beings are no more than one object among an infinite array of non-human objects. When it comes to subjectivity, the same logic leads us in exactly the opposite direction. As Descartes pointed out, the push towards objectivity is mirrored by a push towards certainty, which leads us inexorably towards cogito ergo sum. In other words, the totally objective Universe is mirrored and represented in my completely isolated and subjective consciousness. There is a dialectical relationship between objectivity and subjectivity. The more we dethrone anthropocentrism in the name of objectivity, the more we introduce subjectivity through the back door via consciousness and first person experience. Consequently, the mind sciences suffer from trying to reconcile subjectivity with objectivity while our conceptual framework prevents us from doing so. I think it is time to reintroduce a common-sense anthropocentrism. For one, it is obvious that I view the world through my eyes, not someone else’s. The best we can obtain in terms of objectivity is positional objectivity; i.e., the maximally objective position from where
I am. Secondly, our embodied knowledge systems—as opposed to the abstract Cartesian one—are designed to know the world here and now. In my presentation, I will suggest an approach to the human world that is dialectical in the Madhyamika or Advaitic sense of that term, and shows how the interdependence of the subject and the object leads us towards a solution to some of the vexing questions in the mind sciences.

Rajesh Kasturirangan: Thank you very much for giving me this opportunity. It’s a wonderful experience to be here and to listen to the various talks and, as David has already mentioned, these topics are so huge we could spend the next 500 years just sitting here discussing them—but we don’t have that much time.

What I am going to try to do is to bring up some of the connections that come between mind, consciousness and the world that living organisms occupy, but from a very different perspective.

The first thing I want to say is that there are two kinds of scientists; people become scientists for two reasons. One kind builds labs in their basement and tries to blow up houses using test tubes, right? Another becomes a scientist because they read a lot of science fiction and want “to go where no one has gone before.” I come into the latter category of scientist; I don’t think I’ve ever tried blowing anything up as far as I know.

I want to begin with reference to a very good short novel by Arthur C. Clark called The City and The Stars. It is set in another Yuga, to use an Indian term, hundreds of millions of years in the future. The protagonist is trying to figure out what has happened, why the Earth is the way it is, and what he’s eventually told is that human beings had evolved to such a point that they had managed to travel into space. They went very far away and somewhere at the outer limits of the cosmos they met intelligence so superior to themselves that they decided to return to Earth and work on themselves for a hundred
million years before they felt they would be ready to face this superior intelligence. This is a great theme because this conference is about cosmology and consciousness. It’s not surprising that as we reach the outer limits of the cosmos it makes us want to examine our own selves and find out whether we really have the capacity to understand what the cosmos is. When I say in my title “The New Anthropocentrism,” I mean that at some point we have to examine who we are in order to really understand what the cosmos is. And it’s not that easy, it’s actually very hard to understand who we are.

The modern scientific perspective is that we are not really special. There are 43 orders of magnitude, and we are right in the middle somewhere: we are approximately as small when compared to the Universe, as we are large compared to quarks. We are not special. We are simply not that great as far as the Universe is concerned, or that’s the standard story. But that’s a very objective perspective in a world where quarks are objects, bacteria are objects, galaxies are objects, and we are very ordinary objects. But in the sciences, it’s clear that we are very special subjects because we are the only species, as was mentioned earlier today, too, that seeks to understand all these objects. On Earth, at least, we are the only species that wants to build space ships, that cares about UFOs. Strangely enough, if you explore the world of objects very carefully you seem to come back to the world of subjects, and in the world of subjects we become more special than we should be. And so there is this strange tension between saying that we are extremely ordinary objects and that we are very special subjects. That dialectic is the one that I want to explore.

This is a problem that runs throughout the history of modern philosophy and mathematics, and the theoretical sciences in many ways. The sciences that involve going out and collecting data and having faith in the data also have a very strong philosophical and theoretical history, and mathematics, in particular, a hand maiden-of the sciences on the theoretical side, but not so much on the experimental side.

I’m going to start with the discussion of the specialness of subjects
going back to the first early modern philosopher, Rene Descartes, who was both a mathematician and a philosopher. Descartes was a Frenchman, but in those days if you had interesting ideas, France was not necessarily the best place to live, so he fled to Holland. Holland was cold, like here, and so he spent his days hidden inside a wooden stove. It wasn’t burning, but that was the only warm place in his building, so he would hide himself inside the wooden stove and think these thoughts. I have a feeling that some of his philosophy took the shape that it did because he was hiding inside this wooden stove. But his point was very interesting; he said that he wanted to be a scientist, and wanted to base science on the most certain knowledge that you can get, because if you want objective knowledge, you want it to be certain. He also said that in order for all science to be certain, we have to start from the most certain thing that is possible. What is the most certain thing that is possible? Is it certain that there is a car outside on the road? Maybe there is, or there isn’t, right? If you hear something honking, do you know it’s a car? Maybe it’s a car, or it’s some kid playing with a toy car that makes the same sound. He carries this argument further and further, and says “I can never be certain about anything outside because,” and this was a very Christian way of putting it, “maybe a devil is really manipulating what’s being seen by me,” so that instead of me seeing that there is a car outside, it’s really a devil who is doing it. Anyone who has seen the movie *The Matrix* will understand this particular analogy. Descartes says, “I can therefore not be certain of anything objective outside.” Thus, he starts by trying to find signs of objective reality in the most certain ways possible and he actually finds out that nothing objective can be certain. Instead, the one thing that you can be absolutely certain of is your own consciousness. He says, “I think therefore I am,” which is to say that it’s my experience, or my own consciousness, of which I am certain. My consciousness can be mistaken, I might be experiencing a car, but it could actually be a bird, or a plane, or superman, or whatever. But what you can always be certain of is that you are experiencing something—whether you are in a dream, whether you are awake. The fact that you are experiencing is the one certainty that you have and nobody can take that away from
you. Somebody can tell you that you are experiencing a bird when you think you are experiencing a plane. But nobody can tell you that your experience is not that of a plane, because your experience is your own. It’s the one most certain thing that you have.

That’s the beginning of the modern investigation into knowledge, because knowledge and epistemology, another term that has been used today many times, is the foundation of science. If you cannot be sure of the methods by which you do your experiments, then it doesn’t matter how many experiments you do. And the harder the problem, the more certain you have to be about the conclusions of your experiments. Take, for example, the question: Is there life on other planets? Or is there consciousness in bacteria? These problems require methods that are as certain as possible. Therefore the study of epistemology is central to addressing these questions, and the study of epistemology comes back to human knowledge and where we acquired it.

The one field where we think we are really certain, outside, of course, our subjective consciousness, is mathematics. 2+2 is 4, independent of whether it’s me or you or anybody else doing the calculation. A lot of investigation in the modern philosophical disciplines has taken mathematics as the paradigm of a science that delivers certain results. Now mathematics has a problem: you can argue, what is 4? So, is 2+2 equal to 4? There is something that makes 2 and 2 into 4. Or is 2+2 equal to 4 because that’s just the definition of 4? Is 4 nothing but 2 added two times? Are you simply redefining 4 into 2 and 2? These are questions that are of great philosophical interest, but they became of great scientific interest towards the end of the 19th century when philosophers and mathematicians started forming distinct disciplines and invented what we now call mathematical logic and the foundations of computer science. Mathematicians like Alan Turing and Kurt Gödel started thinking of how a machine could do something like mathematics. You might think why would anybody want a machine to do something like mathematics? The reason is that if you think that human beings are also machines, as many scientists
do, that we are nothing but the movement of molecules in certain biochemically constrained ways in our brains and in our bodies, then there must be a mechanical way to explain how we are epistemological beings. Here is the big problem: if I say 2+2 is 5, you’ll all shout I am wrong, but not because you moved one molecule against another. When a molecule hits another molecule it doesn’t produce a right or wrong; there is nothing right or wrong about an atom moving around another atom; there is nothing right or wrong about a planet moving around a star. But there is definitely something right or wrong about reasoning and about ethics, about all the things that we as humans care about. How then do you get things right or wrong from machines? That’s what makes mathematics such an interesting subject, because it’s in mathematics that people first figured out how to reduce questions of right or wrong into questions that machines could potentially solve. The effects of this are all around us. All these machines that we use are based on Information Technology that at some point was founded on ideas of others who figured out how to manipulate information into machines. That’s an important development of the 20th century. It’s the mechanization of reasoning, of logic, which also has its limits.

One of the things we have discovered in the 20th century is that just as science has limits—in terms of asking the questions is life really different from physics or how can consciousness arise from matter—there are similar limits in logic or mathematics. Are there thoughts that can never be thought, are there problems that are intrinsically unsolvable, are there things that are impossible for us to think? These are questions that at some levels seem to be abstract, but they actually have led to some great developments. It turns out that most problems, in some quantifiable mathematical sense, if they can be posed, probably cannot be solved. There is a very famous theorem by Godel that says that any mathematical system that is more powerful than arithmetic has theorem that are true but cannot be proven. This is amazing. It means that it’s true in some sense, but no amount of calculation or manipulation can prove that it’s true. That’s pretty amazing. This is a new development in the understanding of knowledge that comes from
mathematics, but then it moves in a direction that is more consistent with biology in the development of the mind sciences.

The mind sciences are very new, even newer than biology, and their biggest impulse came in the 1950s when people started to use computers to try and learn how to model how the mind works. What they found is that computation is a good way to try to find out how the mind works. Let me give you an example. In English, I can say, “I ran passed the door.” I can then say, “I was wearing a brown dress when I ran passed the door,” and “I was wearing a brown dress on a rainy Tuesday when I ran past the door.” You can see how each sentence is embedded in another sentence, and this has a very mathematical structure. Yet anyone who speaks English knows that these sentences are grammatical. Intuitively, without thinking, you know that these sentences are grammatical. Somehow your mind works and my mind works in such a way that we produce these perfectly grammatical sentences, which have a very intricate complex structure that nobody ever taught us. In fact, I am almost certain that until five minutes ago not a single person in this room had heard the sentence, “I was wearing a brown dress on a rainy Tuesday when I ran past the door.” The first time in your life you heard a sentence you figured out that it was grammatical without anybody ever teaching you. How is that possible? A very famous cognitive scientist, known as Noam Chomsky, made a hypothesis that the reason why you can figure out that all these sentences are grammatical is because your mind is made that way, that you have an innate capacity, which is mathematically describable, for modern language that is “hard wired.” There’s something genetically hard wired in you to think in certain ways, and those certain ways can be modeled using mathematical techniques, in particular, mathematical techniques that come from computer science. This was a very important development.

The next important development again came from using mathematics—how do we see the way we see? Remember we are
investigating knowledge and how human beings and other creatures acquire knowledge. One of the ways that we acquire knowledge, and in Buddhism in particular, is through perception, which is the foundation of knowledge. Buddhists are very skeptical of concepts being the source of knowledge, but perception is at the source of knowledge in all Buddhist traditions. How do we perceive? You open your eyes and you see three-dimensional objects. When I open my eyes here, I see lots of people wearing robes that are, sort of, maroon, or some maroon and some dark red. How do I do that? How do I see 3-D shapes? And why is this a puzzle? Let me give you three puzzles here; one is that the input to your visual system consists of two two-dimensional images onto your retina. But when you open your eyes you don't see two two-dimensional images, you see one three-dimensional perception. How does your mind convert two two-dimensional images into a three-dimensional perception? You might think, especially if you know some mathematics, that this is easy. All you are doing is taking two projections of one three-dimensional object and doing a reverse geometry, right? Anyone who has done technical drawing will know that you can have different projections of one object, and you can reconstruct the three-dimensional object from the projections. But it's not that easy when we are doing it as people. Why? Because when you are seeing the world, you are moving your head and your eyes all the time. Your eyes focus on a different location five times a second, right? But the world does not seem to be moving five times a second to you. Most of you have a very stable concept of the world, you perceive a stable world, even though your eyes are moving five times a second and your body is moving all the time. You are kneeling, you are getting up, you are raising your head, you are doing all these things and yet the world is not moving and you know that the world is stable. How do you extract the stability even though you don't actually get that as an input? Here is a very simple experiment you can do: stare straight and then move your eyes to the right, not your face, but your eyes to the right as much as possible. Do you see that the whole world has changed? Probably not, and yet there's not a single pixel on your retina that is getting the same input
that it was getting before. There is a 100% different input, and yet the output or perception that you feel is almost the same. This constancy, the fact that the world is constant in your perception and therefore in knowledge, which is what allows us to say that we have some kind of reliable knowledge of the world, exists despite the absolute dynamic instability of the input to your senses. This is a very difficult problem to understand and it’s been almost impossible to solve using computers. We now have a computer that can play chess better than any person, right? Maybe Gary Kasper is the only person in the world who can defeat Deep Blue, but tomorrow I am sure there will be a computer better than him.

And yet there’s not a single computer in the world that can go around a room and grab an object when asked. For example, if I tell a computer, “Go around the room and collect all the water that has been left by people in this room,” it can’t do it. If you tell any person to, they can do it, but a computer cannot. Why? Because there will be water that will be left in mugs, there will be water that will be left in cans, there will be water that will be left in bottles, and there is no computer which can recognize that all these are receptacles of water. Here is another thing that we do very easily and which we cannot get a computer to do: I left this bottle over here and immediately I know that the bottle is not on the table anymore. I don’t need to think, I automatically know, but a computer doesn’t work that way. In fact, copy and paste is one of the greatest things our computers can do. You can have two copies of the same object, but in our real world its ontology does not allow you to copy and paste. Maybe some future quantum computing will help us do that, but right now we don’t have that capability. The kind of furniture of the Universe that we as human beings are completely used to, and that we believe makes the world work, is something that’s extremely hard for us to understand.

This is a hard problem that’s different from the hard problems of physics and the hard problems of biology, because it’s trying to understand why is it that our world is experienced by us in the way that it is. It’s not an objective world and it’s not a subjective world, it’s
somewhere in the middle. It’s a little bit like money; money is both subjective and objective. Unless I am the Federal Reserve, or a similar body, I cannot just print money. It’s really there, you make a salary every month, and that’s how much money you get. It’s not in your head; it’s out there in the world. And yet without human beings there’s no such thing as money. Money is a human construct that requires creatures like human beings to be there for it to exist. The study of things that exist, in an interdependent sense, to use a Buddhist term, not things that exist outside human beings or outside living things, but things that exist because there are living things and because there are human beings, is a whole new world of study that is just opening up. It’s the study that cognitive scientists do, and the study that we would like to do for other creatures.

The famous philosopher, Thomas Nagel, wrote a paper called “What is it like to be a bat?” Nagel said that human being are visual creatures, we learn about the world primarily through vision, but bats are not visual creatures. Bats live in caves where there is almost no light and they use sound to navigate the world. Nagel’s basic conjecture was that there is simply no way for us, as human beings, to understand what is it like to be a creature that figures out the shape of an object using sound rather than vision. For us, the shape of an object is what you see, but what does it mean to see using sound? We have no idea, and therefore what Nagel says is that it is impossible for us to get into the mind of a bat. This goes back to Descartes. Descartes basically says, “I can only be certain of my own consciousness, someone else’s consciousness I have no idea about.” Nagel takes up that idea and transplants it into other species. We may know what other human beings are doing, but we may never know what a creature that is different, such as a bat, would ever do. And I cannot even think about an octopus, which has eight brains, it might be too different from us to ever really know. But as scientists, again in the Star Trek mold, we have a great opportunity to move into certain spaces that we have never gone into before, not spaces as in different stars or different planets, but into the life worlds of other species.
Maybe being a bat is very hard for us to understand. But maybe it’s not possible for us to even understand what it is like to be a Rhesus Macaque. Macaques are monkeys that are not very different from us. They are also social creatures. They are also visual creatures. Maybe the way to make scientific progress on these kinds of questions is to go from how human beings think to how other primates think, and from how primates think to how other mammals think, and then perhaps, all the way to bacteria. Once we get there, my very wild conjuncture is that if we really want to figure out how life is going to be on other planets, we first have to figure out what is it like to be another creature on our planet. I say that because bacteria actually are very different from us. But we are also interrelated. So creatures that are simultaneously alien, and yet similar, but are on this planet, are a lot easier to study than potentially existent creatures on other planets. One thing I think astrobiologists should do is to study creatures that are rather different from us. Maybe we need to invent something like a mind-scope, like a telescope, and use radio astronomy to help us get into other planets in terms of physical characteristics. We need to start building devices that get us into the world of other species. I don’t think it’s impossible.

Here is a thought experiment that we can run: Imagine that you put a camera on a bird and let it fly around, and hook the output of that camera into your systems, so instead of me seeing what I normally see, I spend three days just seeing what the bird is seeing. I don’t know if our nervous system is plastic enough to shift its register from seeing my human world to seeing the world of another species. We haven’t done it, but the technology is available so it should not be that hard for us to start building these kinds of mind-scopes, and once we start doing that and collecting the data, it might turn out that there are some things about other species that are very, very hard for us to understand and some things about other species that are very easy for us to grasp. Just as it turns out that building machines for playing chess is easy, or easy enough, but building machines that can pick-up and collect objects is very hard. It’s not clear to me what bats do that
is hard, and what it is that bats do that is easy.

I am excited about the relationships between the contemplative traditions and science—and Buddhism is the one with the closest relationship with science—because these traditions have a very rich taxonomy and theorization of experience. Science and psychology have a very strong desire to understand experience, but don’t have a very good theoretical grasp on the different mental states and the different perceptual states, the different emotional states, that are found in Buddhism. If you read Buddhist texts you will see a rich vocabulary there; science doesn’t have that. My point is that vocabulary is exactly what we need to really get beyond the naïve anthropocentrism that we have in the cognitive sciences. When I say naïve anthropocentrism, I mean accepting our experience is a given. No self-respecting contemplative would accept ordinary experience as given. It’s one of the tasks of any contemplative tradition to probe experience and discover an organism’s organizing levels, higher or lower kinds of experience, subtle or gross kinds of experiences. These are things that scientists currently don’t think about so much. But once we start considering the theoretical and experimental distinctions, we can start understanding how human experience works and from there begin to understand how non-human experience works. Maybe it isn’t too far down the road, maybe 100 years, when it won’t be impossible for us to experience what it’s like to be a bat, or maybe even an octopus. I don’t know, but that’s my Star Trek moment. If, instead of going into outer space, we can go into the life worlds of other species and use that to probe what it would be like to be hypothetical creatures, since we don’t right now have the evidence, then we have real science happening.
Panel Discussion

Monastic graduates on the panel

Geshe Sangling Trulku
Geshe Jamyang Tendhar
Ngawang Palkyi

**Chris Impye:** I have a methodological question for Rajesh. When you’re talking about what it’s like to be another animal, sentient say, the few experiments I’m aware of that attempt to communicate with dolphins, or even other apes, seem rather unimaginative—they essentially conduit a human mode or channel of communication. I was wondering if anyone is thinking more out of the box on how to do this?

**Rajesh Kasturirangan:** The answer is “yes,” but slowly. Primatologists are starting to look at more ecologically relevant tasks. If you look at tasks that were given 30 to 40 years ago, they tended to be cooperative, while a lot of research now suggests that competition is common between two monkeys. How to get them to do something that is relevant in a competitive situation is something that people are starting to think about. My own group is studying deception, and we are trying to think of ways to get Macaque monkeys to show behaviors that are deceptive in the wild, not in the laboratory or a captive setting. It’s not easy; it’s very hard to know for sure if you’ve gotten the behavior.
**Geshe Jangchup Choeden:** Rajesh, your idea of a mind-scope is quite interesting. In Buddhist monastics studies, specifically when we study Buddhist ethics, there is considerable debate about shape shifting and what happens, for example, if a monk happens to transform himself into the form of a tiger. Is it an offense against the ethical code if that monk kills another human being while in the form of a tiger? The general answer is that if the monk retains his sense of identity as a monk—rather than assuming the identity of the tiger—it is an offence against the code. If he takes on the identity of the tiger then no offence has been committed. If we elevate our consciousness, I think it could be highly possible to transform ourselves into a tiger. Shape shifting is not specific to Buddhism; it is quite a common concept in other traditions. If we manage to shift our shape, it could be possible to do the kind of study you are taking about. Creating a machine, however, could be quite challenging.

**Rajesh Kasturirangan:** I didn’t mean to imply that mind-scopes are tomorrow’s technology. However, it’s not clear how plastic our minds are, that is to say, and ask, are there intrinsic limits? Can we become a monkey? Can we become a tiger? Can we become octopi? Can we become bacteria? Where does it stop? We don’t even know how to approach the question. Scientifically, I don’t mean that a machine will enable you to do it but people are getting better and better at using brain patterns to figure out what you are thinking. Just in the last year, experiments were done which roughly get into the ballpark category of what you are thinking. If you are thinking about games, using brain patterns, computers are able to figure out, roughly speaking, that you are thinking about games. It may not be cricket, or this cricket game versus that cricket game, but it might not be very far in the future, at least when it comes to human beings, that we can enter into human minds using human thought. If that can happen with other human beings, it can happen with other species too. I think that once the technology progresses we will start seeing some very interesting developments. If we are in a technological world where everybody is hooked into a machine that constantly gets inputs from other humans’
experiences too, who knows what kind of consciousness we may develop as a result.

David Presti (Moderator): Several of the questions from the audience relate to your presentation, referring to the idea of trying to get some sense of another animal’s experience. For example, by putting a camera on a bird, and collecting the information as the bird flew around, would that be sufficient to give us a window into the bird’s experience, other than a very narrow visual representation? Another audience member asked a related question: Is there a way we can get around interpreting whatever we find in terms of our own mental constructs since we are the ones ultimately doing the analysis?

Rajesh Kasturirangan: Because the experiment hasn’t been done, I have no way of saying what is going to happen. But let’s start with something less drastic. Say I put a camera and a microphone on Bryce and I receive his visual input and auditory input. Am I hearing and seeing what Bryce is hearing and seeing and not what is in my auditory and visual environment? I bet after a while I would have a much better sense of what Bryce is about than I have right now. That’s my prediction. This is an easy experiment to carry out with people, but with other species it is going to be hard. My general rule of thumb: the physical body and molecular machinery we clearly now know to be continuous across species. We know, it was pointed out this morning, that we are 47 percent yeast. If that is the continuity in the biochemistry, the genetic structure, why shouldn’t there be a similar level of continuity on the subjective side? It’s a very strange assumption that we think that we are similar to other creatures in their physicality, but somehow draw a sharp distinction when it comes to our subjectivity.

Monastic Graduate: You seem to be saying that when we pay more attention to the objective world, it compels us to look inside the subjective world. When you talk about the subjective world, do you mean only the brain or do you have another entity to which you are referring?
Rajesh Kasturirangan: I am not really talking about either the brain or the body, but in terms of phenomenology. For example, we know that color is tied to wavelength. Red is a longer wavelength than blue, and therefore we perceive red and blue differently. What is also true, is that color is a subjective experience, and in many ways independent of the objective qualities. In this room, if you see people, and the light is very different from the outside, and even the spectrum of light is probably different from the outside, yet what is maroon here, will be maroon outside. What’s interesting about subjectivity is the correlation between what might be the subjective variables of how you perceive color and how you see shape, and the objective correlates, like wavelength, mass, and density. A lot of interesting work in the cognitive sciences has gone into understanding that relationship.

Monastic Graduate: Are you suggesting that bacteria, small microorganisms, are the objective world and that human beings are less objective? If so, how do you distinguish between the objective world and the subjective world?

Rajesh Kasturirangan: I did not mean that we are on the subjective side, and bacteria are on the objective side. Though interestingly enough, Descartes, from whom a lot of these distinctions come, put human beings on one side and all other creatures on the other side. This is his distinction, not mine, and his distinction was based on language.

David Presti (Moderator): A number of the questions from the audience immediately went to consciousness, and the evolution of consciousness in the Universe. Some of the questions ask specifically for definitions of consciousness, and it is important to be clear about this if there is going to be any kind of coherent dialogue. You offered one definition in your talk Rajesh, but the way I define consciousness, which is an operational definition that allows us to have a conversation where everyone agrees that we are talking about the same thing, is simply, awareness—an experiential awareness of being in relation to everything else. What is it like to be me is my consciousness? This
definition does not presuppose any kind of connection with brain function or even necessarily with life. We don’t know as scientists how to measure consciousness, but we have a sensory perception centric position on it. We assume that in order to have consciousness, you have to have a nervous system, you have to have a brain, you have to have some kind of complexity. Whereas I’m completely open to a tree being conscious, or bacteria, or maybe even a rock, because I don’t know what it’s like to experience being a rock. I would like to hear what you all think about that as a working definition of consciousness.

**Chris Impey:** I absolutely agree that you have to have something concrete, that you have to start somewhere with a definition. A good definition begs a series of questions. If that definition means a sense of self that in turn means a sense of separation from others, and that in turn implies you have to have a relationship with self and multiple others—because there is only one self and there are multiple others—it seems if you follow that logic, and put those pieces together, you define a landscape, where it might be harder to argue that a tree has that attribute. A dog probably does, and a mouse probably does, but I don’t know. My question then is what are the connotations? You can put a foundation stone in place that people can see and agree on for definition, but almost any foundation stone you can imagine has connotations or implications, and they are interesting too.

**Geshe Jangchup Choeden:** The Buddhist study of mind and consciousness incorporates these ideas. Generally, however, we don’t accept the idea that a tree or a bush or a rock has consciousness because they don’t meet our definition of consciousness. If, however, they did have that sense of self, the kind of substance that does have that clarity, that function of knowing, then we would have to accept that they were conscious because they satisfied the requirements of the definition. This accords with Buddhist logic.

**David Presti** (Moderator): Of course, we are very limited in our knowledge of how to assess experience in anything other than ourselves.
Chris Impey: Do we need to, or must we, assume that an entity that has a sense of self is a biological organism only? In other words can there be other manifestations of the physical self that are not based on biology or DNA, the conventional things we have been talking about for the most part.

Rajesh Kasturirangan: I want to interject here, because I don’t think biologists think that way. When physicists do, it is what in physics might be called universality. What are the properties of having a self or having consciousness, or any other properties for that matter, that one agrees are part of the definition? Maybe it does not depend on the micro-level substrate upon which it is built. It is possible that there are other kinds of entities whose biochemistry is different, but which have enough of those micro-level features, and as was said, if it agrees with the definition, it is consciousness, it has self. But I still don’t think we have good ways of assessing what those building blocks would be.

Chris Impey: A simplistic example of why it seems worth posing the question is that when I think of my sense of self, it is not rooted nor interwoven with any singular sense of synapsis operating or electrochemical pathways in my brain, or the fact that I have carbon bonds at the base of the whole pyramid. None of the other levels of it are manifest to me in my selfness.

Rajesh Kasturirangan: Let me throw out a provocative idea: maybe we should not try to define consciousness at all. It’s a little bit like trying to define matter in physics. Physicists don’t spend that much time trying to define what is matter, and then ask is a light particle really matter or not? These are no longer productive questions in physics. And instead, because the mathematics has driven the subject so much, if something obeys the same kinds of mathematical principles that another thing does, you just club them into the same category. Partly, biology is not as mathematized a subject as physics. But as we develop more formal accounts of how biological organisms work, we might find that we give up a lot of naive categories, like what is life and consciousness, and move towards more technical categories. My understanding of
the Buddhist theories of consciousness, and experience, is that those are very technical terms, with very precise meanings. This is not the way we are using the term consciousness in this more informal setting here.

**Monastic Graduate:** In the Buddhist tradition there is mention of a billion world systems. In one of the science classes we attended with the physicists there was mention of the hundreds of millions of planets where life might exist. When I learned of the similarities between Buddhism and science in terms of the vastness of our Universe and how life can be possible I was really surprised and it prompted this question. Do scientists have any problem with accepting the hypothesis that the first cell, or the first life on Earth, came from another planet?

**Chris Impey:** It’s a remarkable coincidence. The Buddhist number of world systems, one billion, is quite a particular number, and the hundred million number I gave in the Milky Way was just for Earth-like planets, habitable Earth-like planets. In our Solar System, to take the nearest example, if you’re asking how many places might have life in any manner, not advanced life, it’s about 10 or 12. There are 10 or 12 moons in the outer Solar System that are likely to have water under a rocky surface, kept liquid by pressure. They have energy, carbon and water. Use a factor of 10 and you get a billion habitable spots in the Milky Way. So, as in many things, the Buddhists got there first, and got it right. Or we both got it wrong.

For the preceding question, it’s very interesting—the speculation about life elsewhere, habitable worlds in the vastness of the Universe, is old. Lucretius was the first to speculate that there might be many habited worlds, and he was countered by Aristotle, whose weight in philosophy became stronger, so the Earth became the center of the Universe, the only place with creatures. Thomas Carlisle has the great quote about possible worlds with life: “If they be inhabited, what a scope for folly, if they be uninhabited, what a waste of space.”
My question for the Buddhist tradition about the concept of life in the Universe is this: If it turns out through long tedious experimentation that most of these other habitable worlds don’t have any life, and especially advanced creatures like us, would that be a surprise? Is that anticipated? Is there any resonance in Buddhism with the scarcity or abundance of life, of intelligent life, given the vastness of the Universe, which is clearly part of traditional thinking?

Geshe Jangchup Choeden: According to traditional Buddhist scholarship there are lots of possibilities for life within the billion world systems. Some sutras say that in specific world systems, there are specific buddhas and specific teachings. From this point of view, philosophically, Buddhists accept that there is the possibility of other intelligent life. If this is proved wrong, Buddhists scholars will provide a new interpretation of the sutras. This is a common approach in the Buddhist tradition: if something is proved wrong, new interpretations are provided, even of teachings that have been accepted by great scholars for over 2,000 years. In general, Buddhism will adapt its teachings when new empirical evidence is found. From the Buddhist point of view, life is always there. In the vast Universe, there is no shortage of life. But we have no proof, no scientific proof.

Chris Impey: I do have a follow-up question. One of the things that struck me about what you said was that in the Buddhist way of thinking, both life and consciousness are recycled, endless, eternal. I don’t mean to imply that this is a point of distinction or deviation from Western science, but it is a very interesting idea to express because the Big Bang cosmology posits an origin and a time when there was no life, because the physical conditions didn’t permit it, and life exists now in the Universe where once it did not, and by extension consciousness exists in the Universe now where once it did not. My question is what does that imply about evolution, the evolution of thinking, or the evolution about ways of being, if you cannot place yourself in a timeline, in a situation of evolving? Not that everything has to get better, or different, or more complex, or anything in particular, but if time is not really a dimension, of either life or consciousness in the
Universe, however we want to think about it, what does that mean? I don’t understand that.

**Geshe Jangchup Choeden:** There may be an infinite world system incorporating the billion world systems and the Universe that we are talking about. But there could be another universe, and another, and another. If the Big Bang is the beginning point for the Universe, what is the beginning point for other possible universes? If there are multiple universes, there are multiverses and there are more possibilities for life. If there are more possibilities for life, there are more possibilities for consciousness. From that point of view, there is no beginning point for life and consciousness. But there is a possibility for the end of life and consciousness in Buddhism, but that is different, that is presented philosophically in Buddhism.

**Monastic Graduate:** This question is for Rajesh. My understanding of your presentation is that the objective world, what you see in the objective world, does not really exist as you see it, but that consciousness, the subjective world, is real. Do you mean that, or something else?

**Rajesh Kasturirangan:** I mean something else. The argument is that you never really get to the world, the objective world, as it is. It’s always filtered through your sensory nervous system. We say you don’t perceive wavelength, you perceive color. Which is to say, even if the color is a representation of what’s there in the outside world, it’s still a product of your nervous system, and not just what is in the world. On the other hand, it’s not subjective; you’re not inventing it. When I see flowers out there, it’s not that my consciousness is inventing the flowers, but it is representing them in a way that is driven by my nervous system. There is a difference between consciousness being a full creator of the objective world and being the presenter of the objective world in a way that is conditioned by your own biology and history and so on.
Chris Impey: A question for David in relation to the definition of consciousness, or way of thinking about consciousness, that you gave a little earlier. Does that definition necessarily connote memory? A sense of self that is placed in an instant doesn’t seem to me to be a sense of self, because you have to have a relationship between entities and events, and that implies some relationship in time, typically. Is it wrong to suggest that memory is a necessary attribute of consciousness?

