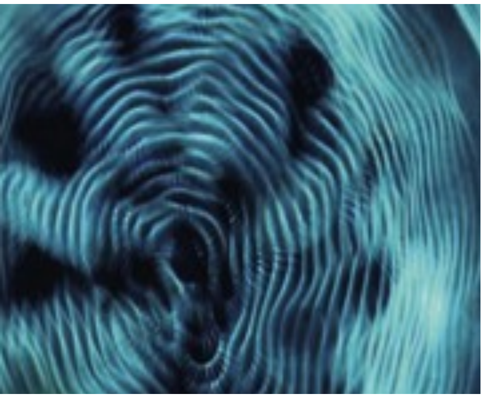
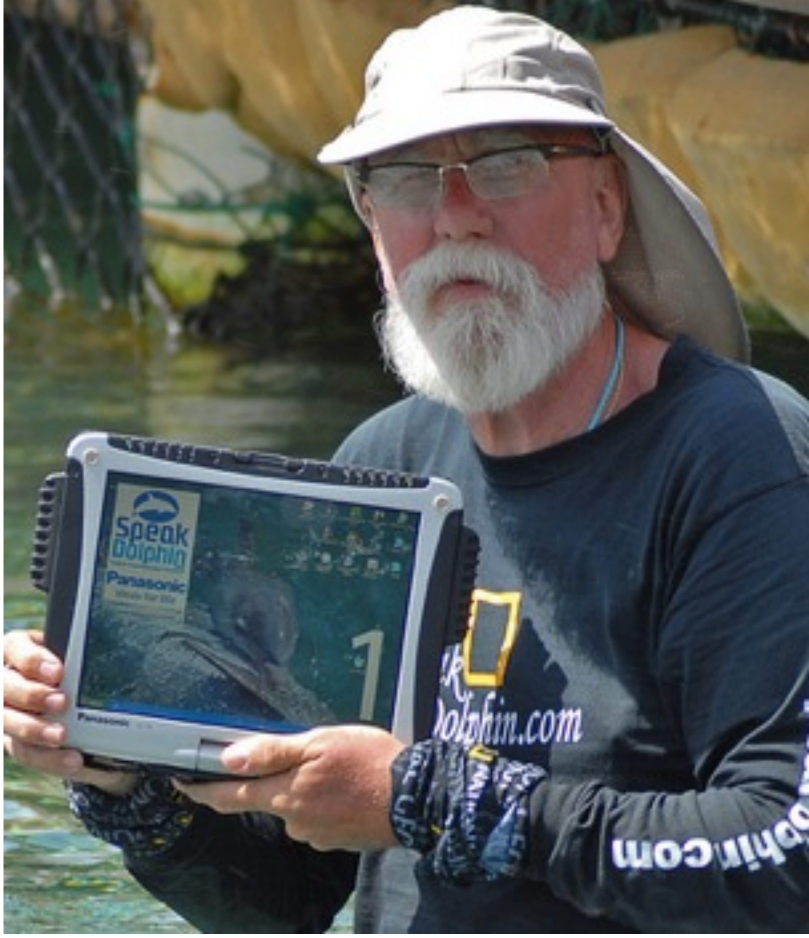
Jack Kassewitz and assistant, working with a research dolphin

An interview with Jack Kassewitz & John Stuart Reid

'Are we alone?'

