# What the Spider Knows: A New Look at an Old Astronomy

*by Harriet Witt*

*Originally published in* The Griffith Observer*, March 1992, as an award winner in their annual astronomy writing contest*

Looking back might not seem like the way to move ahead, but when we find out that the map we've been following is seriously inaccurate, we have little choice but to look in every possible direction for guidance. Our current maps and models of the universe, when viewed under the brilliant light of recent discoveries, reveal disturbing errors. It seems that the universe is presenting us with a greater degree of order and wholeness than our models can explain.

Our difficulties arise, in part, from the discovery of large numbers of galaxies organized into very orderly superstructures. Meanwhile, our most fundamental concepts about the creation of order are being transformed. This is happening in the new science of "chaos theory," which is uncovering new kinds of orderly patterns in a wide range of natural behaviors that we'd always thought were disorderly. Our difficulties also arise from the discovery that the character of physical reality, as recently revealed by quantum physics, is "non-local." This deceptively bland term describes a universe which is not operating along the lines of discrete bodies or specific locations in space-time, but in terms of a quantum-level wholeness that eludes our five senses and defies our current models. Meanwhile, our most fundamental notions of wholeness are being transformed by chaos theory's discovery of a basic, unbreakable link between wholeness and nature's chaos.

During times like these we're often forced to look again at old concepts which we had rejected for reasons that are no longer valid. For example, in the 16th century Nicholaus Copernicus was bothered by the planets moving backward from time to time. Of course, we now know this apparent motion is due to the way the planets orbit the sun, but in Copernicus's day astronomy was still embracing the Ptolemaic notion of an Earth-centered system. The only way this model could "explain" the planets' motions was for astronomers to patch onto the model spherically shaped things called cycles, epicycles and deferents. Over the centuries almost 100 of these things were assumed to exist. Now, Copernicus was suspicious of this bandage method of keeping the model alive. Searching for a simpler, more natural way of explaining the planets' motions, he delved into the works of ancient thinkers, especially Aristarchus, a Greek astronomer who lived in the third century B.C. Aristarchus believed the Earth rotates and revolves, but his idea was soundly rejected because it disagreed with what the great Aristotle had said. However, when Copernicus assumed Aristarchus's perspective, he saw that it explained the planets' motions easily and efficiently, with no need of resorting to the tangled mass of cycles, epicycles and deferents.

Today's model-defying discoveries present us with a choice. We can try to patch up our model or we can experiment, as Copernicus did, with a radical shift in perspective. Since our word radical comes from the Greek word *radix*, meaning root, it suggests a return to our roots—adopting a perspective that forces us to shed all of the unspoken assumptions which are so ingrained in our culture and our thinking that we've grown to regard them as properties of external reality.

There are many ancient or native astronomies we could explore in order to do this. However, there is one which is especially interesting because of thought-provoking similarities between its view of the cosmos and the universe being revealed today by chaos theory and quantum physics. This particular astronomy is also being targeted by the total solar eclipse of 1991.

As the long, slender, black path of solar-eclipse totality snakes across the Pacific and vanishes in the Brazilian jungle July 11, the lava-belching island of Hawaii and its famed Mauna Kea observatory are swallowed by darkness. Hordes of people are spending thousands of dollars for four primal minutes on the biggest island of an archipelago which was discovered by star-guided Polynesian "wayfinders." Although the Hawaiian archipelago is the most isolated island group on Earth, it was discovered and settled by 500 A.D. and possibly as early 100 to 200 A.D. We do not know the precise methods by which the first Hawaiians used the stars to discover Hawaii. Nor do we know exactly how they used the stars to maintain contact with the rest of Polynesia via journeys of 3000 sailing miles each way. However, in exploring what we do know about these people's relationship with the stars, we find an astronomy that radically shifts our perspective.

The universe of classical science is vast, remote and has little connection to our personal lives. The universe of native Hawaii is neither remote nor impersonal. This is because the Hawaiian boundary between Man and universe has what can best be described as a "fractal" quality. Now, a fractal isn't an easy thing to define because it's a natural shape which never becomes defined, no matter how much it's magnified. Fractals—the twisting intricacy of a cauliflower, the edge of a rain storm, the jagged band of twilight between the light and dark sides of the Earth or the moon—are the shapes of nature's processes. These shapes are being mapped by chaos theory, as it explores an enormous range of natural behaviors which we couldn't even begin to understand until very recently. The discoveries we're starting to make now are surprising for many reasons. One of them is that when you zoom in on a fractal to get a better picture of it, you find that the farther you zoom into it, the richer it gets. This means that in the cosmos of native Hawaii, the boundary between Man and universe—having a fractal quality—isn't a chasm of space. It's a richly textured meshing or web.