David Presti (Moderator): I would not make memory a requirement for my definition of awareness or consciousness. Even in human memory research, there is the case of the patient known by the initials H.M., who died last year. H.M. had been studied for 50 years by neuroscientists for his very anomalous memory. He had full awareness of what was happening moment by moment. When he was in his 20s he had surgery to treat a seizure disorder, and in the surgery they removed parts of his brain in the temple lobe area, and as result he had a particular kind of memory impairment where he couldn’t remember anything that happened to him for longer than a minute or so. He had full awareness of everything that was happening, and then one minute later, he would remember nothing. There were researchers who had worked with him for decades, whom he had met hundreds of times, and every time he met them he had no knowledge of ever having met them before. Yet he was fully present when he was present. So I see no contradiction between having full awareness in the moment, even if that moment is only a nano second, and that fully satisfying the definition of consciousness or awareness in the operational away.

Rajesh Kasturirangan: One can imagine a momentary self, something that just arises now, something that is aware of the world now, and then disappears. While the memories and other capacities might help us integrate those moments, I don’t see it as a logical necessity. But are there creatures that are aware, as David mentioned, but that do not have any memory? H.M. is an anomaly because something happened to him. Whether there is actually a fully functional creature that has no memory, but some kind of awareness, I don’t know.
David Presti (Moderator): The kinds of consciousness or awareness that different beings could have would be very different. It’s important to not get locked into the way we experience our consciousness. If a plant has consciousness, it would be vastly different, and even more different than that between humans and bats.

Rajesh Kasturirangan: Isn’t that a problem for understanding consciousness? It seems that the one thing that we are almost designed to view from our perspective, unlike planets or quarks, might be that for anything to be conscious, it might need to be like us. That’s Nagel’s point: to understand another being’s consciousness you have to be able to transplant it into our frame somehow.

Geshe Jangchup Choeden: Technically, in Buddhism, the existence of consciousness covers a vast space. The consciousness that we experience at present is a very limited and distinct form of consciousness and at a very coarse level. As we refine our consciousness, it may enter different levels. In Buddhism, it is possible that people are born into a different realm, where, for example, in the whole life term they only have two occasions of remembering or feeling: I’m born here, I’m dying here. The rest of life, that gap period, they have no feeling, awareness, functioning of mind, knowing. In that stage, we have to accept that consciousness does exist. So consciousness, technically, according to Buddhism, has different layers to it. The layer we are using at present is a very coarse external layer. I think there is something science can learn from Buddhism in this field, but there are also some things that simply might not lend themselves to scientific investigation. As long as consciousness exists, according to Buddhism, life should be there. There is the possibility of the existence of life without the involvement of even the tiniest consciousness. How can we search for that? There does not seem to be much possibility of doing so. It’s very difficult to study these things with machines, unless you look into yourself. But if scientists look into themselves, it’s very difficult for other scientists to prove it. It’s a very difficult to undertake a scientific study in this field.
Rajesh Kasturirangan: Doesn’t that problem arise when a student reports to a teacher, “I had this kind of refined experience.” How does the teacher authenticate that experience?

Geshe Jangchup Choeden: This is a spiritual matter. When the teacher teaches the student how to do certain practices, the student gains some experience and then reports back to the teacher. The teacher can tell from the student’s description and explanation of their experience what level the student has reached and can provide guidance.

David Presti (Moderator): Isn’t it the case within the contemplative traditions, like Buddhism, that there is some consistency of the definition of experience? That is the value of the scientific aspect of the contemplative sciences, that Buddha was able to very precisely develop technology to look into the mind, and have that verified by others when they also went there. That’s exactly what mind science needs, a technology that is reliable and empirically replicable across people when you do the practice.

Rajesh Kasturirangan: I want to push that further, because His Holiness mentioned this earlier today. The Buddha himself says don’t believe what I say, but do it yourself, and accept it only if you have the same experience. But how do you know when you have had the same experience as the Buddha? How does one know within the tradition what the mark of having had the same experience as another person is?

Geshe Jangchup Choeden: When you apply spiritual values in your life, gradually, it changes your life. You feel it. If you observe in the right way, in the right direction, you feel it. But it takes time. It isn’t that you do research for a couple of years and come out with a huge book, and say, “This is my finding.” It won’t come in that way. It takes decades, 25 years; you need to spend a lifetime. In the end you will feel that your life is enriched by living in accordance with those spiritual values. We should not look forward to making every scientist
spiritual, for that is rather impractical. But if scientists really want to understand the mind, they should start looking within themselves and observe their own feelings, their own perceptions, their own different mental formations, and then try to compare them with the text. Where do they stand? Do they meet the definitions given in the text? They should study in that way, and they will come to realize if it makes sense, or not.
NATURE OF MIND AND CONSCIOUSNESS

Is Consciousness Produced by the Brain?

Bruce Greyson, M.D.

Most Western neuroscientists assume that consciousness is produced in some way by the brain, although no mechanism has been proposed by which physical processes could produce thoughts, feelings, or sensations. However, there is a large body of empirical evidence suggesting that consciousness sometimes occurs in the absence of any brain activity. For more than 40 years, scientists at the University of Virginia have been studying phenomena that challenge the belief that consciousness is produced by the brain, including memories of past lives and “near-death experiences,” in which complex thoughts, perceptions, and feelings occur while the brain is severely impaired, and experiencers report encounters with deceased persons and accurate perceptions from a visual perspective outside the body.

Bruce Greyson: Yesterday, we focused on some very big questions: Is there consciousness in other galaxies? What is the origin of consciousness? What is it like to be a bat? Or an octopus? Or a tree? This morning I want to shift the focus to an easier question: What is it like to be a human being? Most Western scientists assume that consciousness is produced in some way by the brain. There is, of course, considerable evidence for such a position, common sense evidence from our everyday lives. When we drink too much alcohol,
when we get knocked hard on our head, our thinking suffers. We also have more sophisticated scientific evidence of the link between the brain and consciousness. We can measure electrical activity in the brain during certain kinds of mental tasks and identify correlations between different areas of the brain and different activities. We can stimulate parts of the brain and record what experiences result. And we can remove parts of the brain and observe the effects on behavior.

All of this evidence suggests that the brain is indeed involved in thinking, perception, and memory; but it does not necessarily suggest that the brain causes those thoughts, perceptions, and memories. As you are listening to me speak, there is electrical activity in the temporal lobe of your brain in a region called Brodmann’s area. But does that electrical activity in your brain suggest that your temporal lobe is producing the sound of my voice? Not at all: the studies showing brain areas associated with different mental functions show only correlations, not causation. They are entirely consistent with the idea that thoughts, perceptions, and memories could take place in a consciousness somewhere separate from the brain, but are then received and processed by specific areas in the brain. It’s much like a telephone or a radio or a television. The signal, the message, is created somewhere else, but the television set or radio or telephone is necessary to receive and process the message. If we were to measure the electrical activity inside a television set, or electrically excite certain parts of the TV, or remove certain vital parts of it, we could show that certain parts of the television were involved in viewing the show. But we would not be proving that the show originated within the television set, anymore than we can prove that our thoughts originate within our brains.

Western science is largely reductionist; that is, it breaks everything down into its component parts, which are much easier to study than the whole. But as Chris Impey said yesterday, the component parts sometimes do not act like the whole. The brain is composed of millions of nerve cells, or neurons; but a single neuron, as Chris told us, cannot formulate a thought. A single neuron cannot feel angry or
cold. It seems that we believe that brains can think and feel, but brain cells can’t. We don’t know how many neurons you need in order for them to collectively formulate a thought, and we don’t know how that collection of neurons can think when a single neuron can’t.

As Chris said yesterday, scientists get around this problem by saying that consciousness is an emergent property of brains, a property that emerges when a large enough mass of brain cells get together. What does that mean? We have no idea what that means. Saying that something is an emergent property is a way of saying that it is a mystery that we cannot explain. There is, in fact, no known mechanism by which physical processes in the brain, or anywhere else, can produce non-visible things like thoughts, perceptions, and memories. The materialistic understanding of the world fails to deal with just how an electrical impulse or a chemical trigger in the brain can produce a thought, or a feeling, or indeed anything that the mind does. And yet, despite having no idea how it could work, most neuroscientists continue to maintain this 19th century materialistic view that the brain, in some miraculous way we don’t understand, produces consciousness. And they discount or ignore the evidence that consciousness in extreme circumstances can function very well without a brain.

Now this idea that the mind and the brain are separate things was what most people in the world believed until a couple of hundred years ago. But in the 19th century, at least in the West, neurologists and physiological psychologists started exploring the notion that the physical brain might be the source of all our thoughts and emotions—indeed, of all of consciousness. For the past century, psychologists have been moving toward the hardcore materialism that characterized 19th century physics, a physics based on classical Newtonian mechanics. They have been attempting to show that consciousness is nothing more than the working of the physical brain. This materialistic psychology was succinctly captured by the American psychologist John Watson, who wrote, “Psychology, as the behaviorist views it, is a
purely objective, experimental branch of natural science which needs consciousness as little as do the sciences of chemistry and physics.”

It is ironic that while Watson was linking psychology to classical Newtonian mechanics, physicists, faced with compelling experimental evidence, were already moving away from that materialistic view of the Universe towards a quantum physics that could not be formulated without reference to consciousness playing an independent role in the Universe. As Harold Morowitz, a molecular biophysicist at Yale University, wrote, “It is as if the two disciplines (psychology and physics) were on fast-moving trains, going in opposite directions, and not noticing what is happening across the tracks.”

Just as the materialistic idea that the brain produces the mind is a reasonably good model for our everyday lives, so, too, classical Newtonian physics was a reasonably good model for describing everyday objects moving at everyday speeds. It was only when physicists started investigating extraordinary circumstances about 100 years ago, involving objects approaching the speed of light, or the behavior of microscopic wave-particles, that we saw the limitations of the classical Newtonian model and the need for new paradigms. The result was the development of a quantum physics that explained the world in ways that classical Newtonian physics could not.

But the price physicists paid in developing quantum physics was to acknowledge consciousness as a fundamental aspect of existence independent of matter. So, too, with the question of the mind–brain relationship: it is only when we look at extraordinary circumstances of mental function, such as what happens when we approach death, that we see the limitations of the materialistic model of mind–brain identity and the need for a different paradigm. Geshe Choeden said yesterday that, according to Buddhists teaching, consciousness can sustain itself without a brain, or indeed without any other physical form. Nineteenth-century reductionist science viewed consciousness as an emergent property that evolved with complex brains. But just as quantum physics now views consciousness as an irreducible
component in the Universe, so, too, scientific research in the past century has explored human experiences that suggest consciousness can function without a brain.

The data that I am going to discuss this morning are derived from scientific research, but I do not want to give you the impression that this evidence is widely accepted by Western scientists. In fact, most Western scientists are completely unaware that this evidence even exists. What then is this evidence that challenges the materialistic conception that consciousness is produced entirely by the brain?

For the past half century, the University of Virginia has had a research division dedicated solely to the scientific investigation of these human experiences that challenge the materialistic philosophy that brain and mind are the same, and suggest instead that mainstream ideas about the relationship between matter and consciousness may be incomplete. In the mid-1960s, Chester Carlson, a wealthy American inventor who invented the first photocopy machine, which he called the Xerox machine, started giving away his fortune. He told his wife that his one remaining ambition in life was “to die a poor man.” His wife introduced him to Buddhism, and he went on to fund several Buddhist centers in New York, including the Rochester Zen Center, led by Philip Kapleau, and the Dai Bosatsu Zendo Kongoji Zen Monastery, led by Eido Tai Shimano. For his good works, Chester Carlson was given the Dharma name Daitokuin Zenshin Carlson Koji.

But Carlson was also trained as a physicist, and he wanted to support a bridge between Buddhism and Western science. He had heard about very young children in India who appeared to remember their past lives, and he searched for a Western neuroscientist interested in investigating these children.

He found an eager disciple in Ian Stevenson, the Chairman of the Department of Psychiatry at the University of Virginia. Carlson donated to the University the funds to establish our research division. With Carlson’s financial and moral support, Professor Stevenson
resigned as Chairman of the Department to devote himself full-time to the scientific study of these children who seem to recall past lives, and to other human experiences that suggest that consciousness may at times function without the use of a physical brain.

As it happened, shortly thereafter His Holiness the Dalai Lama began periodic visits to the University of Virginia to visit Jeffrey Hopkins, a Professor of Tibetan Buddhist Studies who served as His Holiness’ chief translator in English until 1989.

I worked with Professor Stevenson at the University of Virginia from the early 1970s, when I was training to be a psychiatrist at the University. Under his mentorship, I studied a variety of human experiences that suggested that consciousness can function separately from the brain. But I focused primarily on near-death experiences, the complex experiences that some people have on the threshold of death when the brain is shutting down. Ten years ago, Professor Stevenson retired, and I succeeded him as director of our research division.

So what are these experiences that challenge the prevailing materialistic paradigm that consciousness cannot exist without a functioning brain? There are four lines of evidence that I wish to discuss with you this morning. These are: first, the unexplained recovery of consciousness among people who have been unconscious for prolonged periods of time in the moments or days before their death; second, the complex consciousness among people who have minimal brain tissue; third, surprising complex consciousness in near-death experiences, including acquisition of new information, when the brain is functioning at a greatly diminished level; and finally, young children who recall accurate details of a past life.

The first challenging phenomenon I want to discuss is the surprising recovery on the deathbed of mental functions that had long been lost. This unexpected return of mental clarity and memory shortly before death in patients suffering from severe neurologic or psychiatric disorders has been reported in the Western medical literature over the
past two hundred and fifty years, but has received little attention. There are cases published in the medical literature of patients suffering from brain abscesses, tumors, strokes, meningitis, Alzheimer disease and other dementias, schizophrenia, and mood disorders, all of who had long ago lost the ability to think or communicate. In many of these patients, there was evidence from brain scans, or from autopsies, that their brains had deteriorated to an irreversible degree. And yet, in all of these cases, mental clarity returned in the last minutes, hours, or sometimes days before the patient’s death.

We have identified 83 cases mentioned in the Western medical literature and have collected additional unpublished contemporary accounts. Complete recovery of consciousness just before death is not a common experience. In 1844, the German psychiatrist Julius estimated that it occurred in 13% of patients who had died in his institution. However, in a recent investigation of end-of-life experiences in the United Kingdom, 70% of caregivers in nursing homes reported that they had observed patients with dementia and confusion become completely lucid in their last hours before death.

In a case that we recently investigated, a 42-year-old man developed a malignant brain tumor that rapidly grew in size. He quickly became bedridden, blind in one eye, incontinent, and increasingly incoherent in his speech and bizarre in his behavior. He appeared to be unable to make sense of his surroundings, and when his family touched him, he would slap as if he were slapping at an insect. He eventually stopped sleeping, talking deliriously throughout the night. After several weeks of that, he suddenly one night appeared calm and started speaking coherently, and then slept peacefully. The following morning, he remained coherent and talked with his wife, discussing his imminent death for the first time. However, he stopped speaking later that day, and died soon thereafter.

A second case involving Alzheimer’s disease was reported by Erlendur Haraldsson, a psychologist in Iceland. An 81-year-old woman had been demented for a long time and was living in a
retirement home. Her family took turns visiting her, even though she had neither recognized any of them nor spoken to them for a year. On one occasion, her son Lydur was sitting at her bedside, working on a crossword puzzle. Suddenly, she sat up, looked at him directly in the face, and said, “My Lydur, I am going to recite a verse to you.” She then recited a poem clearly and loudly. She then lay back on her pillow, and was again unresponsive, and remained so until she died.

There is no known physiological mechanism for this phenomenon. It is indeed rare, but the fact that it happens at all has no explanation in terms of how the brain functions. It suggests that the link between consciousness and the brain is more complex than traditionally thought. It is as if the damaged brain prevents the patient from thinking or communicating, but then as the brain finally begins to die, consciousness is released from the grasp of the degenerating brain.

Another challenging phenomenon is the presence of normal or even high intelligence in people who have very little brain tissue. There are again rare, but surprising, cases of people who seem to function normally in life, with normal intelligence and normal social function, despite having virtually no brain at all.

John Lorber, a British neurologist, specialized in children who have hydrocephalus, or “water in the brain.” Children with this condition have an abnormal amount of cerebrospinal fluid built up in the cavities inside the brain, compressing the brain tissue and usually leading to blindness, seizures, mental retardation, paralysis, and, if not treated, to death. However, Lorber described dozens of children, and eventually some adults, who had severe hydrocephalus but seemed to lead normal lives. In fact, in a sample of children in whom the cerebrospinal fluid filled up 95% of their skull, leaving virtually no space for any brain tissue, half of them had IQs greater than 100.

Thirty years ago, Lorber published an article in the prestigious journal *Science* entitled, “Is Your Brain Really Necessary?” In that article, he described a graduate student in mathematics at Cambridge
University with an IQ of 126 and a normal social life, with hydrocephalus so severe that he had only a very thin ridge of brain tissue pressed against the skull, hardly enough to allow a person to live, let alone function normally, according to modern medical neuroscience.

Some of the best evidence of consciousness functioning independently of the brain comes from near-death experiences, profound experiences that some people report when they have been on the threshold of death. Of course, there is a Tibetan tradition of people called delogs who have returned from death to describe what they have experienced. Their experiences are in some ways similar to the near-death experiences that I am talking about, but the delogs typically leave their bodies for many days rather than just a few minutes, and their experiences usually include extensive travel to a realm beyond death.

The near-death experiences that I am talking about are the accounts of people who have been clinically dead but are then resuscitated or revived spontaneously after a brief interval with memories of what they experienced during that period. They typically report exceptional mental clarity, vivid sensory imagery, a clear memory of the experience, and an experience that is more real than their ordinary consciousness. All of this occurs under conditions of drastically altered brain function, under which the materialistic model would deem consciousness impossible.

These near-death experiences are reported by between 10% and 20% of people who are revived from clinical death. I have investigated 1,000 of these cases. The average age at the time of the near-death experience is 31 years, but there is a very wide range. One young girl reported an experience she had had when she was eight months old and undergoing kidney surgery. The oldest near-death experience I have studied was 81 at the time of his heart attack. About one third of these near-death experiences occur during surgical operations, one quarter in the course of serious illness, and one quarter from life threatening accidents. The common features of near-death experiences
can be categorized as changes in thinking, changes in emotional state, paranormal features, and otherworldly features.

Changes in thinking during the near-death experience include a sense of time being altered. Often people report that time stopped, or ceased to exist, during the experience. It also includes a sense of revelation or sudden understanding, in which everything in the Universe suddenly becomes crystal clear. There is a sense of the person’s thoughts going much faster than usual and being much clearer than usual. And finally, there is a life review or panoramic memory in which the person’s entire life seems to flash before them.

Typical emotions reported during the near-death experience include an overwhelming sense of peace and well-being, a sense of cosmic unity or being one with everything, a feeling of complete joy, and a sense of being loved unconditionally.

The paranormal features often reported in near-death experiences include a sense of leaving the physical body, sometimes called an “out-of-body experience”; an experience of the person’s physical senses such as vision and hearing becoming more vivid than ever before, sometimes including seeing colors and hearing sounds that do not exist in this life; a sense of extrasensory perception, knowing things beyond the range of the physical senses, such as things that are happening at a remote location; and visions of the future.

Finally, many people report that in their near-death experiences they entered some other, unearthly world or realm of existence; many report that they came to a border that they could not cross, or a point of no return that, if they had crossed, they would not be allowed to return to life; many report encountering some kind of mystical or divine being; and some report seeing deceased spirits, often loved ones, who had died previously and who seemed to be welcoming them into the other realm, or in some cases, sending them back to life.

One of the things about near-death experiences that has interested
me most as a psychiatrist has been the profound after-effects. People reliably report a consistent pattern of changes in attitude, beliefs, and values that do not seem to fade over time. Near-death experiencers report overwhelmingly that they are more spiritual after the experience, that they have more compassion for others and a greater desire to help others, a greater appreciation of life, and a stronger sense of meaning or purpose. An overwhelming majority of near-death experiencers report that they have a stronger belief that we survive bodily death, and just as many report that they no longer have any fear of death. About half report that they have lost interest in material possessions, and many report that they no longer have any interest in personal prestige or status or in competition.

Now, some of you may be thinking that these people are now following the Buddha; they show more compassion, they tend to try to help others, and they are less attached to material possessions and status. But as His Holiness pointed out yesterday, these values are not uniquely Buddhist. These are universal values. Almost all spiritual traditions teach compassion and the transience of worldly rewards. Near-death experiencers do not become more Buddhist; they become more spiritual.

I want to highlight three particular features of near-death experiences that are particularly suggestive that the brain does not produce consciousness. These three features of near-death experiences are: first, clear thinking, perception, and memory while the brain is incapacitated; second, accurate perceptions from a visual perspective outside the physical body; and third, encounters with deceased persons who convey accurate information that no one else could have known, including, in some cases, encounters with deceased persons who were not known at the time to have died, or were not known by the experiencer at all. Perhaps the most important of these features, simply because it is the most common, is the first.

Among several hundred near-death experiencers I have studied, 47% described their thinking during the experience as clearer than
it is in their normal waking state. In addition, 38% described their thinking as faster than usual, 29% described their thinking as more logical than usual, and 17% described their control over their thoughts as more control than usual. Furthermore, an analysis of their medical records shows that mental functioning was significantly better in those people who come closest to death. Moreover, many experiencers report that during their near-death experience, they had a panoramic life review—not just the single brief images that can be evoked by electrical stimulation of the brain, but elaborate events, sometimes from the entirety of that person’s life.

Let me give you an example of clear thinking during a near-death experience. A 25-year-old nurse had become deeply depressed, and decided to end his life by taking a suicidal overdose of medication that he had taken from the hospital where he worked. After taking the overdose, he lay down on his bed expecting to die. Instead, he became ill with nausea and painful stomach cramps. He then decided to telephone for help, so he got up out of bed and tried to walk to the telephone. However, by now he was quite sedated and confused from the overdose, and he had great difficulty standing and walking. In addition, he was having hallucinations of many small people in his apartment who were stopping him from getting to the telephone. In that confused state, he suddenly felt himself leave his physical body, and he found himself standing about ten feet behind his body and above it.

From that new visual perspective he watched his body sway unsteadily, and he could see his body looking around in confusion at the imaginary people. He remembered having seen the hallucinations when he was in his body, and he could see his body still appearing confused. But he himself, from his position ten feet behind the body, was thinking very clearly and could not see the imaginary people. So his center of consciousness that had left his body was thinking very clearly, while his brain was still hallucinating and confused.

Another important feature that challenges the materialistic
model of consciousness and the brain is being “out of the body” and accurately perceiving things that could not be perceived normally. Among several hundred near-death experiences I have studied, 48% reported accurate “out-of-body” vision.

In 1982, the American cardiologist Michael Sabom published a study in which he asked near-death experiencers who had reported leaving their bodies during cardiopulmonary resuscitation to describe in detail what they had seen. He also asked a matched group of seasoned cardiac patients to imagine watching their resuscitations and to try to describe it from a third-person perspective. Eighty percent of the matched group of cardiac patients who did not have near-death experiences made major errors in their descriptions. None of the near-death experiencers made any errors, and 19% of them described specific idiosyncratic and unexpected events that happened during their resuscitation.

A few years ago, the Welsh health care nurse Penny Sartori published a five-year study in which she replicated Sabom’s findings. She found that all the near-death experiencers who claimed to have left their bodies described accurate resuscitation scenarios, whereas all of the cardiac arresters who did not have near-death experiences gave incorrect description of the equipment and the procedures.

The American psychologist Kenneth Ring reported a study of 31 blind near-death experiencers, many of them blind from birth, who were able to describe the scene around them while they were out of their bodies. In some cases, they even included accurate descriptions of the colors of some objects.

In a recent review of 93 published reports of potentially verifiable “out-of-body” perceptions during the near-death experience, the American psychologist Jan Holden found that 92% were completely accurate, 6% contained some minor error, and only 1% were completely wrong. Even in cases in which the “out-of-body” perceptions were reported to an independent witness before they were verified, greater
than 90% of the descriptions were accurate.

Let me give you an example of an accurate “out-of-body” perception. A 56-year-old van driver had an acute heart arrhythmia due to blockage of his coronary arteries, and he underwent emergency coronary artery bypass surgery. During the procedure, while he was fully anesthetized, he left his body, and was able to look down and see his body on the operating table. To his surprise, he also saw the cardiac surgeon standing by the operating table appearing to flap his wings, as if he were trying to fly.

The day after the operation, he asked the surgeon why he had been flapping his arms during the procedure. The surgeon seemed embarrassed and he angrily asked the patient who had told him about that. The patient responded that no one had told him, but that he had seen it himself from above the operating table. When he eventually got over his embarrassment, the surgeon explained that he was watching his assistants begin the operation and that he was supervising the procedure. In order to ensure that his hands, which were in sterilized gloves, did not touch anything that might contaminate them, he put them somewhere he knew they would not touch anything, flat against his chest, and instructed his assistants in the operation by motioning with his elbows, which looked to the patient as if he were trying to fly.

Finally, among several hundred near-death experiencers I have studied, 42% reported meeting recognizable deceased acquaintances in their near-death experiences. These encounters were more likely to be reported the closer the person has come to death. In 33% of these cases, the person was not someone that the experiencer wanted to see or expected to see, but was instead someone else. These unexpected encounters would be surprising if these visions were hallucinations caused by expectation and wishful thinking. Most impressively, some of these deceased persons seen in near-death experiences were people who were not known to be dead at the time. Let me give you an example.
An American pediatrician, Dr. K.M Dale, treated a nine-year-old boy with meningitis, who hovered near death for 36 hours before his fever finally broke. During those 36 hours, he was surrounded by his anxious parents, who never left his hospital bed during that vigil. When his fever finally broke, and as soon as he opened his eyes, the boy described having gone to Heaven, where he saw several of his deceased relatives. And then he added that he had also seen his sister, Teresa, who told him that he had to go back to his body. The boy’s father got agitated when he heard this, because his daughter was at college 1,500 km away in another state and was perfectly healthy. But the boy insisted that Teresa had sent him back and told him that she had to stay there. His father then left the hospital, promising his wife that he would call their daughter as soon as he got home. But when he tried to telephone Teresa, he learned that college officials had been trying unsuccessfully all night to reach the family to tell them the tragic news that Teresa had, in fact, been killed around midnight in an automobile accident.

Even more impressively, sometimes the deceased person seen in the near-death experience was someone the experiencer had not known even existed. The Swiss-American physician, Elisabeth Kübler-Ross, published the account of a girl who had a near-death experience during heart surgery and later said she had met her brother, although as far as she knew, she never had a brother. Her father, moved by her vivid account, acknowledged that her parents had, in fact, had a son who had died before she had been born, and they had never mentioned him to her.

The Dutch cardiologist, Pim van Lommel, reported the near-death experience of a man who, during a cardiac arrest, saw an apparently deceased man he did not know, but who looked at him lovingly. Some years later, his mother, on her deathbed, confessed to him that he had been born out of wedlock, and that the man who had raised him was not his biological father. His biological father was a Jewish man who had been deported and killed when the Germans invaded Holland in World War II. She showed her son a photograph of his biological
father, whom he immediately recognized as the man who had looked lovingly at him in his near-death experience.

The final phenomenon I want to discuss with you are those cases that my mentor Ian Stevenson investigated of very young children who claimed to remember their past lives. The majority of these children live in societies that have some cultural belief in rebirth, and a great many of those live here in India. To study these children, Stevenson traveled many times to remote villages throughout India to interview these children and their families.

Our group at the University of Virginia has studied more than 2,000 cases of these very young children who spontaneously start talking about their past life. About half of these children live in Asia, most of them in India, Burma, Sri Lanka, and Thailand. They usually begin speaking about these past-life memories between the ages of two and five years, and in most cases, these memories tend to fade between the ages of six and nine years. The child gives enough detailed information that we can identify the past life in 60% of these cases. However, that percentage varies greatly from one country to another. For example, in India, Burma, Thailand, and Lebanon we can identify the past life in about 80% of the cases, whereas in the United States the children often give far fewer details and we can identify the past in only 20% of cases.

The average age of death in the past life is 33 years, but that also varies from country to country. In places like the United States and Europe, where there may be less violence in the culture and where health care is more available, the age of death tends to be higher. In 60% of our cases of apparent past-life memories, the past life remembered ended violently, either in a tragic accident or by intentional wounding. The average time that passes between the death in the past life and the birth in the present life is 12 years, but that, too, varies in keeping with cultural beliefs. For example, among the Druse in Lebanon, the children who claim to remember past lives tend to be born immediately upon the death of the past life, which is in keeping
with their cultural beliefs.

As you might expect, these cases are not easy to investigate. These children often live in remote villages that are hard to reach and they often require Western researchers to interview the children through an interpreter.

There are several features of these cases that challenge the assumption that all our thoughts and memories are produced by the brain. First, these children often have detailed and specific memories that correspond to the life of someone who had lived and died in a distant location, of whom they could have had no knowledge by normal means. They will mention the names and occupation of relatives and friends from the past life, and often the specific details of how that person’s past life ended. In some cases, we have been able to take the child to the remote village where he or she claimed to have lived previously, and the child is able to identify people and places he or she had never seen before in this life.

Second, these children sometimes exhibit unusual personality traits, likes, and dislikes that are incompatible with their present lives. For example, some of these children recall a past life of the opposite gender, and they want to dress and play like someone of the opposite gender. A child born to a Hindu family may recall a past life as a Muslim and reject the food his mother cooks because it was not prepared in the Muslim manner. Several young Burmese children claimed to remember lives as Japanese pilots who were shot down over Burma in World War II. They rejected the spicy Burmese food and requested Japanese cuisine, such as raw fish, and they rejected the traditional Burmese clothing and wanted pants as worn by the Japanese. Many of these children have phobias that they relate to their past lives. For example, a child who recalls having been drowned in a well may have an unusual fear of water.

Third, some of these children exhibit unusual skills that they have not been taught, and in some cases, that no one in their village knows.
For example, a child may be able to play a musical instrument without being taught, or may have skills related to their occupation in the past life. We have studied children in Sri Lanka in villages where only the Tamil language is spoken, and yet the child can converse coherently in Sinhalese.

Finally, some of these children have very unusual and unexplained birthmarks or birth defects that they attribute to their death in a past life. These birthmarks and birth defects that are said to correspond to the death wounds in the past life occur in about a third of the children we have investigated. Sometimes, the birthmark fades as the child grows up, but in other cases it does not; and of course birth defects persist throughout the life of the child. In 18% of these cases, we can confirm through medical records or autopsy reports that the death wounds from the past life do indeed correspond to the birthmarks or birth defects in the present child.

Let me give you a few short examples of these unusual birth defects. Myint Thein, a Burmese girl born in 1956, remembered the life of a man who was riding home on his bicycle when he was stopped by a gang who had been hired to kill him. They made him get down on his knees and prepared to cut his head off with a sword. At the last moment of his life, as he was on his knees facing the swordsman, he suddenly raised his hands to plead for mercy, and perhaps to protect his head from the swing of the sword. The fingertips of both his hands were cut off by the sword. Myint Thein was born with just small stubs of fingers on both hands. As a child, the girl insisted on wearing boy’s clothes and referred to her actions with masculine verb forms.

Lekh Pal, an Indian boy born in 1971 in Uttar Pradesh, remembered the life of another boy named Hukum Singh, who lived in a distant village. Hukum Singh had gotten his right hand caught in an automatic fodder chopping machine when he was three years old, and lost the fingers of that hand. Lekh Pal was born with no fingers on his right hand, but with a normal left hand. When Lekh Pal was eventually
taken to the village where Hukum Singh had lived, he identified the correct location where the accident had taken place, and also correctly identified the man who was operating the fodder chopper machine when the three-year-old Hukum Singh caught his fingers in it.

Jacinta Agbo, a little girl born in Nigeria in 1980, was born with an unexplained three-centimeter-wide hairless birthmark that went completely around her head. There is no embryological mechanism that could explain a birthmark like this, where no hair will grow. She remembered the life of a man who had been hit on the head with a club in a quarrel ten years before she was born, and had surgery to drain the blood from his brain and reconstruct the broken skull bones. This photo was taken when she was two years old. When she was interviewed several years later, she showed definite masculine traits and habits.

Although many of the strongest cases of children who remember past lives come from cultures where there is a belief in rebirth, we also have some very impressive cases from Christian families in the United States, in which there was no prior knowledge of rebirth, and certainly no interest or belief in it. For example, a two-year-old boy named James Leininger, who was born in Louisiana, seemed to remember being shot down in the Pacific Ocean in World War II, nearly 60 years earlier. The boy would often play with airplanes and wake up screaming from nightmares about being trapped in an airplane that was on fire. When he was three years old, his mother bought him a toy airplane and pointed out what she thought were bombs under the wings. Three-year-old James corrected her, saying they were not in fact bombs but drop tanks, something she had never heard of. He eventually gave more details of his past life, saying that he flew an airplane called a Corsair that used to get flat tires frequently, something that military historians confirm is often true of Corsairs. He also gave the name of the aircraft carrier he flew from as the Natoma, said that he was killed flying over Iwo Jima, and that he flew with a man named Jack Larson.