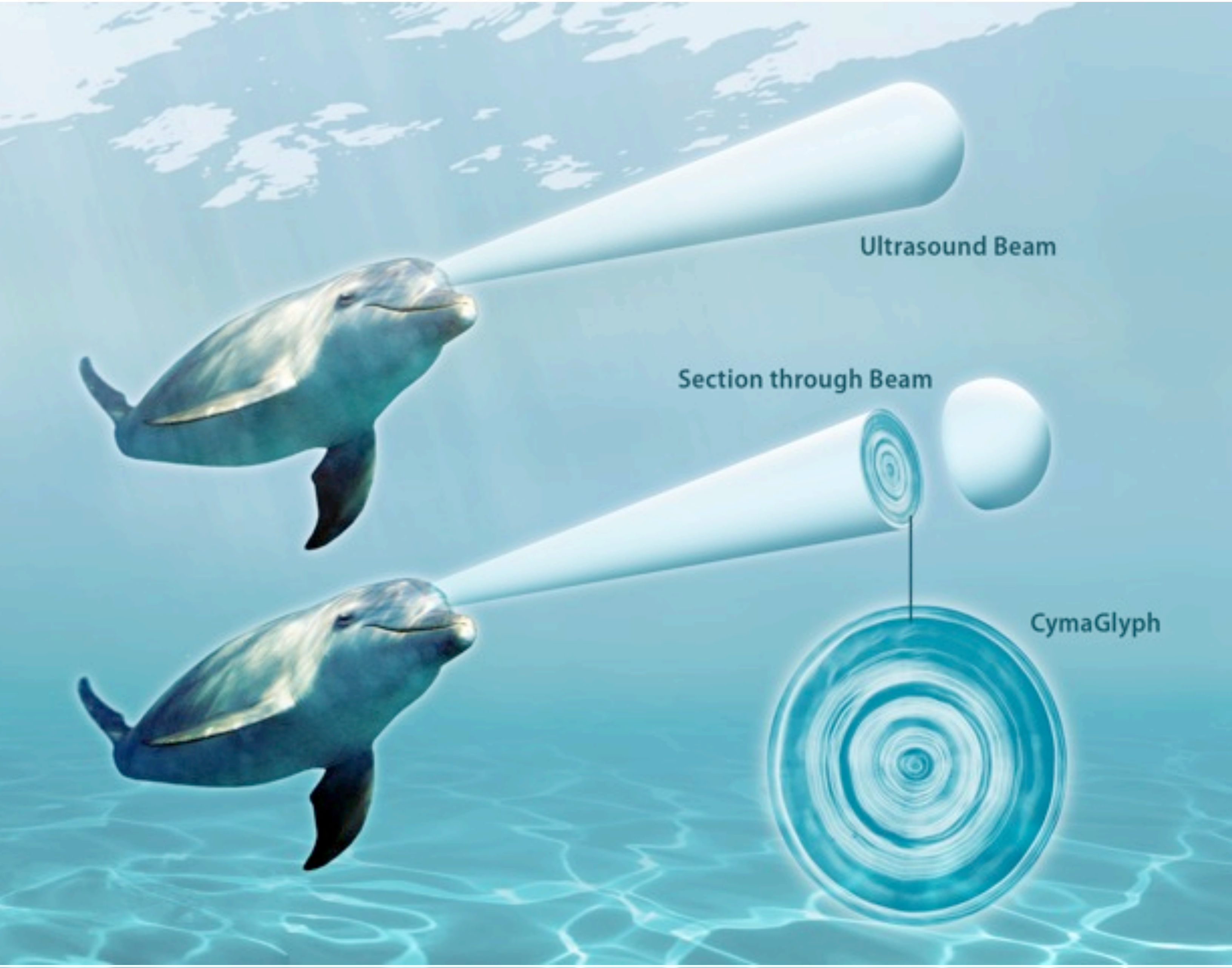


It's an age-old question and the main area of focus for the SETI Institute (the Search for Extra-Terrestrial Intelligence) in California. But if you were to ask dolphin researcher Jack Kassewitz, in Florida, he would unequivocally answer: "Absolutely not." He would point out that SETI's search for non-human intelligence has just been found right here on earth in the graceful form of dolphins.



Kassewitz is the leader of a small team of scientists working to prove what many people have intuitively believed for a century or more: that dolphins have language. Kassewitz and English acoustics researcher John Stuart Reid, are confident that their latest results show not only that dolphins possess language but that the form of language is sono-visual not vocal, meaning that dolphins convey information by sending and receiving sound pictures, not vocal words. While their research is thought by some scientists to be controversial other experts are already hailing the Kassewitz-Reid results as a significant breakthrough in the understanding of dolphin language.

The greatest challenge for researchers in discovering and deciphering dolphin language over the last two decades has been the sheer complexity of dolphin sounds. Not only are they rich in higher harmonics but also their range of frequencies is immense in comparison with human sounds. Most human voice sounds range between about 100 Hertz and 10,000 Hertz whereas dolphin sounds range anywhere between 100 Hertz and 150,000 Hertz. Making sense of the vast amount of data contained in dolphin sounds has been virtually impossible, until now. Whereas most dolphin researchers have been searching the dolphin's complex sounds for what they believed were words, Kassewitz instead asked: "What if the sounds are not words to be listened to but pictures to be seen?" It was Albert Einstein who said "Imagination is more important than knowledge." Imagination is a quality that Kassewitz has in abundance.



