Godhead is light. Nescience is darkness. Where there is Godhead there is no nescience.

# BACK TO GODHEAD

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Science

# HIGH TECHNOLOGY AND THE GROUND OF BEING

Experiments with phase conjugation may help link physics to metaphysics—and metaphysics to a comprehensive spiritual world view.

Text and illustrations by
SADĀPŪTA DĀSA

In the United States and the Soviet Union, scientists compete to perfect optical phase conjugation—a process that can reverse the motion of a beam of light, causing an image scrambled by an irregular medium (such as frosted glass) to return to its original, undistorted form. They hope to use reversed light beams to focus laser weapons on enemy missiles.

At Syracuse University an eminent physicist appears before a large audience. A professor of religion introduces him as the man who may save the world from the fragmentation of modern Western thinking and bring people to a platform of transcendental wholeness. The physicist then begins expounding metaphysical ideas based on physics and Eastern philosophy.

Although it may seem surprising, the military research work and the university lecture share a common foundation in a fundamental feature of the laws of physics. To understand how this is so, let us first consider optical phase conjugation.

The application of the technology of optical phase conjugation to "star wars" weapons systems is still in the conceptual stage, but the unscrambling of light that has passed through frosted glass has actually been demonstrated (see Figure 1). In a typical experiment, light is reflected from an object and passes through frosted glass, causing the light beam to distort in a complicated way. The beam then reflects from a device called a phase conjugate mirror, which reverses the distorted beam and passes it back through the frosted glass. When the light enters an observer's eye, he perceives a clear, undistorted image of the original object instead of a garbled blur, which he would see if the image were reflected back through the glass by an ordinary mirror.

As the reflected beam leaves the phase conjugate mirror, it has the curious properties that (1) it encodes information for the original image in a distorted, unrecognizable form, and (2) as time passes, the apparently random distortion is reduced, and the information contained by the beam becomes clearly manifest. Normally we would expect to see just the opposite—a pattern containing meaningful information will gradually degrade until the information is irretrievably lost.

According to classical physical theory, however, the laws of physical dynamics are reversible, and thus it is possible in theory for any physical process to run backward and recreate an earlier state of affairs from its later end product. This implies that information is never actually lost as a result of physical transformations, and in principle it might be possible to again extract the information from the cosmic energy background. The restoration of a garbled image by a phase conjugate mirror seems to provide an example of this.

While the phase conjugate mirror example shows an apparently random pattern being produced by letting an orderly pattern degrade by natural processes, random patterns can also be produced in other ways. In some techniques of optical phase conjugation, one adds to the reflecting beam a predistorted image—of a face, for example—that was not present when the beam first passed through the clouded glass. As the beam retraces its path, the face undistorts and becomes clearly visible.

**A beam of light emerging from a cloud** focuses on a screen to form a sharp image of an apple. Although this seems highly improbable, such a beam could actually be generated using the technology of the optical phase conjugation. This gives a hint as to how the manifestation of organized form, which to mundane vision seems to proceed automatically from disorganized matter, can be directed by an unseen transcendental intelligence.