James’ father, a policeman and a devout Baptist who was quite
opposed to the idea of rebirth, researched the story in an effort to discredit it. He found that there was an aircraft carrier called the Natoma Bay at the battle of Iwo Jima in 1945, and that only one American pilot was killed in that battle, a man named James Huston, when his Corsair was shot down and caught on fire. James Leininger’s parents tried to find the family of this pilot, James Huston, and they eventually found his sister, who lived in California more than 3,000 km away. She confirmed that her dead brother James Huston did have a friend named Jack Larson, and the little boy spontaneously identified some objects in her home that had belonged to her dead brother. She is convinced that this little boy is indeed the rebirth of her brother.

In summary, there is abundant evidence both from our daily lives and from scientific research that seems to link consciousness to brain function in everyday life. And yet there is also abundant evidence both from life and from scientific research that, under extraordinary circumstances, consciousness seems to come unlinked from brain function, and in fact appears to operate better without the mediation of the brain. Again, I want to note that this evidence is not accepted by most Western scientists, and in fact is not even known to many Western scientists. Nevertheless, it is there, and it is reliable and reproducible evidence.

First, there are exceptional cases in which people whose brains have been deteriorating for years, and who have been unable to think or communicate, suddenly regain full consciousness in the moments or hours or days before death; a phenomenon that should be impossible if consciousness is produced solely by the brain.

Second, there are exceptional cases of people with normal or even high intelligence, but whose brain scans demonstrate that they have virtually no cerebral cortex, the part of the brain that is thought to produce complex consciousness.

Third, there are near-death experiences, in which people on the threshold of death describe heightened levels of consciousness when
their brains are functioning at a greatly reduced level, if at all; accurate perception from a visual perspective outside the physical body; and apparent encounters with deceased people who convey accurate information not known to anyone else, including encounters with deceased people who were not known to have died, or indeed were not known to the experiencers at all.

And fourth, there are very young children who seem to remember a past life. They have accurate memories that correspond to a past life; personality traits, likes, and dislikes that are surprising in the context of their current family but consistent with the past life; unlearned skills that seem to have carried over from the past life; and unexplained birthmarks and birth defects that seem to correspond to death wounds from the past life.

These phenomena, all well investigated by modern scientific methodologies and building upon decades or centuries of prior research, strongly suggest that consciousness can be produced and can function without the intercession of a physical brain. Thank you.
**Discussion**

**Chris Impey** (Moderator): Thanks very much Bruce. It was an extremely fascinating and provocative talk, and I am sure we'll have lots to talk about, so I encourage the audience to start to formulate questions and we'll gather them and fold them into the discussion. I am going to take my moderator prerogative and ask a sociological question. We now have a correlation, rather than a causative testable physical theory, explaining why mind and brain should be linked, and data that you need to explain. In the field of gravity, the advancing perihelion of mercury—a small effect perhaps, but persistent data that had to be explained—led to the downfall of Newtonian gravity and the rise of general relativity, a completely new paradigm. Why, in your view, has no analogous progress been made in neuroscience?

**Bruce Greyson:** That’s an excellent question, Chris. Why has no new paradigm come up to explain these data?

**Chris Impey** (Moderator): Associated with that of course, why has the resistance been so relentless?

**Bruce Greyson:** There is tremendous resistance among Western scientists to the idea that consciousness and the brain are separate, because most of Western science is built on the materialistic model. The scientific method has produced much good for our society. The problem is that many scientists confuse the scientific method with the materialistic philosophy that usually accompanies it. The modern technology we enjoy is the result of the scientific method,
not necessarily of the materialistic philosophy. But the two have been linked so tightly together for the past several hundred years that it is hard for scientists to think of science without materialism. That has changed in the last century among theoretical physicists. They study things that can’t be seen or felt or measured directly—particles that are so small and last such a short period of time that they cannot be seen, and cannot be measured directly. Instead, physicists shoot these particles through what’s called a bubble chamber, a box full of liquid, and as the particles go through the liquid, they leave trails of bubbles. Physicists can then measure the effects of shooting the particle, but they can’t measure the particle itself. They assume that there was a particle there to produce the bubbles, and from the trail of bubbles they can learn a lot about these particles that can’t be seen.

In the same way, the thing that we are talking about, consciousness, cannot be seen, but it does leave effects. Consciousness does affect the body, leaving a metaphorical trail of bubbles that we can follow, and through these effects we can make inferences about consciousness. I think the reason we don’t yet have a good model to rival materialism is that the question is very complex. We’ll get a satisfactory model eventually, but we’re not there yet. As His Holiness said yesterday, Western science is geared towards studying physical phenomenon. It has not even thought about how to approach mental phenomenon, and maybe, when we can bind it to the 2,000-year-old tradition of meditation and introspection, we will find some way of merging science and consciousness research.

Chris Impey (Moderator): I would like to ask the geshes if they have any questions at this point.

Monastic Graduate: It seems that most modern neuroscientists believe that consciousness is produced by the brain, or the functions of the brain. Since we have different types of consciousness, such as the happy state or the sad state, can we identify physical entities or physical particles that are responsible for these different mental states? And, if so, is there a way that we can produce those respective entities
or particles?

**Bruce Greyson:** The problem comes in saying that these physical entities are responsible for these states or produce these states. We can find some physical phenomena that are associated with those states, but they are not necessarily causing them. For example, when people are severely depressed there are changes in the neurochemicals in the brain, but it’s not clear whether those changes in the neurotransmitters are causing the depression, or are the result of depression. They are what we call “biological markers.” We can associate the mental state with the biological changes, but we can’t say which one is the cause and which one is the effect.

**Chris Impey** (Moderator): A question from the audience. There seems to be some significant parallelism between the research you’ve done, the phenomena you described, and things that seem to happen in dreams—enhanced mental functions, paranormal phenomena, hyper-realization of senses. Is there any deliberate attempt to make connections there, or to use dream research in a way that illuminates what you’re talking about?

**Bruce Greyson:** We have not done that, but other scholars have tried to associate the phenomena in near-death experiences with the phenomena in a variety of states, not only dreams, but drug induced states, meditative states, etc. There are certainly some experiences that are common to all altered states of consciousness, and there are some people who argue that it doesn’t matter how you get to that altered state, whether you do it through sleep, through lucid dreams, through drugs, through hypnosis, or through electrical stimulation. But we do find that there are some differences between spontaneous near-death experiences and these induced states. For example, almost everyone who has a near-death experience will be profoundly affected by that change and will be transformed in their attitudes, beliefs, and values. People who have a similar experience in a dream do not necessarily change their lives, and, in fact, if you ask them ten years later, they may not remember the dream. But people who have near-death experiences
will remember their near-death experience.

Chris Impey (Moderator) A connected question from an audience member: What is it about the quality of compassion of a near-death experience? It sounds like what we really want is near-death in a pill, so we can just all take the pill and be more compassionate and have all these benefits of the near death experience.

Bruce Greyson: Well, that’s the American attitude; we want it in a pill.

Chris Impey (Moderator): Do you get the experience?

Bruce Greyson: I think anyone who comes close to death may be changed by that experience. Most people who almost die tend to value their life more highly, but there are many differences between just coming close to death and having a near-death experience. For example, if you just come close to death but don’t have a near-death experience, you usually become more frightened of dying and you become much more cautious. If your doctor tells you to stop drinking, you will stop drinking. If you have a near-death experience, you are not afraid of dying anymore, and paradoxically that makes you not afraid of living to the fullest. You take more risks, you become much more joyful in your life, and that also makes you a less cooperative patient, because if the doctor tells you to stop drinking, you won’t necessarily stop drinking, because you are not afraid of dying.

Chris Impey (Moderator): Any other questions from our guests?

Monastic Graduate: Whether the brain produces consciousness, or consciousness is something else, what is obvious is that consciousness can have effects on our body. In the contemplative traditions, we have methods to deal with minor brain problems and for reducing physical discomfort. In addition to contemplative methods, what scientific methods should we adopt to solve this mind–body problem, or reduce physical discomfort?
Bruce Greyson: That’s an excellent question. I am hoping that we’ll get the answer from this conference. I think most Westerners are aware that there’s a long tradition of consciousness research in Eastern cultures that they know nothing about, and they’ve been reluctant to learn more about it because they are so wedded to their own way of thinking. I understand that consciousness does have strong effects on the body and on health. The problem in getting Western medicine interested is that there is no financial profit in consciousness. If you produce a pill or a procedure or a device to affect the body, you can make a lot of money with it, and you can make a lot of money doing research into it. But if you’re talking about a contemplative discipline, there is no product to manufacture that you can make financially profitable. We are fighting an uphill battle trying to get the attention of people who fund research to look into this question. But this is a direction in which Western medicine must go, and it is becoming increasingly popular on the fringes of Western medicine. I think it’s only a matter of time before people see the power of some of the meditative techniques.

Chris Impey (Moderator): Another question from the audience: Could you speculate on why it is that the clarity and incidence of the rebirth experience plays out particularly in the very early childhood stages and then fades? And do you know if it’s a universal, general phenomenon? Is there anything special about those people?

Bruce Greyson: That’s a very good question. We don’t really know why some people remember a past life, whereas most people do not. If you assume, as Buddhists do, that everybody is reborn, then obviously the normal procedure is to forget your past life, because most of us do not remember. So why do a few people remember? Is it something that has gone wrong that allows them to remember? Children who do remember a past life don’t seem to have any advantage, and it does not seem that people who are particularly virtuous remember their past lives. The few cases we have suggest that a strong attachment to the past life is one factor in remembering it. For example, people who were killed prematurely or violently tend to remember their past
lives. Seventy percent of these cases in some cultures ended the past life in a violent manner. In other cases, people have some other strong attachments to the past life. For example, people who were monks in the past life and seem to be reborn into a non-spiritual home may remember the past life as a monk.

The children tend to remember their past life at very early ages, two or three, and often when they are in some altered states, when they’re sleepy, when they are being given a bath, when they are not engaged in normal activities. Then they will start to remember more things and the memories come up sporadically during the day. As these children get to be the age to go to school and get more involved in this life, they tend to forget the past life, and by the time they are six, seven, eight, nine years old, they tend to forget. We have done some psychological testing with these children in Sri Lanka, in Lebanon, and in the United States, and if you test these children when they are two, three, four, five years old, they have higher IQs than their peers. They have much better verbal skills than their peers. You’d think that would make them more successful in life, but the advantage doesn’t continue. If you test them again when they are teenagers and have forgotten their past lives, they are just like everybody else, and their IQs are the same as their peers. We don’t know why they remember at all, and we don’t know why they don’t continue to remember. There are some cases, a very few cases, where we have identified the family the child claimed to have been in in the past life, and the family has accepted the child and they continue to see the child year after year. And in those cases the memories may persist because of the continuing contact with the past family. But those are unusual.

Chris Impey (Moderator): A postscript question on this from the panel: What is your personal view on rebirth?

Bruce Greyson: What is my personal view of rebirth? Many of the cases that we have are unexplainable in terms of Western medicine, but they are also unexplainable in terms of the reincarnation hypothesis. Sometimes we’ll see two children who seem to remember
the same past life; sometimes we’ll see a child remembering a past life of someone who died when the child was six months old, so the two lives overlapped. It does not fit into a clear model that we can follow. When I talk to near-death experiencers, they always say, “Words cannot explain my experience. I cannot describe it for you.” Then I say, “That’s great; tell me all about it.” We force them to tell us what they experienced. They are putting into words things that don’t fit into words, and I think the same is true of these rebirth memories. What actually happens is something that our brains cannot understand, so the models that we could come up with do not really approach the reality. If you ask me what I believe, I say that what happens after death is something that I can’t possibly understand while I am in this brain.
DOES ONE NEED TO BE CONSCIOUS TO HAVE CONSCIOUSNESS?

Buddhist and Neuroscientific Perspectives on Consciousness.

Geshe Lobsang Tenzin Negi, Ph.D.

Neuroscientific approaches to the problem of consciousness are quite recent, and there is still no consensus among this community as to what qualifies as “conscious,” or “consciousness.” The Buddhist tradition, on the other hand, has concerned itself for millennia with the nature and functions of consciousness. As dialogue between Buddhist traditions and modern science continues to grow, it is important that we clarify and carefully track the range of meanings associated with the term “consciousness.” Whereas consciousness often refers to a minimum degree of self-awareness in modern science, the term carries a broad range of meanings in the Buddhist tradition.

Geshe Lobsang Tenzin Negi: So far, this conference has been most enlightening. The presentations from Dr. Greyson this morning, and yesterday from other scientists, were clear in showing how the scientific community is thinking outside the box. I think this open-mindedness is wonderful as we continue these dialogues between modern science and the contemplative traditions. I would like to focus my presentation
today on the way consciousness is conceived in current neuroscience and Tibetan Buddhism.

I would like to start this conversation by asking, “Do we need to be conscious to have consciousness?” At this conference so far, references to “consciousness” have had a broad range of meanings and implications. What I want to talk about is the very specific way that consciousness is understood in mainstream neuroscience today and in Tibetan Buddhism. As we continue these dialogues, I think it’s very important for us to have a clearer sense of what is meant by the specific terms that we use when we are engaging the two disciplines of Buddhism and neuroscience.

While I cannot speak for the entire field, it seems that modern neuroscience has a consensus on how we define consciousness. In neuroscience, the definition of consciousness relates to a very specific aspect of mental experience that is limited to a sense of self in the act of knowing. Alternatively, the Buddhist definition of consciousness refers to the mind in general and includes all the cognitive, affective, or emotional states, even those emotions and cognitive states that modern neuroscience would characterize as taking place on an unconscious level outside of our awareness. From this perspective, mind or consciousness, which are often used interchangeably, is characterized as luminous and cognizant. The mind is luminous in the sense that its nature is to reflect the objects with which it engages, much like the way a mirror does. However, unlike a mirror, the mind is also cognizant as it does not merely reflect these objects, but engages with them as well. In Buddhism, consciousness is understood both in terms of its nature as well as its functions; the nature of mind is luminous and its function is to cognize or engage with its objects.

When consciousness is used interchangeably with mind, consciousness constitutes all aspects of mind. However, the Tibetan term namshê, or its Sanskrit equivalent, vijnâna, is often translated into English Buddhist texts as “consciousness.” The term namshê, however, would not be used interchangeably with “mind,” as namshê only
encompasses a very specific aspect of mind understood as the primary mind, known also as *tso-sem*. Buddhist psychology makes a distinction between two aspects of mind: the primary mind and the secondary mind, sometimes translated as the mind and mental factors. As such, *namshe* refers only to the primary mind, and not the secondary mind, which is known in Tibetan as *sem-jung*. The primary mind is understood to simply register information. The secondary mind is responsible for the functions of the mind, such as distinguishing the characteristics of this information and labeling them accordingly. The primary mind and the secondary mind are completely interwoven. In fact, they are of one entity, but they are different from a functional perspective. What is important for the purposes of our discussion is not to understand the subtle differences between the functions of primary and secondary mind; rather I would like to draw your attention to the fact that *namshe*, or primary mind, is often translated as “consciousness.” However, within Buddhist psychology, *namshe* refers to a very specific mental event, and not the vast spectrum of mental phenomena that fall under the category of secondary mind or mental factors. Parsing these subtle understandings of the term consciousness is important because if a Buddhist scholar engaged in dialogue with a modern neuroscientist assumes that the neuroscientist is referring to either the broad definition of consciousness as the mind or the narrow understanding of consciousness as *namshe* by the term “consciousness,” this will necessarily lead to confusion as neither of these definitions are the modern neuroscientific understanding of “consciousness.” In order to avoid this miscommunication, it is very important that we make clear what we mean by the term “consciousness” before beginning a dialogue between Tibetan Buddhism and modern science. Perhaps before beginning discussion, the involved parties should agree on a definition of what is meant by consciousness in the context of that conversation.

Engaging in these kinds of dialogues, it is also important for us to consider that modern science and Buddhist traditions come from very different basic paradigms. The fundamental paradigms are completely
different when it comes to the nature of the mind, or life, if you will. Modern science purports that life emerged accidentally, that certain physical conditions were sufficient to give rise to such life, and that life supports a certain kind of entity, which registers information. That is the way mainstream science looks at the origins of the mind, at least on Earth, as we know it. On the other hand, the Buddhist conception is that the mind is not purely an emergent property of certain physical entities, arising out of these physical entities alone, but rather any mental state requires a certain preceding state of mind as its substantial cause. This idea, or this understanding of how mind comes into being, is dependent on two prongs: the substantial cause, which has to be mind, and the contributing cause, which can be a brain, neurons firing, or other environmental factors. To put it another way, Buddhist thought believes that consciousness or mind must be preceded by consciousness: environmental factors, such as having a brain or a body, can make the conditions ripe for consciousness to manifest, but these physical states cannot create consciousness on their own. In this sense we can certainly resonate with what Dr. Greyson was hinting at today: that the brain might not be the sufficient cause of the mind. In other words, the brain may not be the cause that gives rise to consciousness, but it certainly contributes to the various aspects of the mind. Those are the fundamental differences in the paradigms, but those differences need not hinder us in coming together and exploring the functions of the mind and different aspects of the mind in order to utilize them to enrich our lives, whether it be personal health or communal well-being.

How do we understand consciousness from the current, mainstream neuroscience perspective? Obviously, one way is through its evolutionary origins. But neuroscience also looks to explain the nature of consciousness, understood by modern neuroscience as a sense of self in the act of knowing, by breaking it up into two problems: the hard problem and the easy problem. The easy problem, which is still a daunting task, concerns understanding the very specific activities of the neural circuits, neural anatomy, neural function, and
the specific way the neural correlates produce consciousness. From the neuroscience point of view, this is considered somewhat easier, and tremendous advances have been made, although there is still a long way to go to. The second, hard problem of explaining consciousness involves qualia.

Qualia relates to a sense of knowing. Take this bottle, for example. You could have the most sophisticated computer with a camera that takes images of the bottle and analyzes what it is made of and the physical nature of this bottle and the water molecules and everything, but still such a computer would not have a sense of existing. The computer does not know that it exists, and in analyzing the bottle, does not know that it is engaging in the act of analyzing. A recent edition of *Time* magazine has an article on consciousness, and it describes this example of the best computer analyzing a tremendous amount of data and it still not knowing that it exists. The computer may be able to analyze properties of the bottle that we never could, but we are able to know that we are analyzing the bottle, whereas the computer cannot. The hard qualia problem involves how we explain this knowing as we engage with the act of knowing. That part is the part that the neuroscientists have until very recently stayed away from because it’s something that is very hard to study. This is also referred to as “the explanation gap:” we can know what’s going on in the brain when someone perceives something, but explaining how those brain functions lead to knowing is something we have not been able to do.

Antonio Damasio is one of the leading neuroscientists who has dedicated his time and energy to giving a detailed explanation of how consciousness came into being and how to understand it. Damasio’s model presents it in evolutionary terms. Even a single cell organism that has no nervous system is nonetheless equipped with certain abilities to register information and to approach this information in a way that maximizes its survival. That function is there even in the most basic organism, and it tells us that organisms are most importantly about survival. The neuroscience explanation is that as organisms become more complex and have more complex behavior,
more complex mental activities develop. Finally, as you can see in the history of life, when you have the brain stem and limbic system, the thalamus, the more evolved frontal cortex, and so forth the mental activities become more complex. According to Damasio, it also has to do with emotions because emotions are about survival. Emotions are understood as signals that organisms are able to produce in the presence of certain stimuli and that regulate the system in order to protect themselves. If there is danger, we know that there is danger, and we avoid it. But these single cell organisms don’t have that self-consciousness or self-awareness. It is instinctual. Damasio calls it a “proto-self,” but there is no awareness of the self. As emotions are registered in the higher brain, there are feelings and the feelings relate to changes of the internal milieu, the internal organs and biochemical profile. Then there is a sense that the emotions that one is feeling are about the changes in one’s system, and therefore there is a sense of the core self: once an organism has this capacity to know that feelings are their feelings and to understand the sense of self associated with these feelings, consciousness is present. There is also a more complex nature of the self, which more evolved beings such as humans experience: this is what he calls the “autobiographic self.” This is neuroscience’s story when they talk about consciousness.

Buddhism does not see it that way. That’s why I started with the question of whether you have to be conscious to have consciousness. From the Buddhist point of view, you certainly do not have to be conscious to have consciousness. For example, a person in deep sleep, according to neuroscience, has no consciousness because there is no sense of self. However, from the Buddhist point of view, a person in deep sleep has consciousness because they have mind: sleep itself is a state of the mind. I believe that until very recently neuroscientists even considered people in a coma to be unconscious. That has changed since British and Belgian scientists subjected people in comas to tests by asking them names and observing responses from certain brain circuits associated with the names. When they were asked to imagine playing tennis, certain motor circuits lit up. Even when they were asked
about their names, the certain area that lights up whenever you think of your name, or of yourself, lit up in these comatose patients. These findings challenge the prevailing idea that to have consciousness you need to be awake in the conventional sense. When you see these kind of findings they demand that the scientific community step back and revisit how we understand consciousness; if those unconscious people are able to create very specific brain images, almost no differently than those people in wakeful states, how do we then decide who has consciousness and who does not?

As we develop a better understanding about these inner states, the methodology we apply is very important. In modern science, most investigations involve the externally measurable physical world. In recent years, the mind, and consciousness, have become the object of science, but the approach has remained largely conventional. I am talking about the third-person approach. To do science, an object must be measurable and, in the third-person, objective sense, it must also be reproducible. But there is a serious problem with that approach when it comes to investigating the inner states of the mind that are experiential, even though in some direct ways we can find many correlations through brain imaging and other behavioral measures. Ultimately, as His Holiness the Dalai Lama points out in his book *The Universe in a Single Atom*, we also have to utilize the first-person approach to investigate this inner state of the mind, and that’s where the contemplative traditions become so helpful. Contemplative traditions, like the ancient traditions upheld by the great Indian masters and kept alive in Tibet for so many centuries, are living traditions among which you can find very advanced meditators. These advanced contemplative practitioners who have advanced skills in attention, mindfulness, compassion, and other mental qualities are able to recognize and distinguish their inner mental states with reliability and clarity. These skilled meditators provide an unprecedented opportunity for scientists to combine first-person and third-person approaches to investigate some of these inner mental states.
This is precisely what has been happening in places such as Dr. Richard Davidson’s lab in Wisconsin. In one of the first studies of its kind, advanced Tibetan Buddhist meditators examined very specific mental states, such as attention or compassion. These researchers wanted to see if a person, subjectively and deliberately, could generate certain states that could be measured through the third-person approach using brain-imaging scanners. If these deliberately cultivated mental states repeatedly correspond with certain brain regions, we can say that the subjective experience of the meditator is valid in accordance with this objective data. Otherwise, introspection is considered an unreliable way to learn about what’s going on inside the mind, because each individual has a different account. In a landmark study, Venerable Matthieu Ricard was subjected to this test in eleven one-minute intervals. He was asked first to focus and cultivate attention, and then to relax, and then do it again, and relax for a minute, and then again, and so on. When you see the graph of Matthieu’s brain activity during the experimental period, it resembles the skyline of New York city, with high rises, gaps, and more high rises, precisely matching the one minute intervals when he was cultivating attention. This was also demonstrated with other mental states, including devotion and compassion. There are now hundreds of studies conducted on meditation, including studies concerning mindfulness and its impact on depression and the changes in the speed of recovery from psoriasis, a stress-related skin disease, among many others. This kind of collaborative work is building and gives a tremendous amount of hope and optimism for us to develop more understanding about these mental states in the future.

What do these changes that we can bring to the mental or emotional inner states mean in terms of our health and social well-being? We live on this globe together, as neighbors and co-workers, and if we are out of tune with each other, if we are not able to pick up on each other’s mental states, we will not be interacting in a meaningful and healthy way that will promote harmony. Is there a way, or foundation, for contemplative practice to enable us to become more finely tuned with
the inner experiences of others? The good thing, again, is that science and the contemplative traditions have come together in beautiful ways where this is concerned, converging understanding from both traditions.

Neuroscience is studying mirror neurons in organisms, particularly humans. These mirror neurons enable us to understand each other’s mind, thoughts, and feelings. It’s not necessarily happening consciously, but often times we sense others’ emotional states without realizing it, as demonstrated by the findings in studies with mirror neurons and other empathy-related neural networks. But we can get better in understanding such things. This is the thesis of Daniel Goleman’s recent bestseller, *Social Intelligence*. This book has to do with the social world that we live in. Social intelligence is paramount for us to function properly in the social world, and certain meditation practices help you empathize with others, thereby increasing your social intelligence. One of the studies we have done at Emory University was about measuring empathy accuracy through a test known as “reading the mind in the eyes.” This is a test that asks people to read an emotional state from the eyes, and to see how accurately they can pick up whether someone else is sad, happy, angry, and so forth. The idea is that the better you pick up another’s emotional state, the more accurate your empathy level. In the study that has been done on compassion meditation, after eight weeks of meditation the meditators’ accuracy was much higher when compared to the control group, even among meditators with no prior meditation experience. These findings of increased empathy accuracy were also associated with corresponding changes in the brain: areas of the brain rich with mirror neurons were more active in the meditation group than the control during the task of “reading the mind in the eyes.”

These collaborations are very promising. Thirty years ago, far ahead of his time, His Holiness the Dalai Lama envisioned collaboration between modern science and traditional Tibetan Buddhism that would bear this kind of fruit with such inspiring results for the benefit of humanity. I am personally indebted to have an association with the
Library of Tibetan Works and Archives to work on a project that furthers the mission that His Holiness envisioned, the Emory–Tibet Science Initiative, and to promote this work where contemplatives and scientists can come together and collaborate in exploring these inner resources. We are just barely scratching the surface with this program for educating monks and nuns in the modern sciences in the hope that we can tap into their knowledge of the inner world of mind and emotions so that the whole world can benefit and be a better place. Thank you very much.
Panel Discussion

Monastic graduates on the panel:

Geshe Tenzin Topden
Tenzin Dhondhen (Namda Khentrul)
Geshe Sonam Gonpo
Tenzin Lhadron

Chris Impey (Moderator): Thanks very much, that was great. Let me start by asking the geshes if they have any questions to pose.

Monastic Graduate: This question is for both speakers. There are many stages in the history of scientific development. Quantum physics, particularly, has made a lot of progress in its understanding of very subtle details of particle physics. Compared to physics, neuroscience, whether in psychology or contemplative neuroscience or neuroscience in general, is lagging far behind. What are the major reasons for these differences in development?

Chris Impey (Moderator): I would like to hear both of you answer that.

Bruce Greyson: I am not sure I can give you a good answer to that. Neuroscience and psychology have been lagging very far behind in this, but some physicists are now trying to tackle this in ways that we can understand. For the first century of quantum physics, they talked
about consciousness as being an elementary construct in the Universe that has some causal effects on the physical world, but they never went into detail because they were physicists who study the material world and they don’t deal with things like consciousness. In the last ten years or so, there have been a few collaborations between quantum physicists and neuroscientists to try to explain consciousness in terms of quantum mechanical processes. These are very rudimentary efforts right now, but they are bringing together psychologists, cognitive scientists, and quantum physicists to try and determine if there is a way to be more rigorous about how to define the role of consciousness in the Universe using quantum mechanics.

**Chris Impey** (Moderator): Roger Penrose has been a leading writer on this. It’s not trivial, because there are still very profound issues in quantum physics and they are not very well understood within the realm of physicists. There are causal effects in the laboratory that are not yet fully understood. There are correlated, associated phenomena on microscopic scales that are not understood. It’s one of those difficult situations where you are trying to marry a field that itself is still not fully mature after a century, with a field that is robustly immature. It’s not clear how to proceed. In fact, you are not applying a finely honed, maturely understood subject of quantum theory to a brave new world. It’s a little messier than that.

**Bruce Greyson:** I would add to that. These physicists who have been so brave as to tackle the questions “What does it mean to be conscious?” and “How does consciousness relate to the physical world?” are sometimes criticized by other quantum physicists who insist that quantum physics is purely a mathematical model, that it is not meant to be real, that it is just a mathematical way of trying to make predictions, and that it is a mistake to try to be concrete about it and try to be real about it.

**Chris Impey** (Moderator): The profound philosophical and conceptual issues raised by quantum theory were clear to the practitioners in the first few decades, in the 1920s and the 1930s,
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... to Heisenberg, Bohr, Einstein and so on, and they essentially set aside most of that profound subtlety and incomprehension in favor of something called the Copenhagen Interpretation, due to Neil Bohr’s influence in the 1930s. They became pragmatists who applied quantum electrodynamics theory that is accurate to the 12th decimal place. It’s an incredibly precise theory, it works in the lab hundreds of thousands times a day, and most practicing physicists choose to set aside philosophical explanations. It became, as Bruce implied, somewhat disreputable to put it on the table, although it was never addressed, it was never properly dealt with even by the titans of the field, the true geniuses who conjured up the theory. It’s still waiting to happen.

Gehse Lobsang Tenzin Negi: Part of the reason that the physicists may not have seriously tackled the issues of mind and consciousness may have to do, again, with the methods by which the experiments were done with a heavy emphasis on the third-person approach. In many ways what prevented them from tackling the question is that they essentially had a world view of science as necessitating third-party observation, without room for the subjective experience; this is behaviorism. Behaviorism is the thing that scientists finally began to tackle. The psychology of the day was behaviorism, because you can measure behavior. They put the mind in a black box. You could not talk about the mind, but what you could talk about was the stimulus and the response, and you could measure the response. Only in the 1950s, when computers were developed and artificial intelligence emerged, did psychologists use this idea of information processing to create new models of the mind, memory, perceptions, and so forth. It also has to do with the method of investigating the mind. The third-person approach is not a direct way of investigating mental states.

Monastic Graduate: My question goes to Geshe Lobsang. There are some people with a philosophical background who believe that consciousness is separate from the brain. There are also many scientists who don’t view consciousness and reincarnation in the way that we Buddhists do. What methods have you found most effective
in engaging with “non-believers?” And what plans do you have for future dialogue with them?

**Geshe Lobsang Tenzin Negi:** Over the past few years I have been in the West and have had opportunities to interact with some of the scientists and scholars that come from the Western traditions. Certainly, when it comes to the topic of the mind and the mental realm, the perspective of having previous and future lives is somewhat limited to religious traditions. And even then, monolithic religious traditions don’t accept the concept of a previous life. They maintain that you have this life and then it continues into the future, but there is no position about the previous life.

I am not that familiar with Western philosophical positions, but I have had some opportunities to interact with scientists, particularly cognitive psychologists and those who are working in the realm of emotions, and it is there that I find Buddhism and cognitive science have a lot to learn from each other. They complement each other particularly well when talking about mental states, like memory, how memories are formed, how memory is understood, perceptions, attention, emotions, and even emotional states like compassion and empathy. There is a growing understanding—not just theories but experimental-based understanding—about these various mental functions and states, and that’s where Buddhism has a lot to say. For Buddhists, the important thing is what we can learn from scientists about those physical elements that are involved in producing these mental states, and certainly for Buddhists there is a lot to offer in terms of how to cultivate and how to enhance those mental states. It’s a very rich field for interaction between science and Buddhism.

**Chris Impey** (Moderator): Why do we see very few women discussing consciousness here, or in general, when we know that they are the ones who bring life into the world? Their experience of forging a new life within may give us answers to where consciousness comes from.

**Geshe Lobsang Tenzin Negi:** I think we should definitely have
more women participating in this dialogue. I think there is no question about the role of women. They certainly are more empathetic; studies show that women have greater empathy than men. We definitely should have more women participating in all aspects of our future discussions.

**Chris Impey** (Moderator): An Action Item. In general, we see some dichotomy—maybe that is too strong a word—between Eastern and Western views or approaches, methodological approaches, philosophical, conceptual approaches. I don’t believe in strong cleaving between genders in general and there are definitely illuminations that would come from having a balanced perspective.

**Bruce Greyson:** There are many studies showing that women experience more spiritually diverse states than men, and when they do experience these altered states they are more likely to engage them more fully than men. But men are far more likely to try to understand these states and translate them in ways that others can understand. Although more women experience spiritual states, you see more men trying to study them, trying to understand them.