Dolphins can see with sound by sending out a narrow beam of ultrasound

He came across the work of Reid in 2008 who, potentially, seemed to have the perfect solution to the problem in the form of a new instrument—the CymaScope—that remarkably renders sound visible. Kassewitz recalls his first exchange of emails with Reid in which he learned the astonishing fact from the English researcher that sound waves don't actually exist.

Instead, Reid told him, all audible sounds would look like bubbles if we could see them, and the high frequency sounds of dolphins would resemble flashlight beams. **The concept of sound as a wave is simply a label used to describe the fact that sound bubbles and sound beams pulsate in and out in a rhythmic motion.** It is this pulsation within the bubble or beam that is typically shown as a wave-like graph. In other words, when scientists describe sound as a wave they are referring to its rhythmic pulsation depicted graphically, not its actual shape. The result of this confusion is that most people incorrectly visualize sounds wiggling their way through air or water rather than visualizing pulsating sound bubbles or shimmering sound beams.

This new knowledge was a revelation to Kassewitz. Reid agreed to use the CymaScope to image the sounds of a baby dolphin calling out to his mother, which Kassewitz had just recorded. Rather like an MRi scanner imaging a slice through a body, in a sense the CymaScope allows us to see a slice through the sound bubble or beam. The result was the world's first dolphin sound made visible. The CymaScope imprinted the baby dolphin's complex sound on the super-sensitive surface of water, making it visible and available for study. Instead of analyzing dolphin sounds as words the Kassewitz-Reid results indicate that previous research scientists would have had greater success studying the creature's sounds as pictures. Dolphins possess an extraordinarily large brain in order to produce and process sono-pictures. For instance, a typical static image in a digital camera contains around two million pieces of information (2 megabytes). And at 24 frames per second for movies that amounts to a huge amount of data, which is why, says Kassewitz, dolphins need such a wide range of sounds—to carry the picture data—and a large brain to process the sono-pictures.

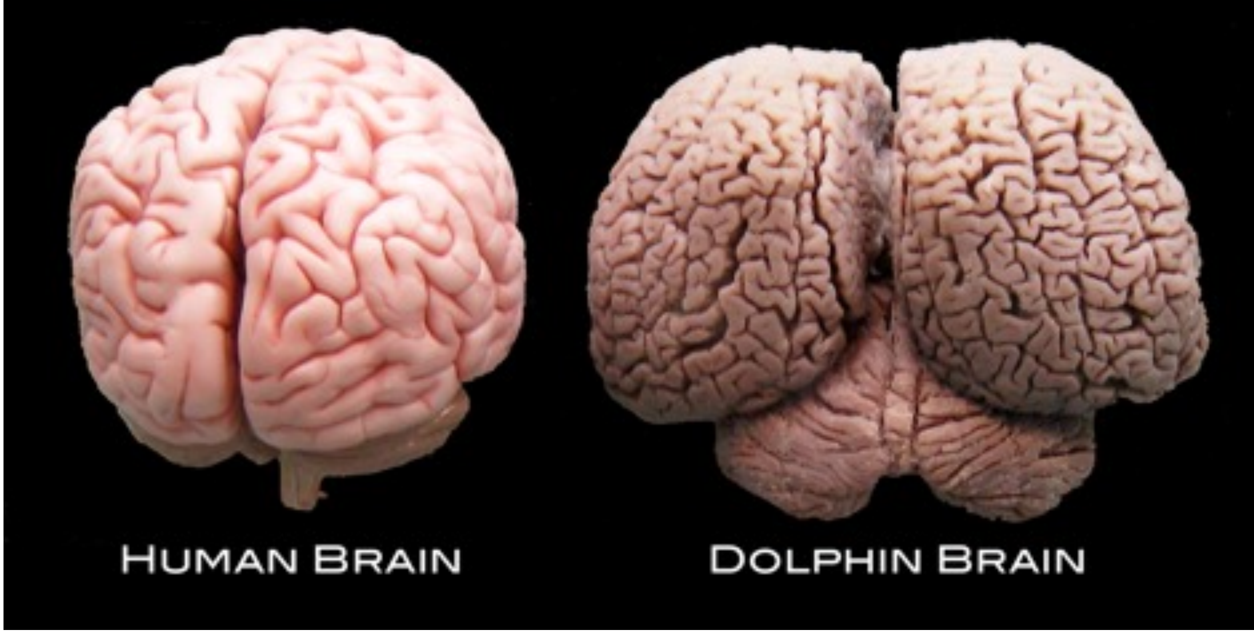
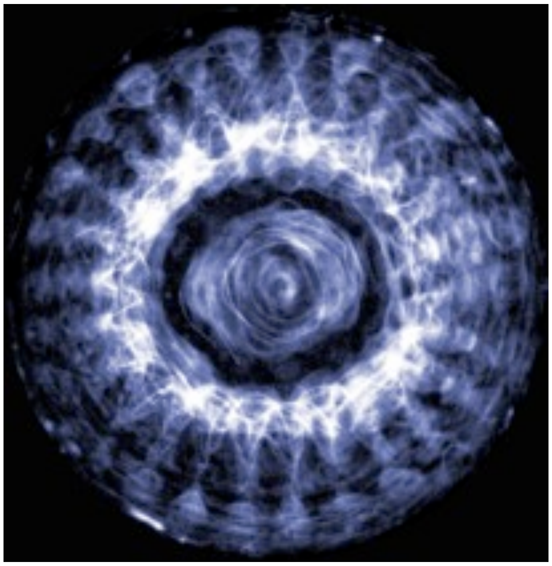