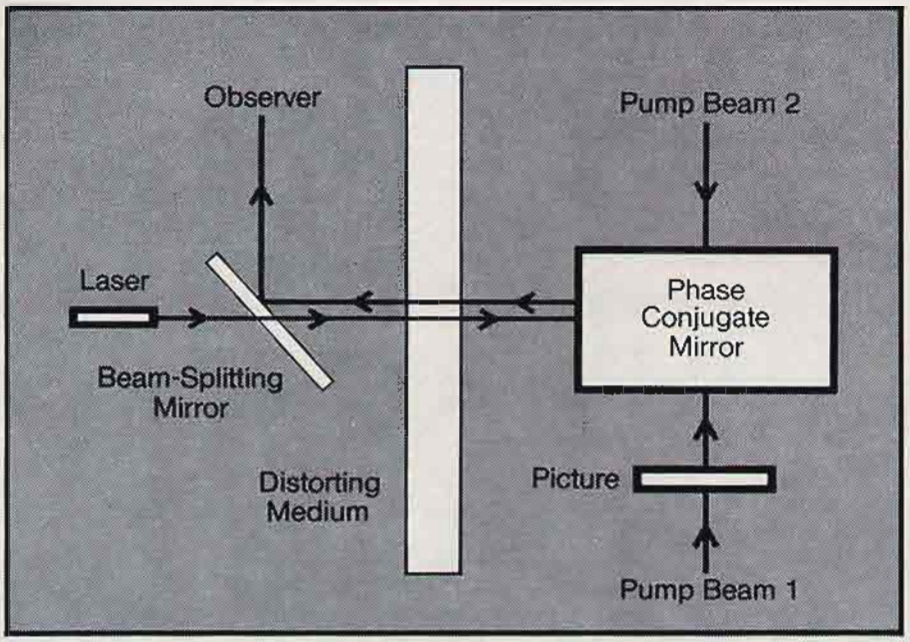


**Figure 1:** A diagram of apparatus for sending an image through a distorting medium such as a pane of frosted glass or a cloud. Light from the laser (at left) first passes through the distorting medium and stores in the phase conjugate mirror (right) information encoding that medium's particular pattern of distortion. The first pump beam of the phase conjugate mirror passes through a transparency of the image to be transmitted and is combined with the distortion information encoded in the phase conjugate mirror. The result is a predistorted beam that moves to the left through the distorting medium, emerges on the other side, and carries to the observer (top left) a sharp image of the picture being transmitted.

This example of research in optical phase conjugation has bearing on metaphysical questions. Could it be that the universal background of random electromagnetic noise incorporates patterns that are imposed on the physical medium by a transcendental source of order, and which are programed to naturally generate orderly forms and sequences of events?

*The Implicate Order*

As it turns out, the fact that dispersed information can give rise to localized organization has been used as the cornerstone for a comprehensive metaphysical world view. This is the theory of the implicate order, devised by David Bohm—the physicist in our second scenario.

Bohm generally illustrates his ideas with an apparatus consisting of two concentric cylinders with the space in between filled with a viscous fluid such as glycerine. If a drop of ink is placed on the surface of the fluid and the outer cylinder is slowly rotated, the drop will be drawn out into a long, thin strand that ultimately will become invisible. If the outer cylinder is then slowly rotated in the opposite direction, the stretching out of the drop will be reversed, and at a certain time the drop will again become briefly visible. Then it will again stretch out and disappear as the rotation of the cylinder continues.

We can see that this is another example of how information for an organized structure—in this case the drop of ink—can be dispersed throughout a physical medium in an unrecognizable form and then recovered through a physical transformation that restores the original structure. Bohm would say that the dispersed ink drop has become enfolded in the fluid, and that when it reappears, it has become unfolded.

From this example we can understand Bohm's world view by two steps. In the first step, we imagine that all phenomena in the universe are enfolded in an ultimate physical substrate—the ground of all being—which Bohm calls the "implicate order." As processes of physical transformation occur in this substrate, successive enfolded patterns unfold and emerge in explicit form, manifesting the "explicate order" of our ordinary experience.

The second step in understanding Bohm's world view is to understand his conception of the implicate order as a unified whole consisting of apparently distinguishable parts. According to Bohm, although the parts seem distinct, each part is identical with the whole since it includes, or "enfolds," the whole. To Bohm the most important characteristic of ultimate reality is undifferentiated wholeness. Athough he accepts the existence of distinct parts as an aspect of the explicate order, he regards it as incorrect to suppose that, on a fundamental level, reality is actually made up of distinct parts.

The intuitive basis behind this idea of wholeness is that when information is enfolded into a physical system, it tends to become distributed uniformly throughout the system.

