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Scientists say dolphins should be treated as 'non-human persons'



Dolphins have long been recognised as among the most intelligent of animals but many researchers had placed them below chimps

Jonathan Leake

Dolphins have been declared the world's second most intelligent creatures after humans, with scientists suggesting they are so bright that they should be treated as "non-human persons".

Studies into dolphin behaviour have highlighted how similar their communications are to those of humans and that they are brighter than chimpanzees. These have been backed up by anatomical research showing that dolphin brains have many key features associated with high intelligence.

The researchers argue that their work shows it is morally unacceptable to keep such intelligent animals in amusement parks or to kill them for food or by accident when fishing. Some 300,000 whales, dolphins and porpoises die in this way each year.

"Many dolphin brains are larger than our own and second in mass only to the human brain when corrected for body size," said Lori Marino, a zoologist at Emory University in Atlanta, Georgia, who has used magnetic resonance imaging scans to map the brains of dolphin species and compare them with those of primates.

"The neuroanatomy suggests psychological continuity between humans and dolphins and has profound implications for the ethics of human-dolphin interactions," she added.

Dolphins have long been recognised as among the most intelligent of animals but many researchers had placed them below chimps, which some studies have found can reach the intelligence levels of three-year-old children. Recently, however, a series of behavioural studies has suggested that dolphins, especially species such as the bottlenose, could be the brighter of the two. The studies show how dolphins have distinct personalities, a strong sense of self and can think about the future.

It has also become clear that they are "cultural" animals, meaning that new types of behaviour can quickly be picked up by one dolphin from another.

In one study, Diana Reiss, professor of psychology at Hunter College, City University of New York, showed that bottlenose dolphins could recognise themselves in a mirror and use it to inspect various parts of their bodies, an ability that had been thought limited to humans and great apes.

In another, she found that captive animals also had the ability to learn a rudimentary symbol-based language.

Other research has shown dolphins can solve difficult problems, while those living in the wild co-operate in ways that imply complex social structures and a high level of emotional sophistication.

In one recent case, a dolphin rescued from the wild was taught to tail-walk while recuperating for three weeks in a dolphinarium in Australia.

After she was released, scientists were astonished to see the trick spreading among wild dolphins who had learnt it from the former captive.

There are many similar examples, such as the way dolphins living off Western Australia learnt to hold sponges over their snouts to protect themselves when searching for spiny fish on the ocean floor.

Such observations, along with others showing, for example, how dolphins could co-operate with military precision to round up shoals of fish to eat, have prompted questions about the brain structures that must underlie them.

Size is only one factor. Researchers have found that brain size varies hugely from around 7oz for smaller cetacean species such as the Ganges River dolphin to more than 19lb for sperm whales, whose brains are the largest on the planet. Human brains, by contrast, range from 2lb-4lb, while a chimp's brain is about 12oz.

When it comes to intelligence, however, brain size is less important than its size relative to the body.

What Marino and her colleagues found was that the cerebral cortex and neocortex of bottlenose dolphins were so large that "the anatomical ratios that assess cognitive capacity place it second only to the human brain". They also found that the brain cortex of dolphins such as the bottlenose had the same convoluted folds that are strongly linked with human intelligence.

Such folds increase the volume of the cortex and the ability of brain cells to interconnect with each other. "Despite evolving along a different neuroanatomical trajectory to humans, cetacean brains have several features that are correlated with complex intelligence," Marino said.

Marino and Reiss will present their findings at a conference in San Diego, California, next month, concluding that the new evidence about dolphin intelligence makes it morally repugnant to mistreat them.

Thomas White, professor of ethics at Loyola Marymount University, Los Angeles, who has written a series of academic studies suggesting dolphins should have rights, will speak at the same conference.

"The scientific research . . . suggests that dolphins are 'non-human persons' who qualify for moral standing as individuals," he said.

Additional reporting: Helen Brooks

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Dolphin therapy fights depression

Swimming with dolphins appears to help alleviate mild to moderate depression, researchers have found.

A University of Leicester team tested the effect of regular swimming sessions with dolphins on 15 depressed people in a study carried out in Honduras.

They found that symptoms improved more among this group than among another 15 who swam in the same area - but did not interact with dolphins.

The study is published in the British Medical Journal.

All the volunteers who took part in the trial stopped taking antidepressant drugs or undergoing psychotherapy at least four weeks beforehand.



Dolphins are increasingly being used in therapeutic treatments

“ Animals, and especially mammals, can favourably change our social dynamic ”

Dr Iain Ryrie

Regular sessions

Half the volunteers swam and snorkelled around dolphins for one hour a day over a two-week period.

The others took part in the same activities, but without dolphins around.

Two weeks later, both groups showed improved mental health, but especially so among patients who had been swimming with the dolphins.

“ We are part of the natural world, and interacting with it can have a beneficial effect on us ”

Professor Michael Reveley

The researchers say dolphins' aesthetic value, and the emotions raised by the interaction may have healing properties. Some have speculated that the ultrasound emitted by dolphins as part of their echolocation system may have a beneficial effect.

The Leicester team believe that using animals in this way could be a productive way to treat depression and other

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psychiatric illnesses.

Researcher Professor Michael Reveley said: "Dolphins are highly intelligent animals who are capable of complex interactions, and regard humans positively.

"Some people who are depressed may have issues with other humans, and might respond more positively to other types of interaction.

"We need to remember that we are part of the natural world, and interacting with it can have a beneficial effect on us."

Dolphin therapy is already used to help children undergoing rehabilitation for a range of conditions.

Shared brain system

Dr Iain Ryrie, research programme director at the Mental Health Foundation, said that humans and dolphins shared a limbic brain system that plays a key role in regulating many of the body's physiological and emotional processes.

He said: "Emotional contact is a biological need for mammals, stimulating their limbic systems, ensuring the suckling response and providing gentle encouragement toward ever more maturity.