**Chris Impey** (Moderator): A question from the audience that is probably for Bruce and relates to that business of having to describe a phenomenon. You alluded to out-of-body conscious experiences related to body senses—seeing, hearing, feeling—that are specific to the human experience, when you might imagine that an out-of-body experience could have all sorts of qualities well beyond sensory. Is that the problem that you described—the difficulty of verbalizing something that’s maybe hard to verbalize?

**Bruce Greyson:** I think that is the problem, and it is best typified by the experiences of people whom Kenneth Ring interviewed who were blind from birth. From their near-death experience, they became aware of things, including colors, of which they had no experience. When we ask that they tell us about them, they used the vocabulary of vision, which is the only vocabulary we have to describe what things
look like. Clearly, they weren’t seeing things; they weren’t in their bodies. Whatever form or substance they were in did not have eyes, so they were not seeing things the way we were. Furthermore, for these people, their normal physical eyes didn’t work, and yet we asked them, “What did it look like?” You have to use the words of vision, and we were forcing people who had out-of-body experiences to use bodily language to describe it to us.

Chris Impey (Moderator): This is a question from the audience for the geshes. Does Buddhism have a way of talking about some of the anecdotal evidence that Bruce was talking about? For example, a situation where the person who died was reincarnated as a person who was six months old, overlapping lives if you like, or the experience of meeting with relatives who are unknown to the person. Do some of those pieces of evidence that Bruce was talking about make sense in a Buddhist tradition?

Monastic Graduate: The evidence of rebirth that Dr. Greyson discussed this morning, like the birthmarks, isn’t surprising to our tradition because we believe in reincarnation. We believe in life after death, and when we talk about life after death and reincarnation, we believe that our mind goes from one life to the next. Through that, reincarnation takes place. I can’t say that I have had an experience of how reincarnation happens, but the best example that we can see in our society, or we can give you from our society, is the recognition of the high lamas or the high Buddhist spiritual leaders like His Holiness the Dalia Lama. We try to find reincarnations of these spiritual leaders. We might show them ordinary objects that belonged to the leaders in their past lives and there are many cases where they can recognize those objects; the present reincarnated lama can recognize those objects. These are the things our tradition and our belief have in common.

Monastic Graduate: In addition to what my friend has said I would like to give two examples about remembering our past lives. I have a relative and she is a nun, and so she has a spiritual teacher. Her
spiritual teacher gave her a spiritual name, Lobsang Dharma. After some time her spiritual teacher passed away. Later on, they found his reincarnation. When she came to know about her spiritual master’s reincarnation, he was two or three years old. The nun went to visit her spiritual master, that reincarnated young boy, and as soon as she entered the room the small boy recognized her and asked, “How are you doing? How did you come here?” There is also another example where an old man gave a togag to a nun, and after that man passed away he was reborn as a small boy in their family. Later, when he was old enough to speak, he recognized the togag that was given to this nun from his previous life. These are a few examples that I am aware of, and such examples are very common in our tradition and our society.

Bruce Greyson: There may be other ways in which a child can get information about a past life. For example, is it possible, in theory, that a deceased spirit could possess a child and cohabit that body with the child’s spirit, or a disembodied spirit could theoretically displace a child’s spirit and take over that body, or information about a deceased person could exist in some discarnate state, the way information from your personal computer gets loaded up to the cloud where other people can access it? Maybe this child is accessing this cloud information. These are all theoretically possible scenarios, but none of them explains the data from these children as well as the reincarnation hypothesis does, and even the reincarnation hypothesis doesn’t explain all of it. What we might be seeing is that these cases of apparent past-life memories do not all have one explanation. Some may be better explained by reincarnation, some better by possession, and some by other better means we don’t know of yet.

Chris Impey (Moderator): I suppose that if consciousness is compared to some kind of energy, then it can be measured. If that is so, if consciousness leaves the physical body, the body should be lighter in its absence. Have there ever been attempts to measure this? This reminds me of attempts to measure the weight of a soul as it flees the body. You might know the research.
Bruce Greyson: There actually have been some attempts to measure what departs at death. The first one I know of was done by William McDougall at Harvard University around 1910, and he came up with 37 grams as the answer. But various people have noted that when someone is on his or her deathbed, water vapor evaporates from the body and there are various things that can account for a small amount of weight loss. You really need to do this type of study in some type of vacuum-sealed enclosure. But the question really is not only what are you measuring, but why would we assume that consciousness is an energy that we are able to measure? We know of certain types of energy that do not seem to correspond with consciousness, but there are obviously some energies that we are not able to measure at this point. We often make assumptions about what we can measure, what we have the technology to measure.

Geshe Lobsang Tenzin Negi: This is not commonly accepted within all schools of Buddhism, but certainly from the Vajrayana point of view consciousness is not completely independent or separated from any form of energy. The cause of consciousness is certainly correlated with the cause of energies. They even have their own biochemical substrates, but the subtle consciousness, the most subtle consciousness, which is usually what the clear light of death is referring to, and its energy correlate, if you will, are not necessarily two distinct entities. It is basically the same entity with two expressions. I don’t know if there will ever be a device that can really measure such subtle energy. Nonetheless there are phenomena in the Tibetan Buddhist tradition, as you all probably know, when accomplished masters die and enter into what is known as heart meditation. Such a person’s physiological states remain intact, instead of deteriorating or decomposing. Sometimes, they can go for weeks. Just couple of years ago, one of the great masters in South India remained in that post-death meditation for 18 days.

Chris Impey (Moderator): Mention of the heart made me retrieve a question from the audience. This is very much in the manner of Western scientists who, of course, consign the heart to just being a
pump. Why are scientists not investigating this, when, according to Tibetan medicine, the heart is also important to mind function? Are Western scientists missing something in looking so strongly at the connection of mind and brain?

**Bruce Greyson:** There certainly are large collections of nerve cells in different parts of the body called ganglia. There is one around the heart, and there is one in the gut. In thinking about the octopus nervous system that you were mentioning, I remembered that there are nerve ganglia at each of the eight tentacles that are obviously very complex and can do something that creates a response to a stimulus, whether or not you can call that thinking. It may be that the reason some people can think and feel without a brain is that the other parts of their nervous system and nerve ganglia in other parts of the body are carrying on some of these functions. We just haven’t studied ganglia in other parts of the body as well as we’ve studied the brain. And it may be not only nerve cells, but also other cells that can carry on some of these functions. For example, the heart muscle certainly has its own electrical conduction system, which is independent of nerve cells in there. If the heart muscle itself can conduct electrical signals, maybe there is another way of communicating information that we haven’t really studied.

**Chris Impey** (Moderator): The octopus’ distributed brain is actually quite highly functioning. If an octopus looses an arm in an attack, that arm will continue to crawl away and continue to make quite complex camouflage patterning for a while. After talking to a field researcher on cephalopod intelligence, I was cured of eating something that may be smarter than I am.

**Geshe Lobsang Tenzin Negi:** I believe that there is now a certain group of scientists—they are small—who do put as much emphasis on the body as they do on the brain. At Emory University we have a Department of Psychiatry where they are very much about looking into the body. I don’t remember the specific substance they use, but apparently when they inject it into the body of a rat they can see that
it makes the rat smarter and faster. Also, isn’t there an understanding now that there are probably more cells in the gut than in your entire body? And those cells in the gut are actually processing much of the information that our brains process? There is a small group that is interested as much in the body as the head.

**Monastic Graduate:** My question is for Dr. Greyson. You have done a lot of research on consciousness that isn’t so much related to the brain itself and there is a lot of evidence of rebirth and life after death. How convinced are you by this kind of evidence that there is life after death, or that consciousness is not dependent on having a brain? From the Buddhist point of view, when we talk about the purpose of learning something or doing something, the purpose is to benefit the physical world that we live in and the living beings that are in this physical world.

**Bruce Greyson:** How convinced am I that there is life after death? I think it is more likely than not. I can’t put a number on it. I was raised in a Western scientific tradition where we don’t ever know the answer; we just collect data that make one answer more or less likely. The evidence has convinced me that it is certainly possible, and probably likely, that we survive death, but I can’t say that I am convinced. I think that is something the Buddha probably would approve of—not saying you are convinced of it.

The question of consciousness existing without a brain is interesting to me intellectually. But what really attracts me to this study of near-death experience is the way it does change people’s lives, making them more compassionate, more loving, less attached. Approaching this from a Western perspective, I want to try to take apart the near-death experience and see what it is about that experience that makes people change in those ways and how we can replicate that. You asked about the value of the Buddhist traditions in cultivating these mind states, and I think it is a very valuable thing for Western science to start to approach. It’s something that Western science hasn’t done a whole lot with, and I think that is the value of programs, like
Geshe Negi’s, that make bridges between the Buddhist tradition and the Western scientific approach. I think that’s the way that Western science needs to go.
Limits of Knowledge and Knowing

The Boundaries of Science

Paul Doherty, Ph.D.

Science is a process for finding out about the Universe. A core part of science is based on the results of repeatable experiments. In order to perform an experiment an observer must be able to detect the results of that experiment. Over the history of science, scientists have encountered limits to what they can observe, these limits are the boundaries of experiment-based science. Three of the current limits to science can be seen if we plot objects in the Universe on a graph of mass \( M \) versus radius \( R \), an MR diagram. On this diagram we can plot every physical object that we know. These objects appear within three boundaries, which form a triangle, the edges of this triangle prevent us from acquiring complete information about what is beyond the edge. The edges are: the edge of the visible Universe, the event horizon of a black hole, and the Compton wavelength of an object. These boundaries of experimental science illustrate that science defines itself as incapable of answering a wide variety of questions about the Universe. Questions outside of these three boundaries, and other boundaries as well, must be dealt with by theoretical science or other knowledge-seeking philosophies.

Paul Doherty: I’d like to thank the monastic graduates—the geshes—for being my students and teaching me for the last two weeks.
Science has boundaries and today I’m going to take you on a tour of a few of them. There are many boundaries to science and it’s important to realize that there are things beyond those boundaries. The boundaries I’m talking about are the boundaries of physical science. I’ll give you an idea of why they are the boundaries.

Science began in the late 1600s about the time the Royal Society was formed. There was lots of knowledge about the world before then; some of it right, and some of it wrong. How do you find the true from the false? The Royal Society’s motto, in Latin, says, *Nullius in verba* or “don’t take anyone’s word for it,” including mine. Do an experiment. Any time you see a scientist and they say anything, you can always ask them, “How do you know that?” The answer to that question has to be an experiment.
To do an experiment, you must get the results. Out there in the Universe, there are barriers to information flow: we don’t see information flowing across the edge of the Universe, we don’t see information flowing out of black holes, and there are quantum mechanical limits to information. The history of science has been the history of pushing back those boundaries, and those are the boundaries we have today in the physical sciences. But there are more boundaries beyond that. I look forward to us pushing back some of those boundaries.

You can’t get information beyond the edge of the Universe, you can’t get information out of a black hole—you can dump it in, but you can’t get it out—you can’t get information smaller than the quantum limit. These are not perfect boundaries. Scientists now wonder if there are other universes out there beyond ours. We might learn about them if they expand and we begin to see them appearing in our Universe. It hasn’t happened yet. The boundary of the black hole, I can’t get information out, but there are some things that leak out, we’ll find out what those are later. Consider the entire Universe known to physics. On the bottom axis of this graph is the radius in meters of an object, and the center little tick-mark there is ten to the zero; that’s a scientist’s way of writing one meter. Going up from there is a man, one meter in size. On the left is a man’s mass, or about 100 kilograms. A man’s length, about one meter, and his mass about 100 kilograms. And a mountain is 1,000 meters, or an increase in size by a factor of one thousand.

The Earth is an even bigger jump. This Earth is 10 million me’s lined up side to side to get from the middle to the edge, and the mass is one with twenty four zeros, it’s a huge mass. It’s a tremendous jump. It’s this beautiful blue sphere out in space. There are other planets: Jupiter is 1,000 times the volume of the Earth, 11 Earths across, 300 Earth masses. The slide shows a giant storm that Galileo saw in his telescope 400 years ago, still running. Now there’s a storm! That’s the biggest planet in our solar system. Here is the smallest dwarf planet; we have dwarf planets. It would be nice if we discovered two more,
then there would be seven of them. One of the dwarf planets is called Vesta. We just went there. We have a spacecraft orbiting Vesta taking pictures. Vesta is nice and spherical; its gravity has pulled it into a sphere. So, there are small planets, there are big planets, we are now finding planets beyond our solar system. When you look out at the stars, within a hundred light years of Earth, as of this month there are 687 planets going around 474 stars. The smallest we’ve found so far is 1.6 times the mass of the Earth, and the biggest is 31 times the mass of Jupiter. That’s the range of all the planets, and so if I look on this graph, you can see Earth and all the planets on a little straight line up there.

We are moving our way towards black holes and the edge of the Universe. But bigger than the planets is the Sun, and the Sun is 700,000 kilometers in radius and two times ten with thirty zeros kilograms, and yet our Sun is just a middle-sized star. There are bigger stars, there are smaller stars, and as stars age there’s a lot of mass there, there’s a lot of gravity pulling it in. Inside the Sun, there is nuclear fusion heating up the atoms, making them dance around, pushing out on the gas, keeping it from going out. If you look at the very top line of this diagram, you will see the Sun, an average star, lives its life—billions of years—swells up as the nuclear combustion comes towards the surface, blows off matter, and then what’s left behind is the mass of the Sun in the size of the Earth. A thing called a White Dwarf. And then, if the star is more massive than the Sun, gravity really wins out. It blows up into a Red Giant, it explodes into something called a Super Nova, and then it collapses into one of two things: if it’s under three times the mass of the Sun, it becomes a Neutron star, and if it’s more than three solar masses, it becomes a black hole. Black holes are where I’m going to go with this talk. You can see that a White Dwarf is the size of the Earth and the mass of the Sun. The Neutron star is several times the mass of the Sun and the size of Delhi. The mass of the Sun fitting into the size of Delhi, that’s really hard. And the black hole is more than three times the mass of the Sun and about thirty kilometers across.
On the graph, there is a blue line up the middle, and that blue line connects everything you know from every day and a little bit beyond every day. Everything on that line is made of atoms. Richard Feynman said if all scientific knowledge was going to be erased from the world, and he had one sentence to convey/save, that sentence would be, “all the world is made of atoms, small particles, continuously in motion.” He thought that would be the best start. And this blue line connects everything that’s made of atoms that are touching. Stars are made of atoms that are touching, they’ve lost some electrons, but they are mostly atoms, likewise planets, mountains, men, and cells, and then the atom itself. But now you’ll notice some things off that line. Up on top of the stars, to the left, you see the White Dwarf with the mass of the star, but smaller. And to the left of that, there’s the Neutron star, with the mass of a star, but smaller still. And to the left of that is a black line. You see these three lines on here, this triangle of lines, that upper left line that goes up from left to right, that’s the line that tells you when any given mass turns into a black hole. If I started at man, and I go left to that line at ten to the minus twenty-three meters, that’s almost a billion times smaller than an atom. If you squeezed me down that small, I would become a black hole. We don’t know of any black holes that size, but that line shows me where they would occur. The black holes we know of are just to the left of that Neutron star and up the line a bit.

We don’t have any pictures of black holes. They’re hard to photograph. For one, they’re black. Two, they’re surrounded by bright glowing matter, which shields them. A black hole has a sharp boundary around it. The gravity of the black hole is so great that it bends light; when light comes around the black hole, it bends. In fact, when light goes by any planet or star, it gets bent. The black hole just happens to be very small, very massive, and it bends light a lot. At the center of our galaxy, which we will see shortly, there is a black hole. It’s a super massive black hole, 4 million solar masses. It’s a gigantic black hole. And this is an image taken through a telescope and the arrows here show you are pointing to the middle of the galaxy; you cannot see the
black hole. How do we know it’s there if we can’t see it? The nearby stars have been photographed for over a decade, and we can see them orbiting nothingness in space. There must be something there pulling on them with gravity, so we know that the black hole is there.

We can calculate the radius of a black hole. The gravity becomes so strong that light shot upward from the surface of the black hole cannot escape. If I shoot light up from the Earth, it escapes. If I throw a spacecraft out of the Earth at escape velocity, it escapes. Newton was misquoted saying, “What goes up must come down.” It’s really, what goes up at less than escape velocity must come down, but even light cannot escape a black hole. John Wheeler said of black holes, “Black holes have no hair.” It reminds me of monks, but what he meant is that information does not leak out of the black hole. We can only know its mass by dropping objects into it and watching how they fall. We can know their electric charge, and we can know if they are spinning or not, their angular momentum, because as they spin they rotate the vacuum of space around them. But information cannot get out of that black hole. I can drop in, crossing the event horizon, but then there’s no trace except for my mass, my charge, my spin left behind. When you hear scientists talking about the inside of a black hole, you have to realize that it’s theory, and theory is great, it helps us, it guides us to where to do experiments, but it’s not experimental science.

Above the line on the top left of the graph you see the words, “realm of the black holes.” Now, let’s go to the edge of the Universe. If you go out at night, on a clear night, you might see a bright band in the sky, that’s the Milky Way. That bright band we now know is stars, and glowing gas, and dust. And dust gets in the way of creating a black band. The indigenous people in South America make their constellations out of the black regions of the Milky Way. They use the solid black in the Milky Way to make their shapes and figures, whereas European traditions connect the dots from star to star. By looking at infrared light coming from the Milky Way, we see that we are out in the suburbs of the galaxy. We’re out on the rim, looking in at our galaxy.
As we look out to the galaxy and beyond there’s an important rule of physics; looking out in space is looking back in time. When I look at Geshe Nyima, it takes ten nanoseconds for the light to get to me from Geshe Nyima. Ten nanoseconds. He could do anything in that ten nanoseconds, that’s 10 billionths of a second, a very short time indeed. But you can go out and look at the Moon and you see it where it was one and a half seconds ago. You don’t see the Moon where it is; you see it where it was. And when you look at the Sun, you see it where it would have been eight minutes ago. It’s moved. The light takes time to get to you. This gets really exciting when you look at the stars. When you look at the nearest star, other than the Sun, you see it where it was, and as it was, four years ago. It could have exploded and you wouldn’t know for four years. Light from the Andromeda Nebula takes two million years to get here, so you’re seeing it way in the past.

If you were to look with a radio telescope at radio waves, you can actually look back to the beginning of time. You can look back and see the light that left the Big Bang, 13.7 billion years ago. Galaxies formed 13 billion years ago, and we know this is only 700 million years after the Big Bang, so the galaxies had time to form in 700 million years. On the right hand edge is the edge of the Universe, that vertical line on the right, a constant radius, 13.7 billion light years. You can see the dot at the top there for mass and size of the Universe, and it was discovered in New Jersey, in 1965, by these two gentlemen: Arno Penzius and Bob Wilson. Their radio telescope was used to hear the radio song from the Big Bang.

The fact that the Big Bang started out with hot and cold places created the Universe we see today. In fact, this pattern also tells us that the world we know—those atoms that I was happy and so proud to tell you about—only makes up 4% of the Universe. This pattern just hit scientists and told them, “You thought you understood the Universe?” Twenty-three percent of the Universe is something called dark matter, and we don’t know what it is. We know it exerts gravity and attracts things. We can find out places where it exists, and we are on a tremendous search right now to find it. What could it be?
But even worse than that, 73% of the energy of the Universe is in the form of something we call dark energy, and that's gravitationally repulsive, it pushes things apart, and we don't have the slightest idea how to look for that.

What I’m telling you is that scientists have a really good idea about 4% of the Universe; the other 96% we’re looking into. I think people have the wrong idea about science. They think that we know everything, and we don’t, we really don’t. The radius of the visible Universe, out to that edge that you saw, is 13.7 billion light years, and as Chris mentioned the other day, you can actually look beyond that wall. That wall is a wall to light, you can’t see beyond it with light, but if you look beyond it with particles, you can actually see the particles that come and have been created back to one tenth of one billionth of a second after the Big Bang. Well, the Universe expands. What’s it expanding into? Nothing. It turns out that you may have this picture of the galaxies rushing apart from each other, but in fact, the modern scientific view is that the galaxies are not moving through space; the galaxies have new space appearing between them and us. New spaces, a new vacuum is appearing, that’s the modern view of the expansion of the Universe.

In fact, here’s a view that’s likely to be disturbing. If you look at the star you see it in the past, remember? You see stars in the past, and in the past the Universe was smaller. If you look where there’s no star, when you look in that direction, you see the light that came along that curved path from the Big Bang. If you look out in that direction, you’ll see the birth of the Universe. And what is it? It’s a point. In fact, as I look at all places in the blackness of space, I see a point, in the four dimensions of space-time we are surrounded by a point. A very strange idea indeed, and that’s why it’s hard to see beyond the edge, because beyond the edge is the inside of a point. That hurts your brain. We are surrounded by a point beyond the edge of the visible Universe.
There's one more line left, and that's the bottom left line. That bottom left line is the limit of quantum knowledge. We've discovered that all particles behave as waves. In 1801, Thomas Young did the two-slit experiment, which I'll tell you about. Richard Feynman again said, “All of quantum mechanics is contained in the two-slit experiment. Unfortunately, no one understands the two-slit experiment,” and we heard that mentioned earlier today. It's not esoteric; you can do it. If you put a laser through a slit and have it pass through two slits, the light makes a pattern on the wall. If you open a second slit, which Thomas Young did in 1801, a different pattern appears, blackness appears. What he discovered was light plus light equals dark. Light from one slit, when you add a second slit, created darkness in some places. In fact, even if you shoot one particle of light—light is a particle and a wave—if you shoot one particle of light at a time through the two slits, it passes through both slits in some way and makes the pattern by itself. You only need one particle at a time to do this. This picture shows you a photograph of the two slits with light going through it, one particle at a time. We've done the two-slit experiment with light, photons, electrons, neutrons, atoms and bucky balls, which are groups of sixty atoms.

This means that all of those things that you may think of as particles are also waves, and they interfere with themselves. And because they are waves, they have a wavelength, and things that are going faster have shorter wavelengths. The shortest wavelength possible is called the Compton wavelength. It's reached as particles approach the speed of light. You cannot ask questions about the structure of particles that are smaller than that Compton wavelength. There's a limit to the size, and the questions you can ask. That is the quantum limit, and when you hear scientists talking about things that are smaller than the quantum limit, they are pushing the edges of science. The theory can go there, and then the experiment must follow. They are doing it; they're pushing that edge all the time.

There are other limits to science. What is consciousness? What is mind? There's the speed of light limit. And you might have read
recently that scientists may have observed neutrinos, a particle going faster than light, and everyone got really excited, because whenever you approach one of these limits we get really excited about pushing beyond the limit. Other scientists will have to repeat that experiment, because we don’t take anyone’s word for it. We must do the experiment. So if you hear scientists talking about what’s inside a black hole, what’s beyond the edge of the Universe, what’s smaller than one wavelength of a particle, of particles that go faster than light, realize that they are pushing the edges of experimental science. That’s a good thing. That’s what scientists have always done, and scientists themselves have to remember that there are things beyond the simple world of physics that we must investigate.

Is this the end of science, or the beginning of the new science? I hope it’s the beginning of the new science. To show the kinds of things that might be at the beginning of science, I now point you to the places on the diagram where the lines come together. At the very top, there’s a black hole with the radius of the Universe. You will notice that the Universe we know, that black dot that I labeled Universe, shows that we are not in a black hole, the Universe is not a black hole. That’s a nice thing to know. On the left where the two lines meet, that’s a quantum black hole, a black hole that is a wave, and that black hole is right at the edge of science. The theoreticians are really working at that. You might have heard of it, it’s called String Theory. The upper left line, the black hole line, is described by a wonderful physics theory called General Relativity, which has never been shown to be wrong. The bottom left line is Quantum Electrodynamics, a wonderful theory, never been shown to be wrong within the limits of measurement. But where they meet, they disagree. We have these two completely correct theories that have been tested, and they come together and they disagree. We know there’s great science there, and the theorists are poking at that science. The experimentalists have to catch up with it. At the bottom is a mass, a tiny mass, which has only one wavelength that fits in the entire Universe. That’s so far beyond anything we’ve explored.
There’s so much more to look at in science. So, I leave you with the idea that science does have boundaries, and I urge you to go look for them.

Discussion

Chris Impey (Moderator): That was great. We have a short time for questions, so I’ll invite the geishes to start.

Monastic Graduate: Thank you. I only have one month’s background in science so I don’t think I need to stress how fortunate I feel to be able to sit here with you and in front of you. I would also like to thank today’s speakers. They have both been very kind for taking the time to teach us, especially a novice like myself. I was going to speak in my native language, Tibetan, but some of my friends somehow convinced me I could pull this off in English. I’m not sure I can but I’m going to pretend that I’m not scared and you can pretend that I’m making sense! My first question is to Dr. Doherty: As a physicist, how would you connect the dots between cosmology and consciousness? Maybe you can present a different view than Rajesh did yesterday.

Paul Doherty: The fact that the human consciousness can conceive of this Universe, can look out at the Universe, and come up with some simple ideas that begin to describe it, and not its entirety but just a hint of it, can create the idea of the Universe, requires the conscious to look out. There is a great story that in the early days astronomers looked at the planet Mars through a telescope, and on the planet Mars they saw canals. Schiaparelli wrote a paper in which he said, “I see canals on Mars.” As telescopes got better, the canals vanished. There were no canals, and it turned out the canals were created by the human eye and brain; the dark patches on Mars, these faint dark patches
seen through bad telescopes, the brain immediately made into lines. I believe it was Carl Sagan who said that the canals on Mars were the sign of conscious life. At first, we thought the conscious life was on Mars carving the canals, but in the end we know it was the conscious life on Earth creating them, the human mind seeing the canals that were not there.

**Monastic Graduate:** When we talk about the limits of knowledge, we are actually talking about whether our consciousness can know all the knowable things in the Universe. In Buddhism, there is an example in one of the mind-training texts, which says that if there is a land that is filled with thorns and you want to get rid of those thorns you can’t pick them one by one and throw them away. Rather than picking the thorns, you should wear metal boots so that you won’t be harmed by the thorns on the ground. This example is telling us that if you want to know all the knowable phenomena in the Universe, you better look inside yourself and try to refine your consciousness, or your mind, instead of trying to find phenomenon one by one. If you are able to refine your mind by removing the two obscurations, then you will know the whole physical world. Knowledge will appear to you without knowing. You don’t need to find knowledge one bit at a time.

In physics, we talk about the limits of knowledge and Dr. Doherty has given four examples, like the limits of the black hole and the horizon of the visible Universe. A question related to this concept is that if the event-horizon of the black hole is a limit to knowledge, what has the scientific community done to make this understandable to the general community? Second, because of scientific achievements we have made so much progress in areas like economic and material development. I feel that if we can direct these achievements towards the betterment of society or a more peaceful society, it would be more meaningful. What is your stance on this?

**Paul Doherty:** I like the idea of the steel boots stomping down the thorns of science, and in fact physical scientists are guilty of picking the points and bits of knowledge one at a time. But then we gather
them together and look at them as a whole and try to make rules and new ideas that encompass the whole Universe, like the law of conservation of energy, which we apply everywhere.

I’ll use that one right now to jump to the last point, because if you understand the law of conservation of energy then you will understand a lot about the power system that you use to power your homes; the gas and the electricity. If you understand that law, as science teachers should impart the understanding of that law, then people that come to you and promise you free energy or free energy for a price—which is what they tend to do—you will know whether they are lying or not.

It’s not just the science, it’s the science teaching that is needed; it’s taking the big ideas that we assemble from the small ideas and spreading it to people. Everyday some newspaper in the United States mentions the term “black hole.” It’s in common usage around the United States. I think we really are trying to bring these ideas to everyone, and there are people who specialize—science journalists—in bringing these ideas to the world. Indeed, my answer is “yes,” I agree with the points that you made, but scientists are not finished yet. Scientists still have things to learn, and that’s why we are here listening to these ideas from Buddhist monastics about looking at the world as a whole.
What can be said about the nature of the human mind, and about how mind is related to the physical properties of the brain and body? What can be said about the nature of physical reality, and about the structure of the observed Universe? How might consciousness and cosmology be related? Twenty-five years ago, His Holiness the Dalai Lama initiated a dialogue with Western scientists directed toward developing a deeper understanding of the most profound questions about existence. His Holiness drew attention to how the nature of mind and the nature of reality are central questions both in contemporary science and in Buddhist philosophy. And since the investigative approaches in Western science and in Buddhism are complementary, perhaps interesting new ideas might come from engaging in conversation. Indeed, fruitful new research directions in neuroscience and in psychology have come from this dialogue. Still, within the Western scientific tradition, an understanding of how mind is related to everything else in the physical Universe presents a deep puzzle. It may be that a paradigm shift in the metaphysical framework of Western science will be necessary to take us to the next phase of more deeply understanding the nature of mind and consciousness and how they relate to the rest of physical science. How might such a paradigm shift even be envisioned? We will consider the following
features: (1) that such a shift may include an experiential dimension present as a fundamental feature of reality, similar to the present status of space, time, and energy; (2) certain phenomena, considered anomalous within the current framework of Western science, may point the way toward a new framework; and (3) quantum mechanics, the very successful fundamental physical theory describing the behavior of matter and energy in Western science, may contain hints as to the nature of the new framework. This broad arena of discourse may be one in which the evolving Buddhism–science dialogue may forge powerful new collaborations.

David Presti: This is a tremendous honor. This is a really special moment in the evolution of this dialogue that His Holiness had the wisdom to suggest back in the 1980s that brings contemplatives and scientists together to discuss questions that are at the most basic level of appreciating who we are, what our mind is, and how we relate to the rest of the Universe. For 25 years there has been a very active dialogue, which has been institutionalized in the Mind and Life conferences that have involved His Holiness and various scientists over the years, but relatively few other monastics. It is an amazing thing that we are now, through educational programs such as Science for Monks and the Emory–Library collaboration, able to expand this dialogue to so many people in the Buddhist tradition. It is a tremendous thing, so many venerable monks and nuns being here, so this is a very special moment.

Many really powerful ideas have been put forward over the day and a half that we’ve been talking, and more will come. What I will say, though, will be my way of saying it. Sometimes different ways of hearing the same thing are valuable in appreciating the complexity of these problems.

The Andromeda Galaxy is the famous galaxy that is our nearest neighbor in the heavens. Some time back in the 1970s, there was a 10-minute documentary made called Powers of Ten. It tried to
illustrate, and it actually did a very good job of illustrating, in movie form, the scale about which Paul Doherty was just talking, from the very largest things like the size of the Universe all the way down to sub-atomic particles, $10^{42}$ orders of magnitudes or so. It illustrates a very interesting thing about the theme of our conference, “Cosmology and Consciousness.”

You asked a few minutes ago about the connection between cosmology and consciousness, and what we can say about it. We can certainly say what Paul said: that everything that we know about anything at all is coming through our consciousness, it’s coming through our awareness, and any theories we have about the physics of the Universe have been created by our brains and minds. There is that connection between cosmology and consciousness. In fact, it was something like that connection that first got me interested in this whole subject. When I was an undergraduate student, I was studying physics and general relativity and I began to wonder how it was that Einstein could sit in his room and invent a theory that describes the whole of the Universe. How was it possible for humans to do that? That’s definitely a connection between cosmology and consciousness. I think another connection, which we don’t know about yet, is whether there is some profound connection between the inner reality of our mind and the outer reality of what we call physical reality, including the large-scale nature of the Universe. How these are connected is still very much beyond the limit of our knowledge. I believe that perhaps the next big revolution in science will somehow shed some light on that. That would be very exciting. There is no reason why that might not be the case, and what we are doing here speaks to that possibility.

The word “science” actually comes from the same word as “knowing,” and so science is a way of asking questions about our world of experience and designing ways to test, to gather data, to do experiments, and then to form theories to try to explain the organization of things. It’s a way of gathering information, organizing it, and expanding our framework of understanding. It’s a very, very general term. It applies to understanding our outer world, and there
is every reason to believe that it can also apply to understanding our inner world; asking questions, gathering data, developing theories, and so forth. Western science, which developed out of the traditions of Europe and America, has now spread to the entire world, it’s the way in which science is conceptualized across the entire world.

It is grounded in astronomy. It began with trying to understand the movement of the planets, the movement of the Moon and the Sun and the Earth. These guys here on the screen are sort of the acknowledged founders of Western science: Copernicus, Galileo, Descartes, Newton. Descartes was actually one of the first people to suggest that Western science works well in trying to understand our outer world, but that our inner world may be more complicated. Newton took this to the next step. He explicitly said, “I can’t deal with experience. I don’t know how to account for the redness of red. What I can talk about is the mathematical properties of light.” And he invented an entire mathematics, and physics, to do that. Newton also was very good at making connections between the movements of the planets, the Sun, and the Moon, and what was happening here on Earth, like an apple falling. He also showed that there were universal regularities and laws that could describe these things.