For example, when a drop of ink is enfolded into the glycerine, the pattern of ink from which the drop can later be recovered stretches out over a broad area. If we could somehow remove the ink from all parts of this pattern except for a small region, then we would find that a dim image of the original drop could be restored, or unfolded, from the ink in this region

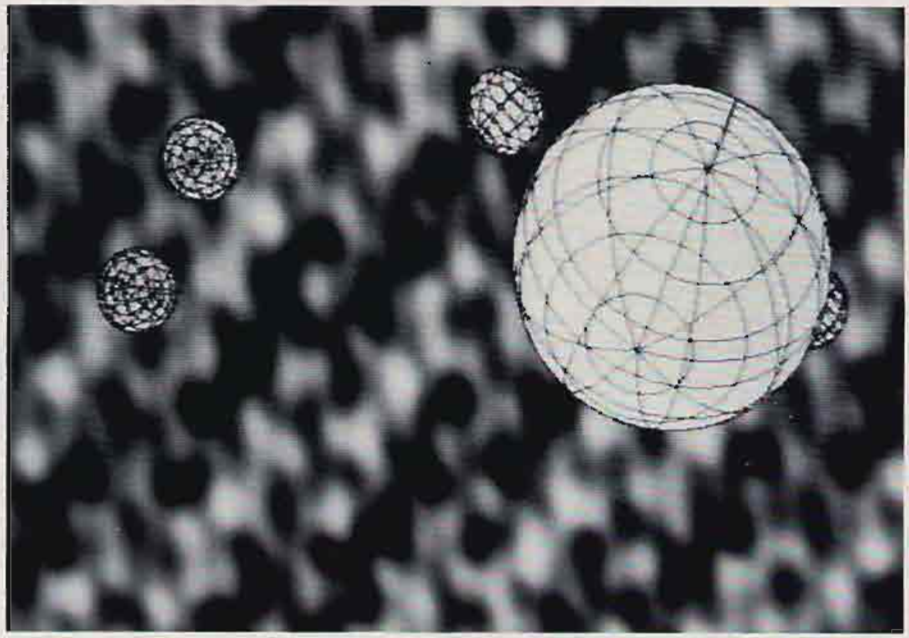

**Figure 2:** The creation of space from transcendental sound vibration. According to Vedic literature, transcendental sound vibrations propagating through a subtle medium (background) generate universal globes having the properties of space as we know it. Similar ideas are being contemplated by architects of the grand unified theories of modern physics.

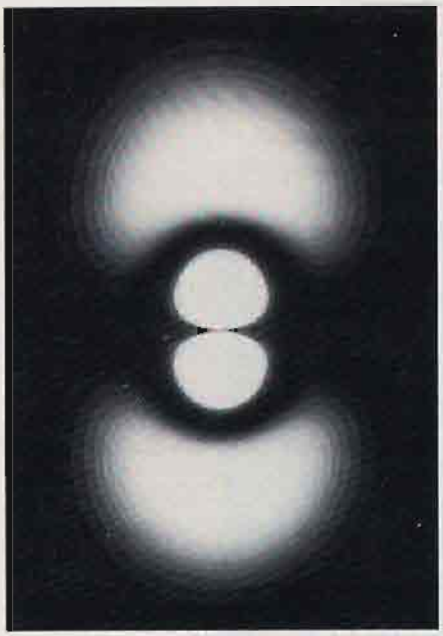

**Figure 3:** The generation of matter. According to Vedic literature, after the manifestation of space, various forms of gross and subtle matter are generated from transcendental sound vibration. In essence, matter is a transformation of sound vibration. This is reminiscent of modern physics. In this figure we see a hydrogen atom, which in quantum mechanics is represented as a vibrational pattern.

alone. Thus, in one sense, the enfolded drop has been distributed over many different parts of the glycerine at once.

This leads to the idea of a continuum in which all patterns ever manifest in any part are represented equally in all parts. Speaking loosely one can say that the whole of the continuum in both space and time is present in any small part of the continuum. By invoking quantum mechanical undefinability, which holds that a particle such as an electron must be defined simultaneously as a particle and a wave, one can then leap from this idea to the idea of a unified entity encompassing all space and time, in which each part not merely represents the whole but contains the whole and is thus identical to it.