Image Source: Wikimedia Commons

The result of the initial work with the baby was published in their December 2008 press release titled “Songs from the Sea.” In it they presented an overview of their novel approach to dolphin language and drew parallels with the decipherment of Egyptian hieroglyphs. In the early 19th century Jean-Francois Champollion and Thomas Young had used the Rosetta Stone to discover key elements of the primer that allowed the Egyptian language to be deciphered. Kassewitz and Reid likened the CymaGlyphs (sound pictures produced on the CymaScope) to the hieroglyphs of the Rosetta Stone.

Dolphin CymaGlyph



Kassewitz went on to design an experiment in which he recorded dolphin echolocation sounds as they reflected off a range of eight submersed objects, including a plastic cross, a toy duck and a flowerpot. When the reflected sounds were replayed to the dolphin in the form of a game, the dolphin was able to identify the objects with 86% accuracy, providing strong evidence that it had understood the echolocation sounds as pictures. This in itself was a great result but Kassewitz then had the idea to play the same sounds to a different dolphin. He drove two hours to another dolphin facility, set up the test objects in the water and, one by one, replayed the sounds to one of the research dolphins. This dolphin, that had never experienced the sounds before, also identified the objects with a similar high success rate at which point Kassewitz realized he had discovered something important. He called Reid, "I remember clearly the stunned silence when I called him [Reid] on the phone and recounted my two experiments. Apparently he got goose bumps when he realized the importance of my discovery, 'This is a seminal moment in science', Reid said. I hinted at the possibility that dolphins had evolved their sound picture sense as a form of visual language. He wanted to get to work right away on imaging the echolocation sounds to test the accuracy of my hypothesis."

Kassewitz sent the series of recorded echolocation sounds to Reid who began the tricky process of capturing their imprints on water with the CymaScope. After many failed attempts Reid recalls the first time he saw the shape of the flowerpot on the water's surface. "I had struggled for days to balance the dynamics of the sound signal and to capture on-camera what is actually a very short-lived event. But then, suddenly, there it was—the flowerpot, rather fuzzy but distinct enough to make out its shape. I could even see the hand that had held the pot in the water. I was amazed at these results and became convinced that Kassewitz's idea was credible, that dolphins not only see with sound but almost certainly use this sense as a form of language."