This has become an extremely successful framework, which has been expanded by people like Maxwell and Einstein into the 20th century. It provided, by the beginning of the 20th century, an awesomely successful framework for describing our physical world. In the 19th century, this began to be applied to biological things too. Darwin was really the main mover of a revolutionary way of looking at living organisms, and as our technologies of observations got better and better in the 20th century we could examine cells and later molecules and so forth. We were able to describe the cellular and molecular chemical make-up of living organisms in a very detailed way that was completely continuous with the way physics and astronomy described the larger-scale structure of the Universe. If we bring this to the present day, we now have an awesomely beautiful and stunningly powerful framework of understanding, which we call physical
science or bio-physical science, that describes everything from the furthest reaches of the observable Universe all the way down to the microscopic layers and the makeup of cells, the makeup of organisms, the structure of DNA, the structure and functioning of the brain.

This is all beautifully articulated in this framework that we can call Western physical science, and again we call this Western physical science but everybody does it. It has led to all of the wonderful things that we like to play with, like computers and mobile phones. If you have a mobile phone, you are a beneficiary of this way of looking at the Universe. It really works. Then to introduce a few more terms, these ideas of physicalism, or physical materialism, are other ways to describe the framework. I keep using this term framework. Science, as I said, is just looking for knowledge, gathering data, and doing experiments. Right now it is within a particular framework that can be called physicalism, or physical materialism, which is basically the idea that everything is made of matter. More technically stated, it is the idea that everything is describable in terms of mathematical quantities attached to coordinates in space-time. That's the way everything is described, including what's going on in the brain. We don't usually talk about it in exactly that language, but if you really traced it you could.

This has given rise to a hierarchy or connection between different fields of science, with physics often considered the most fundamental because it describes things at the very microscopic levels of interaction. The behavior of atoms can be described by physics, but when you get a larger number of atoms coming together to form molecules, a new kind of area of scientific description emerges that we call chemistry. And then, if some of these atoms come together, if molecules come into particular stable configurations and form entities that can maintain their stability over time by consuming energy and replicating themselves, we call that life, and that's studied by biology. If we look at a particular piece of biology that is related to how the body and brain are working to produce behavior and analyze sensory
information, that area of science is called neuroscience.

What’s missing from this is mentality or mental experience, or mind, or consciousness, or whatever we wish to call it, that experiential piece. Another thing that I don’t want to spend a lot of time on right now is the different ways that those words are used, because in Western science there really is a very limited history of being interested in describing mind, consciousness, mental experience, and so forth. In fact, it’s been almost explicitly excluded, beginning with Descartes and Newton and continuing until the end of the 20th century. The focus was always on the external word and what could be described by mathematical relations. Western scientific language is impoverished in the way those terms are used when compared to Buddhist philosophy, which has a much more elaborate and nuanced appreciation of those terms. I will use the terms loosely, and hopefully you will forgive me for that right now and we can come back and repair those things later.

There’s no place in this particular hierarchy for mind as it’s conceived of right now, which leads to what has been called the “mind/body problem” in Western science. That is, how is this mind thing, this mental experience, this consciousness, related to the processes that are happening in our brain and body that we can measure by our technologies and scientific analyses? I am not being exclusive to the brain here. We know that the brain is very important for the mind because if you damage the brain you get really powerful and specific damage to mental function, but there’s a lot of stuff going on in the body that is also related to our mental experience. How they are connected is the question. If you put this question to most neuroscientists, they’d probably say, as most philosophers do, that we have to somehow identify these subjective internal mental processes with their objective, physically describable neural correlates. By neural correlates I mean what can we measure that’s happening in the brain when this mental experience is also happening? If we’re feeling happy, what kind of brain activity and body activity is related to that? If we’re feeling sad, what kind of brain activity or body activity is related to that? Many folk, even though they don’t know how at this point, will
simply identify that with the mental experience, but nobody knows how this happens. Nobody can answer that. They simply believe that because this framework of scientific explanation has been so successful for so many centuries, it will eventually be successful here too. We just need to study the brain more, build better fMRI machines, do more experiments with a greater diversity of people, and eventually an explanation of how these things are connected will somehow emerge from body and brain physiology. And maybe that will happen, that is certainly one possibility, even though nobody exactly knows how.

One hundred years ago or so, one of the great pioneers in American experimental psychology, a fellow named William James, was very interested in the study of the mind and how the mind is connected to the body and the brain. He actually proposed, more than a hundred years ago, that one way for the science of mind to move forward would be to develop a rigorously empirical introspective way of making observations and doing experiments. This would be somewhat like the contemplative traditions have a long history of doing, but James seemed not to have a lot of knowledge about those traditions at that point. He tried to get things like this going in American experimental psychology and it went absolutely nowhere. In fact, it got completely bulldozed by the movement that Bruce Greyson mentioned this morning, behaviorism, which stated that rather than study the mind on its own terms of subjective internal experience, we should just study the brain and the body because we’re better at doing that.

But James also said something else, which was very, very profound. In a piece that he wrote back in 1895, he pointed out that all these ways of observing matter are based on the physical science of the time, and that the assumptions of those natural sciences are provisional and revisable. He said this in 1895. It was remarkable because in 1895 many physicists thought that physics was a closed book and that everything interesting had been discovered; that measuring things with more precision would be the future of physics. No group of people were ever more wrong, because just a few years later, in 1900, Max
Plank and Heisenberg were to plant the seeds of what was to become quantum theory. They didn’t have quantum theory, they just had the notion that quanta of energy would lead to an enormous revolution of physics, a true revolution. By revolution, I mean that before and after these events people viewed the world in very different ways.

The world of physics was very different before and after the development of quantum theory in the 1920s by Heisenberg, Schrödinger, and Bohr. Quantum theory rose out of a necessity to describe experimental facts that were gathered in the study of atoms, but that were completely inexplicable in terms of the physics that had been developed by Newton, Maxwell, and Einstein up to the 20th century. It is, as Paul just mentioned, very much illustrated in the double slit experiment, which I won’t dwell on. Just to point it out though, this slide actually does show pictures of single photons of light hitting a photographic film. You can pick out the dots one at a time, and it shows that over time they build up, illustrating an interference pattern that demonstrates that these single particles of light have somehow gone through both slits and interfered with themselves. Now I’m not going to dwell on that, except to say that this was the first hint that the way in which questions are asked in fundamental physics had an impact on the finding of the experiment. But it goes beyond that; recent experiments have demonstrated that there is a way in which the very essence of physical reality is not definable until the question is asked, which is a very profound statement. I don’t have a deep enough understanding of this, and I’ve been struggling with it for years now, so if you don’t fully understand what I say when I say that, don’t worry.

The bottom line with quantum mechanics is that there is a very strong suggestion that there’s something about the interaction with the physical, what we call the external physical world, that is very much intertwined in some way with our own mentality, our own decisions, our own consciousness, our own perceptions, and nobody has a clear answer to this. Many brilliant physicists, beginning with the founders and continuing to this day with many very prominent physicists, have thought about this and everyone agrees that this is a problem and no
one has a good answer to it.

The seeds are there for some very interesting stuff connecting mind and brain in some way. As was mentioned earlier, people like Bohr, Heisenberg and Schrödinger appreciated this. They also appreciated that they weren’t psychologists, they weren’t biologists, they weren’t neuroscientists, and they didn’t really know how to deal with consciousness. So they didn’t really go there. They simply said there is weird stuff happening here, and the equations still work and they allow us to make predictions, and maybe someday, somebody will do something with this. Maybe this is the day.

In summary, there are a number of pieces of data that support the need for an expanded explanatory framework to describe these things that relate to our minds or our consciousness. One is the simple inability to get some kind of experiential or conscious awareness out of brain physiology, out of the movement of atoms and molecules and so forth inside our brain. There is very powerful data, described by Bruce this morning, from near-death experiences and reincarnation studies—and of course you have many more examples of reincarnation stories—that is not explained by simply saying that consciousness is a product of our brain and body working in some way. Certainly our bodies and brains are very much a piece of the picture while we’re alive, but somehow there is more going on. It may be that there isn’t a simple way that is graspable by us yet, or ever, to explain reincarnation, but there may be interesting and weird things going on in the movement of characteristics of our consciousness across lifetimes. There are also things that we haven’t talked so much about, but for which there’s an enormous amount of scientific evidence. For example, data collected over more than a hundred years of careful experimentation demonstrating things like telepathic communication between people, or precognition; having some sense of things that are going to happen that haven’t happened yet. And, again, these are very common in the Buddhist tradition where people have precognitive dreams that will indicate that something is going to happen.
In the ancient traditions of India, including Buddhism, people talk about siddhis, or other special powers, that can come from long periods of practice, and which include things like precognitive and telepathic abilities. There is a lot of data, but none of it is taken seriously by Western science because there is no way that it can be explained in the framework that we have right now.

If you talk to the people who are really working at the frontiers of physics right now, folks that are involved in particle physics—the Large Hadron Collider on the border of France and Switzerland where they’re banging particles together in very high energy and trying to create new things—some are very confident that any day they’ll discover the Higgs–Boson and that would be the final proof that the “standard model,” which is a nice package or way of describing elementary particles that has been developed over the last 30 years, will be complete in some way. I have a standing bet with some of my physics colleagues that they won’t find the Higgs–Boson in the next three years in the Large Hadron Collider, and not finding it might be the most interesting thing. That would mean that there is something really missing in the way that we’re conceptualizing microscopic matter. There’s very interesting stuff at the frontiers of physics, way down there and in the other direction—there have been several allusions already to dark matter and dark energy which composes something like 95% of what we believe the energetic content of the Universe is—that may not be easily explicable.

It could be that there will be some completely new way of looking at the large-scale structure of the Universe that will come about before we understand these things. The day before I left for India, I was talking to one of my colleagues who is involved in an experiment to detect dark matter in some mine deep in South Dakota and he said, “You know, I don’t think we’re going to find anything. I think that what we will really contribute is that we will very carefully demonstrate, to the limits of experimental precision, that we can’t detect it.” That means that there’s something really missing in the way that we conceive of the Universe and we’re going to need to go
back and look at the structure of the Universe, which is very exciting. I actually believe that we are poised for a revolution in the mind sciences. The science of mind in Western science has not had any revolutions, like biology did with Darwin, or physics did with quantum mechanics and relativity and Copernicus and Newton. Mind science is really poised, and wouldn’t it be interesting if whatever the revolution in mind science is, somehow it also embraced things in cosmology and there was greater insight there? That’s a long shot, that’s a wild one, but wilder things could happen. That’s really what makes this dialogue super interesting, because the revolution is poised to happen. Perhaps a part of that would be a more deeply analytic examination of the mind, which many of you are experts at, and also the capacity to really think out of the box and to think in new ways about how to explain phenomena that may not be easily explicable from either of our perspectives. It may need some new synthesis, some completely new way of looking at things. Wouldn’t it be cool if it happened while we were around in this lifetime to see what it is?
**Discussion**

**Monastic Graduate:** My question is related to biology, so this is for David. In biology when we talk about the evolution of living beings, we talk about how life began in the ocean from single-cell organisms that became multi-cellular organisms, and then primates and finally human beings. The Buddhist traditions, however, have a different point of view. They say that when life started, it had more power, mentally and physically, which gradually reduced with time. And when we talk about the physical world that we live in, we talk about how the wind element was generated first, and then the other elements, such as fire, and gradually there’s also a process of how this physical world came into being. My question is: When we talk about life on this Earth, and the physical substance that is embodied in our bodies, embodied in living beings, can we say that it comes from a different planet? Or did it come from Earth? I’m talking about the origin of that first cell. How did the first cell on this planet come into being?

**David Presti:** That’s an excellent question, and the excellence of that question really is highlighted by the fact that Western science does not have an answer. Many brilliant scientists have worked on that and are continuing to work on it. We do not have a story to explain the origin of life other than the conventional one, that with lots of time and lots of banging around, something will happen. It’s one of the reasons astrobiological research is so interesting, because if you try to look for life in other places that either look the same or look different, there is value in addressing this question. Some scientists of prominence, including people like Francis Crick, who was the first to discover the structure of DNA, the co-discoverer of the structure of DNA, have suggested that life on Earth actually did come from other places in the Universe and maybe landed billions of years ago as some kind of spore or something and then evolved here. It’s a wonderful question for which we don’t know the answer.
Chris Impey (Moderator): The idea that life travels between two worlds is called panspermia, and it’s a 150-year-old idea in science. Astrophysicists and planetary scientists have investigated it and taken it seriously, and the answer at the moment seems to be that transport of potentially living organisms inside rocks is quite possible within the Solar System. In fact, the conveyor belt, the inefficient transport system in the Solar System, works quite well from Mars to the Earth, because Mars has weaker gravity and less atmosphere, and the Earth is closer to the Sun. It’s less efficient going the other way. Provocatively, since we know that Mars was almost certainly habitable 3 or 4 billion years ago, it is distinctly possible, but very hard to prove, that life on Earth came from Mars. There are possibilities of moving life within a Solar System.

This question of life traveling between stars has also been investigated a lot in the last decade, and it turns out that there are two issues when travelling on a rock. One, can the rock be ejected from the system, and two, does a rock take so long to travel that a microbe could survive? The answer to the second question is that microbes have been resuscitated after being dormant for 15 million years, although some consider that work controversial, and that’s about the time it would take to travel between near star systems. In principle, therefore, a dormant microbe could survive the journey, but the probability of a rock being ejected from a planet and landing on a moon or a planet of another star system turns out to be infinitesimally small. Astronomical calculations suggest that life being transported between star systems is very, very unlikely, and of course if life originated elsewhere, you have essentially just shoved the problem somewhere else. You haven’t explained its origin; you’ve just put it off to another place. You still have something to explain. That’s what the astronomers have figured out.

Actually, having talked for a couple of minutes myself, we’re a little over time. Let’s take our break until four and let’s thank David and Paul.
Panel Discussion

Monastic graduates on the panel:

Trulku Ngawang Kunga

Geshe Lobsang Dhondhen

Geshe Dawa Namgyal

Chris Impey (Moderator): Welcome everyone to the general panel discussion, where we can revisit any of the topics discussed today. I will start with a question for Paul, and for general discussion, on the limits of knowledge. There is an optimism, which may in scientists shade into hubris, which suggests that we can understand everything, but we ourselves may pose one limit to science. For instance, the master of string theory, Ed Witten, said that string theory was some 21st century physics that dropped in to the late 20th century, and we may not be smart enough to figure it out. Theories of mind may be in that category too. Do you think it’s possible that this is a problem we are just not smart enough to figure out?

Paul Doherty: I agree. At the end of the 19th century La Plosse found out that there was some very simple systems of planets going around stars that Newtonian mechanics—the ruling paradigm of science which held that things could behave like balls that fall under gravity and given their initial conditions you could predict their positions forever—could no longer explain. The interactions of three simple bodies could be so complicated that none of our mathematics could
predict beyond a certain period of time where these bodies would be. Even in the case of seemingly simple Newtonian mechanics, we know there are limits to our actual ability to predict the future. When we think of the emerging properties, like consciousness, they simply may not be understandable in our current framework of science and mathematics.

**Chris Impey (Moderator):** Here is a question from the audience for the *geshes*. In your view, what has been, or is, or will be, the benefit of the dialogue between Buddhism and science? What, from your perspective, is the point of it or the benefit of it?

**Monastic Graduate:** In Buddhism there are areas of study, like particles, that are not clearly discussed in the texts. Modern science has a much deeper understanding of these subjects. As Buddhists, we can take this knowledge from the scientific community and we can learn from the scientific community through engaging in dialogue. When we talk about the mind and the concept of consciousness, Buddhism offers detailed descriptions of different mental states and mental factors that provide insights for the scientific community. This dialogue provides scientists and Buddhists with the opportunity both to share and enhance their existing knowledge.

**Monastic Graduate:** Thank you for this question. Thanks to His Holiness the Dalai Lama we have increasing opportunities for dialogue and it’s important to know the objective. Whether you are a Buddhist or not, you need to be aware of developments in science because they have universal implications. For example, when scientists talk about neurons, they are actually talking about me. There are parallels here with Buddhism. We say, “He is not a bad guy, he is just angry.” In science, you might say, “He is not a bad guy, he just has different chemical reactions in his brain.” Or to detach yourself, you can say, “She’s not so beautiful, it’s just the way her skin cells are formed,” or, “His skin tone is not so bad, it’s just the way wavelengths deflect from it.” His Holiness is not suggesting that scientists accept a consciousness that is other than mind and brain. I think he wants
scientists to apply the knowledge of ancient traditions in their own fields to better understand how the brain works.

**Chris Impey** (Moderator): I think you are pointing out, as was very clear throughout the day, that the traditional scientific approach—which is not just Western science—has had some phenomenal successes, some things that have not succeeded at all, some things it has ignored. Maybe it is time to change that. What resonated with me this morning were the personal subjective states that are extremely clear to the individual. You don’t need Western scientists to explain your sense of being; you have your sense of being, right? Western science cannot validate it. A theory of mind cannot validate something that you experience, nor can it validate a sense of contemplation or meditation or the well-being that results from it. What western science clearly seems to need is new methodology for moving in the direction of being able to benefit from the awareness of Eastern religions, and other ways of thinking about being. I’m interested in other people’s thoughts on how we get beyond this third-person and first-person issue, or have new approaches.

**David Presti:** When I first read about William James a hundred years ago talking about how an empirical science of subjective observation was needed to move the science of mind forward, I resonated with that. I believe that it is really the methodology, which the contemplative traditions are so well versed in, that needs to be introduced into the domain of Western science.

Two years ago I was giving a talk to some of my colleagues in Psychology at UC Berkeley, and they said, “But what are you talking about? We already have the methodology to empirically describe subjective experiences. It’s called the Likert scale.” That’s a technical scale in experimental psychology that rates how you’re feeling on a scale of 1 to 10. That’s the level of sophistication of a lot of Western psychology and that doesn’t go very far toward understanding the deepest recesses and connections of consciousness.
To introduce this methodology of looking inward into Western science, and to incorporate that in some way with all the power and technology of Western science, is huge. This is something Western science is very good at. I referred briefly at the end of my talk to an “expanded metaphysical framework,” where experience is essentially given a similar status to that which we give space and time in our current metaphysical framework. This would mean that there would be some kind of fundamental acknowledgement that from the beginning one needed to have an experiential component to explain all of reality at the next level of incorporation. Now, that may not explain everything, but it is an interesting hypothesis. There were philosophers who introduced these ideas into Western science a hundred years ago, but they never really got very far. It’s an interesting hypothesis to entertain: if you adopt this expanded framework, does it take you in to some new places and provide some experimental tests and so forth?

**Chris Impey** (Moderator): This question is from the audience. It is almost a generalization of the previous question, and maybe it foreshadows the last panel discussion tomorrow, when we will talk about serving humanity. The question is: What is the purpose of doing never-ending research in science?

**David Presti**: It is a really interesting question, a profoundly interesting question, and an important question. We humans seem to be eminently curious beings, and it is something that may have evolved along with our greater cognitive capacities to help us get along in a complicated world. If you take the standard perspective in biological evolution, our brains and our mental capacities have developed over evolutionary time to facilitate our survival in this complex environment. Part of that has involved being adventurous and curious about exploring new places to live and sources of food and new ways to survive and so forth. In some sense our intellectual curiosity about all of this is part of that evolutionary tradition. We do it because we are curious beings, and for me personally that is part of the motivation. I think it is a fascinating challenge to address this. The most interesting question that I can think of asking is, “Who am I and how do I know what I
know, and how do I fit in to the rest of reality?”

An even bigger motivation for me is that the kinds of things that we are discovering in this endeavor are allowing us to develop a greater appreciation of how interconnected everything is. Even if we just think about what’s already happening in conventional Western science, we appreciate more and more deeply how interconnected everything on planet Earth is: all the environmental impacts that we have, the biological processes, with the geology and the atmosphere and the weather, and this is a tremendously important lesson.

When it comes to human consciousness, I believe that the results of this kind of investigation will lead us to a place of greater appreciation for how interconnected we all are as humans and how interconnected all of life is, and that will foster more compassion and improved ethics in the way that we conduct our lives. It can’t help but have the side effect of increasing our appreciation of more deep connections.

Paul Doherty: I agree. Science is useful and changes our lives. I would like to add one more point. For me, to find out something that nobody has found out before is just plain fun. It’s good to have the joy in your life of discovering things, and it’s also a joy to share it with people, to be a teacher, to share what you have discovered. The sciences provide this double opportunity to bring joy to my life and to many others I am sure.

Monastic Graduate: This question is for Paul and it is related to the limits of knowledge in science. When you talk about the limits of knowledge you talk about the event-horizons of the black holes, and about fundamental particles, such as quarks at the quantum level. When you talk about quarks, you talk about a specific wavelength, or the smallest possible wavelength beyond which you cannot go deeper or smaller. When you talk about those wavelengths, do you mean that this wavelength is a property of that particle or quark, or that the wavelength itself is the quark? And do quarks have colors, or maybe
shapes?

**Paul Doherty:** David concluded with a very nice slide that showed all the particles of the standard model in physics, and one of those is called a quark. All particles are wave-like and particle-like, and those words sound like common words, but we scientists layer some other meanings onto those terms. What a scientist means by a quark being a particle, or an electron being a particle, or a photon being a particle, is that its energy is created all at once, all or nothing at all, and is destroyed all or nothing at all. It’s a unit. It comes as a whole. Yet, as we calculate where it’s transmitted and where it originates and where it’s absorbed—the path in-between—we have to use its wave-like nature to calculate.

I think the answer is that the quark, or the particle, is both wave and particle, always created and destroyed as a particle, and it travels as a wave. There are properties to this particle, other properties like its mass, its energy, its electric charge, and there are some other properties that we would attribute to waves, and we might have to name them. Quarks, which are the particles that might make up the protons in a nucleus, have this other property, and it has three possible values. Electric charge has two values. Benjamin Franklin picked out the names for the electron charges: he called them plus and minus to remind us of the two properties of positive and negative numbers. The scientists, when faced with picking out the names for three properties for quarks, used this metaphor of color because you can make the largest number of colors by adding three primary colors of light: red, green and blue. So we chose those as the names for the quarks, but they have nothing to do with the actual colors that your eye can see. It’s just a metaphor that helps scientists to remember the zoo of particles.

**Monastic Graduate:** I have two questions. The first question is related to the limits of knowledge and paradigm shifts in science. When we talk about a paradigm shift in science, we feel that a paradigm shift is necessary when we face some challenges or problems, and thus
limits in the scientific field. When we talk about consciousness and non-material phenomenon, have scientists envisioned a paradigm or a scientific framework in which you can actually talk about consciousness and non-material phenomenon?

The second question is about neurotransmitters. After listening to the science teachers in the past month, and especially the neuroscience teacher, it seems that whatever we think or whatever we see, all consciousness or perceptions, are due to neurotransmitters or chemicals that are related to our thoughts and dreams. If this is the case, when we talk about the idea of self, or the theory of the self, is this self also related to a neurotransmitter? Is there a specific chemical substance or a neurotransmitter that is responsible for the idea of self? If this is the case, that neurotransmitter only exists in the brain, and because of that the self can only exist in the head, above the shoulder. In Buddhism, we think of the self as the whole body. What is your take on this?

Chris Impey (Moderator): As to the first question, the answer is no. There is no theoretical framework in physical science that is suitable for addressing the phenomenon that we’ve been talking about. Unfortunately, the successes of physical theory result from a paradigm that involves interchangeable mass and energy and four fundamental forces. The mechanisms that relate those fundamental forces into a unified theory are the subject of current research and speculation. It is conceivable that on the cutting edge of string theory other manifestations of these underlying elements of nature will manifest other mechanisms, other manifestations, but the theory is extremely immature and extremely difficult to advance. The problems physicists are trying to solve are very challenging. They are busy trying to reproduce standard quantum theory from a much more difficult basis in string theory. There is no sense in which they are in a position to address the issues we’ve been talking about. The simple answer to the question is that there is a theory deficit, but where there is deficit, there is opportunity.
The second question is a great one. Let me attach it to a question from the audience. Very simply phrased: What is the relationship between self and consciousness?

David Presti: To address the neurotransmitter question first—certainly neurotransmitters are the chemicals that the brain uses to send signals between cells. The brain is extremely complicated, with billions and billions and billions of nerve cells continuously signaling one another with dozens of different neurotransmitter chemicals, trillions of times every second probably. So it’s never possible to say that there is one neurotransmitter that’s responsible for a particular kind of perception, or emotion, or sense of self, or something like that. It’s always a complex symphony of many different things happening at the same time all over the brain and interacting in a highly complex way. However, the question of whether the sense of self is somehow mediated by the brain in some complex way involving many chemicals and many kinds of signaling is certainly one taken seriously by neuroscientists, and the conventional view would be that it is.

I keep saying brain, but any sophisticated neuroscientist would say that the brain is highly interconnected with the rest of the body, and we sometimes don’t know what’s going on in the brain, or what’s going on in the body. All of this is important, but there is some kind of neural integration of information that’s coming in from our sensory perception of the world around us, and how our body is moving in the world, and what we see, and what we touch, and what all of our muscles and joints are feeling, and the way we move, and out of that we build up some sense of our body, a perception of our body. You can do simple things to the brain, or you can do things to the body, to manipulate how we actually perceive our body. For example, if you do a simple experiment where you are tapping on somebody’s leg under the table and then tapping on the table with exactly the same rhythm as the leg, and you do that for a while, the person begins to identify with the table. How would you prove that? How would you do an experiment to measure that? Well, you can show that if you then take
a hammer and you get ready to hit the table, the person will react much more strongly if this tapping has produced this rhythmic connection with the table. It’s as if they have extended their body to become the table in some strange way. You can do more sophisticated versions of that test to show that our sense of what we consider to be our body is somewhat distorable.

There is no doubt that we have a map of our body in our brain that is corresponding to the way that we perceive touch and temperature changes in our body. There is no doubt that whatever our sense of self it is partly related to this body sense and how the body moves through the world. Whether that’s everything is certainly unknown, because that gets at the nature of our ability to be aware at all. That’s part of our sense of self, and since we don’t know what the basis of that is, it is not possible to say. There is something going on in the brain, but whether that’s the whole picture is still part of the mystery that remains to be explored.

**Monastic Graduate:** Scientists have given detailed explanations of many external phenomena, and also about how our neurons work, but something you said struck me. You said that everything we know comes from our sensory organs and mind? If that’s true, then how can we be sure of anything outside when we don’t really know much about the mind? In many cases, we know that what our mind projects is not really what’s outside, as in the case of color.

A second question is, when you talk about a paradigm shift, are you suggesting that scientists move towards the possibility of consciousness as something other than the brain? Or are you saying that scientists should use the Buddhist viewpoint to enlarge their understanding?

**David Presti:** Let me address the question about the paradigm shift first. It kind of follows on from what Chris was just saying, in the answer to the previous question, that we currently do not have a framework in the physical sciences to accommodate consciousness and that some
kind of expansion will be needed to do that. Maybe it will emerge if we can solve string theory and unify the forces and better understand the brain, maybe an experience will somehow be there, but I doubt it. My money is on us needing some kind of expanded framework. We don’t know what that is, and I think the contemplative perspective is a powerful way of expanding our understanding of what the mind is and what consciousness is, and that has valuable contributions to make. I don’t believe that that’s the paradigm shift. The paradigm shift is in a new direction that will come from an appreciation of what the contemplative traditions have to offer as inner telescopes, and what can be built on the foundation of a very powerful physical science by expanding it in someway. One possibility is that some kind of consciousness dimension, or component, or coordinate, or whatever we want to call it using mathematical metaphors, will need to be added in as somehow fundamental. I know one person who works in string theory, at the periphery of string theory, who has suggested that maybe some of the extra dimensions in string theory, those that the mathematical string theorists don’t yet understand, may provide some room for mentality. Maybe that will be a way of introducing some of these ideas into physical science. It’s kind of an interesting idea to explore.

Chris Impey (Moderator): Is that progress when we go from grass being in straws to grass being in extra dimensions?

David Presti: Yes, it is progress, though I doubt it’s that easy. But it’s interesting at least metaphorically. What was your other question?

Monastic Graduate: If everything that we know comes from the sensory organs and mind, how can we be sure of the outside world?

David Presti: I am not sure of the outside world. I think that we infer some kind of existence because in science we make these measurements, we agree on repeatability, and we build up this picture that has been reliably reproduced over centuries now. It gives at least a very powerful illusion that we know the Universe has a particular
structure to it. But what really is going on out there, I really don’t know.

**Chris Impey** (Moderator): To follow that up and to be very provocative, there is a perspective—if you take it seriously—that we are neither the first nor the most advanced intelligent civilization by far in the Universe.

Using only modest projections of our own capability, there could be a civilization that would be able to create synthetic creature like us computationally, without biology. That’s a materialist philosophy, but if you work out the numbers the computational power required to create the history of all human thought processes on Earth is within reach in a century. Once a civilization could do that, and it’s cheap for them to do, simulated entities like us are likely to outnumber the real biological ones. That’s one proposal that’s out there. A physicalized version of that includes the fact that we harness a ten-billionth of the energy of our star, and not very efficiently, using fossil fuel. If you are a more advanced civilization that can harness maybe one, even ten, percent of the energy of your star, you would have enough resources and energy to create a physical simulation whereby everything we experience and measure with our science methods is constructed. You only need to simulate the Universe with sufficient veracity to image the stars and the galaxies that we see with our telescopes. We’ve only just pin pricked the Earth, so you just need to make the physical Earth. It could be hollow, and the planets that we’ve just inspected just facsimiles, and we could just be all the play things of some civilization, and all this that we know and love is just a little playground that they created for us.

These are extreme positions, but philosophically they are worth pursuing because they actually are quite hard to negate.

Here is one for Paul. Is it possible to create a black hole on the Earth, or has anyone tried?
**Paul Doherty:** There was some worry that when we turned on the Large Hadron Collider it might create a black hole, which would then have enough—small though it might be—gravity to pull in adjacent atoms and become larger and more massive and eventually swallow the entire Earth. Luckily for us, that didn’t happen, and nor was it likely to happen, because nature has been conducting this experiment on Earth for the entire age of the Earth. For the last four and a half billion years, the projected age of the Earth, cosmic rays with very large energies have been hitting the Earth, striking the Earth with the same energy that the Large Hadron Collider would be producing, and they have yet to produce black holes that ate the Earth.

The black holes that we are beginning to have evidence of now are all more massive than three times the mass of the Sun, and they go up to billions of times the mass of the Sun. We’ve not seen any smaller black holes. Theoretically during the Big Bang some small black holes could be created, and so some day we may have one pass through and detect it, but we haven’t detected them yet. I would say the experimentalist answer is that we haven’t seen one yet, and the theoretician answer is possibly that they could have been made, but it takes a lot of energy, a lot more than the Earth has experienced in its whole history.

**Chris Impey** (Moderator): A lot of physics concepts have a mathematical basis and therefore might not even necessarily exist. I will comment briefly on this, and Paul may want to say more.

It’s interesting; the mathematical basis of physical theory is profound. You said that if Feynman were given one sentence to capture the most important thing about science, it’s that everything is made of atoms. In the same interview, he was asked what he would add if he could say a second thing, and what he said is a little more esoteric. It’s that symmetry principles underlie all the laws of physics, by which he meant that the conservation laws that are the basis of physics—conservation of energy, conservation of charge, the symmetry between matter and antimatter—all have a mathematical
basis. General Relativity, of course, has an extremely elegant and profound mathematical basis, just as all of our most successful physical theories are mathematical in essence, and that is a counterpoint to Paul’s correctly posited experimental basis for science. There is some Platonic thread in science that has a very mathematical and abstract basis. It’s an open question as to whether that mathematical basis could ever extend to consciousness in the brain. It’s why I feel a theoretical insight or revolution may be needed, rather than an experimental revolution.

In terms of the limits of knowledge and the nature of knowledge, do you have a comment?

Paul Doherty: It’s been said by other scientists, and I find this to be true, that it’s amazing that we can write things using the language of mathematics that describe the world in the following way: If I tell you what I am going to do, what the experiment I am going to conduct is, very often these mathematics predict what the outcome would be to within some error. It’s just amazing that mathematics actually works in physics.