This is Bohm's implicate order. Although it is partly based on physics, it also clearly involves ideas that are quite alien to traditional physical science. In fact, Bohm's implicate order represents an attempt to build a bridge between physics and a metaphysical system some call the "perennial philosophy."

The essence of the perennial philosophy is that reality consists of a hierarchy of levels ranging from gross matter through mind, intelligence, and ego, and culminating in an all-encompassing transcendent state of absolute oneness. Many cultures have expounded such philosophies, and the most highly developed examples include Buddhism, the *advaita-vedānta* philosophy of India, Sufiism, Taoism, and Christian mysticism.

Though Bohm does not explicitly say so in his books, it is clear from published conversations that he is trying to create a synthesis of physics and the particular form of *advaita-vedānta* expounded by the Indian philosopher Krishnamurti, whose teachings Bohm greatly admires. Thus Bohm's implicate order is motivated by metaphysical ideas extending far beyond the limits of his reasoning about physics.

The idea that "unfolded" information can give rise to observable organized form is based both on physical theory and practical examples, such as the phase conjugate mirror. But the idea that the parts of the implicate order actually include the whole does not arise naturally from these sources of inspiration, and indeed it is very difficult, if not impossible, to formulate this idea mathematically.

Where, then, does this idea ultimately come from? Bohm speaks of insight that comes from beyond manifest thought, and that may even originate from a level transcending the implicate order.

He emphasizes, however, that human thought cannot grasp the unmanifest, and he stresses the danger of becoming deluded by false insights. But if human thought is not an adequate instrument for gaining knowledge of the unmanifest, then how will we be able to distinguish between true and false "insights"?

As we have indicated, Bohm's ideas come from the Indian philosophical system of *advaita-vedānta*, which forms one school of thought within a diverse body of tradition generally known as Hinduism. According to this tradition, transcendental knowledge can be reliably attained through the mutual reinforcement of two forms of revelation: internal and external.

The external revelation is expressed in scriptures, or *śāstras*, which descend to the human level through a chain of enlightened beings, and which originate from a transcendental, supremely intelligent source. The general term for this body of revealed knowledge is *Veda*.

The internal revelation is directly transmitted into the consciousness of a spiritual aspirant from the same supreme intelligence that introduced the Vedic

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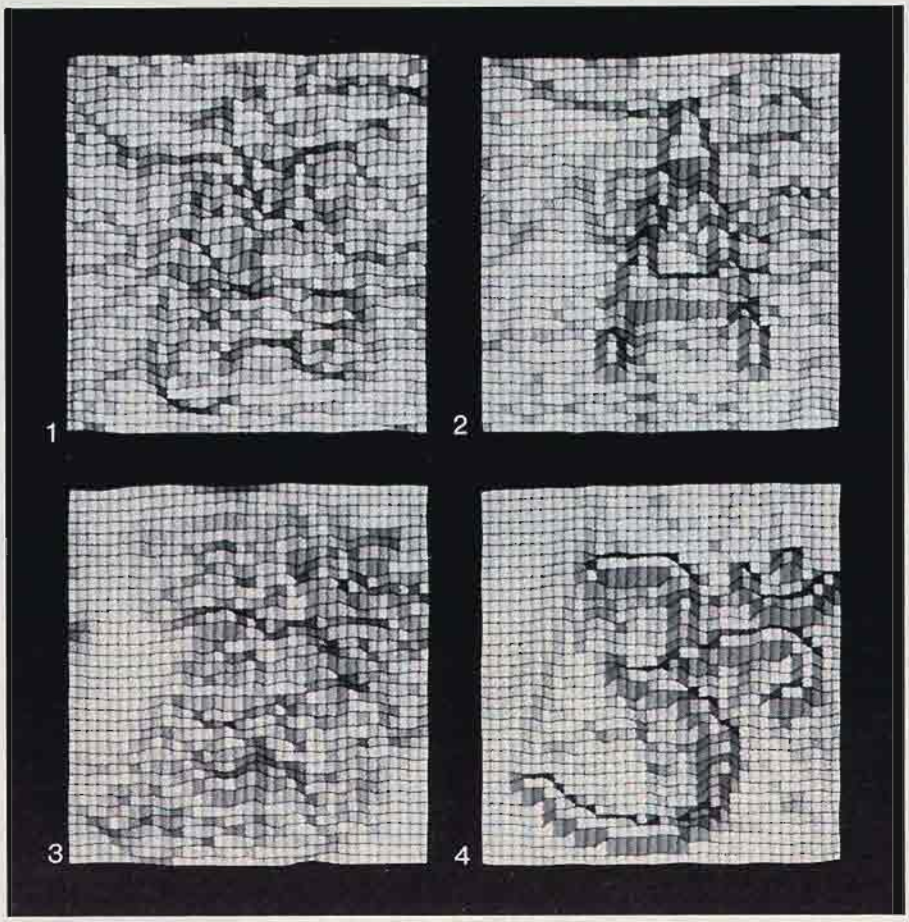