"As humans we are hard-wired to need touch and to be connected to others, something that differentiates us from reptiles say, who don't have a limbic communication system and who are not suckled.

"So it's possible for humans to make loving relationships with many different mammals because of this biological/social similarity."

Dr Ryrie said research had shown the symptoms of depression could be ameliorated by pet assisted therapy.

The technique had also been shown to aid young people with attention deficit hyperactivity disorder, and older people with dementia.

"Animals, and especially mammals, can favourably change our social dynamic, which is typically one of withdrawal and increasing isolation among people with depression.

"Swimming with and caring for dolphins as a group activity in a vacation context is very likely therefore to alleviate depression."

However, he said researchers would probably do better to focus their efforts on animal interactions that were more readily available closer to home.

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Dolphins, Therapy & Autism

by

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~ Dedicated to Dreamer Dolphin ~

*I have met with a story, which, although authenticated by reliable evidence, looks very like a fable...- **Pliny the Younger (A.D. 62?-c.A.D. 113)***

*Dolphins may well be carrying information as well as functions critical to the regeneration of life upon our planet. - **Buckminster Fuller***

*Dolphins have new understandings that seem to lie just beyond our present knowledge. There may be a common thread of consciousness between man and dolphin. - **Joan McIntyre***



Most of us are aware of dolphins as loveable, playful animals that appear in oceanarium shows, on television and in movies. They are subjects of naval and other research to find out how they use sound to communicate, navigate in their environment, use Sonar and stun fish.¹ They are among the most intelligent of all creatures. Throughout history the dolphins have helped people, taking children to school in ancient Greece, fishing with us, guiding ships,

¹ **S**ound **N**avigation **A**nd **R**anging – use of projected sounds and analysis of the resulting echoes for navigation.

saving people from drowning, and recently, escorting Elian Gonzales when he was at sea on an inner-tube drifting from Cuba to the United States.

Dolphin Self Awareness & Language

The voice of the dolphin in air is like that of the human, in that they can pronounce vowels, and combinations of vowels - Aristotle

Dr. Ken Marten at Sea Life Park in Hawai'i recently demonstrated that dolphins recognize themselves in mirrors, which shows dolphins are *self-aware*, a trait shared with only humans and great apes. Dolphins were also taught to recognize some 40 spoken Hawaiian words by Dr. Wayne Batteau, and were taught to imitate English by Dr. John C. Lilly, M.D. Dolphins currently working with Dr. Louis Herman in Hawai'i can recognize some 300 hand signs in some 2000 combinations.² Dolphins have done better at language tasks than any other creature. Research in Russia by Markov and Ostrovskaya concludes that dolphins *have their own language* with up to a *trillion* "words" possible.³

Dolphins, along with other *Cetacea* (dolphins and whales), have acute senses, which are faster and have a broader bandwidth than our senses. They have large brains, like the Sperm whale with the largest brain - 9600 grams vs. our 1400 grams. The Cetacean brain is comparable to ours in complexity and processing capability. With larger brains, they have more processing capacity – just as a large computer has greater capability than a small one. The Cetacean brain has expanded most in the cerebral cortex, where thinking, reasoning, and other "higher" processes are felt to occur.

The brain of a dolphin, for example, is larger than the human's (at a weight of some 1700 grams) and has about 40% more *association cortex* (where we feel thinking occurs) than a human. In addition, humans use a large part of their available processing capacity just to deal with gravity and balance. The Cetacea live in a buoyant environment where gravity is much less a factor. This leaves large amounts of their brains free for other tasks. So the Cetacea have greater available brain capacity than humans.

² Herman, L. M., D. G. Richards and J. P. Woltz, *Comprehension of sentences by bottlenosed dolphins*, Cognition (16) 129-219, 1984.

³ Vladimir I. Markov and Vera M. Ostrovskaya, *Organisation Of Communication System In Tursiops Truncatus Montague*, A. N. Severtsov Institute of Evolutionary Morphology and Ecology of Animals, USSR Academy of Sciences, 33 Leninsky Prospect, Moscow 117071, USSR. From *Sensory Abilities of Cetaceans: Laboratory and Field Evidence*, Edited by Jeanette A. Thomas and Ronald Kastelein (Harderwijk Dolfinarium), NATO ASI Series, Series A: Life sciences Vol.196.

The number of such [signal] blocks in a [dolphin's] signal [is] from 1 to 24, averaging to 5-7. The number of structural types of blocks has [yet to be] established definitely, but it is well over one hundred. Using this data and standard formulas from Games Theory, one can calculate easily that 10¹² signals [that is, a trillion unique signals!] could be produced by means of free combining. ... All this makes it possible to think that the communicative system of bottlenose dolphins is 'open' in terms of vocabulary formation. This conclusion is indirectly supported by the fact that dolphins use hundreds of structural types of signals for communication.

I conclude that the *Cetacea* (dolphins and whales) are self-aware, fully conscious, sentient, and have their own complex language. Because they have larger brains, more available cortex, and more processing power available (because of their lives in water) the Cetacea, including the dolphins, are more intelligent than we are. The Sperm whale has the largest brain (much of it association cortex) and likely has proportionately greater processing capacity - making it in all probability - the most intelligent creature on Earth.

Therefore, when considering dolphin abilities, we are dealing with an intelligent creature that has capabilities equal to or exceeding our own.

Dolphins Can Help Restore Us

*To speak of lower animals is both arrogant and blasphemous. All traditional peoples have viewed animals as messengers and mediators of the divine which is a lesson we need to relearn ... that consciousness takes many forms beyond human. - Larry Dossey, M.D. **Healing Beyond the Body***

There are now dolphin assisted therapy (DAT) programs operating in Florida and elsewhere. Generally a client swims with dolphins and has on-land lessons. Details vary with the condition being treated. The swims can occur over days to weeks. Dolphin therapy is still at an early stage of development and controlled experiments (where one strives to test single variables while holding all other factors constant) are rare and our understanding still rudimentary. Some results are based on anecdotal evidence. Many factors remain to be sorted out. For example, similar therapy using horses or dogs shows positive results, so what part of the result is unique to the dolphins? There may be placebo effects, where expectations determine results. Understanding all this requires on-going research.