Chris Impey (Moderator): Another question from the audience: According to Stephen Hawking, if the “unified theory” is successfully constructed then we can explain anything. Please explain. That’s interesting because the idea of the “unified theory of nature” is that you attain some very high degree of unification and simplicity in your mathematics, and in some ideal case you have one equation, or one set of equations, to explain everything. Of course, the irony is that if you ever attain that, you don’t explain everything because of the hierarchy problems I mentioned where your grandiose physical theory with that beautiful elegant basis is completely inadequate to explain the complex scales of $10^{12}$ neurons and their $10^{15}$ connections, or the $10^{28}$ atoms in the human body, and so on. The reductionist approach fails and the deterministic idea fails, so the mathematics doesn’t help you, unfortunately. Even if you get that wonderful so-called “theory of everything,” it’s not obvious that it helps you with the topics we
have been discussing.

**David Presti:** The “theory of everything” never includes consciousness in everything. The people who talk about the “theory of everything” are not interested in the mind, mentality, and consciousness. They tacitly believe that somehow that will pop out of understanding the brain better.

**Chris Impey** (Moderator): I have a request for the geshes. A comment was made this morning I think, and in passing, and after hearing Paul talk very elegantly about the triangular bounds on knowledge—the knowledge in mass and radius and the theories that underlie them—that in Buddhist philosophy and understanding there are ways in which you could know everything, that those boundaries are illusions of our approach. I would like to hear more about that.

**Monastic Graduate:** When we talk about the limits of knowledge in Tibetan, we talk about *shija*, which means “something that is knowable.” When we talk about phenomena that are knowable, or knowable by our consciousness, there are no limits to these knowable phenomena. I think from both a scientific perspective and a Buddhist perspective, knowable phenomena are unlimited. When we talk about the limits of knowledge we are talking about the ability of our consciousness.

When we talk about knowable phenomena in Buddhism, we differentiate between different types and different levels of phenomena. The most physical level is physical phenomena. From the Buddhist point of view, physical phenomena include *form realms* and *formless realms*. When we talk about knowledge in science, we only talk about physical realms; we don’t talk about *formless realms*. We only talk about human beings and sentient beings in the physical world that we know about. That’s why, from the Buddhist point of view, knowable phenomena is unlimited, and you cannot know everything and learn everything without changing your mind, opening this closed level of your mind. Instead of trying to know everything that is there in the Universe, our consciousness knows the knowable phenomena.
Instead of approaching the phenomena, you can change your mind or your consciousness.

From the Buddhist point of view, when we talk about our inability to know the known phenomena it is because of two obscurations, and if these defilements that block our mind are eliminated through mind training, then you reach a certain stretch where you know everything by itself.

**Monastic Graduate:** When, as a Buddhist, I talk about the limits of knowledge, it’s like I’m shooting in the dark with the nearest gun, because I don’t really know. Whatever is knowable is knowable through your perceptions, something that has arisen from your awareness. That is how we explain it. Rather than going outside and knowing everything, if you can come face to face with your awareness, you will know everything. If you want to know of something in Buddhism that could be considered outside the limits of knowledge, I think I can give you an example. In Buddhist epistemology, we have a definition for everything that we know, but we cannot give one definition that can define everything in detail. To define everything, every phenomenon, in detail is something that is beyond the Buddhist limits of knowledge.
In Buddhism there is an emphasis on the existence of the sixth sense—mind consciousness—and its functions regarding how the subject (the perceiver) engages the object (of perception). The perception of the five senses—sight, sound, smell, taste, and touch—all function through this mind consciousness, and without mind consciousness there would be no perception. My talk will explore Buddhist explanations of direct perception and the different kinds of perception. Some of these are seemingly incompatible with modern neuroscience. I will try to share my understanding of mind and mental factors and make some comparisons with some of the big ideas in neuroscience.

Geshe Nyima Tashi: First, I would like to thank you for not only giving me this opportunity but also for providing some of the monastics the opportunity to study science for more than a decade.

Before I proceed with my talk, I just want to share with you the challenge of definitions that is inherent in these exchanges. To me, one of the biggest problems in participating in these dialogues, as
Geshe Lobsang pointed out earlier, is the difficulty of terminology. For example, when we use the term “consciousness” in English, and she-pa in Tibetan, they often do not seem to carry the same meaning but they are used as exact translations. There are often times in English when we might say “unconscious,” but in these cases, the Tibetan notion of she-pa is still there, still relevant. We use different terms because it is difficult to find exact terms that map onto the definition of the other. In addition, we often interchange the terms “secondary mind” and “subtle mind” to imply the same meaning. This is a bit sloppy as they have distinct meanings in Tibetan.

When I was asked to give this presentation, I accepted immediately without asking what topic I should talk about. This is not because I think that I have a lot of information to share, but by being here I hope to encourage other monastics to participate in similar dialogues. Some of the other monks and myself have been active since joining the first science workshops, and we have tried to be trailblazers. It’s about giving you monastics an example, so that you too can be active in this role.

Today I will be talking about the sense organs, sensory perception, and the sixth sense, or mental perception. I am interested in understanding the sense organs, which are described in Buddhist texts, and finding out if there is common ground with modern science. I’m going to be speaking on the biological and Buddhist concepts of sense organs. Buddhist texts describe three conditions that are necessary for sensory perception, and I will describe these three conditions for each type of sensory experience. I’m not trying to create a consensus, but I am trying to find out if there are points of overlap—common ground where the different interpretations converge. I’ll talk about sense consciousness and the thalamus, which, from the neuroscientific point of view, plays a very important role in sensory perception. Then I will briefly speak on the object and subject, and finally on the existence of a sixth sense and some of the properties of the sixth sense.

In Buddhism we identify six senses. In general, I think all schools
of thought agree that there are five senses, but there may be some disagreement as to the existence of a sixth sense. When we talk about a sense, we often first investigate the sense organ itself. Scientists mainly speak about a receptor, not an organ. In Buddhism, we talk about the sense organs, but what is a sense organ? According to the Abhidharma, a sense organ is a very clear physical phenomenon that sensory consciousness is dependent upon. The Abhidharma addresses the sense organs of the eye, ear, nose, tongue, and body.

First, I will talk about the eye. There are very complicated structures in the eye, but I will mainly focus on the retina. In the retina there are many cells, such as photoreceptors, bipolar cells, and ganglia cells, etc. Light hits the eye, passes through the pupil, travels to the photoreceptors in the retina, then a chemical signal is sent back to the bipolar cells, which in turn sends the signal to the ganglia cells. The ganglia cells send the information to the optic nerves, and the optic nerves take the information to the lateral geniculate nucleus, and then to the visual cortex. From the visual cortex, information is sent to the different areas of the brain, the higher brain, or wherever the information needs to go because, according to Buddhism, it is a hidden phenomenon.

There is a subtle distinction I would like to make here. When Buddhist texts talk about the body organ or body sense organ, they are referring to the entire body. But from a neuroscientific understanding, even though our whole body is covered by sensory receptors, the body itself is not a sensory receptor. In Buddhist texts, the sense organs are described as hidden phenomena. We cannot see the rod or cone receptor with the naked eye, but scientists see it by magnifying it thousands of times. This is one reason why our monastic friends often have a problem accepting the rod and cone as an eye sense organ.

I would like to talk about the three conditions necessary to experience any of the five sensory consciousnesses: (1) the objective condition, (2) the dominant condition, and (3) the immediately preceding condition.
We move to the objective condition, the one that produces, or generates into, the aspect of its own object. If you are looking at a flower, the flower is the objective condition: any external phenomenon that you are looking at is considered the objective condition. If you are hearing something, the particular sound that you are hearing is the objective condition, and so on. If we take as an example the eye perception, which perceives blue, maybe we can say that the eye organ—the dominant condition—that perceives blue is one that produces or generates into the aspect of blueness. I have a very interesting piece of information for my Buddhist colleagues that I learned during our science workshops. If you write a big letter “A”, when you look at that letter the active neurons in your visual cortex respond in a very similar shape as that letter. This was very interesting because the objective condition should be like the perception that sees the objects and generates into the aspect of that object. The question then arises as to which part of the brain is consciousness dependent upon? The retina, the LGN inside the thalamus, and the visual cortex all have this information, but which one is most appropriate to designate as the dominant condition? I want you to decide which would be the most appropriate.

Now let’s talk about the immediately preceding condition. The immediately preceding condition is what produces the experience part of any sensory perception. Maybe we can take an example from this flower. When we look at this flower, we can perceive, or we can recognize, that it is a flower. But if somebody asks me, “What kind of flower is this?” I might not be able to answer. I might not know what kind of flower it is or what it’s called. We need another condition to recognize that flower. If there is someone who knows botany, they may know the name of the flower. Here, I think we can understand that the immediate preceding condition is needed to recognize the flower, to know the flower.

Let’s take another example. When we look at the night sky we see a bunch of stars, but we might not have the condition in our mental field to distinguish them, to say, “this is a star,” or “this is a
planet.” It’s a practical experience. When we were at a workshop in Bir we went outside to look at the stars one night with Professor Chris Impey. He brought the Galileo telescope and we looked through the telescope. Of course, when we looked into the sky, we saw a bunch of white dots, but we didn’t know which were which. Professor Impey told us, “this is Jupiter,” “that is Mars,” and then he pointed out the star constellations as well. Without the immediately preceding condition, even when two people are looking at the same place, and both individual’s retinas are functioning normally, some can perceive which star this is, which planet this is, but some cannot. The two people are receiving the same information, but while one can make a distinction, another cannot. I think this indicates why the immediate preceding condition is very important. It is not just what we see, but what we hear, what we smell, where we touch, and all of these types of perception. When the perception arises—any perception, mental or sensory—the immediate preceding condition should be there. The immediate preceding condition is a common property of mental phenomena; it is not necessary for physical phenomena where you don’t need this immediate preceding condition.

If eye consciousness needs an immediately preceding condition, and because the immediately preceding condition is a mental phenomenon, Buddhist logic of cause and effect dictates that it needs another immediately preceding condition, and so on. At one of the Mind and Life conferences, His Holiness said that if we investigate closely the immediately preceding condition, then we may finally touch on the Buddhist idea of the subtle mind, which is common to all the Buddhist schools. I think this could even be a very good approach for studying life after death and the continuation of the consciousness, because in finding this immediately preceding condition we might not need to go very deep down, we might not need to look to past or future lives to understand how the immediately preceding condition functions in this lifetime. Perhaps we can do an experiment to try to understand. Scientists have been trying to measure what the speed of light would be between here and there, say ten meters, but it is
very difficult, perhaps impossible to measure over short distances. They will not try to do it. They will try to find out over a much larger distance, and then apply this knowledge to the phenomena that occur over shorter distances. In the same way, with the immediate preceding condition, perhaps in this lifetime, in maybe 10 years, 20 years, 50 years, maybe we can apply these insights to other phenomena like the consciousness of a new born baby, or the consciousness of a deceased person.

There are some interesting overlaps between descriptions of the sense organs found in Buddhist text and the findings of modern science. I’ve already mentioned some for the eye organ, now to sound. Inside the cochlea, scientist have found a lot of hair cells which are very, very small, where the vibrations hit and send the information to the nerves. The Abhidharma text describe many tiny nail like structures inside the ear organ, and these descriptions seem to be very similar to the scientific descriptions of the hair cells that identify a small stone at the end of each hair cell. For the smell organ, Buddhist texts talk about something like a copper needle, which is very, very thin. Likewise, from the scientific perspective, within the olfactory epithelium there are very tiny cilia that respond to contact with molecules in the air, and then send information back to the olfactory bulb. Next is the taste organ, the tongue. From the Buddhist text, the tongue organ is like a crescent moon, and perhaps this parallels the scientific finding that the taste receptors are not distributed evenly across the tongue; there is significantly greater density along the edges of the tongue. Now to touch. Scientists differentiate many types of touch, and there are receptors for experiences like pressure, soft touch, heat, and coolness. Each type of touch has different receptors. Once a fellow monk asked a scientist if we have touch receptors even on the tongue: “Does the taste receptor detect touch? Do we have touch sensory receptors on the tongue?” The scientist responded that on the tongue there are also touch receptors, but the taste receptors do not detect touch, and touch receptors do not detect taste. That one receptor will not detect two different sense objects is very clear to the monks. According to
Buddhist texts, one sense organ cannot detect the sense object of another: the tongue cannot see, the ear cannot smell, etc.

Most of the sensory information goes through the region of the brain known as the thalamus. But why does olfactory information not go through the thalamus? That’s one question. Is there an evolutionary explanation? The thalamus is associated with learning and memory. We have found many regions associated with memory inside the thalamus. In the thalamus, there’s one center, which they call the house nuclei, that seems to be important in controlling consciousness. What do we mean when we say it controls consciousness? In the thalamus, many mental activities like learning and planning are involved. Many of these associated regions of the brain, like the visual association area and the auditory association area, interact with the thalamus in creating and recalling memories. Of course, in Buddhism, memory is a very important mental factor, which is included in the category of determining mental factors.

Is this area, the brain area, responsible for memory? Or maybe it’s not really memory, but related to memory, and perhaps some other factors related to memory? Many questions arise. This is just an overall picture of the pathway to and from the thalamus. The questions are: Why do all of the sensory signals travel through the thalamus except for the olfactory? What is the mental state when the signal arrives at the thalamus? Does the visual cortex have the capacity to recognize or describe the object, and do the auditory cortex and somatic sensory cortex, likewise, have the capacity to recognize their objects of perception?

We now move to the discussion of object and subject. From the Buddhist perspective, all phenomena can be included in the object, which we call yul, the perceivable. However, within perceivable phenomena there are conscious phenomena (subjective) and non-conscious phenomena (objective). Buddhist texts distinguish different categories, like the object of apprehension, appearing object, referring object, the conceptual object, and the determined object. For
example, every level of consciousness has an appearing object. The conceptual object is not a direct perception. In Buddhism this means that the object is only that which the conceptual level can perceive. Compared to Western convention, there seems to be a different usage of terminology of object and subject, objective and subjective.

What does direct perception and conceptual perception mean? Direct perception is an awareness that is non-mistaken, free from concepts, and produced from its own uncommon dominant condition, which is physical. It is mainly for sensory direct perception, not the sixth sense. Direct perception leads to the affirming perception, which validates the perception. In one of our science workshops, we learnt that when we look around our eyes receive a lot of information, but only 5% of this information makes it to the mental level. We don’t really know what happens to the rest of it. For example, when I look out at the audience all of the information, all of the photons entering my eye make contact with my retina, but only information about one or two people in the audience can be sent to my mental state at any one time, that is very obvious. Even Buddhism says direct perception always focuses on the object; the object is not separated from the perception of that object. We call that which engages its object, that which differentiates it into its separate parts, a limited engager or subjective consciousness. This is one aspect. Additionally, in looking at a flower, your direct perception can be looking directly, but thought is coming through your consciousness, or perhaps, informally, we can say through your imagination.

Neuroscientists have demonstrated that when you’re looking at the object, the neurons in the upper part of the frontal lobe and the visual cortex are active. There is activity of neurons in these regions when you are looking at something, and when you are not looking at it but are thinking about the object after you have looked at it. But there are different parts of these two regions that are more or less active when you are looking at it and when you are thinking about it. Here, we don’t see too much difference in the frontal lobe, but you can see a very clear difference in the visual cortex. When you are looking at
something, many places are activated, but when you are thinking, very few places are activated.

In Buddhism, we talk about many mental factors. I will not talk about all the mental factors, but the selective mental factors that are most important to perception. If we were to try to find each mental factor in the texts, they would be countless. Hence, Buddhist scholars categorize mental factors that have completely separate functions. According to one Buddhist text, the Abhidharma Samuchaya, there are 5 omnipresent mental factors, 5 determining factors, 11 virtuous mental factors, 6 root afflictions, 20 secondary afflictions, and 4 changeable mental factors. So all together, in this text, there are 52 mental factors. But in another text, the Abhidharmakosh, there are 46 mental factors. Also, there are some texts that divide the mental factors into 72 factors. The categories are similar between the texts and conceptually there are no real differences, but when they are counted, there are differences. When you go into them deeper, you don’t see much contradiction. Mainly, we will focus on the five omnipresent mental factors. First is tsorwa or “feeling.” In Tibetan, tsorwa often takes on a different meaning than its English equivalent. In the Tibetan language, tsorwa is a body and mental sensory experience, so it is not how we feel about food or someone who tried to cheat us. If a mental state arises in your brain or your mind, there is a feeling, or tsorwa, which we divide into three types: pleasant, unpleasant, or neutral. The second omnipresent mental factor, dhushe, is translated as “recognition” and sometimes as “perception.” Yesterday’s presentation by Geshe Lobsang considered the differences between the mind and the mental factors. Recognition is like a mental factor that separates things, such as “this is white” and “this is blue.” The third factor, sempa, is a mental impulse that pushes your primary mind closer to the object. Fourth is rekpa, translated as “contact,” which means to contact and analyze: it is the coming together of the organ and consciousness. Fifth is yilajepa, translated as “attention.” These five factors accompany any type of mental state; that is why they are called omnipresent.

For ordinary beings, mental direct perception is an extremely
hidden phenomenon, therefore the three conditions are also considered extremely hidden phenomena, even the dominant condition. Many of my fellow monks have a difficult time accepting the rod and cones as the dominant condition of the eye organ, because in the Buddhist text the dominant condition is considered an extremely hidden phenomenon. For me there is no contradiction that we can see the sense organs through a microscope that is magnifying hundreds and hundreds of times.

As to the sixth sense, the question arises: Is there a sixth sense? If so, how do we define it? When we are sleeping, sensory consciousness doesn’t function. At that point, only the sixth sense is functioning. In Buddhism, there are two things that know a visual image: one is eye consciousness, and the other is mental consciousness. Buddhist texts also consider non-Buddhist philosophers who contend: If there is a sixth sense, what is the object of this sixth sense? Is the object similar to that of the five senses already perceived? Or is it different? If the object perceived is different then, according to the debate, the blind should see visual things, even in the waking state. The great Indian philosopher, Chandikirti, said that in sleep there cannot be eye consciousness, only mental consciousness. And the Buddha said the eye perceives blue, but cannot see blue as blue, but the mind or mental consciousness can both perceive blue and perceive blue as blue. According to Buddhist philosophy, the sixth sense must also satisfy the three conditions: an objective condition, a dominant condition, and an immediately preceding condition. For example, if you’re dreaming of a flower, the image of the flower is the objective condition. The dominant condition is a little confusing, because for the five sensory experiences the dominant condition is the sense organ, but here, for the sixth sense, the dominant condition is mental, which is said to be the last state of mind related to perception. The immediately preceding condition is the consciousness that leads to the experience of the perception of the flower within the dream.

According to several Buddhist texts, phenomena are categorized into mental phenomenon and non-mental phenomenon. The
consciousness that perceives one’s own mental phenomenon is called rangrik in Tibetan, which means seeing your own mind. In addition to the mental phenomena of mind, there are sensory perceptions, and also mental perceptions, and then something we call yogic perception, or the mental state that arises from and is dependent upon the meditation stabilized union of vipassana and shamatha. According to all of these views, consciousness or mental development is infinite.

How does the sixth sense arise? There are three different ways of explaining the arising of the sixth sense: (1) alternating production, (2) production of three steps, and (3) production of the end of the continuum. However, it is rather complicated and there is disagreement among the philosophers. For example, the first Dalai Lama opposed the production of three steps; he didn’t accept it. His way of thinking was that the production of the end of the continuum, when we continuously see something, refreshes in our mind moment to moment.

Buddhism describes seven types of mental states which roughly translate as: (1) direct perception, (2) inferential understanding, (3) subsequent cognition, (4) inattentive perception, (5) presumption, (6) indecisive mind or doubting mind, and (7) distorted awareness. The first three are the valid conscious level, and the last four occur at an unconscious level and are considered invalid. To understand reality, the subjective is very important, as many scientists believe. They take illusion, especially visual illusion, very seriously. Since the ancient Greeks, Leonardo, Galileo, and Einstein have all taken illusions, and the way in which they may disturb our understanding of reality, very seriously. Indeed, they have found that reality does not exist as you see it. What then is reality?

Thank you.
Developments in modern brain research have attracted the attention of present day scientists regarding epistemological issues associated with the age-old theories of self-awareness developed in ancient Indian traditions. What is “self” or how is “self” generated in the context of modern neuroscience? The first step in this direction is to resolve the mind–brain problem: the relationship between the brain, body and the external world. A common hypothesis is that this “mind,” which may or may not represent external reality, has evolved as a goal-oriented device that implements predictive/intentional interactions between a living organism and its environment. Prediction may be localized in the brain, but does not occur at only one site of the brain. What pulls these functions together, or what is the repository of predictive function? Here, we refer to “self” as that which is the centralization of prediction. According to this view, the self can exist without awareness of its own existence. For the nervous system to predict, it must perform a rapid comparison of the sensory-referred properties of the external world with a separate internal sensor. A novel approach called internal geometry, or functional geometry, associated with the central nervous system has been proposed to understand the functional role of neurons and their circuits in relation to the predictability of the brain. This development sheds new light on the issue of “self” or “generation of self” and “self-awareness.”
Sisir Roy: Some people might wonder, as a scientist, why I am here, or why the monks are here. For the last two days, a great deal of discussion has taken place between these two groups. My own view is that we scientists, especially the physicists, because I am speaking as a physicist, think that most of the physical phenomena in the Universe can be explained with the laws of physics and, hence, physics is the most fundamental of all the physical sciences. We are looking for ultimate reality, but we are only in the process of looking. We have not yet found a unifying theory of the Universe.

The Sanskrit meaning of the word “Buddha” is enlightened. An enlightened person means someone who has experienced ultimate reality. So, from the perspective of Buddhists, their teachers, their masters, experienced ultimate reality. Their teachings include reference to epistemological and ontological issues that are prevalent in all the physical and biological phenomena in the Universe. The Buddhist scholars who are here today can help to solve the epistemological and ontological problems that we scientists are facing. They might be able to share with us their insights on how problems might be addressed from the Buddhist perspective. And they, too, might benefit from the exchange. Let me give you one great example about Heisenberg, who was the discoverer of the uncertainty principle in quantum theory. After discovering the uncertainty principle, he faced a dilemma: he was uncomfortable and perhaps a little confused regarding epistemological issues related to uncertainty relations. He came to India and visited a place near the city of Kolkata where the famous poet, Tagore, was staying. He met Tagore and spent a few days with him discussing epistemological issues associated with the newly formulated uncertainty principle. After the discussion, he said, “Now, I feel comfort.”

Western physical sciences have evolved from a classical regime, or Newtonian regime, to quantum theory, and with that shift a new set of epistemological problems have emerged. But what about neuroscience? In my talk, I’ll try to describe the epistemological issues coming from modern research in neuroscience that might be of
interest to Buddhist scholars and where I think it might be possible to have a dialogue between the two communities.

Let me start by saying a few words regarding methodology, because the methodology adopted in physical science is rather different from the methodology used in consciousness research or even brain research. In physics, we start by constructing a theory, just as Einstein constructed the general theory of relativity. Quantum theories were initially formulated, and later verified experimentally. If you come at it the other way, trying to explain a phenomenon after you make the observation, there are many possible explanations. A good theory has predictive power. In neuroscience or brain research, and especially in consciousness research, people are finding associations or correlations between the activity in certain neural networks and different feelings or states of consciousness. If someone has a particular type of feeling and we take an EEG recording of his or her brain waves you can see that some portion of the cortex might be activated. As scientists, we say, “Well, there is a correlation and association with our thoughts and neurological activity.”

So, what are the developments in modern neuroscience and associated epistemological issues that might be related to Buddhist ideas? The first question you might ask me, being a theoretical physicist, is why I became interested in studying brain science or neuroscience. There is a famous statement by Warren S. McCulloch from MIT, who was a theoretical physicist and later became a neuroscientist. In his statement he writes, “... by the term mind, I mean ideas and purposes, by the term body, I mean stuff and processes.” Stuff and processes are familiar to every physicist as mass and energy and space and time. But ideas and purpose, he keeps only in the realm of discourse and will not postulate them with the phenomena he observes. The problem is that we have understood the dynamics of the galaxy, the dynamics of the stars, dynamics of the planet and system. We constructed another theory called quantum theory to understand the behavior of the smallest particles, like electrons, and protons. And we human beings are in the middle. We are here, in the middle, between these two
extreme scales, and we, too, have enormous complexity.

How do we understand this complexity in terms of physical laws? This is the debate. I am going to tell you something about self, or qualia, a kind of consciousness. I was fortunate to spend many years with the famous neuroscientist, Karl Pribram. He used to ask me, “Sisir, tell me where is my mind? Is it something outside my head?” It begs the question: What is the starting point? Being a scientist, I should have a starting point. In physics, we start with atoms, molecules, etc. You just aggregate. If we aggregate atoms to molecules, and than aggregate the molecules we get a macro object or material object. That’s how that starting point works. So what’s the starting point for mind? The basic unit is the nerve cell, a neuron, and the brain contains billions of neurons, which are active for different functions. Is the neuron the correct starting point?

I want to discuss sense-dependent geometry, self, and self-awareness. A renowned philosopher of physics, Ernst Mach, who had a great influence on Albert Einstein, discussed sense-dependent geometry. In his famous book, The Analysis of Sensation, he coined the term, “Hindu geometry” because of his inductive approach, and in contrast to Greek geometry, which is deductive. I think I need to have an extended dialogue with Buddhist scholars regarding this kind of geometry. I will try to explain what this geometry means later in my talk.

But let me first say something about the representation of reality. You know the famous allegory of the cave by Plato. You place a group of people in a cave with a light to their back. The rule of the game is that they cannot turn around to see what is going on. They have to look only towards the front. So they only see shadows. Throughout their whole life, they think that the world is full of only shadows. How can they then distinguish what is true in “reality” from what is false? So there exist two worlds: a world that’s constructed only in our minds, made by our experiences and genetic predispositions, and another world of the domain of things themselves. So the issue is
what is the relation between perceptual entities and physical objects?

I am looking at the flowers here, the information is being processed by my central nervous system, and then I say that this is a rose, or another kind of flower. One of the curious things about perception is what is called the problem of time gap. In the nervous system, information propagates at different speeds so there is a time gap. We are looking at a particular instant: how does the brain recognize the object at that instant? This is called the time gap problem, and in the language of neuroscience it is known as the problem of simultaneity. In physics, we also discuss the concept of simultaneity. From the experimental point of view, neuroscientists can say that there exists a particular rhythm called 40-hertz oscillations that is responsible for, or at least correlates with, our conscious states. This exists both in the awake state, as well as in the non-awake dream state. So this existence of 40-hertz oscillation implies that there is a quantity of time, which is approximately 10 to 14 milliseconds. If you look at the different information propagating through axioms, coming through the same location in the nervous system, the time gap is exactly 10 to 14 milliseconds. So we have an instrument that has the same resolution as the 40-hertz oscillations associated with consciousness, and that’s why we are getting simultaneous events. In this way neuroscientists address or approach the problem of simultaneity.

But let’s see what the situation is from the Buddhist perspective. For Buddhist philosophers, the time gap problem is different. Different in the sense that objects and perception are discrete, so they can never be simultaneous. How then do we apprehend things, if they have ceased to exist when we perceive them? This was discussed by the followers of the famous Indian Buddhist philosopher, Dharmañjītu. As I understand it, the common Buddhist view of perception is awareness directed to an object. Another definition of perception is contact with external reality. The first definition emphasizes the presence of the object to cognition, and the latter states the time gap between object and the subject. I would like to hear from the monastic graduates,
maybe in the panel discussion, on how they solve these issues.

What is the main function of the brain? Prediction, perhaps, is considered the ultimate function of the brain. So what do we mean by prediction? We mean that prediction is a forecast of what is likely to occur. Suppose you are playing Ping-Pong, the ball is coming, and you have to swing your paddle such that it strikes the ball at exactly the right moment. This is a kind of prediction. I do not think that the brain calculates the speed of the Ping-Pong ball, the time it will take to cross the table, and those sorts of details. I don’t think the brain does these types of calculations in the way that a digital machine does. What about the movement needed to swing the paddle? Apart from sensory input, we also have motor output. A mosquito lands on your face; your hand rises to slap it. Likewise, the blinking of the eyes, all of these are examples of motor activity. Active movement plays a very important role in prediction.

Some have theorized that only organisms that move have brains. Plants don’t move and we say they don’t have brains because they don’t have a nervous system. According to this theory, only entities that move have brains; entities that don’t move don’t have brains.

Let us imagine that there is a carton of milk in the refrigerator, and we are going to pick-up that carton of milk. So what happens in reality? From a functional perspective, even a simple movement often engages most of the body muscles, resulting in an astronomical number of possible simultaneous or sequential muscle contractions. It seems very simple to go and bring a carton of milk from the refrigerator. However, suppose there are 50 key muscles in the hand, arm, and shoulder that are engaged in the act of reaching for the carton. From algebraic calculations, you can show that there are $10^{15}$ combinations of possible muscles contractions. This is an astronomical, huge number. Further, suppose that during every millisecond of the grasping sequence, $10^8$ decisions have to be made: this would require a processor of a million gigahertz, or perhaps a million laptops.
Let us delve further into how the brain predicts. For the nervous system to predict, it must perform a rapid comparison of the sensory properties of the external world with a separate internal sensory motor representation. Once a pattern of neural activity has internal significance, the brain generates a strategy of what to do next. And that strategy represents another pattern of neural activity. This strategy can be considered an internal representation of what has become a prediction imperative. There is one school of thought in neuroscience that says we are born like a blank slate and up to a particular age, say six or seven years, there is a learning process happening and all these kinds of patterns or forms are being installed. As we grow up, and there is a stimulus from the outside world, our brains try to match this with the internal patterns developed during childhood. We have a kind of potentiality for storing these phenomena. What we call functional geometry or dynamic geometry involves a different type of learning. Here, geometric patterns or forms were created by our genes and all possible forms/patterns have been there since birth.

Let me jump directly to what is self in terms of brain function. We can call it the neurology of self. We say that self is the centralization of the predictive imperative. So, what does that mean? Suppose the brain predicts a particular event, taking a particular duration of time, and at the same time makes a second, alternate, prediction for the same event, which takes a different duration of time. So you have two different time durations needed for the different predictions for the same event. Interestingly, prediction is not a localized phenomenon. You cannot pinpoint the neuronal circuits responsible for the self, but you can perhaps say that it seems to be distributed over a particular region, and that there is a particular abstract mental state we refer to as I, or self. According to this view, self can exist without awareness of its existence.

According to the Tibetan Master Tsongkhapa, there are two definitions for the term self: (1) a self conceived in terms of an intrinsic nature that exists by means of intrinsic being, and (2) the self conceived in terms of the sense of the object of a simple natural
thought, “I am.” Of these two, the first is the objection of negation by reasoning, while the second is not negated, already accepted as conventionally real. For Tsongkhapa, whether or not self exists is not merely an epistemological question, nor is it solely a therapeutic one. It is an ontological question. That is to say it is a question regarding ontological status of person. Tsongkhapa understands the concept of self to be highly complex with degrees of reality that are constructed through different thought processes. So here I ask the Buddhist scholars: What is your understanding of self?

We are saying self is nothing but a particular mental state of the brain. Debates have been going on for many centuries regarding self-awareness in Indian and Western traditions. Here when we say Indian traditions, this also includes Buddhist schools. There are theories of self-awareness specially developed in two main Buddhist schools: one we call reflectionist or other-illumination, and the other reflexivist or self-illumination. The self-awareness thesis says if a subject is aware of an object, then the subject is also aware of being aware of that object. The other-illumination thesis says self-awareness is the product of a second order awareness. The self-illumination thesis states self-awareness occurs simultaneously through the object of consciousness and the aspect of the conscious state itself.

It seems the more neuroscience progresses, the greater the opportunities for Buddhist scholars to compare their debates with the findings of neuroscience. Let us talk a little bit about the philosophy of perception. We want to gather information from the outside world through our physical senses. Post-cartesian philosophy distinguishes three positions on the nature of perceptual experience: direct realism, representation realism, and phenomena realism. Although these positions do not necessarily exclude each other, they represent three distinct strategies adopted by Indian and European thinkers to explain the perception of the subject.

We say that a central issue in brain function is the internalization of the properties of the external world into an internal functional
space, the functional space of the neurons. By internalization, we mean the ability of the nervous system to fracture external reality into sensory messages. In other words, the firing of neurons, and patterns of firing of neurons, simulates each reality in different brain systems. We call this dynamic geometry or functional geometry.