**Figure 4:** The manifestation of organized form from intelligently directed wave patterns. In frame 1 we see an elastic medium capable of transmitting waves (the surface of a pond is an example). The wave pattern in frame 1 seems chaotic, but in frame 2, which shows the wave pattern after a time interval has elapsed, we see that a letter *A* has emerged. In frame 3, representing a slightly later time, this form has disappeared. Still later, in frame 4, a pattern appears representing the symbol *Aum*. Actually, the information for both the *A* and the *Aum* was encoded in the wave pattern of frame 1.

DRAWING BY PARIKŞIT DĀSA

**The Absolute Truth is inaccessible** to the mundane mind and senses. On this basis, empiric philosophers may deny that the Absolute has form, but to be consistent they should also deny the formless, impersonal conception of the Absolute Truth, which is equally beyond the grasp of their material minds. According to the Vedic literature, the Absolute Truth is endowed with form and personality, and the Lord will reveal Himself to those who surrender to Him with love and devotion.

# TECHNOLOGY

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*śāstras* into the material realm. This corresponds to Bohm's idea of insight originating from a source beyond the implicate order. In the Vedic system, however, this insight is corroborated by the *śāstras,* which are directly accessible to the external mind and senses. By accepting the guidance of the *śāstras,* a spiritual aspirant is able to discriminate between genuine and spurious spiritual insight. We suggest that Bohm's metaphysical system is incomplete without some form of explicit external revelation.

If one is going to seriously seek transcendental knowledge, one should at least theoretically accept that (1) the ultimate transcendental source of this knowledge is able to communicate with human beings, and (2) records of genuine communications of this kind do exist in human society. If this is not so, then one has little hope of understanding that which lies utterly beyond the grasp of the mind and senses.

One might therefore seriously consider the perennial notion that a supreme intelligence, known in the West as God, may be the source of the organized information that gives rise to our manifest world. Bohm, in fact, comes very close to admitting the possibility of a sentient supreme being. However, in line with the philosophy of *advaita-vedānta,* he finally turns away from this idea, declaring, "There's nothing we can do with that."

*Simultaneous Oneness and Difference*

It is interesting to note that the Vedic *śāstra* entitled *Brahma-saṁhitā* gives a very clear description of Bohm's idea of a whole that is fully contained in each of its parts. Ironically, this is part of a series of prayers to God as a supreme person:

> He is an undifferentiated entity, as there is no distinction between potency and the possessor thereof. In His work of creation of millions of worlds, His potency remains inseparable. All the universes exist in Him, and He is present in His fullness in every one of the atoms that are scattered throughout the universe, at one and the same time. Such is the primeval Lord whom I adore.