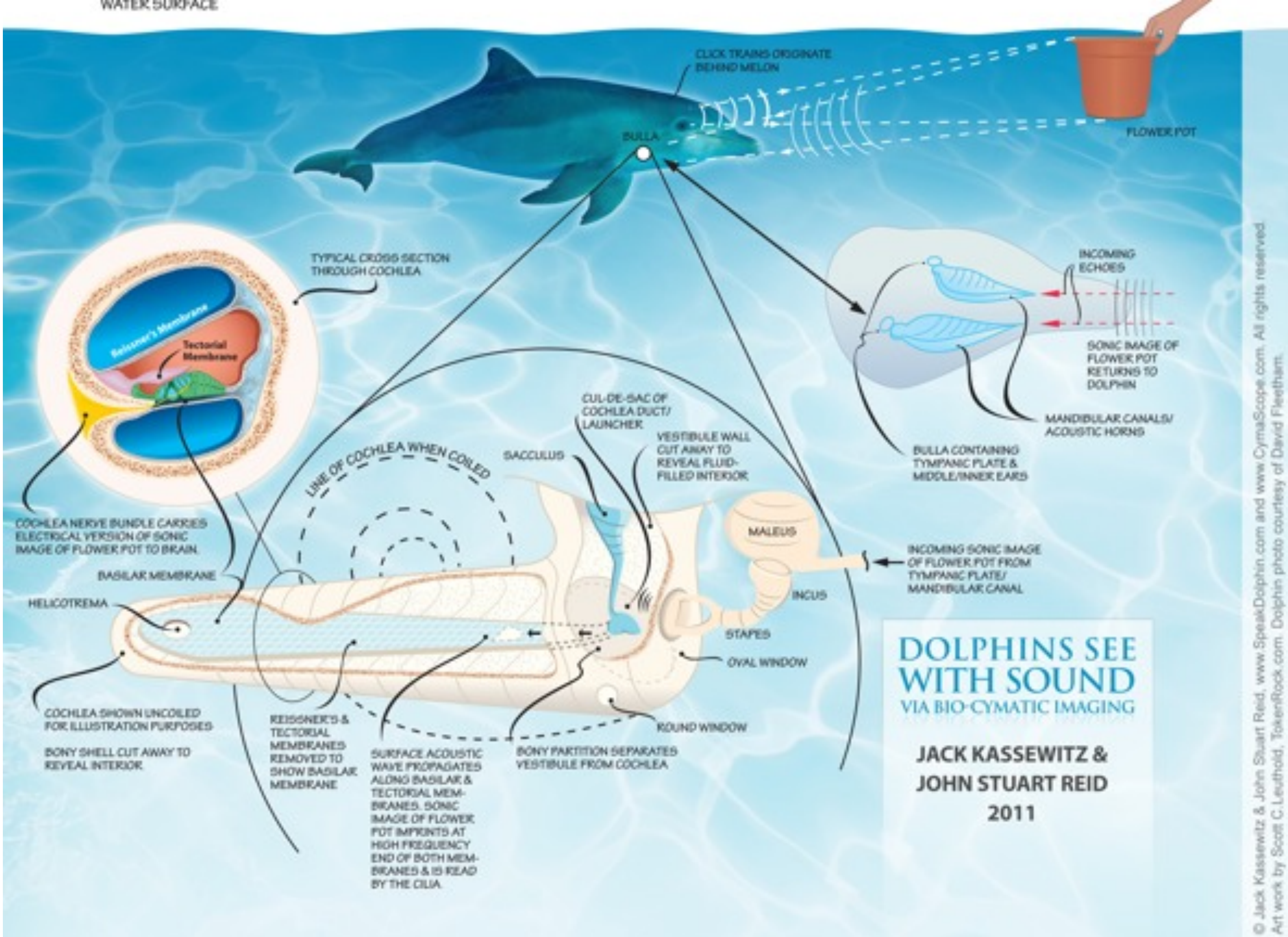
John Stuart Reid working with the CymaScope in the laboratory of Sonic Age Ltd

Following that first success Reid went on to capture the same flowerpot imprint many times, to prove the robustness of the technique, before moving on to image some of the other plastic objects. He likens the fuzzy sono-pictures to Edison's first scratchy recording of 'Mary had a little lamb' that eventually led to today's superlative hi-fi recordings. He has no doubt that the CymaScope technique can be improved to the point where it will be possible to obtain clear pictures of what dolphins are sending and receiving.

Reid explains the basic principles of the dolphin's sound imaging sense:

"When a dolphin scans an object with its high frequency sound beam, emitted in the form of short clicks, each click captures a still image, similar to a camera taking a photograph. Each dolphin click is a pulse of pure sound that becomes modulated by the shape of the object. In other words, the pulse of reflected sound contains a semi-holographic sonic representation of the object. A portion of the reflected sound image is collected by the dolphin's lower jaw, its mandible, where it travels through twin fat-filled 'acoustic horns' to the dolphin's inner ears to create the sono-pictorial image. Surprisingly, it is not necessary for the dolphin, or us in the laboratory, to have the entire reflected sound to be able to recreate the shape of the object; every small part of the dolphin's reflected echolocation beam contains the full image."