**A Dolphin-Assisted Therapy session, Island Dolphin Care, Inc., Key Largo, Florida
Deena Hoagland, LCSW; Katrina, 13 year old autistic patient; and Squirt, Therapist**

Parents with an autistic child may be looking for, and willing to try, almost anything to improve their child's life. While positive and sometimes remarkable results have been reported, it is beyond our ability to *guarantee* results from dolphin therapy. Therefore, evaluate this and other sources carefully to find if this approach is right for you.

The reports included here seem valid to me. I am personally convinced that these results justify greater effort to find out how dolphins do what they do. In the future, we will be able to apply what we learn, duplicating dolphin methods to make them widely available.

The Beginning of Dolphin Assisted Therapy

Dolphin assisted therapy began in 1973 when Dr. Hank Truby, a linguist and acoustic phonetician who worked with Dr. Lilly and the dolphins for 17 years while they were teaching them English, first took autistic children to meet the dolphins at the Miami Seaquarium in Miami, Florida.

In this first encounter, two autistic boys who usually had about five minute attention spans, began to play with the dolphins. There was a close rapport between the children and the dolphins. While these children ordinarily showed little interest in external things, they showed great interest in the dolphins. The children and dolphins played games for an hour and a half with the children playing the entire time. By the end of the session, the children were cooperating with each other and the dolphins, to fill buckets with water to dump over the dolphins and feed the dolphins fish.

To the parents it was astounding the children maintained interest for over an hour and cooperated; this was unique. Dr. Truby reported these results at conferences for some two years and received little interest. Finally, intrigued by Dr. Truby's results, Dr. Betsy Smith performed similar studies with positive results and began therapy programs at Dolphins Plus on Key Largo and Dolphin Research Center at Grassy Key in Florida.

Currently, Dr. David Nathanson has programs at Dolphin Research Center, and similar work continues at Dolphins Plus. Nathanson reports that their program has treated some 450 autistic people, many children with generally positive results. Nathanson reports that while there is often improvement with dolphin therapy, dramatic improvement is rare. (See Nathanson references) Several other facilities are operating in Florida, the Bahamas and elsewhere. With the interest in dolphins and the positive results of DAT, more centers are opening. (See Appendix III.)

My involvement with dolphins began when I read John Lilly's works as a child and was privileged to be with dolphins in Texas for a summer when I was 14. They have been part of my life ever since. Later, at the University of Miami, pursuing degrees in neuroscience, I met and worked with Dr. Truby for some 12 years, especially with the Dolphin Project of the World Dolphin Foundation which Dr. Truby and our team created.

I have learned a great deal from the dolphins and they are always fascinating. My experiences led me to later join the Sirius Institute, now based in Hawai'i, as its research director. With our founder, Paradise Newland and others, we are establishing a *human-dolphin habitat* where we will live closely with the dolphins; learn from each other; communicate objectively; birth children underwater with them; and investigate the nature of the "dolphin effect" on autism, brain trauma, and other conditions.⁴ Since Dr. Truby's first studies, the field has expanded. Among other conditions, DAT has improved the following:

⁴ See: www.planetpuna.com/Projects.htm and www.planetpuna.com/si.htm

Autism (Hank Truby, Betsy Smith, Robert Nathanson)
Joint problems (various reports)
Down's syndrome (Nathanson)
Depression (Horace Dobbs, Operation Sunflower)
Cerebral palsy (Nathanson, Dolphin Research Center)
Improved learning - Children can learn 2-10 times faster around dolphins (Nathanson);
Angina (Roxanne Kremer)
Acoustic "zap" of a tumor (personal comm.),
Microcephaly [See below]
Dreamer dolphin fixes a neck [see below]
Restoration of partial vision loss [see below]

Some of these reports are expanded below.⁵

A Case of Microcephaly

Scott Taylor of the Cetacean Studies⁶, while at the 2nd International Conference on Dolphin Assisted Therapy in Cancun, Mexico, reported about dolphin therapy with a baby that had microcephaly, a rare disorder where the skull is too small to contain the brain. We have yet to develop effective ways to correct the condition.



**Figure 3. A Child & Dolphin -
Dolphin is sonaring at point blank range (from S. Birch)**

The baby was floated in water and attended by 4 dolphins. One dolphin put its rostrum at the medulla (base of the skull), two others came to both sides of the neck, with the forth at the base of the spine. The dolphins made produced sounds or "ensonified" the child for about 20 minutes at a time, a few times per day for about a week. At the end of this period the skull plates were developing normally.

⁵ An extensive listing of treated conditions is at Dr. Nathanson's website:
<http://www.dolphinhumantherapy.com/>.

⁶ Institute (<http://www.linknet.com.au/dolphin/home.html>, Email: dolphin@cybermesa.com)

Mr. Taylor heard in the oral presentation that medical records confirmed the above results. I recently reconfirmed with Mr. Taylor that this account is accurate. We expected a full report in the written proceedings. However, the paper is more cautious and waffled on the change in the skull growth and its medical confirmation. Mr. Taylor said after the dolphin therapy conferences "*This will change the face of medicine.*"

Dreamer Dolphin Heals My Neck

I have a personal experience of Dreamer dolphin improving the state of my neck. I had injured my neck at age 12 and compressed 6th and 7th cervical vertebrae. There was always a noticeable "grinding" sound when I turned my neck. I was swimming with Dreamer at age 42. We were both underwater, Dreamer was about 3.5 feet from me, when I felt and heard some 20 very loud, short, sound pulses distributed rapidly, over my head and neck within perhaps a second. The sounds were louder than anything I have ever heard from a dolphin. At the time, I thought she was probably sonaring a fish far away.