One might object that the human mind acting on its own could not possibly demonstrate the truth of the personal conception of the supreme whole. Therefore, one should adopt a more cautious conception that is abstract and impersonal. The point can be made, however, that *any* conception of the Absolute generated by the finite mind is as mundane as any other, including both personal and impersonal conceptions. One then may as well forego all metaphysical speculation and restrict one's attention entirely to the manifest world of interacting material energies.

But if one does want to introduce ideas about the Absolute derived from revealed knowledge, then the Vedic literatures give concrete indication of how direct realization of this knowledge can be attained. Although the Supreme Lord is inaccessible to the mundane mind, the Lord will reveal Himself to persons who surrender to Him and serve Him with love. This, of course, is also a perennial philosophical conclusion.

*Back to Physics*

We have seen that key aspects of Bohm's world view are based indirectly on traditional sources of revealed transcendental knowledge. One might ask, however, what part of his philosophy of the implicate order can be based exclusively on physical observation and theory.

We suggest that this is limited to the observation that macroscopic forms can arise by physical transformations from patterns of minute fluctuations that look like random noise. These patterns may appear in many forms, ranging from light waves to distributions of nuclear magnetic fields. The patterns are not necessarily spread throughout all space, but patterns that will later give rise to distinct macroscopic events may co-exist in the same volume of space.

We can use these observations to show another way in which a link can be established between physics and metaphysics. Our proposed link is derived from the Vedic literature *Śrīmad-Bhāgavatam.* It is the idea that the material creation is brought about and maintained through the injection of divinely ordered sound vibrations into a primordial material

substrate called *pradhāna*.

According to this idea, the *pradhāna* is an eternally existing energy of the supreme that is capable of manifesting material space and time, the material elements, and their various possible combinations. Left to itself the *pradhāna* would manifest none of these things, but it does so under the influence of intelligently directed sound vibrations generated by the Supreme Lord.

Here the word *sound* is a translation of the Sanskrit word *śabda*. Since the *pradhāna* is even more subtle than space as we know it, this *śabda* does not refer to ordinary sound, consisting of vibrations propagating through gross matter. We will therefore interpret "sound" here to mean any type of propagating vibration, however subtle.

The creation of the material universes by sound (see Figures 2 and 3) involves (1) the generation of material space and time, (2) the systematic building up of the subtle and gross material elements, (3) the organization of these elements into worlds living beings, and, finally, (4) the continued maintenance and direction of these worlds.

Optical phase conjugation provides an analogy to this picture of the relation between material and transcendental levels of existence. Consider an arrangement in which pictures are being transmitted through a sheet of frosted glass. An observer on the receiving side would see successive images emerging from the glass screen, but he would not be able to see the transmitting persons and apparatus on the other side.

Similarly, according to the Vedic conception, the material energy serves as a veil of illusion, or *māyā*, that prevents living beings in the material realm from directly perceiving God. God is actually in direct control of the material energy, but He is manipulating it in such a way that His presence is hidden, and complex patterns of events seem to unfold simply by material action and reaction.

Let us suppose for the moment that organized wave patterns are continually being injected into the known physical continuum from subtler levels of physical reality. Such patterns will appear to be random, especially if they encode information for many different macroscopic forms and sequences of events. For this reason they will be difficult to distinguish from purely random patterns by experimental observation.

Thus much of the random noise that surrounds us may consist of information for patterns that will "unfold" in the future to produce macroscopic results, while the rest consists of the "enfolded" or "refolded" remnants of past macroscopic patterns. If a pattern of microscopic vibrations *does* unfold to produce an organized macroscopic effect, then this will make a very striking impression if it can be observed.

To indicate the possibilities for such an event, we can give an example based on the idea of a wave field. The surface of a pond is a simple example of such a field. The first frame in Figure 4 shows the wave field in an apparently chaotic state of motion. However, this pattern of waves contains hidden information. The successive frames show the motion of the waves (according to the wave equation) as time passes. In frame 2 we see that a letter *A* has appeared in the field. This form quickly takes shape and dissipates, and it is replaced in frame 4 by the similar rapid appearance and disappearance of the symbol ॐ (*Aum*). Actually the information for both symbols is present in all four frames of the figure.