When ancient Hawaiians looked at the sky they saw a spider web tracing the sun's apparent daily and yearly path. This web was inscribed onto gourd-maps and celebrated in the *Kumulipo*, ancient Hawaii's long, creation-of-the-universe chant:

> Ordaining the days and nights,
> Like a cunning spider,
> For six months south constantly,
> For six north the sun goeth.

This sun is more than a great and fiery celestial billiard ball. It's also a cyclical path through space-time, so the Hawaiian word for sun also means a day. Other stars equate with other paths. These rising and setting "highways of stars" were memorized and used by ancient Polynesian wayfinders for navigation. It goes without saying that the stars describe cyclical patterns for all of us, but a navigating culture whose survival depends on these patterns—and whose fishing and agriculture must be in complete harmony with them—is profoundly aware of them. To this culture the universe is more than a collection of great celestial particles. It's also a pattern of waves: an intricate web of cycles connecting life-on-Earth with the heavens. To this culture the universe isn't "out there." It's a vibrant matrix of geo-celestial rhythms.

What are the similarities between this cosmos and the universe being revealed by recent scientific breakthroughs? To answer this question we need to keep in mind some basic things about fractals. "The concept of fractals," explains Scientific American, "exploded into the consciousness of mathematicians, scientists and the lay public in 1983, when [Benoit] Mandelbrot's ground-breaking book, *The Fractal Geometry of Nature*, was published." This geometry is a radical departure from the classical (Euclidean) geometry that has dominated Western mathematics, science and thinking since the third century B.C. Classical geometry is still the perfect tool for describing man-made objects like cogs and wheels which were developed with this geometry in the first place. However, it's not the geometry of nature's processes. As Mandelbrot explains: "Clouds are not spheres, mountains are not cones, coastlines are not circles and bark is not smooth, nor does lightning travel in a straight line."

Experiencing the universe from the perspective of fractal geometry is in itself a radical shift because the concept of a fractal is so alien to our English-speaking, Western-philosophy, classical-science culture. In a sense, a fractal is like an invisible trail of crumbs left behind by the unfolding of a natural process, and what's important about it is its shape. Science writer James Gleick describes fractals as "forms in nature—not visible forms, but shapes embedded in the fabric of motion." Therefore, fractal geometry isn't so much about objects as about processes, cycles, relationships, transitions and patterns. Many of nature's fractal behaviors, in the eyes of Western civilization, need to be smoothed over, evened out, civilized, avoided or just plain eradicated. Why? To classical mathematics and science they look like randomness, erratic jiggling, meaningless noise, disturbing unpredictability, pathological irrationality, hideous monstrosity or terrifying turbulence.

Nature's turbulence brings us back to native wayfinders, navigating the turbulent ocean by integrating guidance from the highways of the stars with many other inputs like clouds, winds, weather, sea-surface interference patterns, birds' flight paths, the water's smell and taste, the olfactory sense of an on-board pig, seaweed, driftwood, and the navigator's testicles. Sitting cross-legged and nearly naked on the bottom of his all-vegetable-matter canoe, the wayfinder feels in his testicles the distinctive patterns of different ocean swells vibrating against his boat. This raises a question which is difficult for classical science to answer: How does the wayfinder integrate his astronomical data with this complicated array of very different inputs? Most of these inputs are phenomena that don't lend themselves to precise measurement and, because they're of different orders, don't allow like-to-like comparison. Yet, measurement of comparable things is essential to classical science. Furthermore, integrating these inputs demands interdisciplinary thinking—a wholistic view of the cosmos—but classical science is splintered into many separate disciplines and sub-disciplines.