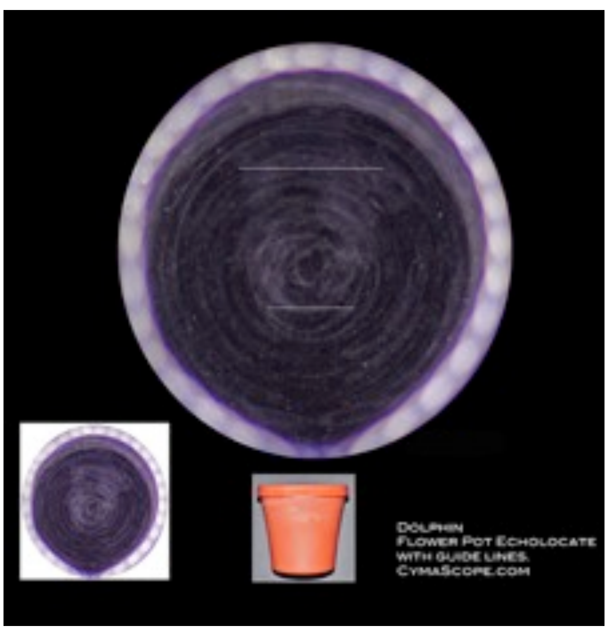
The precise mechanism concerning how the sonic image is 'read' by a dolphin's ear is still unknown but the team's present hypothesis is that each click-pulse causes the image to momentarily manifest on the basilar and tectorial membranes, thin sheets of tissue situated in the heart of each cochlea.

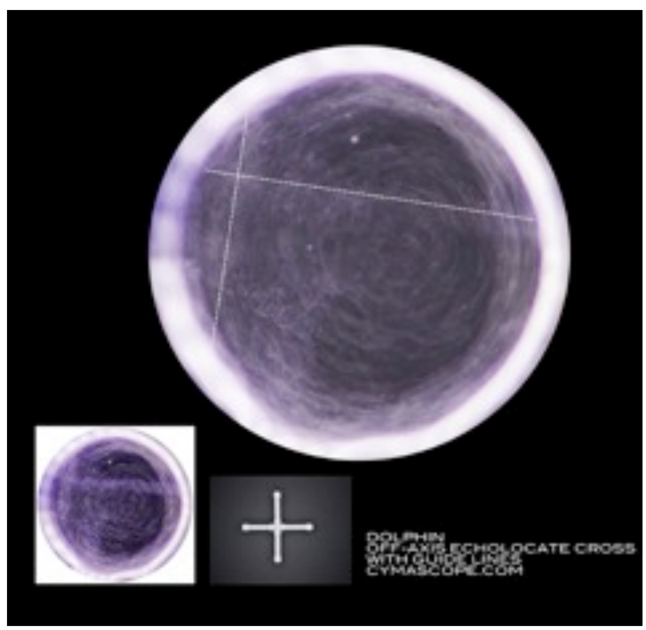


Microscopic hairs in each cochlea connect with the tectorial membrane and 'read' the shape of the imprint, creating a composite electrical signal representing the object's shape. This electrical signal travels to the brain via the cochlea nerve and is interpreted as an image. It is thought that dolphins may be able to perceive stereoscopically with their sound imaging sense and since they emit long trains of click-pulses it seems possible that dolphins have persistence of sono-pictorial perception. This is similar to the way our eyes have persistence of vision, allowing us to perceive a series of still frames as a smooth, continuous, moving image. The team postulates that when a dolphin emits a fast train of clicks its perception mechanism may operate like a movie camera capturing a series of still images which, when projected at 24 frames per second appears as a moving image. The dolphin, then, may see sound pictures as smooth, continuous moving images.