I had been with dolphins many times before, and had swum with Dreamer the year before; yet this time, the sounds were different than any other dolphin sound I had ever heard or felt. They felt precisely targeted, powerful, tightly focused. Each pulse felt like a tiny "explosion" that I could feel were localized in spherical areas about 1/4 cm diameter or less.

About an hour after our swim, the muscles of the left side of my neck (the most injured side) suddenly relaxed. Right after that, my back got warm in some 5 new places, apparently because the blood distribution had changed. Next, I felt and heard at least 3 vertebrae click into new positions. I then turned my neck back and forth, and the "grinding" sound was gone! It felt like my neck had been "oiled" and it moved more smoothly than at any time in 30 years. The improvement has persisted for 14 years thus far.

Dreamer Dolphin & Pod Relieve Angina

Roxanne Kremer, a dolphin researcher working in the Amazon with the fresh water dolphins, reports the following. Her mother had had severe **angina** (severe pain in the chest) and had two angioplasty procedures to expand the coronary vessels. Generally, the procedure relieves the angina. In her case, the angina remained. Roxanne took her mother to Dolphins Plus where she swam with Dreamer and 3 other female dolphins. At one point in the swim, Dreamer and the other dolphins put their beaks on her chest. With that action, the angina was gone, and at last report, this had persisted for at least 2 years.⁷

Dreamer Dolphin "Zaps" a Tumor

I have learned that a woman swimming with Dreamer thought she had been rammed. The woman was taken to hospital for examination. The woman had a large bruise. X-ray revealed that under the ribs, near the center of the bruised area, there was a small tumor. It is my feeling that Dreamer likely "zapped" the tumor with a powerful sound pulse, perhaps to

⁷ Roxanne Kremer, Personal Communication, 1989.

heal it, and the high intensity sound left bruising from hydrostatic shock. At the least, the bruising called medical attention to the tumor.⁸

Restoration of Vision

NBC's "The Other Side" aired a segment in February, 1998 on dolphin therapy. They interviewed a man who had had a head injury. The injury had given him tunnel vision. Months later, he was swimming with the free Spinner dolphins off Kauai. He felt and heard the dolphins sonaring him, and *while in the water*, his peripheral vision returned, and he was then able to see some 30 dolphins all around him. How this was done is a mystery. At minimum, the dolphins *may* have corrected an ischemic blood flow reduction (this is speculation).⁹

Improvement of Mental Age in Cerebral Palsy

On the same program was a child of 8 with cerebral palsy. Melissa was from my hometown of Winnebago, Illinois. She had been with the dolphins and Dr. Nathanson at Dolphin Research Center, in Florida. I arranged for her to be on the NBC "The Other Side" show¹⁰ that was filmed in Hawai'i. The parents told me the functional mental age level of their daughter had improved from 3.5 months to about 3.5 years after about a week around the dolphins.¹¹



Figure 4.
Melissa gets a “kiss” during a therapy session

It is important to confirm such results with better studies and research. It appears dolphins can do remarkable things, and we would be wise to learn more.

⁸ Dolphins Plus, Personal Communication, 1989.

⁹ NBC, *The Other Side*, television program aired February 1998.

¹⁰ NBC, *The Other Side*, television program aired February 1998.

¹¹ Personal Communication with Melissa's parents, 2003

Autism – Description & Causes

Autism is a neurological disorder characterized by impairments in language, cognitive and social development, usually manifesting in the first two years of life. Once considered rare with an incidence of 1-3 per 10,000 births, autism is now reaching 20-40 per 10,000 births with “clusters” of 1 per 150 reported. Autism now ranks third among childhood developmental disorders, more common than Down’s Syndrome, Cerebral Palsy, Muscular Dystrophy or Cystic Fibrosis.¹²

Immune, gastrointestinal and neurological abnormalities, as well as heavy metal toxicity, (especially mercury) have been documented in autistic children. One source of mercury is immunizations. June 1999, the FDA announced “Infants who receive thimerosal containing vaccine at several visits may be exposed to more mercury than recommended by Federal guidelines for total mercury exposure.” Mercury is the third most toxic substance known and is the most toxic non-radioactive metal and is known to be neurotoxic, especially in brains of small infants. Mercury disrupts cell physiology by binding to sulfur with resulting dysfunction of enzymes, membranes, and structural proteins.

Symptoms of mercury toxicity in young children mirror those of autism. *Thimerosal*, a preservative used in some vaccines, is 49.6% mercury by weight. Infants vaccinated with multi-dose vials can receive *62.5 micrograms of mercury per visit*, about 100 times the 0.1 micrograms per kilogram of daily exposure considered safe by the EPA. The increased number of children with autism correlates with the hepatitis B and HIB vaccine given to infants in the early 1990s. For more on this see Appendix I. where Dr. Bernard Rimland, (consultant for the film *The Rain Man*), discusses mercury as a primary cause of increasing autism. As of 2003 mercury is still being included in the manufacture of several vaccines: DPT, hepatitis B, influenza, H. influenzae.¹³

Susan J. Crockford shows that global changes in body structure (expressed phenotype) can result from changing just a few genes that control thyroid hormones, especially the patterns of its timed, pulsatile, release. Geographic or breeding isolation of pioneer groups, say, to a colder climate, change thyroid patterns, and with genetic drift, the patterns of thyroid timing soon differ from the general population. This leads to behavioral and physiological changes that become fixed through further selection. A similar mechanism explains sexual dimorphism.¹⁴

Simon Baron-Cohen presents a view of autism based on the observation of behavior types ranging from *empathizing* (common in females) and *systemizing* (common in males). Extreme autistic and Asperger’s syndrome people, male or female, have extreme “systemizing” behavior. This leads to the kind of obsessive focus on detail, mechanical and other systems often seen in autistics. He theorizes, following the work of Norman Geshwind, that the differences in the brain seen here may result from variations in the amount of