Fortunately, fractal geometry is revealing that much of what we had always thought was complicated is complicated only in the context of Euclidean geometry. Many phenomena we had always thought were unrelated are unrelated only when seen through the classical-science filter. Removing that filter and putting it in its proper place, we now perceive a unity we were blind to for centuries. For example, we see how the fractal pattern in the bronchial branching of our lungs is mirrored in the movements of a fast-flowing river and in the growth of certain vegetable forms. Different natural systems behave identically, but we couldn't see this until recently because we were focusing more on our yardsticks and categories than we were on nature. In contrast, the star-guided Oceanic wayfinders who discovered and settled Hawaii were ignorant of our yardsticks and categories, wore no Euclidean filters on their perceptions and experienced themselves as woven into the cosmos by a web of geo-celestial rhythms.

Of course, the unity revealed by fractal geometry doesn't involve a sameness of objects, but of processes—a sameness in the patterns or shapes traced out in space-time by different natural systems. And nature's various fractal shapes—despite what our Western philosophy and classical science lead us to expect—display no characteristic size or location. They're independent of scale. "The process," explains mathematician Mitchell Feigenbaum, "doesn't care where it is, and moreover it doesn't care how long it's been going." Consequently, the term fractal was coined by Mandelbrot to describe a shape which exhibits its detailed structure over a large range of scales. The term comes from the Latin, *fractua*, meaning irregular, but we now know fractals embrace a wide variety of behaviors. All of these behaviors are "self-similar:" they maintain the look of their detail at smaller and smaller scales. There is self-similarity in the pattern of variations in sunspot brightness. There is self-similarity in the chaotic tumbling-in-its-orbit of Saturn's moon, Hyperion. And on a more mundane level, stock market recessions are mimicked in monthly and daily price fluctuations.

Mathematician Ian Stewart suspects that the classical-science notion of phenomena being limited to certain scales "…is really an artifact of the limitations of the human mind, rather than a genuine truth about nature. Our minds just can't grasp something as big as the universe on a level of fine detail. So we dissect it up into large-scale structures, like galactic superclusters, and then dissect these into their component galactic clusters, and dissect those into galaxies, and galaxies into individual stars, and so on. Nature, in contrast, operates on all scales simultaneously."

Our discovery of nature's independence of scale allows us to return to our question about the similarities between the cosmos of native Hawaii and the universe being revealed today by recent scientific breakthroughs. In the native Hawaiian cosmos the concept of scale is strikingly and totally absent. In fact, its absence is celebrated in the great *Kumulipo* creation chant. In this chant, explains John Charlot, who received his Ph.D. in Religious Studies from the University of Munich, and is with the East-West Center in Honolulu, "…universe and [the human] body are two levels of meaning for the same words."

Being independent of any spatial or temporal scale, nature's fractal shapes transcend space and time, thereby unifying phenomena which, to classical science, look unrelated. In other words, the self-similarity of nature's fractals suggests that the universe—like a hologram—is made up of an infinite number of copies of itself. According to the *Kumulipo* , each one of us is one of these copies. From this perspective, the heavenly bodies are not just remote celestial billiard balls. Nor are they occult influences over our destinies. They are tracing out enormous cyclical patterns—patterns that are simultaneously repeating themselves on smaller and smaller scales as the processes in nature and the processes in ourselves.

In this kind of a cosmos the word moon refers to every time and every place a moon-like cycle is unfolding, so it includes the menstrual cycle. This cycle involves the womb's protecting, caring and nourishing. The Hawaiian word for protecting, caring and nourishing is malama, which also means moonlight and lunar month. The word malama, in the related Polynesian language of Samoa, means the ninth month of pregnancy. Similarly, the Hawaiian word *la*, meaning sun and a day, is also the diurnal body clock in each of us.

The native Hawaiian cosmos, as we have seen, is made not just of great celestial particles, but also of waves or cyclical processes. With these processes unfolding on many different scales simultaneously, every line in the *Kumulipo* holds multiple levels of meaning. Even the simplest Hawaiian poem isn't literal or one-dimensional. In fact, the composers of ancient chants took great relish in vying with one another to achieve more and more simultaneous layers of meaning. In the *Kumulipo*, "The same descriptions," explains Charlot, "…refer to various stages of the evolution of the universe and, equally well, to various stages of the growth of a human being. All the devices of Hawaiian poetry are used to effect this parallelism."

Hawaiian gods, recognized by scholars as anthropomorphized descriptions of natural processes, include the sun and moon, and they appear simultaneously in many times and places. These gods, like the universe they inhabit, are independent of scale. "With these gods," explains Charlot, "the Hawaiian thinker accepts the challenge of elucidating simultaneously the mysteries of nature and personality."