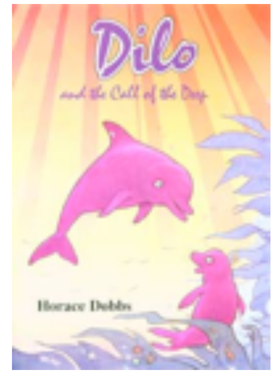
Reid said, "The CymaScope imaging technique substitutes a circular water membrane for the dolphin's tectorial, gel-like, membrane and a camera for the dolphin's brain. We call the technique 'bio-cymatic imaging,' capturing the picture before it expands to the boundary of the water. We think that something similar happens in the dolphin's ears where the sonic image, contained in the reflected click-pulse, travels as a surface acoustic wave along the basilar and tectorial membranes and imprints in an area that relates to the carrier frequency of the click-pulse. With our bio-cymatic imaging technique we believe we see a similar black and white image to that which the dolphin sees when it scans an object with sound, albeit the dolphin almost certainly sees the object with greater definition. Our images resemble sonograms used in hospitals, although while sonograms and CymaGlyphs are created with high frequency sound the CymaScope imaging technique is fundamentally different."

Two of the faint sono-pictorial dolphin images photographed on the CymaScope instrument





Dr Horace Dobbs is Director of International Dolphin Watch and a leading authority on dolphin-assisted therapy. “I find the dolphin mechanism for sonic imaging proposed by Jack Kassewitz and John Stuart Reid plausible from a scientific standpoint. I have long maintained that dolphins have a sono-visual language so I am naturally gratified that this latest research has produced a rational explanation and experimental data to verify my conjectures. As early as 1994, in a book I wrote for children, *Dilo and the Call of the Deep*, I referred to Dilo's ‘Magic Sound’ as the method by which Dilo and his mother pass information between each other using sonic imaging, not just of external visual appearances, but also of internal structures and organs.”



Another expert to comment on the team’s findings is David M. Cole, founder of the AquaThought Foundation, a research organization that studied human-dolphin interaction for more than a decade. “Kassewitz and Reid have contributed a novel model for dolphins' sonic perception, which almost certainly evolved out of the creature's need to perceive its underwater world when vision was inhibited. Several conventional linguistic approaches to understanding dolphin communication have dead-ended in the last 20 years so it is refreshing to see this new and highly-nuanced paradigm being explored.”

As a result of Reid’s bio-cymatic imaging technique Kassewitz in collaboration with research intern Christopher Brown, of the University of Central Florida, is beginning to develop a new model of dolphin language that they are calling Sono-Pictorial Exo-holographic Language, (SPEL). Kassewitz explained, “The ‘exo-holographic’ part of the acronym derives from the fact that the dolphin pictorial language is theoretically propagated all around the dolphin whenever one or more dolphins in the pod send or receive sono-pictures.

Reid has found that any small part of the dolphin’s reflected echolocation beam contains all the data needed to recreate the image cymatically in the laboratory or, he postulates, in the dolphin’s brain. “Our new model of dolphin language is one in which dolphins can not only send and receive pictures of objects around them but can create entirely new sono-pictures simply by *imagining* what they want to communicate. This is a tremendously exciting possibility.”


‘a picture speaks a thousand words’

Dolphin Language

Kassewitz commented, "It is perhaps challenging for us as humans to step outside our symbolic thought processes to truly appreciate the dolphin's world in which, we believe, pictorial rather than symbolic thoughts are king. Our personal biases, beliefs, ideologies, and memories penetrate and encompass all of our communication, including our description and understanding of something devoid of symbols, such as SPEL. Dolphins appear to have leap-frogged human symbolic language and instead have evolved a form of communication outside the human evolutionary path. In a sense we do now have the dolphin "Rosetta Stone" that we first searched for in 2008. The CymaScope allows us to tap into their world in a way we could not have even conceived of just a year ago. The old adage, 'a picture speaks a thousand words' suddenly takes on a whole new meaning."

And what of the future? When can we look forward to holding a conversation with a dolphin? Kassewitz is already planning the next step in the process, involving recording sound transmissions between dolphins, in effect monitoring the pictures they are sharing with each other. He will then send the recordings to Reid to see if the sounds produce pictures in an attempt to learn what the dolphins were 'saying' to each other. For example, a dolphin might send a picture of itself in a particular posture, a form of body language that may convey a thought. It seems that the day when Kassewitz can 'speak dolphin' has just taken a giant step closer.

Donate

Mr Kassewitz and Mr Reid are seeking donations to help support their research into dolphin language. Donations, small and large, are most welcome and will be rewarded by a special gifts related to their research, as a memento of your assistance with the Dolphin Language Research Program.