*The Theory of Evolution*

Natural history is an area in which the

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## Lord Jagannātha and the Daffodils

by Mathureśa dāsa

The sun broke through in February
And brought both joy and sorrow,
For though the air was mild today,
I feared the frost tomorrow.

A spell this warm would raise the heads
Of daffodil and buttercup.
Drenched in sunlight, bathed in dew,
They'd figure winter's time was up.

Sure enough, I spied green shoots
Emerging from the earth,
Poking through the garden beds,
Arms upraised in mirth.

With trowel and flowerpot in hand
I hurried to the rescue,
Knowing I couldn't save them all,
Resolved to save a few.

They're up here in my office now,
Sitting on the sills,
Looking a mite homesick—
Four buttercups, three daffodils.

Outside it's cloudy, cold and wet,
Though not yet back to freezing.
The daffs are waiting at the window.
They'd find some sunlight pleasing.

Winged yellow faces fully spread
To catch each golden ray,
They're gazing toward the western sky,
Where their friend set yesterday.

Little do they know that here,
Upon a silken cloth,
Behind them on my top bookshelf,
Resides Lord Jagannātha.

Daffodils and buttercups
Are each a part of Him—
Infinitesimal spirit souls,
As are trees and birds and men.

He is the father of us all,
The friend fore'er well-wishing.
The sun and moon are His two eyes.
He is the sun-rapt spring.

So I've advised my daffodils
That while their sun is hiding,
They ought to turn around and see
Lord Jagannātha presiding.

But there they sit beside the glass,
Their faces turned away,
Their longing eyes upon the clouds
That dim the light of day.

Although I know they hear me well,
The sun still has their heart;
For while quite pretty, young, and gay,
They really aren't so smart.

# TECHNOLOGY

(*continued from page 23*)

hypothesis of unfolding of subtle information has relevant applications. Since the mid-nineteenth century, the prevailing scientific viewpoint has been that the origin of living species can be explained by Darwin's theory of evolution by natural selection and random variation. But there have always been prominent dissenters from this view.

In the nineteenth century Alfred Russell Wallace, the co-inventor of Darwin's theory, felt that the action of some higher intelligence was required to account for such biological phenomena as the human brain. A similar point is made by Bohm, who feels that "natural selection is not the whole story, but rather that evolution is a sign of the creative intelligence of matter." As we have pointed out, Bohm regards this intelligence as emanating either from his implicate order or from beyond.

In the theory of creation by sound vibration that we are considering here, it is to be expected that the forms of living organisms could be generated or modified through the effects of organized wave patterns transmitted into the physical realm by the supreme intelligent being. This will also be difficult to either demonstrate or disprove empirically, because of the incompleteness of the fossil record and the presumed rarity of radical transformations of species.

When evaluating a possible transformation of this kind, there will always be the problem of making sure that the transformation is not a result of ordinary physical cause and effect. To do this effectively would require detailed knowledge about the transformation, which would be very difficult to obtain.

Actually both the theory of creation by sound vibration and the Darwinian theory of evolution are extremely difficult to test empirically. On the physical level both theories are dealing with phenomena that are extremely complex and are not subject to experimental manipulation.

The theory of creation by sound vibration involves transcendental levels of reality not accessible to the mundane senses, and thus in one way it is more unverifiable than the purely physical Darwinian theory. However, if a purely physical theory turns out to be empirically unverifiable, then there is nothing further one can do to be sure about it. In contrast, a theory that posits a supreme intelligent being opens up the possibility that further knowledge may be gained through internal and external revelation brought about by the will of that being.

Of course, the dynamics of obtaining such knowledge are different from those of empirical, experimental science and mathematical analysis. Instead of forcing nature to disclose its secrets, one surrenders to the Supreme Lord in a humble spirit and pursues a path of spiritual discipline and divine service.