¹² See: <http://www.autism-mercury.com/>

¹³ *ibid.*

¹⁴ Susan J. Crockford, *Thyroid rhythm phenotypes and hominid evolution: a new paradigm implicates pulsatile hormone secretion in speciation and adaptation changes*, in: *Comparative Biochemistry and Physiology Part A* 135(2003) 105-129, 2002.

testosterone encountered by the developing fetus. Increased testosterone causes increased growth of the right hemisphere of the brain, and results in a more “systemizing” brain, generally lacking in empathy.¹⁵

Crockford points out that the release of pituitary hormones, and the cascade of effects from them, including testosterone release, is controlled by the thyroid hormones. So we now have a general model that can help to explain speciation, sexual dimorphism, phenotypic variations, and autism spectrum disorders. Crockford presents a consistent model of sexual dimorphism and brain-gender-behavioral complexes that lie at the core of why we have male (systemizing) and female (empathizing) behavior patterns. Testosterone is controlled by thyroid hormones that can be changed by genetic, biological, and environmental factors (such as metal toxicity). Should any of these factors increase fetal testosterone, it will tend to produce a person in the autistic and Asperger syndrome spectrum of behavior.

Relevant to vaccines and autism, mercury is some 100 times more toxic in the presence of testosterone. This may explain why males are more often affected by autism. Mercury clearance *rates* were found to often be less in males, so a given dose of mercury could affect males more severely. Mercury can poison many systems and this could, in turn, change thyroid pulse patterns, etc. along the lines suggested by Crockford.

Careful evaluation of these matters should make the mechanisms clear. For the moment, we know that mercury can be cleared from the body using chelating agents and clathrates.

A remarkable story of success treating autism using diet and other alternative measures is included as **Appendix II**. Their experience offers methods to explore what anyone could do.

We also know dolphins often improve these conditions. Let's investigate how they accomplish their feats.

¹⁵ Simon Baron-Cohen, *The Essential Difference - the truth about the male & female brain*, Basic Books, New York, New York, 2002.

Models for Dolphin Assisted Therapy

*I'm a scientist and I know what constitutes proof. The reason I call myself by my childhood name is to remind myself that a scientist must also be absolutely like a child. If he sees a thing, he must say that he sees it, whether it was what he thought he was going to see. See first, think later, then test. Always see first. Otherwise you will only see what you were expecting. Most scientists forget that. ... the other reason I call myself Wonko the Sane is so that people will think I am a fool. That allows me to say what I see when I see it. You can only be a scientist if you stop minding that people think you're a fool. - Douglas Adams in ***So Long and Thanks for All the Fish****

Now we come to the crux of the matter of dolphin assisted therapy. Most reports show at least some improvement of autistics. Some hug their parents for the first time; some say their first words soon after dolphin contact. These cases and others show that dolphins are capable of profoundly benefiting even severe conditions for which we have little to offer from extant medical systems. Dolphins are complex creatures and our knowledge of them far from complete.

The mystery is - What are the dolphins doing to effect these changes? In what follows, I offer models of how dolphins affect our wellbeing and who the Cetacea, the dolphins and whales, are on our planet.

Most people like dolphins. Most dolphins like people. Many people experience great love from them. As a boy of 14, I found the dolphins accepted me as I was, with all my warts, yet loved me and were very friendly. They knew and sensed many things about me instantly. They knew my level of courage, my breath holding time, and my endurance levels. We swam together and touched a lot. My main impression was one of love, play, happiness and joy. The dolphins were the first sane beings I had ever met. The summer I lived with them was a joyous time for me. We became great friends.

At a fundamental level, please recognize the extreme gentleness and restraint the dolphins use in their approach to us. They have always, in my experience, been supremely gentle with children. Lilly concluded that the ***single most important*** conclusion from his work with the dolphins was ***that they had clear and consistent ethical behavior toward humans***. Humans were always helped and treated with respect. I have found this to be true with (only 1-3 exceptions out of many reports for the last 2500 years or so).

Over time with the dolphins, and later the whales, I came to feel they are beings from a race far older and wiser than ours. Here is my personal summary regarding the dolphins and the other Cetacea.

The sperm whale has the largest brain we know of, some 9600 grams vs. our 1350 or so. They hunt giant squids in abyssal depths of at least 9,000 perhaps 12,000 feet for about an hour's dive. The dolphins are their human-scale relatives, with brain sizes of 1600 grams or

so, with 40% more association (thinking) areas than in our brain. They have larger short-term memories than we do.¹⁶

The Cetacea are *always* awake. They are *conscious breathers* – this means that every breath is a conscious act. Should a dolphin be knocked out, they will stop breathing and must be artificially respiration. We, on the other hand, can be knocked out and breathe under autonomic control. So the dolphins are always awake, either with one hemisphere of the brain, while the other naps, or with both hemispheres. The dolphins, as determined by Lilly and associates, have far more of their behaviors under conscious control than do we.

Dolphins can dive to 1000 feet, jump 25 feet out of the water, and precisely take a fish from your mouth, stay down 20 minutes on one breath and swim 18 knots/hr sustained with a top speed of about 35 knots. They have a built in, high power, sophisticated sono-electric system that can do everything from stun food to perform the most delicate, focused, targeted, gentle resonant therapy.

If our fossil dating is correct, dolphins and whales have been here with complete sonar systems and brains equal to or larger than our own for at least 15 million years and perhaps as long as 30 million years. For this vast time, something like *three times* our evolutionary history as genus Homo (counting from genus Home, e.g. Homo *habilis*, estimated at 5 million years or so)

The Cetacea are a planet-spanning culture with multiple species, communicating across the globe, by acoustic and perhaps radio means, and communicating in an “open” linguistic system with a trillion symbols to choose from.

Further, their senses are, in a word, *broader band* than ours. For example, their sound interval discrimination ability is 10X better than a human. Their acoustic system brings in data at something like 40X our own rate at over 10X our frequency range (maximum frequency heard by humans, ~20,000 Hz; for the dolphin ~200,000 Hz or better).