We call dynamic geometry the very minimal time resolution or quantity of time associated with 40-hertz oscillation, which is responsible for the conscious state that is considered to be responsible for recognizing external events, and generating the concept of simultaneity. So we have an instrument that has a defined resolution. Recall that Ernst Mach coined the term Hindu geometry. He says that there might be geometry that is inductive and sense-dependent and he said it is Hindu geometry. On the other hand, Greek geometry is deductive geometry. So another question for the Buddhist scholars: Do you have any thoughts about this kind of inductive geometry in relation to understanding the brain?

In functional geometry or dynamic geometry we have many patterns, infinite patterns, stored in the geometry of the brain. Stimulus from the outside world modulates the brain. If you think of a musical instrument, like a violin, you can modulate the strings to produce harmonics and other sounds. So our brain is like a musical instrument. When there is a stimulus, our brain modulates and patterns are formed. Now there is another aspect of consciousness called intentionality. We discussed prediction, but prediction must have a goal. If it is not referentially based, it is purposeless; it is not only wasteful but can also be quite dangerous. So the goal or object of movement must be well defined and we may define it here as that which one intends to do in relation to that object. So intentionality is another aspect of consciousness.

And then comes qualia. This is one of the major issues of debate among philosophers and modern neuroscientists. Qualia refer to subjective experience of any type generated by the nervous system such as pain, color, etc. Qualia are manifestations associated with
the functional state of the brain. There are a lot of philosophical issues related to this. We face a serious philosophical problem in our framework, but perhaps that’s not the case in the Buddhist framework.

Is functional geometry a unique feature of the human brain? No, this type of functional geometry is not unique to living organisms. At the same time, the outside network and internal network are both evolving, but, why this peculiarity? We say that only living organisms have qualia, or subjective experience. Why not the outside world? What is the transformation from external geometry to an internal one? This is a mystery we have yet to explore.

The goal of my work is not that of reductionist looking at just neural activity, instead we are looking for unifying principles. Thank you for listening.
Body, Mind and the Three Nyepa

Pema Dorjee, M.D.

The three Nyepa (rlung, tripa and bekam) emanate from the three mental poisons (desire–attachment, hatred–anger and closed mindedness) and the three mental poisons from the self-grasping ignorance. These three Nyepas act as a bridge between body and mind, and activate the physical, mental and vocal activities of a human being. They are also responsible for different kinds of human temperaments and emotions. In a balanced state, the Nepas are the seed of disease; in an imbalanced state, they are the cause of physical and mental disease. Our body, mind, and the three Nyepa are interrelated due to their common connection with the five elements (earth, water, fire, air, and space).

Pema Dorjee: I’m a practitioner of Tibetan medicine and I feel that there definitely are good reasons why the Tibetan medical community should contribute to this fruitful discussion. We have many wonderful new doctors who are skilled in the field of Tibetan medicine and who are also fluent in many languages. My talk is based on body, mind and the three Nyepas. Before touching upon this subject, I would like to say what I mean by “body” and what I mean by “mind.”

Is it possible to form a body without a mind? The Tibetan medical
system says that it is impossible for a fetus, or an embryo, or a body to form without consciousness of the three Nyepas. Here Nyepa means the same as Dosha in Ayurveda: to harm, defect, or defile. Nyepa helps us in the movement of our body, mind, and speech. It also gives heat to the body. The final outcome of Nyepa is destruction of the body—and the suffering of the body and mind that occur as the result of disease.

The body is comprised of many elements, including chemicals, atoms or molecules, flesh, fat, and so forth. But what is its real composition? According to Tibetan medical texts the body of a sentient being is composed of four principal or material elements: earth, water, fire, and air. These elements need space, so space is regarded as the fifth element. All diseases are nothing but disruptions or imbalances of the bodied elements. Thus, remedies in the form or medicine or food made up of these five elements are needed to correct these disruptions or imbalances. If we don’t understand the interrelation between body, mind, and the five elements, questions will arise: Why are we given medicine? What is it composed of? What will it help in the body? Disease is nothing but something that is lacking in the body, something that is in overproduction, or something that’s disrupted or imbalanced. To correct a lack in the body, we need to stimulate it with the element that is lacking; to correct over production we need the element that will restore normal levels.

What is the composition of a tiny embryo or fetus at the point of conception? Are the sperm and ovum, the reproductive seeds of the father and the mother, healthy? The very basic seeds of the child are from the parents, so these seeds must be healthy. Normally when we talk of childcare we are referring to childcare that occurs after conception, but in Tibetan medicine we say if you really want a child then you must check the quality of the seeds of the parents. Only then can we determine whether or not the parents can have a healthy child.

Childcare here means healthy semen and egg from the parents, and this healthy semen and egg are also of the nature of the four
elements. Consciousness during this period is being driven by karma and elusive emotion. Consciousness is directly connected to the child’s karma, but the parents should have at least some kind of link with their child’s karma. Next we visit the elusive mind. Let me explain by way of example. Suppose the child is to be male, then that consciousness in the very early stages of the body’s development, as an embryo even, feels a hatred for and jealousy of the father. The developing embryo thinks that the sperm is his, and therefore feels greater attachment to the mother, and vice versa if the child is a girl. It is important to have that kind of negative thought, even if it’s a delusion, during the period of conception. Finally, the most important thing is consciousness, and for that we need a sampling of the five elements from the father’s seed and from the mother’s seed.

If the consciousness has the subtle elements, it is very easy for it to have a link or connection with other materials, because all are composed of the five elements. If there is no quality or property of the five elements that connects them with consciousness, it is very difficult to talk about the connection, especially the nerves, or neurons, or brain. When we talk about the sensory organs, and the sense objects, and the sense in the sensory channel, what exactly is there in that particular sensory channel which has the power to see, or to touch, to feel, or to smell? If this eye, for example, is completely absolute, or completely independent, then why can’t we see when we are sleeping? During that period of time, everything exists intact, so why can’t we see? Where does that particular sense go? To understand these matters from the viewpoint of Tibetan medicine is critical to understanding the different types of elements.

I would like to quickly mention the heart, and the importance of the heart in Tibetan medicine. In the medical texts, *nying* is the heart, the “king” of all the internal organs, because it is the base of consciousness, the base of life. This is why it is given precedence over the brain, which is concerned with sensory organs. The heart is the base of the sensory channels, the base of the memory and the base of life. If something goes wrong with the heart, we see strange symptoms,
which doctors of Tibetan medicine know well. For example, in front of the heart we have the basis for the sense of ear, which is, from the perspective of the heart, the east direction, and is normally black in color. The right side, which is south of the heart, is the sense of eye, and it is red in color. The upper part of the heart is the sense of body, green in color, and on the lower side you find the sense of mind, blue in color. Thus, we have the six senses. It is strange that we know these things but are unable to prove them. While we are sleeping, in a dream state, we might meet a person in a black coat coming from the eastern direction. How can we prove this when in a dream?

Now the question is: What is the basic cause of disease or suffering? Every disease has a cause and effect and different symptoms. If a patient has a headache today, as a doctor I’ll say they have either this or that, and it will be a very proximate explanation. But, if you investigate, you find that the patient has a headache as a result of their action, their karma. It is very difficult to explain the workings of karma to the patient—it is said that even enlightened people have difficulty explaining every cause and effect. According to Buddhism, and Tibetan medicine, the remote cause is ignorance. Due to our ignorance we do many things that are improper. Or, in other words, we commit a lot of non-virtuous acts, we make a lot of mistakes, physically, mentally, verbally due to ignorance, or not knowing, and as a result we experience problems. And with that ignorance comes the specific cause, which is what we call the three mental poisons: desire–attachment, hatred–anger and closed mindedness.

It is clearly mentioned that Lord Buddha was the supreme physician. He was a medical person, but his specialty was treating the diseases of mind: desire–attachment, hatred–anger and closed mindedness. The three Nyepas, or defects, temporarily help us, but their final effect is that they destroy the whole system. The first Nyepa is called rlung, the real meaning of rlung, the exact meaning of rlung, is movement; rlung means movement. The movement of body, mind, and speech is called rlung. It’s very important to know the characteristics, because if you use words other than movement, or lightness of movement, you lose
the subtle quality of the characteristics. Then you won’t be able to find
the exact effect of that particular object, the Nyepa. So, in short, any
movement that we have in our body, mind, and speech is from rlung.
Yesterday, I heard about waves or movements or transformations.
Even if these are very small, we can say rlung. And some texts in the
Tibetan medical commentary, mention force. Force can also be used
to describe rlung.

There are ten different types of rlung in our body. Basically we
can say that the origin of the rlung is the life-sustaining rlung, or the
subtle rlung that we have with consciousness. What is the particular
movement of egg and sperm when they first combine? How does the
fetus develop over the period of nine months? What is the basic cause
of that movement? Here, we are not concerned with the seeds, but
instead with what elements develop inside the fetus for nine months.
According to Tibetan medicine, it is nothing but rlung, Srog ‘dzinrlung.
Srog ‘dzinrlung comes from the basic intermediate consciousness. It’s
very important: Srog ‘dzinrlung is the base of all movement or all types
of rlung. Roughly we have ten different types of rlung: five basic rlungs
and five secondary rlungs. Swallowing, inhalation, all this is taken care
of by Srog ‘dzinrlung. Srog ‘dzinrlung is the mother of all rlungs, or, in
other words, all movements, whether voluntary or involuntary, in body,
mind, or speech—whether it’s a wave or a vibration, or an electrical
movement, these are just characteristics of Srog ‘dzinrlung. From there,
you have ascending rlungs. There are different types of ascending
rlungs in our body: some movements ascend and some descend. These
are what we call pervasive rlungs. All these different types of rlungs,
movements in the body, are the movement of rlung.

There are connections with different types of elements. For
example, life-sustaining rlung is called ugh and is connected with air;
pervasive rlung is connected with space; fire-accompanying rlung is
accompanied with fire; and descending rlung is connected with water.
How can we say that some type of rlung that moves downwards is a
rlung? Because it has a connection with water, and you’ll rarely see
water going upwards. Fire always goes up. So it’s very important to
understand the different types of *rlung* and their connection with different types of elements.

What are the characteristics of *rlung*? This, I think, is the big question. We cannot say something is *rlung* because it moves the tree or the national flag; that is not enough. To know exactly what *rlung* is you have to understand its characteristics. It is rough in the sense that when you have *rlung* disease it makes everything rough, and then light, like lightness in the mind or lightness in the body, and then cold, hurt, stiff. When people say, “I have muscle tension,” my question is always, “Where does the tension come from?” When people have stiff necks, “Where does the stiffness come from?” The same with dizziness, “Where does this movement, this dizziness, come from?” Or dryness in the mouth, or ringing in the ears: where do these come from? We can say that a person with a bad case of *rlung* disease will have dry skin. And movement means the person is very restless, hyper, and very talkative. This is what we observe in our patients. Why does a patient who used to be very silent, and very quiet, and very relaxed, change their behavior and become very talkative and restless? When movement, which is the characteristic of *rlung*, increases too much we get abnormal moments in the form of symptoms. So, what is *rlung*? The Tibetan doctor will say rough, light, cold, subtle, hurt and *tiba*, which means inflammation, burning, or heat. We need this *tiba* even though it is a *Nyepa*. *Tiba* is slightly oily, sharp, with a reaction like fire that can burn very fast. It is said in the Tibetan medical texts that without anger and a lucid mind it is impossible to have *tiba*, and without *tiba*, it is impossible to have any type of fever-related disease. You can see the different characteristics of *tiba* and *rlung*.

We have another characteristic called *bekan*, which is basically set in the brain and which is very important from the Tibetan medical point of view. *Bekan* is oily, cool, heavy, slow, stable and sticky. When you vomit, or find your feces a little oily, and your body becomes swollen and oily and, most importantly, you feel heaviness in the body, this is characteristic of too much *bekan*. The stability of *bekan* is opposite to the movement of *rlung*. When there is too much *bekan* in our system,
we gradually lose our movement. We become lazy and lethargic, and prefer to sit in one place. Our minds also become slow. According to Tibetan medicine, bekan, or ignorance, lies in the brain. When we have a problem in understanding something, we will say, “I feel very dull” or “I feel very heavy.” When they cannot solve a problem, many thinkers point their finger to their head. Why do they do this? It is because of too much bekan—because of heaviness, dullness in any kind of activity of body, mind, or speech. What is the element that increases movement? When there is too much movement, when movement is too light, we need heaviness to slow it down. This characteristic lies with bekan.

Let’s talk about the qualities of the five elements and their actions. If I say a handful of soil is an Earth element, this is absolutely wrong; it has the composition of all five elements. If we really want to know the five elements and their characteristics then we have to understand that the characteristic of the so-called element Earth is heavy, stable, smooth, oily, and then dry, and its action is to make things firm, make things compact, assemble things. Due to its heaviness, stableness, and oiliness, it cures rlung disease, which has as its character lightness, mobility, etc. Earth-based material in general, and in medicine, has a strong smell. In a similar way, water is liquid, oily, cold and flexible, and it makes the body smooth and assembles things. It cures tiba. The fire element has a hot, sharp, dry, rough, oily, and mobile character. It generates heat, brightens the complexion, and cures bekan disease, which is its opposite. And then rlung means the air and is light, mobile, cold, rough, absorbent or dry, and it makes the body firm. It transforms the nutritional essences and it cures bekan and tiba diseases. Finally, without space, though it is not the active material of body, we cannot form anything. Space is essential for any material to have room.

Thank you very much. And smile at least three times a day—it can lead to world peace!
Sleep: A Window to Evaluate Neurophysiological Correlates of Higher States of Consciousness.

P.N. Ravindra, M.D., Ph.D.

Understanding consciousness and its underlying psycho-neuro-physiological attributes has been the greatest intellectual challenge across the spectrum of neuroscientists, psychologists, and philosophers. Wake, sleep, and dream are the three distinct states of routine conscious experience. However, the classical literature of contemplative practices (meditation) describes many other conscious states, which are neither completely awake, nor asleep, nor dream. There is experimental evidence which indicates that during meditation practice EEG has a distinct feature of being both “restful and alert” simultaneously. The effect of such a distinct state is also demonstrated during deep sleep. These correlates speak volumes about the other possible ways a neural network (thalamocortical interaction) can take place; thalamocortical systems can integrate information by bringing about synchronization of different areas of the brain, thus modulating the neuronal networks. Earlier studies have demonstrated that expert meditators can bring about such functional integration by inducing a high amplitude gamma synchrony. Emerging evidence has clearly demonstrated that a meditation practice brings about plasticity changes in neural networking. Hypothetically, these plasticity changes induced by meditation practices probably would aid in accessing other neural networks that would otherwise be insulated. Different degrees of thalamocortical communication induced by meditation practices, along with plasticity changes, would aid in accessing
other consciously occult network, thus bringing about a higher conscious state and experience.

P.N. Ravindra: Good afternoon. At the outset, I thank the organizers for giving me this very great opportunity to interact with learned scholars and monks. What I would like to do in the next half hour is to give you an overview of sleep, how the long-term practice of meditation influences sleep, and a hypothesis that studying sleep can unravel the neurophysiological basis of varying states of consciousness brought by meditation practice.

Even though many things have been said about sleep in the ancient text of the Indian traditions, scientifically, the neuropsychological correlates of sleep, and what happens to the brain during the different stages of sleep, are still not fully understood. As to the simple question of why sleep is essential, there is still no definite answer. The field of sleep in neuroscience is new, and to understand sleep in expert meditators is very, very new. Very few people in the scientific community have evaluated sleep in meditators. The outcome of the work is very surprising and has given us clues as to how we might understand consciousness. How can studying sleep, or studying how the brain works during sleep, help us to evaluate, or help us to understand, the neurophysiological underpinnings of consciousness?

Neuro-physiologically speaking, the content of consciousness and degree of subjective experience depends on the capability of an individual to have access to different neural networks. Why is my subjective experience different to someone else’s? Why is my subjective experience during different behavioral states different to someone else’s? Could this be because I have access to different neural networks? We can take a clue from vision research. When I see you people in the audience, when the light falls on my retina and goes to my visual cortex, how do I consciously perceive and report the same? The answer to this is the feedback connections between different neural networks: when feedback connections, or recurrent connections, or recurrent information processing takes place between different parts
of the brain, conscious perception and its reporting take place. Take vision, for example, where there is a recurrent connection to my language area. From there I have a recurrent connection to my frontal cortex and access to my vocabulary for words to describe what I am seeing. These recurrent connections are the main basis of a conscious experience. The recurrent connections, or feedback connections, are very important in gaining access to different neural networks for the conscious experience. Let me take a clue from meditation practice. During meditation practice—starting from the breath, or starting from a mantra, or whatever it may be—we are conscious of our visceral sensations. What is happening is that the recurrent information from the visceral sensations from my breath is going back to the brain. When this recurrent information is going to the brain, these particular networks become very strong so we try to give our attention to one particular attribute of our consciousness.

All the somatic sensory information comes into the thalamus and from here information goes to the cortex. We call this the thalamocortical network. However, visceral sensation is relayed via a small part of the brain called the insula. This thalamocortical network, and the connections of the insula, plays a very important role in meditation practice. When I am awake and conscious, my thalamocortical network is in an active state. When I go to sleep, my thalamocortical network is in an inactive state that we call a hyperpolarized state. When I first started mediation classes, I would start meditating and after few minutes would generally feel very drowsy. Then I would consciously say, “focus on my breath” or “focus on my mantra” and I would become very active. This “on and off” of the thalamocortical network is common during the initial days of meditation practice; once practice is established we tend to be in a meditative state for longer periods of time and there will be minimal or no intermittent active or drowsy/sleepy states. The maintenance of this particular state for considerable lengths of time, where the thalamocortical network is neither fully active nor fully depolarized, is of paramount importance. Sensory information is coming to the thalamus but the expression of the same
at the cortex is different. How such practices bring about this delicate balance in thalamocortical oscillations, neither active nor inactive, is a great and critical question in understanding the neurophysiological correlates of mediation practices. We do not know how it actually happens. When such a delicate balance is maintained should there be a different type of connection that should take place from the thalamus to the cortex?

Taking a clue from basic sleep neurophysiology, a number of studies have shown that during sleep those neuronal networks, which were predominantly active during waking hours, reactivate. If I learn something or focus too much on one particular subject during my waking hours, some of my brain network is very active; when I go to sleep the same neural network is reactivated. This is the basis of memory consolidation. There are many studies that have shown that meditation practice can have a tremendous effect on the waking state, on waking behavior, on cognition, on perception. But does meditation practice bring about any change in my sleep? That’s the question that we have asked.

Sleep is a very complex behavioral state. It is not a single state, and it is not a uniform state. We know that we have two types of sleep: REM sleep and NREM sleep. REM sleep is rapid eye movement sleep, and NREM is non-rapid eye movement sleep. If you look at a person who has been asleep for at least one and a half hours you can see their eyeballs starting to oscillate. We call this REM sleep. At other times there will be no eye movement. This is NREM sleep. So, during a whole night of sleep, we go through different stages of sleep. When I go to sleep at 10.30 pm I’ll be very drowsy for a few minutes, and then I’ll enter NREM sleep and pass through Stage 1, Stage 2, Stage 3, and Stage 4. Stage 3 and Stage 4 are called deep sleep, or slow-wave sleep. Later REM sleep starts. This is when we dream, and in this dream the emotional component is predominant. This cycle of NREM and REM sleep is called the sleep cycle. One sleep cycle will last for 90–120 minutes and normally we will have four or five sleep cycles during the night. In NREM Stage 3 and 4 there is a complete sensory cut off, and
the brain is by itself. During my waking hours my brain is bombarded and is always busy sorting information. During deep sleep, when all our sensory input is blocked, the brain is by itself. In this particular state, when thalamocortical oscillations are almost hyperpolarized, we experience slow-wave sleep, when no other information is coming into the brain. During this state cortical networks talk to each other (cortico-cortical oscillations), which is recorded as a very slow-wave sleep, less than 1 hertz. This plays an important role in bringing about plasticity changes in the neuronal network, which has a critical role in many physiological functions, including how I feel when I get up the next morning—how fresh I feel. It brings about memory consolidation, and helps brain growth and repair.

Another important aspect of sleep is that it is the one physiological function that first changes with aging. The first thing that changes with age is the reduction of slow-wave sleep. When a person is around 20 or 25 years their slow-wave sleep starts to reduce. When the person is around 50, 55, or 60 years their slow-wave sleep completely disappears, and when the person crosses 65 or 70 years their REM sleep starts coming down. This reduction of slow-wave sleep has an effect on what happens in the neural network. Probably no cortico-cortical dialogue takes place, which means that there could be less plasticity changes in the neuronal network. We have studied and evaluated the sleep of expert meditators, ages 30 to 70 years, and have found that even the 70-year old person who has been regularly meditating for a long duration of time has a slow-wave sleep equal to that of a much younger adult. This result speaks volumes about how the thalamocortical network, or the cortical neural network, interacts in meditators. It suggests that more plasticity changes should take place in meditators even in their old age. This brings about greater changes in the functions of different neuronal networks of the brain. We have also found that the REM percentage is significantly more in meditators. As I mentioned earlier, REM is the stage of sleep in which we dream. Decades of research have shown that NREM is the non-dream state. However, there are a few reports that say we dream even
during NREM sleep, but that the content of the dream is different. In REM sleep, the content of the dream is more emotive in nature; in NREM sleep, the dream is more of a working memory. During slow-wave sleep, delta and theta waves, which are slow frequency waves, are produced. The power of delta and theta, which indicates the approximate amount of neurons that are working to bring about a particular stage, can be measured. We have seen that even though meditators spend a very large percentage of time in slow-wave sleep their delta power is less. What does this mean? It means that fewer neurons are required to bring about a particular stage, which means more economy, or conservation of energy, for the brain. Conservation of energy and the recruitment of fewer but efficient neurons for a task is a great benefit for the brain. Cognitive studies have shown that the combination of theta waves and gamma frequency correlates to the memory processing that is taking place and the combination of alpha and gamma supports the attention process. When I pay attention to one particular task my alpha and gamma increases, and when I try to rehearse it, and put it into my memory bank, then theta and gamma is predominant. We also heard Dr. Roy say that there is a 40-hertz frequency that happens in our neural network; we call it the gamma frequency. The gamma frequency tries to glue the different areas of the brain together so that my sensory perception of the external world is perceived as a single unit. In other words, you are seeing me, you are hearing me, and even though the information processing capacity of these two neural networks is different, the overall experience, you seeing and hearing me, is happening simultaneously. It is not that you see me first and then you hear me. This binding of different areas of the brain is brought about by this gamma activity, the 40-hertz gamma activity.

The presence of this continuous gamma activity in any state, whether a waking state or a sleep state, especially a REM sleep state, brings about a unity of experience, or a conscious experience. Whenever there is an interruption in the gamma activity of communication between the different neural networks, it will be non-conscious. In
terms of neurophysiological correlation, the conscious experience is about how different neural networks integrate themselves and get overall integrated information. Does this integration of information happen during sleep? If you analyze a non-meditator during REM sleep, gamma activity is very minimal. But we have observed that an expert meditator, a very senior experienced meditator, will have an increase in gamma activity during REM sleep. This is an important aspect because meditators report that they are either a lucid dreamer—a person who knows they are dreaming—or, if not, when they wake they are able to narrate their dream sequence by sequence. So what happens during sleep? There are no external stimuli. The brain is by itself with its own intrinsic activity, and this intrinsic activity is largely dependent on how my neural networks interact with each other during my waking state.

How do we neuro-physiologically correlate whether someone does or does not dream? There could be error in a subjective experience or report. Studies have shown that during REM sleep there will be more eye movement. One of the explanations for this eye movement is that it is a saccade, a rapidly jerky movement of the eye that will try to scan the visual image during dreaming. This saccade means that dreaming may be taking place. We have seen that the saccade of a control subject, a non-meditator, is less than that of a novice meditator and that the experienced meditator has the highest number of saccades. This suggests that long-term meditators are likely to dream a lot. Their subjective experience is also likely to be different to non-meditators; as there is more gamma during REM sleep there should be more synchrony between neural networks from different areas of the brain.

Other events that occur during sleep are also very important. In Geshe Nyima’s presentation, we heard that just as there are connections between the thalamus and the cortex there is also interaction between the cortex and the hippocampus. The hippocampus is the main area in the brain where memory consolidation takes place. During sleep, whatever information we have gathered during our waking hours is exchanged between the cortex and the hippocampus and from the
hippocampus back to the cortex. This occurs at the frequency range of theta-gamma. It is in this theta-gamma dynamic where these memory processes takes place. It is likely that the activity of the neural network, which is generated by consistent and recurrent thought during waking hours, gets reactivated and consolidated during sleep. I have no definite proof of this but in principle it should happen. I’m not well versed in traditional texts, but I overheard somebody saying that memories are rooted in sleep. I don’t know whether we can correlate this or not. I will have to get input from the Buddhist scholars and the monks who are here.

My overview suggests that sleep provides a good paradigm to study the neurophysiological correlates of consciousness because during sleep the brain is not bombarded with the noise that comes from sensory input. The brain is by itself and the state of neural networks during sleep is more dependent on what our mental state is during waking hours. So during sleep we can study the function of the brain by itself without any noise from external stimuli. Even thought these ideas are very new, and there have not been many experiments, I thought I would share them with you. Your input from the Buddhist perspective will help to deepen our understanding.
Panel Discussion

Monastic graduates on the panel:

- Geshe Tsering Choephel
- Gyaltsen Jampa
- Geshe Thrinley

David Presti (Moderator): I thought we could start out by reconnecting with the questions we left off on having to do with sleep, and consciousness during sleep, and in particular dream states. Several questions were related to what’s going on in dreaming, beyond of course brain activity, rapid eye movement, and so forth. Is there significance to the dream state? What can neuroscience say about the dream state? In particular, some of the questions submitted by our audience ask are there things that we can become aware of during dreams, like premonitions, or information about things that haven’t happened yet? Is this possible?

P.N. Ravindra: Why do we dream and what is the importance of the functions of dreaming? As far as the dream state is concerned, there are many theories that have been put forth. They have not yet been studied under the framework of neuroscience so they cannot be evaluated or authenticated. One theory is that dreaming is a way of letting out a subconscious will or wish. Another is that the dream state is a stress buster; a way of letting out whatever is being packed into
our subconscious mind. There are subjective reports that claim that precognition and such things come about during dreams, but there isn’t any hard evidence to support these claims. To make authoritative claims would be premature.

One thing we can say is that nature has given us a very beautiful mechanism during REM sleep in that our muscle tone is completely lost or diminished. This contrasts with the waking state, when we have good muscle tone and are active. That’s why the REM sleep is called the paradoxical sleep: even though our EEG shows that our brain wave is like that of the waking state, our muscles are almost paralyzed. Nature has given us this mechanism, so just enjoy your dream, don’t enact your dream. Dream enactment is a disorder where people wake up and enact what they see in their dream. Nature has given us the dream state in order to enjoy our dreams.

David Presti (Moderator): I like that, “Enjoy your dream.” I’d like to make one comment, since there were several references to the idea that dreams might be able to say something about the future. In psychological studies, they call this precognition, or having a mental idea about something that becomes true later that would seem impossible to explain in any kind of easy way. It’s a very interesting question. If this is happening, how is it happening? If it is happening, conventional Western physical and biological science has no explanation for it. And yet in some traditions, I suspect in the Buddhist tradition, there is evidence that these things occur, that people get information in dreams about things that haven’t yet happened.

There have been some attempts recently by Western scientists to do very careful experimental laboratory studies on this phenomenon of precognition, in an artificial set up in a laboratory where they present stimuli, and respondents make responses to it. The respondents are making judgments that they shouldn’t be able to make because they don’t have any information yet. They look for statistical correlations and there have been some careful studies recently, one of which was published in a prominent psychological journal by a Dr. Bem from
Cornell University. Also several studies were conducted by a colleague of mine named Dean Radin in the San Francisco area using EEG.

The reactions of the scientific community as to whether this phenomenon is happening or not have been interesting. When this first study was published, the reaction of many people was that this is impossible, this should have never been published, it was a travesty that such a thing should be published, this would violate all the laws of physics and bring down the entire edifice of Western science, and this was in the New York Times. Other studies, based on very good EEG experimentation, have not been accepted for publication yet as far as I know. They were submitted to two important journals in neuroscience, and the journals wouldn’t even look at them. They said this couldn’t be true, so we’re not going to review the paper. It’s very interesting how difficult it is to get a good scientific evaluation of these topics that are not easily explicable within the framework that we have. Dream research may eventually encounter these kinds of barriers also.

**Sisir Roy:** A question for the scholars. In some of the Hindu schools, they say they can change the future in their dreams, that they can foresee that something is going to happen and it is possible for them to change it. Is there such a thing from the Buddhist perspective?

**Monastic Graduate:** When we talk about sleep in Buddhism we divide it into two levels: we have a subtle level, and a gross level. When we are in a deep sleep we don’t have dreams. We only have dreams when we are not in a deep sleep. We also believe that dreams, or signs and signals in dreams, can help to predict future events. Highly realized or special practitioners, and even the average person, can have dreams in which they see signs and signals of future events. By studying these they can predict an event. In order to prevent the fruition of an unwanted event, we sometimes perform rituals or undertaken other action.

**Monastic Graduate:** In addition to what my friend has said, Buddhism does not consider dreams to be real. We view them as a kind of illusion, or mistaken view. Consequently, we don’t pay much
attention to dreams or their content. In the Tantra tradition of Tibetan Buddhism, there is mention of looking at signs in the dream from which you can predict things that may happen in the future. As my friend mentioned, there are rituals that can help prevent the event from taking place. Generally speaking, dreaming is a mistaken state of mind and we do not give much credibility to dream states.

**Pema Dorjee:** The dream is very important for doctors of Tibetan medicine, and even for Ayurvedic doctors, because dreams indicate and predict many things. We also see dreams as part of an omen, which provides information. When a Tibetan doctor visits a patient they see many omens. When you see somebody crying, or see something burning or broken, this provides an indication about the life of the patient, as do sudden changes of behavior or temperament. In terms of dreams, if a patient reports that in their dream they are naked and riding a buffalo, or donkey, towards the south in the direction of a Lord of Death, this gives the doctor information about the status of the life of the patient. There are also good dreams in which you are praised by people you like very much, such as your parents or colleagues, and then you receive a white scarf or other white items, good gifts, that are precious and pure in nature. This indicates that you will be receiving some kind of good luck. In my practical experience, dreams provide a great deal of information that in many cases is reliable if interpreted properly. Dreams are not superstition.

**P.N. Ravindra:** Proper recollection of the dream is very important.

**Pema Dorjee:** The best time for such dreaming is in the pre-dawn or early morning because at that time the central channel will be balanced.

**David Presti** (Moderator): How close do you think neuroscience is to being able to directly stimulate the brain to produce dream states? And perhaps even modulate or affect those dream states in some way?

**P.N. Ravindra:** We do not know of any direct evidence that supports the idea that there is a specific area where dreams are generated. We
know in terms of networking. In that case it can be very difficult to bring about assimilated vividness of the dream. I don’t know because we do not know of any specific area that will really bring about these dreams. Even for dreams, it’s probably a totally integrated networking of the whole brain that brings about this dream state.

**Geshe Nyima Tashi:** What do you mean by the network? Is it like dreaming of a flower where the visual neurons must be functioning? Or what about dreaming of hearing a beautiful sound? They must be on different networks. When dreaming of different things maybe a different network will be used. How do you mean that we know the network? Is there a common network for the dream?

**P.N. Ravindra:** No, there is nothing called the common network for the dream. Network in this sense is the subjective feeling a person has when in a dream state. These dreams happen in the early morning because in a normal sleep pattern the REM sleep increases in the second half of the sleep, which is in the early morning phases. During those phases of sleep, fMRI studies have shown that the activation of the amygdala is very high. And when the person has been woken up to report their subjective feelings, they narrate their dream story, and their feelings are emotive in nature. But when you ask about vividness, colors and such things, I don’t know, we don’t have an answer.

**David Presti** (Moderator): In terms of actually stimulating the brain to dream, we don’t seem to be close. Chemically, there is a particular neurotransmitter called ester-choline, which is involved in the activation of the brain during REM sleep. There are substances that activate the ester-choline receptors, most famously nicotine from the tobacco plant. There are some shamans, especially in South America, where tobacco comes from, that use tobacco to invoke powerful dream states. That’s one way of doing it that doesn’t necessarily allow for manipulation. A better study of how to generate and manipulate dreams probably comes from Tantric dream yoga practices, where folks cultivate the ability to readily control something about the nature of the dream. Many mystics and many experienced yogis have said
that at some level of practice, there is no distinction between the wake state and the sleep state. That’s a very interesting statement, what does that mean? It’s a very interesting thing to ponder.