Simultaneity is the key concept here: In the native Hawaiian cosmos, explains George Hu'eu Sanford Kanahele, who received his Ph. D. from Cornell University, "Events happen not because they are causally related but because they are interrelated… what appears to be one event causing another is really two events happening in relative simultaneity."

This simultaneity is interesting in the light of recent discoveries by quantum physics. As predicted by theory (Bell's Theorem), it has been proven that subatomic particles once joined and then separated are communicating with each other instantaneously, no matter how far apart they are. When one particle changes the other does too, and their changes are simultaneous, with no time for a signal to travel from one to the other. The "non-locality" revealed here could be the "most important discovery in all of science," according to Henry Stapp. Why? Because all subatomic particles in the universe were joined at the time of the Big Bang, and these particles are now distributed everywhere, from the most distant stars to our own bodies.

The importance of this wholeness reaches far beyond astronomy and physics. Consequently, Menas Kafatos, a physicist specializing in astrophysics, general relativity and the foundations of quantum theory, teamed up with Robert Nadeau, an associate professor of English and a student of cultural history who has done post-doctoral work in the history and philosophy of science. The two have written about non-locality in layperson's terms. They explain that "…no previous discovery has posed more challenges to our sense of everyday reality than the discovery that non-locality is a fact of nature." Consequently, Kafatos and Nadeau believe that "…we must profoundly revise our previous understanding of the relationship between part and whole in physical reality, including the part we call 'ourselves' and the whole we call the 'cosmos.'"

This revision of our understanding has already begun in connection with holography. To follow it briefly, let's imagine we have a hologram of a dolphin. The hologram is the information on the photographic plate. When we shine laser light through the plate, it creates a three-dimensional dolphin in the air on the other side of the plate. When we shine laser light through a tiny part—any part—of the plate, what we get isn't just a tiny part of the dolphin, but the entire, 3-D creature. This dolphin isn't as brilliant, but all of it's there. Why? Because any part of the hologram, no matter how small or seemingly insignificant, contains all the information about the whole thing. The hologram, incidentally, follows the same principle that governs your genetic data: each cell in your body contains all the genetic information about your whole body, not just about the part where that cell resides. In other words, the hologram displays self-similarity. Because its information is independent of scale, the part is in the whole and the whole is in the part. That is to say, the hologram's pattern of information is stored everywhere on the plate, so it's non-local.

If we inhabit a universe of non-locality, then why do our five senses keep telling us that the universe is made up of discrete bodies with specific locations in space-time? We might be able to answer this question by looking at one of those electric advertising signs where a group of lights is regularly flashing on and off in a certain cyclical pattern. Our brains interpret this pattern as an object moving through a defined space, such as a man moving his hand back and forth as he puffs on a cigarette, a dog wagging its tail, a moving arrow, etc. Because of the way our mind interprets the incoming data, substance appears to emerge from no substance.

The subject of fundamental insubstantiality brings us back to spider webs. What does the spider of ancient Hawaii's cosmos have to do with science's discoveries of wholeness? What does the spider know? What the spider knows the spider weaves, and what the spider weaves is a web of cyclical interconnection between part and whole in this cosmos. However, the spider's web is invisible to the Euclidean mind which has modeled the universe as a great machine. To this classical-science mind, native Hawaii's universe seems like primitive mumbo jumbo. But to the post-classical-science mind of quantum physics and chaos theory, the native Hawaiian universe seems like something that might be worth looking at again.

Much of what was once known about this universe has been lost. Much was destroyed by missionaries who considered themselves better than the Hawaiians. Some of what was once known is being kept in hiding. So we may never find out how this cosmos translated into a wayfinder's map or what it was like to plant, fish, live, love, learn or die in this cosmos. However, we do know that Hawaiians weren't the only Polynesians living in it. The Hawaiians' Maori cousins of New Zealand inhabited this cosmos too, and their sage, Nepia Pohuhu, chanted:

> There is nothing of which it can be said, it is of the earth alone, or of the heavens alone… The stars, the Moon, and the Sun are all a part of the earth and the heavens…

The Polynesians' ancestors sailed long ago out of Asia. And in Asia we find a cosmos described in a Buddhist text:

> In the heaven of Indra there is said to be a network of pearls so arranged that if you look at one you see all the others reflected in it. In the same way, each object in the world is not merely itself but involves every other object, and in fact is every other object.