So when I am in the water with a dolphin, I am faced with the humbling truth: compared to the dolphin, I am almost blind, almost deaf, can hardly swim, have a smaller brain, and a shorter evolutionary history!

I feel I have learned more about their nature than most people on this planet, since age 13 onward. I know many of the old Greek tales about dolphins are true because I have lived them. I am a proud inheritor of the Lilly/ Truby/ Morgane/ Bateson/ Munson et alia tradition of dolphin research.¹⁷ It is from this experience that I now write.

From a scientific point of view, consider this a “preliminary report” mainly presenting observations suggesting connections with known data, and directions for further study. I

¹⁶ Dolphin short term memory size is about 12 units; ours is 5 + or – 2, i.e. a maximum of 7 units (which is why telephone numbers have 7 basic numbers).

¹⁷In fond acknowledgement of Communication Research Institute including: John C. Lilly, M.D., Hank Truby (linguist, acoustic phonetician, etc.), Peter Morgane (neuroanatomist), Gregory Bateson (biologist), George Munson (Bell Labs Electronics Research) *et. alia*.

seek the truth, and I am always open to the truth, should anyone have better ideas or corrections.

The Cetacea are increasingly coming to contact us. Certainly more humans than ever before are aware of them and going to meet them and learn from them. Let us meet the dolphins and other Cetacea with our finest. I know we will be richly benefited by what we will learn, especially for our children. Call it their love that they share with us. It is their gift, and I know it would bode well for the humans to recognize the magnitude of this gift and respond in kind. Let us now consider some to the dolphin's capabilities.

Empathy, Telepathy, Telempathy

Autistic people are “systemizing” and the dolphins show great empathy and care, especially with children. Perhaps being around the strongly empathic dolphins helps balance autistic patterns. We know that touch, affection and love can be deeply healing. Being with the dolphins can be a deeply spiritual experience. Many of us that have been with dolphins have experienced profound transformations.

In particular, many of us have experienced a strong connection and communication with the dolphins that is best described as telepathic or telempathic. We have yet to know how this works, yet it occurs with many of us. Patricia Saint-John met the dolphins and had deep telepathic experiences with them. She was moved to work with autistic children based on what she learned. She found that by being in the state of mind she had with the dolphins she was able to telepathically contact autistic children and had much success in improving their functioning and communication.¹⁸

It is important to evaluate these channels and consider them in any dolphin therapy, even if they are beyond our consensus science. There are signs that science is catching up with our experiences. Consistent physical models are possible for what might be otherwise classed as “paranormal” events.¹⁹

Dolphins also produce acoustic and electromagnetic fields capable of causing effects such as resonance and entrainment. We discuss these aspects below to develop models of dolphin therapy mechanisms and capabilities.

¹⁸ Patricia St. John. *The Secret Language of Dolphins*, New York Summit Books, 1991.

¹⁹ Elizabeth Raushcher & Russell Targ, *The Speed of Thought: An investigation of a Complex Space-time Metric to Describe Psychic Phenomena*, Bay Research Institute, 1010 Harriet St., Palo Alto, Ca., 94301.

Resonance

All systems have *natural frequencies* at which they prefer to vibrate. An external energy of the proper frequency and with the proper timing or *phase* near a system's natural frequency will cause the system to vibrate with or *resonate* with the external energy. A simple example is the common child's swing. To make a swing move in a larger arc, you must push it at just the right time (phase) and this corresponds to the swing's natural frequency. Another example is two guitars. If a string on one guitar is plucked, the same string on the other guitar will vibrate, even if the guitars are many feet apart. Systems driven at resonance can absorb large amounts of energy. A soprano holding the resonant frequency of a crystal glass can transfer enough vibrational energy to the glass that it shatters.

I was once swimming with Liberty Dolphin in Florida. In the murky water I accidentally jammed my elbow into his blowhole area. I think it hurt him. He came around in front of me, and at about 2 1/2 feet from my chest, began to put out a high intensity, fairly low frequency sound, probably less than a thousand Hz. First, at low power, I could feel the water vibrate. Then his power increased and I felt the water in front of my chest *get warmer*. Then, Liberty increased power again and I felt my *chest wall* get warm. Then he changed frequency and soon, *all my chest hairs were vibrating* - even in the water, so strongly that my whole chest tickled with an intense buzz. Liberty stopped his sounds at this point. I had the distinct impression that he was just showing me part of what he could do, something like: *"This is just a demonstration, I could do a lot more, I'm just warming up"*

So dolphins are masters of resonance.

Entrainment

*Entrainment can be defined as “ the tendency for two oscillating bodies to lock into phase so that they vibrate in harmony. It is also defined as a synchronization of two or more rhythmic cycles. The principle of entrainment is universal, appearing in chemistry, pharmacology, biology, medicine, psychology, sociology, astronomy, architecture and more”*²⁰

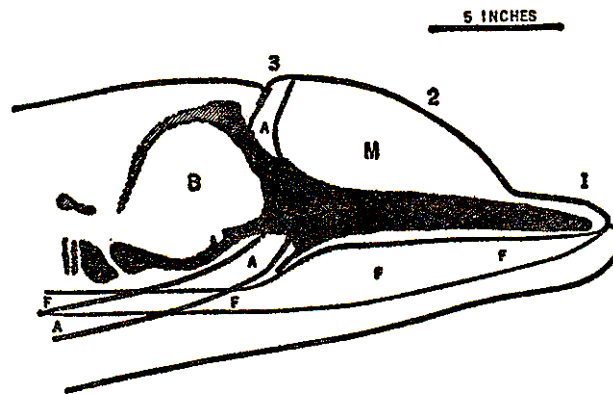
When we are exposed to periodic signals, such as a sound, a light or electrical signals, our bodies tend to track and match the core frequency and phase of the applied signals. For example, if you look at a light blinking at about 4 Hz, your heart rate and *EEG* or "brain waves" (*electroencephalogram*) will tend to match the rate of the light and shift more of their energy toward 4 Hz. Entrainment causes systems to vibrate more in phase or move in synchrony. If the phase of two oscillations match, the most energy will transfer between them. Stephen Birch showed that entrainment of the human EEG occurred during and after swims with free dolphins. *The EEG of the human subjects reduced in frequency and increased in power after swimming with free dolphins.*²¹

²⁰ www.rifetechnologies.com

²¹ Steven Birch, *Dolphin-Human Interaction Effects*, Monash University, Melbourne, Australia, 1997.