**Sisir Roy**: A question again for the Buddhist scholars. Until about four or five years ago, we believed that people who were blind from birth did not have visual dreams. But one survey in the United States, not yet published, holds that blind people claim to have visual dreams, very vivid visual dreams, where they describe exactly where they are staying, how their houses have geometrical figures—rooms and doors, etc. Tell me from the Buddhist perspective how blind people have these images?

**Monastic Graduate**: When we talk about dreams in the Kalachakra (cycles of time) text, there is mention of four essential drops. One of these is responsible for dreams. These drops can move from and to the different parts of our bodies. From the Buddhist point of view, it is possible that blind people can see visual objects in their dreams. Even though a particular individual is blind in this life, since their mental continuum comes from a previous life they can have visual signs or sights in their dream.

**Geshe Nyima Tashi**: I don’t think this is restricted to blind people. People who can see may sometimes have dreams where they see something they have never seen before. The dream has a lot to do with imprint, or in scientific terms, adaptation. In Buddhism, you say the imprint of earlier cosmic imprints, or maybe adaptation.

**David Presti** (Moderator): This is probably related. There were other questions related to Geshe Nyima’s talk about mental consciousness. Could you say more about the sixth sense?

**Geshe Nyima Tashi**: I have been trying to look into what scientists and Western philosophers are saying about the sixth sense. I don’t think they have accepted this, but they describe some beautiful things. There’s a sixth sense that is something that you experience which is
unseen by the five senses. There is something you cannot see from the eye, you cannot hear or touch beyond the object of these five senses, and the sixth sense detects that object.

David Presti (Moderator): What does Buddhist philosophy have to say about mental consciousness being a place where all other kinds of information is realized, for example, through dreams?

Geshe Nyima Tashi: According to Buddhist texts, the mental concept, the mental perception, can perceive everything, and not only what the five senses can detect. It has the capacity to know everything.

David Presti (Moderator): Does that mean, for example, that if dreams can somehow sense information that goes beyond what normal senses might be sensing, then the mental consciousness might be involved?

Geshe Nyima Tashi: In Buddhism, sleep is one kind of mental factor, which is considered neither virtuous nor non-virtuous. Before you go to sleep, if your mental state is positive or virtuous, we say that your whole night dream is going to be virtuous. If you go to sleep with anger or hatred, then your whole sleep will be a negative or non-virtuous sleep.

Monastic Graduate: I think this question is for Sisir Roy and Dr. Ravindra. Can we have neurotransmitters that are specifically responsible for different mental states like happiness or sadness?

P.N. Ravindra: Yes, there are various neurotransmitters that are chemicals that are being correlated with the various mental states, including happiness and sadness. For example, it could be dopamine or melatonin. What do Buddhist texts say about non-dream sleep states? Do they have any specific role?

Monastic Graduate: In Buddhist texts, it is said that when we go to sleep all our five sense perceptions cease to exist. When we enter into the sleep state, only our mental consciousness is present; there is no
sensory consciousness. When very highly realized practitioners enter the very deepest level of sleep, they can actually direct that sleep state to examine the nature of emptiness and the nature of phenomena, the real nature of phenomena. The average person experiences different layers of sleep. However, if we are not practitioners we don’t realize, or we don’t directly perceive, the existence of our consciousness during our sleep state. It becomes kind of dormant and demonstrates that we don’t know, or we don’t recognize, or we are not aware of our own consciousness at that time.

**Monastic Graduate:** In Buddhism it is also said that the mental state you are in when you fall asleep, whether positive or negative, will carry forward irrespective of whether you dream or not. If you are in a positive mental state when you go to sleep, your mental continuum remains in a positive state until you awake the next morning.

**Sisir Roy:** A small question again for the Buddhist scholars. A couple of years ago a scientist discovered fruit flies have a dream like state. What does the Buddhist tradition think about that?

**Geshe Nyima Tashi:** First, I would like to know how we know that the fruit fly is actually dreaming? However, I think we are not surprised if it does.

**David Presti** (Moderator): Neuroscience says that the fruit fly has an electrical state that is similar to REM sleep in humans. Since that is correlated with dreams in humans, then maybe the fruit fly is dreaming. Of course, we don’t know the mental experience of a fruit fly.

**Geshe Nyima Tashi:** It seems that the way in which the sign and dream are defined is closely related to culture.
Serving Humanity

Panel Discussion

Monastic graduates on the panel:
Kachen Lobsang Thugje
Lopon Shelnang
Khenpo Jamyang Gonpo
Geshe Phuntsok Namdol
Geshe Passang Gyatso

Chris Impey (Moderator): This is the last session of a very exhilarating and intriguing three days. I think it is going to be a challenge to recapitulate three days in an hour, but we will try. I ask that everyone around me be brief and conscious of time. We are a large group and we want to hear from everyone.

We’re going to have a couple of questions that come from the monastic graduates summarizing a general concern, or issue, that will
be open for any of the panelists to respond to. Then I’m going to ask the presenters to give their own version of what the next steps might be.

Let me start with the two questions summarizing the input of the monastic graduates. First, what is the most important goal that has so far been achieved in this dialogue between science and Buddhism? Second, what do you expect to achieve in the future?

**Paul Doherty:** The important goal is sharing both ways. Buddhism has well over 2,000 years of thinking about the meaning of words, and probing the mind, and the young upstart science has only 400 years of probing the physical world. As we noted in the conference, science has one of its limits in quantum mechanics. As we probe the very small, we run into particles that behave as waves and waves that behave as particles. When we begin to ask questions of those particles and waves, to do experiments with them, it seems like the questions we ask are about the consciousness of the observer. The doing of the experiment interacts with the experiment, and we are on the verge of trying to understand how that can be. I believe the long tradition of Buddhism may give us some guidance on how to think about doing those experiments.

**Chris Impey (Moderator):** Many thanks. That’s a good thought and a good model for an answer.

**Bruce Greyson:** As a Western scientist, I am a methodologist, not a theoretician. What excites me most about this dialogue is learning new techniques from the Buddhist scholars—the long tradition of technology in meditation and introspection and the vocabulary for these internal states that we in the West have barely begun to explore. I’m excited about the possibilities of taking some of these techniques and applying them in our Western settings.

On a larger scale, I think one of the biggest advantages, or benefits, from this collaboration is a change in attitudes on both sides. As a
Western scientist, I know that a lot of Westerners feel that science and religion in general are enemies and cannot ever coexist peacefully. And from what His Holiness said on the first day, many of his advisors thought that it would be dangerous to introduce science into Buddhist training. I think what we are seeing here is that there is a lot we have in common and there is a lot more we can do to help each other. We don’t have to be on opposite sides; instead we can collaborate in helping enhance our scope of knowledge and our ability to help humankind.

**Geshe Lobsang Tenzin Negi:** With regards to where we go from here, the next phase is to implement science education and dialogue into the monastic curriculum itself. That is the goal of His Holiness the Dalai Lama, to bring science into the core curriculum in monastic education. That is the next goal.

I think that the dialogue that has been taking place between scientists and Buddhist contemplatives over the last 20 or 25 years—ever since the first Mind and Life Conference in 1987 that His Holiness initiated—has produced really impressive outcomes. Now there is a new field in academia called the Contemplative Sciences. To make authoritative claims would be premature.

What is the next phase of this interaction in terms of the larger scale? I think we need some form of academic program that would teach what his Holiness the Dalai Lama calls secular ethics, which he has emphasized for many years. I think that’s where we need to go to make a real contribution to the wider community—changing the very culture of people’s mindsets—because ethics is the key for the harmony and wellbeing of society at large.

**Rajesh Kasturirangan:** I’m going to try to expand the question just a tiny bit in that I want to include not just Buddhism, but the other Indian philosophical and religious traditions. There is now increasing recognition that ideas from these traditions have just as much to say about how mind and consciousness are to be investigated, and that if
new insights are to come from these traditions they might over turn the way that this particular mind science is done.

But even more dramatic would be to take things that are at the foundations of science and apply the insights of these traditions. The mind sciences are a relatively small corner. Physics is considered the most fundamental science—and maybe mathematics is as fundamental as physics. One possibility is that even our ideas of mathematic and physics will change because of the insights we get from these traditions. To give you a quick example: we were talking yesterday about how we think of mathematics as just bedrock, $2 + 2$ is always 4. But maybe that’s just conventional reality. Right? If that were the case, then the entire foundation of science would have to be rethought. These are the kind of radical experiments that can be done to address how science itself is to be understood. Science has a specific history in the West; if it had developed in the East it might have taken a different shape.

These are the questions that we can now begin to ask because of this kind of dialogue. We can also consider the distinction between is and ought, which is so central to modern science. We might see that this is actually a false distinction—that the way the world ought to be and the way the world is are not that different from each other. Of course, for these contemplative traditions that’s central because reality is not just the way the world is, but also the way the world ought to be.

**Monastic Graduate:** I think there are many things that we can gain from this kind of dialogue. It gives scientists and Buddhist scholars the opportunity to meet and share their knowledge. It also provides an opportunity for Buddhists scholars to meet each other. We belong to different traditions of Tibetan Buddhism and live in different monasteries. We don’t have many opportunities to meet with our colleagues to share our knowledge, wisdom and ideas.

Dialogue also provides Buddhist scholars with the opportunity to learn from the scientists. For example, in Buddhism we have a
profound knowledge about how objects are viewed by the subjective mind but not much detailed description. When you look at a flower, for example, it is said that your consciousness, or the eye consciousness, is engaging with the flower, or that eye consciousness sees the flower. Science provides a more detailed description. Our science teachers have explained how light is formed on the flower, how light is absorbed and reflected from the flower and then goes to our eyes, retina, and the visual cortex and how the brain processes the whole image. This kind of detailed description enhances our own knowledge. This is just one example. There are many ways in which we can benefit from this dialogue with scientists and I hope the scientific community gains as well.

Chris Impey (Moderator): I would echo the sentiment behind that. Monastics and scientists share something—we both, sometimes, need to get out a bit more! Scientists can be monastic in their own way. Getting out, and looking at the world in a new way, illuminates the perspective you have on your own, or what you are familiar with, and I know that’s true for me as a scientist.

To continue and answer the question—and to relate to what Paul said—in the West, and in our realm of professional science, many people adhere to the view of the late Stephen J. Gould, who said that science and religion were not overlapping. That’s fine, but it ignores the fundamental fact that faith and reason coexist in human beings all over the world. For me, the fact that the dialogue works, is fruitful, rich, invigorating and inspiring to each side, and the practitioners, and makes them look at their own fields in a new way, is the biggest achievement so far.

The next step is implementation. We may hope for some of these grand advances of a general theory of neuroscience, but it probably isn’t going to happen anytime soon. In the meantime, we have to chip away at some of the Western scientific paradigms—they provide no complete explanation, no perfect theory—and find ways to increase the landscape of overlap and co-operation, and scientific experiments
and exchanges.

**Geshe Jangchup Choeden:** It’s a great pleasure and opportunity to be part of this conference and dialogue with so many great scholars and honorable colleagues. In the last three days, I’ve listened to scholars from many different fields—including the fields of neuroscience, physical science, experimental physics, and even the fields of rebirth and Tibetan medicine. It would take me half a year to read up on the literature in these fields and I would not get the same valuable and essential information. It’s an unprecedented experience to be in such an environment and I feel that I have learned a lot.

I have access to a few books from time to time, and I remember that in one of his books Chris said that science, and culture, and spirituality are the creations of human beings and each has its own beauty. We need to be open to seeing the beauty in different fields of study and different paths. The participants in this conference are open-minded people from different fields. There are probably many hardline scientists who would not take part in these exchanges. I really do appreciate your openness. It is something I respect from the depths of my heart.

I think it is important that in future conferences we have more monastic scholars, and more open-minded scholars and academics from all the fields of science. As Rajesh said, it’s also important to include representatives of other contemplative traditions. After all, it’s a learning process. We can learn from everyone, even a child, so why can’t we learn from other contemplative traditions too? We should always remain open. I think we should be open in organizing future conferences and dialogues.

**Chris Impey** (Moderator): That’s an excellent sentiment. I think we have a clear message to expand the conversation. We heard earlier that it would be nice to have women more involved, and there are fields that illuminate many areas that we’ve been talking about, such as philosophy, which are not truly represented. There are other
contemplative traditions. Yes, the conversation can be expanded. If we become too closed a group, we just stay in our comfortable circle of people who are familiar with these dialogues.

To segue to the second question, I’m going to ask you what is the single most interesting, important, surprising thing you learned during the conference?

**Geshe Jangchup Choeden:** I learned a little bit about the black hole from dear Professor Doherty and I also learned something about neutrons. I learned many exciting things. I do appreciate that. Thank you.

**Bruce Greyson:** In one sentence, although Buddhist philosophy and scientific philosophy start with very different assumptions, I’ve learned how similar they are in the sense that their methodology is the same in looking at an assumption and then testing it out, not assuming that it’s true, but trying it out and seeing whether it works.

**Geshe Nyima Tashi:** I learned from Dr. Greyson how they are seriously trying to find our mind outside the brain.

**Chris Impey** (Moderator): The thing that struck me the most—because it’s present in the Buddhist tradition and empirically from Bruce’s talk—is the idea of a mind not needing a brain. It’s a game changer. In my field, it changes everything about the search for life in the Universe. We are looking for our keys under the lamp because that’s where we can look for our keys. We look for planets around stars and life forms on planets that are like Earth. But if mind and consciousness and intelligence don’t need a brain, then we don’t really know what we are doing.

**Geshe Lobsang Tenzin Negi:** I literally learned something from every presenter, but one thing that really struck me was Dr. Ravindra’s presentation on how the meditative states can have an effect on sleeping patterns. And, in turn, how such changes in sleeping patterns can affect health and have an impact on your well-being. That was a
new insight for me, and I’d really like to learn a little more about that.

Paul Doherty: I was most impressed by the way that the monastic graduates learn. I have never met a group that is so present while learning and takes such an active role in questioning and arguing. It’s an active learning that I wish I could take back with me and spread around to American institutions of learning.

Chris Impey (Moderator): I’ve got to echo that. Having taught in the Science for Monks workshops, I would like to somehow bring the 22 million undergraduates at colleges and universities in the United States to be flies on the wall, to see what happens in the classrooms here with the monastics, and than say, “Go back, do your best, try and do this! And laugh more.”

Rajesh Kasturirangan: Actually just a segue from what Chris just said, at the very end, and on a half serious note, the thing that I liked the most was that the monks have a great sense of humor, and even when we don’t understand what they are saying, it’s great to see people cracking-up both on stage and outside.

David Presti: Also in line with those comments, here is another university teacher who really appreciates the enthusiasm for learning among all of you. Especially for folks who had no previous exposure to science, had no kind of existing investment, the enthusiastic openness displayed continuously all the time is remarkable, and I totally agree, I’d like to bring all the students in America to witness this.

Chris Impey (Moderator): The second question gets back to the title of this panel discussion, which is “Serving Humanity.” I’ll read the second question and then crystallize it with a little more focus: Since we haven’t solved the problems we hoped would be solved by the development of science and technology, what should be our future directions for solving the problems we face? That’s a huge question. Let me give it a slightly tighter focus and ask anyone to respond to the question of how we take the things we’ve learned and talked about
and give them an application that benefits humanity, that improves people’s wellness or state of being, or illuminates their lives in some way.

First of all, we don’t need to be too despairing about science and technology. I don’t think it’s a negative–positive thing. The failures of the materialist, reductionist view of science have been clearly on display in the last three days. However, science and technology in the last century have helped to raise one and half billion people out of poverty and improved life spans by 20 years. That is a phenomenal impact on the human race, and there is no reason we can’t feed a planet with 7 billion people. The landscape is not bleak in that regard; the failures are there but they don’t overwhelm the successes.

As far as taking this in the direction of benefit, it’s far from my field, but I’ve seen very clearly the ways in which the illumination of the boundaries of the Western view of these scientific fields leads to new insights and new ways of thinking. That’s true even without the revolution that would accompany a paradigm shift with a true theory of neuroscience akin to our fundamental theories of physics. It’s clear that there are ways that we can improve wellness—Bruce alluded to some very profound ones and we’ve heard some more this morning. There are ways we can do it using the information that is the landscape that the Buddhist tradition has experienced for centuries, and the ideas go back millennium. To bring those into the Western realm of medicine seems like an obvious way to improve lives. Bringing those philosophical ideas into the Western way of doing science “opens up the box” on our thinking and leads to the possibility of better theories in places where basically we are stuck. That’s what I would see as possibilities. Anyone else?

Monastic Graduate: I teach Buddhism in my monastery and before I joined this one–month workshop I had no knowledge of science. I learned a great deal from the workshop and conference and it has strengthened many of my beliefs, as well as my faith in what I teach. I used to think that scientists were mainly concerned with material
development and making money. After listening to the workshop teachers and conference presenters I have come to realize that not all scientists are like that. I have also realized that scientists follow empirical evidence and that they see reasoning and empirical evidence as the highest authority. This is important for us. In the future, I will adopt the findings of any theory or field of knowledge that are driven by empirical evidence even if the findings go against my beliefs and tradition. I will follow the new path based on reason and evidence. After attending the workshop and conference, I now understand why His Holiness is encouraging us to learn science.

I'm not in a position to organize these kinds of dialogue, but I ask those who are to organize many more. We would especially like to thank Geshe Lhakdor and Bryce for organizing the workshop and conference. We would also like to thank the presenters.

Chris Impey (Moderator): Not to correct you but I think all the graduates of the Sager Science Leadership program, and all the students who have been through the Emory program, are indeed in a position to lead the dialogue themselves. That's part of the reason we are doing this. Maybe the dialogue is small, maybe it's within the monastery, with your young monks, or maybe it's outside in the communities near your monasteries, but you actually are qualified. You're equipped to continue the dialogue.

Bruce Greyson: How this dialogue can help humanity is a very important question because I think it is a question that scientists have gotten out of the habit of asking. I think one of the effects of this dialogue will be to remind scientists of why we are doing science.

When scientists apply for a research grant, or submit a paper for publication, we have to justify our choice of research participants, our choice of methodologies, our procedure, our instruments, our measurements, our statistical analyses, and explain how our study relates to previous knowledge. But we are not asked, “How will this make people happier?” We just assume that any advance in knowledge
will help humanity. As Chris pointed out, it often does, but not always. If we made it a part of every grant application to ask, “How will this make people happier?” that could change the type of research we do and how we do that research. I think we need to keep asking ourselves, “How does this work really help humanity, and how can we change it so it will do it better?” Just asking the question is half the battle, I think.

**Monastic Graduate:** When I took part in the neuroscience and science classes, I began to question my idea that mind is the only *real* thing and began to see the brain as more significant. After listening to the presentations in this conference, and especially Bruce’s presentation, it seems that mind, or consciousness, is the most important. This is one of the experiences I had during the conference.

**Geshe Nyima Tashi:** I was just saying to my Buddhist colleagues, “Why are we learning science? Why science and Buddhism? Why science and ancient culture? Why are we doing it? What could be the reason?” The reason has been made clear by His Holiness the Dalai Lama many times. Now, our responsibility is to work on that path. I was suggesting that it would be good to make our monastic colleagues—those who didn’t attend the conference—aware of science. Thank you.

**Pema Dorjee:** From my experience, there is much in the Tibetan medical tradition that can be shared during these dialogues. It’s very important. My suggestion is to at least study the basic concepts of Tibetan medicine.

**Rajesh Kasturirangan:** As His Holiness himself said on the first day, there is a need for a secular ethics that may come out of these dialogues. I think we need to expand that a little bit, we need a kind of package. I’m thinking of a cognitive tool kit, with things that are basic to science, reasoning, and ethics that everybody needs to know to be a citizen in the 21st century. Something that is easy enough for everyone to understand, that isn’t dependent on culture, and that will be of use
to all of us. Even if we cannot address all the problems of the world, we may have a method by which we can arrive at reasonable answers.
ABOUT THE PRESENTERS

Chris Impey

Chris Impey is a University Distinguished Professor and Deputy Head of the Department of Astronomy at the University of Arizona, in charge of academic programs. His research is on observational cosmology, gravitational lensing, and the evolution and structure of galaxies. He has over 160 refereed publications and 60 conference proceedings, and his work has been supported by $20 million in grants from NASA and the NSF. As a professor, he has won eleven teaching awards, and has been heavily involved in curriculum and instructional technology development. Impey is a past Vice President of the American Astronomical Society. He has also been an NSF Distinguished Teaching Scholar, a Phi Beta Kappa Visiting Scholar, and the Carnegie Council on Teaching’s Arizona Professor of the Year. Impey has written over thirty popular articles on cosmology and astrobiology and authored two introductory textbooks. He has published three popular science books: The Living Cosmos (2007, Random House), How It Ends (2010, Norton) and How It Began (2012, Norton). He has three more popular books in preparation, including one about the Science for Monks program called Humble Before the Void (2013, Templeton Press). He was a co-chair of the Education and Public Outreach Study Group for the Astronomy Decadal Survey of the National Academy of Sciences. In 2009, he was elected a Fellow of the American Association for the Advancement of Science. He has participated as instructor in the Science for Monks program since 2008.
Khen Rinpoche Jangchup Choeden

Khen Rinpoche Jangchup Choeden is Abbot of the prestigious Gaden Shartse Monastery, located in the state of Karnataka, Southern India. He was appointed to this position by His Holiness the Dalai Lama in 2009. Prior to his appointment, he studied Buddhist philosophy for many years under the great masters and former abbots of the monastery and held several administrative posts including General Secretary of the Education Development Project. In 1997 he was awarded the Lharampa Geshe degree from Gaden Shartse Monastery. A decade later, in 2007, he was awarded the Ngagrampa degree in Tantric Studies from the famed Gyuto Tantric University, Dharamsala, Northern India. Geshe Janchup Choeden is fluent in many languages and has traveled extensively to teach the Dharma throughout America, Europe and Asia. In February 2011, he supervised the successful visit of His Holiness the Dalai Lama to Gaden Shartse Monastery.

Rajesh Kasturirangan

Rajesh Kasturirangan’s research interests are in cognitive science and philosophy of mind. His current work relates to applying a combination of philosophical argument, mathematical techniques and empirical observations to classical problems in cognitive science and the philosophy of mind such as the semantics of natural languages, the epistemology of beliefs and the structure of intentionality and consciousness.

Bruce Greyson

Bruce Greyson, M.D., is the Chester Carlson Professor of Psychiatry & Neurobehavioral Sciences and Director of the Division of Perceptual Studies at the University of Virginia, and a Distinguished Life Fellow of the American Psychiatric Association. He was a founder and Past
President of the International Association for Near-Death Studies, and for 26 years edited the Journal of Near-Death Studies. Dr. Greyson graduated from Cornell University, received his medical degree from the State University of New York Upstate Medical College, and completed his psychiatric residency at the University of Virginia. He held faculty appointments in psychiatry at the University of Michigan and the University of Connecticut, where he was Clinical Chief of Psychiatry, before returning to the University of Virginia, where he has practiced and taught psychiatry and carried out research since 1995. His research for the past three decades has focused on near-death experiences and has resulted in more than 80 presentations to national scientific conferences, more than 100 publications in academic medical and psychological journals, and several research grants and awards. He is the co-author of *Irreducible Mind: Toward a Psychology for the 21st Century* (2007), and co-editor of *The Near-Death Experience: Problems, Prospects, Perspectives* (1984) and *The Handbook of Near-Death Experiences: Thirty Years of Investigation* (2009).

**Geshe Lobsang Tenzin Negi**

Geshe Lobsang Tenzin Negi, Ph.D., is the founder and director of Drepung Loseling Monastery, Inc., in Atlanta, GA, and a Senior Lecturer in Emory University’s Department of Religion. He also serves as Director of the Emory–Tibet Partnership, a multidimensional initiative founded in 1998 to bring together the foremost contributions of the Western scholastic tradition and the Tibetan Buddhist sciences of mind and healing. In this capacity, he serves as Co-Director of both the Emory–Tibet Science Initiative and the Emory Collaborative for Contemplative Studies. He also developed Cognitive-Based Compassion Training (CBCT), a compassion meditation program that is currently utilized in a number of research studies, including an NIH-funded study examining the efficacy of compassion meditation on the experience of depression. Dr. Negi, a former monk, was born in Kinnaur, a small Himalayan kingdom adjoining Tibet. He began his
monastic training at the Institute of Buddhist Dialectics in Northern India and continued his education at Drepung Loseling Monastery in Southern India, where he received his Geshe Lharampa degree, the highest academic degree granted in the Tibetan Buddhist tradition, in 1994. Dr. Negi completed his Ph.D. at Emory University in 1999; his interdisciplinary dissertation centered on traditional Buddhist and contemporary Western approaches to emotions and their impact on wellness.

**Paul Doherty**

Paul Doherty is a Ph.D. physicist who graduated from M.I.T. in 1974. He then became a professor of physics at Oakland University for a dozen years. For the last 25 years he has been a scientist at the Exploratorium. In 1992 he was the founding director of the Center for Teaching and Learning at the Exploratorium. He is now a senior staff scientist and the co-director of the Teacher Institute at the Exploratorium. In 2002 the national Association of Science Teachers presented him with the Faraday Award for Excellence in Science Teaching. Dr. Doherty has authored many books including the Exploratorium Science *Snackbook*, and the million-selling *Explorabook*. In 2011 he taught his first science course for Tibetan monks and nuns in India.

**David E. Presti**

David E. Presti is a neuroscientist at the University of California in Berkeley, where he has taught in the Department of Molecular and Cell Biology for nearly twenty years. For many years he also worked as a clinical psychologist in the treatment of addiction and of posttraumatic-stress disorder (PTSD) at the Department of Veterans Affairs Medical Center in San Francisco, where he treated thousands of individuals for these conditions. His areas of expertise include the chemistry of the human nervous system, the effects of drugs on the
brain and the mind, and the treatment of addiction. He has doctorates in molecular biology and biophysics from the California Institute of Technology and in clinical psychology from the University of Oregon. He teaches large undergraduate courses at UC Berkeley on the subjects of “Brain, Mind, and Behavior,” “Drugs and the Brain,” and “Molecular Neurobiology and Neurochemistry,” as well as small seminar classes on “Music and the Mind” (for freshmen) and “From Synaptic Pharmacology to Consciousness” (for molecular biology and neuroscience graduate students), and has received multiple University awards for teaching. His primary research interest is the relation between mental phenomena (such as what is called consciousness) and brain physiology, the so-called mind–body problem.

Geshe Nyima Tashi

Geshe Nyima Tashi was born in 1961 and became a monk of Sera Monastery, Northern India, at the age of 12. He completed his formal monastic training in 1998. After receiving his Geshe degree, he worked for Sera Monastery for four years in the Department of Philosophy and Dialectic Studies where he also served on the exam committee. Geshe Nyima Tashi attended the first science workshop organized by the Library of Tibetan Works and Archives in 2000 and has since attended over a dozen workshops organized by the Library. He has been active in bringing science education to Sera Monastery and has served as the coordinator for the Science Meets Dharma program and regularly participates in the Science for Monks program as a coach and co-organizer.

Sisir Roy

Sisir Roy is a Professor of Physics and Applied Mathematics and Professor-In-Charge of Physics and Earth Sciences at the Indian Statistical Institute. His research is on Foundations of Quantum
Theory, Quasar Astronomy and Cosmological Debates, Modeling Brain Function and Cognitive Activities. He has over 100 refereed publications in international journals and 20 conference proceedings. So far he has published ten research monographs. Recently he has published a book called **DEMystifying The Akasha: Consciousness and the Quantum Vacuum** jointly with Prof. Ralph Abraham, University of California, USA. The authors discussed the implications of 21st century physics and various metaphysical issues in the context of Indian philosophy. He has co-published a paper with provocative ideas entitled “The prediction imperative as the basis for self-awareness” in *Philosophical Transactions of the Royal Society*, jointly with Prof. Rodolfo Llinas, New York University School of Medicine, USA. The epistemological issues related to the ideas presented in this paper might have deep connections with Tibetan Buddhist views.

**Pema Dorjee**

Dr. Pema Dorjee was born in Tibet in 1950 and is an alumnus of the Central School for Tibetans in Darjeeling, West Bengal, India. Dr. Dorjee completed his medical studies at the Mentsekhang Institute in Dharamsala, Northern India, in 1974 under the renowned professor Dr. Barshi Phuntsok and his internship under the guidance of Dr. Yeshi Dhonden, the former personal physician to His Holiness the Dalai Lama. Dr. Dorjee has served as chief medical officer at various branch clinics of the Mentsekhang Institute. He has travelled extensively to Tibetan settlements in India, giving consultation to patients and public health care talks. Dr. Dorjee was the first Chairman of the Central Council of Tibetan Medicine and General Secretary of the Mentsekhang Institute. Dr. Dorjee has served the Institute for the last 30 years and as a Tibetan medical practitioner for the last 35 years. At present he is the advisor and one of the governing members of the Institute. In addition to his achievements as a medical practitioner, Dr. Dorjee is a successful author and the recipient of numerous honors. He has been the keynote speaker at many conferences.
P.N. Ravindra

P.N. Ravindra is an Associate Professor in the Department of Physiology and Neuroscience at the Sri Siddartha Academy of Higher Education and the Sri Siddartha Medical College and Hospital, Karnataka, India. His research interests include mechanisms involved in bringing about changes in the central nervous system, and in peripheral cardiovascular, autonomic, and immune systems, by yoga / meditation practice and their therapeutic application.
About the Organizers and Editors

Geshe Lhakdor

Geshe Lhakdor is the Director of the Library of Tibetan Works and Archives in Dharamsala, India. A distinguished Buddhist scholar, he was the English interpreter and translator for His Holiness the 14th Dalai Lama from 1989 to 2005. He has co-translated and co-produced several books by the Dalai Lama. From 1976 to 1986, Lhakdor studied specialized Buddhist philosophy at the Institute of Buddhist Dialectics, Dharamsala, and received the Master of Prajnaparamita in 1982 and the Master of Madhyamikain 1989. In the same year, he received the Master of Philosophy from the University of Delhi. Since 2002, Geshe Lhakdor has been an Honorary Professor at the University of British Columbia, Vancouver, Canada. In 2008, he was conferred an Honorary Professorship by the University of Delhi, Department of Psychology.

Bryce E. Johnson

Bryce Johnson has 12 years’ experience directing and implementing inquiry-based professional development initiatives for the Science for Monks program in India, and is currently a Staff Scientist at the Exploratorium in San Francisco, USA. He received a B.S. in 1997 and M.S. in 1999 from the University of California, Santa Barbara in Mechanical Engineering. During this time he developed a personal interest in science and philosophy. Bryce lived in Dharamsala for two years from 1999 to 2001 where he helped start the Library of Tibetan Works and Archive’s science education initiative. During this time he
began to develop a deep appreciation for Buddhist philosophy and sharing Western science with Tibetan monastic scholars. In 2007, he completed a Ph.D. in Environmental Engineering from the University of California, Berkeley. Dr. Johnson has worked as a scientist for the California Environmental Protection Agency on water quality issues related to mercury contamination in Northern California. In 2008–2009 he worked as an IC Postdoctoral Fellow at Texas A&M University at the Laboratory for Oceanographic and Environmental Research in Galveston, Texas. At the Exploratorium, Dr. Johnson works with the Exploratorium’s Teacher Institute on professional development for middle and high school teachers, and with the Outdoor Exploratorium developing exhibit ideas that connect visitors with the San Francisco Bay. His teaching interests focus on environmental sciences with an emphasis on the connection between humans and their impact on aquatic environments.

**Science for Monks Program**

The Science for Monks program was established in 2001 through a unique partnership between the Library of Tibetan Works and Archives and the Sager Family Foundation based in Boston. Since its inception the program has worked to establish the indigenous capacity of the Tibetan monastic community to learn science and engage scientists in dialogue.

[www.scienceformonks.org](http://www.scienceformonks.org)

**Library of Tibetan Works and Archives**

The Library has a 43-year history in the exiled community as a non-sectarian public institution dedicated to the preservation, dissemination, and continuation of the unique culture of the Tibetan people. The Library is one of the premier institutions in the world specializing in Tibetan studies, providing comprehensive resources and programming that attract scholars from around the world.

[www.ltwa.net](http://www.ltwa.net)
Exploratorium

The Exploratorium is a museum of science, art, and human perception founded in 1969. The Exploratorium’s mission is to create a culture of learning through innovative environments, programs, and tools that help people nurture their curiosity about the world around them. Each year, more than 1,000,000 individuals visit the Exploratorium, approximately 20 million visits are made to its web site, and more than 400 teachers participate annually in more than 40 hours each of professional development.

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