This approach to knowledge and to life also constitutes one of the great perennial philosophies of mankind, but it has tended to be eclipsed in this age of scientific empiricism. To obtain the fruits of this path to knowledge, one must be willing to follow it, and one will be inclined to do this only if one thinks the world view on which it is based might possibly be true. Establishing this possibility constitutes the ultimate justification for constructing theories, such as the one considered here, linking physics and metaphysics.

*SADĀPŪTA DĀSA obtained his Ph.D. in mathematics at Cornell University, specializing in probability theory and statistical mechanics. He has published many scientific articles in the fields of mathematical biology and remote sensing, and has recently completed a university textbook, titled* Computer Simulations of Self-organization in Biological Systems. *"High Technology and the Ground of Being" was excerpted from the first chapter of Sadāpūta's upcoming book,* The End of Physics.

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# AMAZON

(*continued from page 21*)

the jungle, however. Unable to find our way back to the *Piraiba,* we wandered aimlessly for hours alongside the bank of the river. Suddenly we found ourselves in an eerie swamp, lit only by the dim lights of thousands of fireflies. Then, in our efforts to get out, we got stuck on a sand bar . . . or so we thought.

As I stepped out of the lifeboat to free our craft, my leg was suddenly sucked under—quicksand! I pushed the boat desperately to free myself. Fortunately, the devotees were able to grab me, and we broke free. Once safely inside the boat, my small flashlight lit up the eyes of an alligator just a few yards away. Within an hour we had found our way back to the *Piraiba* and the security it offered in the middle of the wilderness.

On our third day up the river we came upon our second village. Here we didn't have time to guess about our reception. As soon as we came within sight of the group of thatched huts and small wooden houses, a dozen boats from the village came out to meet us. News of our last stop had spread, and the people had come for food and medicine. Having barely enough medicine for ourselves, we distributed *prasādam* overboard into eager hands.

As the weeks went by, we came to respect the mighty jungle that was our home. Despite the many hazards and austerities it imposed on us, it was God's creation, undisturbed by man. As wild as it was, it seemed perfectly orchestrated by Him. Each morning as the sun rose, its orange rays beautifully contrasted with the deep green of the jungle and set a majestic backdrop for the activities of the jungle's millions of inhabitants. Our morning classes on the bank of the river were often visited by curious onlookers: chattering monkeys, colorful parrots, wild boars and buffalos. Once, a leopard studied us momentarily from a distance. Strangely enough, we often felt at home so far from civilization.

Winding our way up the river, we would visit three or four villages a day, some with as few as twenty inhabitants. Several times the village leaders came back to our boat for a vegetarian dinner and an evening of philosophical discussion. And we would always present them with a copy of Śrīla Prabhupāda's *Bhagavad-gītā As It Is,* ensuring that the timeless wisdom of Lord Kṛṣṇa would remain behind even as we continued on our way.

One night, halfway through the journey, disaster almost struck again. Plying silently through the water while we were fast asleep, our boat hit a sandbar concealed just below the surface. Everything lurched forward, and the boat began to tip to one side. We called out to Lord Kṛṣṇa for help. In the darkness it was difficult to perceive our actual position, but I knew that the river would be merciless if we capsized. Suddenly, by Kṛṣṇa's grace the swift current freed us, and we drifted off the sandbar to safety.

After one month we reached our destination, Tefe. As we pulled into port, we looked forward to some of the amenities of civilization we knew could be found here in this larger town, connected to the rest of the world by a small airport. Sewing needles, bandages, sun protection cream, and dysentery pills were the first order of business.

As we prepared for our return trip, I realized that I didn't regret the risks and austerities we'd undergone. We had enjoyed the privilege and satisfaction of taking Lord Caitanya's *saṅkīrtana* movement to this jungle for the first time. Even as we began our voyage down the river and back home, I took out my map and pondered once again—were there any other regions left in which to pioneer the mercy of Lord Śrī Caitanya Mahāprabhu?