Dolphin Sounds

To better understand the sound capability of dolphins, it is useful to review a little of their anatomy and their means of sound production. The drawing below is a tracing of the midplane of a dolphin. Labeled areas: 1. **Rostrum** or “nose”; 2. External surface of the **melon**; 3. **Blowhole**. The skull and upper jaw are *black*. The airway passes through the bony nares (“nostrils”) anterior to the brain (B) in the skull. The food-way (F) starts in the mouth and passes on each side of the airway (A) at the larynx. (After J. C. Lilly)²²



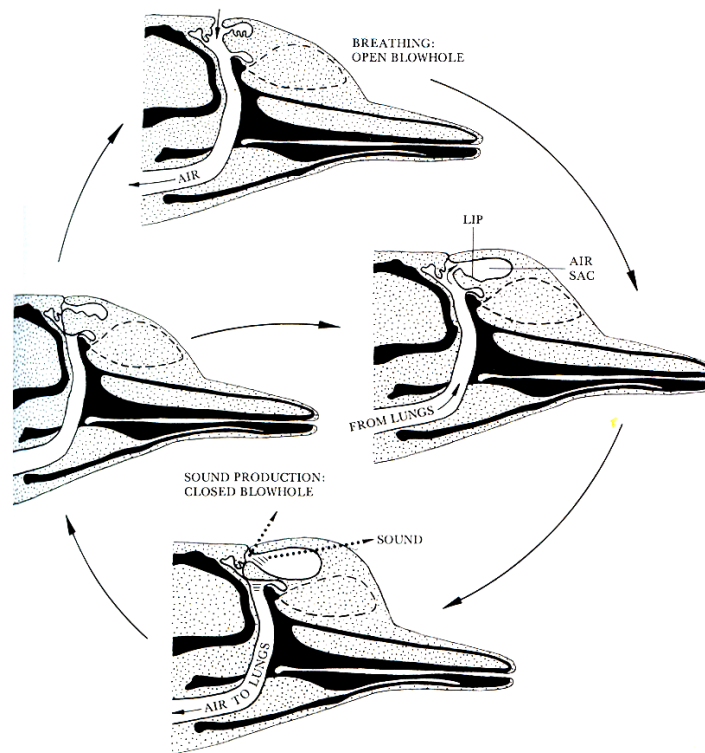
A Diagram of the Head of a Bottle-nosed Dolphin
(*Tursiops truncatus*)

The palatine bones in front of the skull (left of A, above) form a parabolic sound reflector behind the phonators. The naso-pharynxes are located at the focus of this parabola. Therefore, sounds from the phonators, reflected from the palatines, go forward as *collimated* parallel beams. The sounds transit a structure called the **melon**, an oil-filled sack located at the front of the dolphin's head. The melon is, in part, an acoustic lens that focuses out-going sounds. Four sound-producing **naso-pharynxes** (also called “phonators”) are arranged in left and right pairs below the blowhole, roughly at point A in the diagram above.

How dolphins make sounds

The naso-pharynxes are similar to vocal cords with air sacs above and below them. The dolphin apparently shuttles air between the top and bottom air sacs and past the naso-pharynxes to make sounds. The diagram below shows roughly how sounds are made by the dolphin: **Inhaling** - the blowhole is open and the air is sucked into the lungs (top drawing). **Vocalizing** - the blowhole closed and air from the lungs is forced into an air sac near the top to the head. As the air sac fills, the forehead swells (middle right drawings). Then the dolphin closes the lip of the air sac and releases air back toward the lungs (bottom drawing). The air sac lip (one of four **naso-pharynxes**) then produces a sound (much like releasing air from a balloon).

²² John C. Lilly, M.D., *The Mind of the Dolphin*, Doubleday & Co., 1967.



The sounds reflect off the *palatine bones* that form a parabolic reflector in front of the air tract which collimates them through the *melon* (dashed line region) which then focuses the sounds. The middle left drawing shows the deflated air sac. The dolphin may then open the blowhole and refill the lungs or refill the air sac to make more sounds. (After Joan Macintyre)²³

Using their phonators, dolphins can produce high intensity sounds ranging in frequency from about 500 Hz to at least 280 kHz (or perhaps as high as 1 MHz). Russian work has measured the peak output power as some 235 dB, which means that dolphins are capable of sound pulses of about 1 kW of acoustic power. Roughly, 1 kW is equal to 1 horsepower!

The 4 phonators or “vocal cords” are under exquisite and *separate* control. One dolphin can make at least 4 simultaneous sounds that are all different, for example, 4 click tracks, 4 whistles, or any combination of clicks and whistles. This is illustrated in the figure below.

²³ Joan MacIntyre, *Mind in the Waters*, Charles Scribner’s Sons, 1974.



Operation of three sound generators:

A) All generators working in the tonal regime; B) All generators working in the pulse regime; C) Different versions of combined signals; Vertical Axis- Frequency; Horizontal axis – Time (After Markov & Ostrovskaya)²⁴

The figure shows a sonagram or “voiceprint” of sounds made by a Bottlenosed dolphin (*Tursiops truncatus*) showing the *simultaneous production of three separate sounds*. The darkness of the graph is proportional to sound power. Clicks appear as vertical lines and whistles as more horizontal traces. As you can see, the signals are complex.

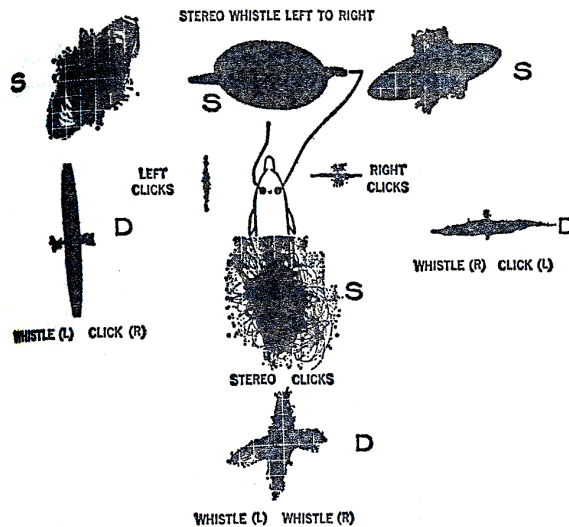
Dolphins have a fifth sound channel with a frequency of 130KHz. It is a high intensity, narrow beam directed by the teeth acting as a wave-guide, like an acoustic Yagi antenna. It is likely used for “private” communication at short ranges. We have yet to fully understand how this sound is made.

Phase Control, Sound Aiming and Sound Cancellation

If the peaks and valleys of two signals coincide, they are said to be “in phase”. Two signals in phase will reinforce each other and their power will add; two signals exactly out of phase will cancel. Dolphins control the *phase* of their sounds. Lilly showed how dolphins use phase to steer their sound beams. Microphones were placed on either side of the blowhole of a dolphin. At times only one microphone picked up sound while the other showed zero signal. This means that the dolphin was making *at least two sounds* such that, say, sounds to the left were cancelled out, while sounds to the right were reinforced, and vice-versa. The same principle is used in phased array sonars and radars. Thereby the dolphins can aim their sounds with the head still.

²⁴ Vladimir I. Markov and Vera M. Ostrovskaya, *Organization Of Communication System In Tursiops Truncatus Montague*

The figure below shows a dolphin making separate simultaneous sounds on the left and right. Sometimes the microphones (placed about 6 inches apart on either side of the blowhole) picked up sounds *only* on the left *or* right (the instances of vertical or horizontal patterns). The dolphin was generating an *anti-phase* sound that actively *cancelled out* sounds on the “quiet” side.



Dolphin Sound Production on the Right and the Left Side

Hydrophones were placed on each side of the dolphin's blowhole (as shown). Sounds from the right side deflected an oscilloscope trace horizontally and sounds from the left side deflected the trace vertically. The figure shows photographs taken during sound production. If the dolphin clicked only on the left, one sees only a vertical trace. Clicks on the right form horizontal traces and similarly for whistles on each side. Whistles coupled between both sides form complex ellipses on the screen. In a given click train, the dolphin may control the clicks such that the ellipse patterns shift their axes. [Capital "S" means stereo, i.e., sound linked on the two sides and "D" means “double” (or separated) sound production on the two sides without coupling.] (After J. C. Lilly)²⁵

Another time Lilly picked up a whistle as recorded by *one* hydrophone (underwater microphone) that appeared to be made by one dolphin. However the same signal was picked up by a second hydrophone. Analysis showed the whistle was made by *two* dolphins. One made the first part of the whistle and the second finished it. The transition between the two dolphins was *smooth and in phase*! This demonstrates exquisite *phase control* and *phase locking* among dolphins.

So the dolphins, singly and in pods are masters of phase control.

²⁵ J. C. Lilly) *Stereophonation & Double Phonation in the Dolphin* [manuscript, 1966].

What can a dolphin do with these sounds?

Dolphins use high intensity sound pulses to stun fish and other prey. If their 1KW of acoustic power were focused to a small point, the water would turn to steam, causing *cavitation*. This level of acoustic power focused on a fish could easily stun or kill it. Dolphin sounds are loud enough to allow communication over a range of at least 36 miles.

When dolphins use their sonar, they direct sounds toward a target and receive the returning echoes with their ears. The dolphin may perceive an echo “image” showing density differences in the target, be it a fish or a human body. For example, gas bubbles in the stomach reflect sound strongly, while soft tissues with densities near water are largely “transparent” to the sounds. Bones, being denser than water, also reflect strongly. Therefore, the dolphin may have a sort of “acoustic X-ray image” of us in the water, much like the images formed using medical ultrasound.

At frequencies of 280 kHz to 1 MHz, dolphins are able to sense quite small features, perhaps with resolutions under a millimeter. We know that they can detect and retrieve a 2mm diameter “BB” shot dropped in the water at a range of 70 feet. Dolphins could also focus sounds into spots under a millimeter. With 4-5 separate sound sources, use of other techniques like *acoustic interferometry* are possible.

Dolphins produce what are called *semi-coherent acoustic waves* where a sound’s wavefronts are “in step” or “in phase” and therefore are, roughly, like an acoustic “laser”. As we saw they can steer their sounds using techniques akin to phased array sonars and maintain phase coupling among two or more dolphins.

Dolphins could use what is called “time reversed acoustics”. In this technique, incoming sounds are recorded at several points and then played out in reverse to send an amplified sound directly back to its source. Such techniques have been used to break up kidney stones using what is called a *self-focusing lithotryptor*.²⁶

From the dolphin anatomy and sound capability, I conclude they are capable of many such feats. Consider the complexity of the 3-D sound fields the dolphins could create in groups with each dolphin producing four sounds each, while maintaining tight phase locking among themselves. With four phonators plus a 130 kilohertz signal from the jaw, dolphins can focus their sounds into small areas at high powers. They can, in principal, break kidney stones, remove bone spurs, cause cavitation in small regions, etc.

²⁶ Mathias Fink, **Time-Reversed Acoustics**, Scientific American, November 1999.

Vortex Ring Production



As one example of dolphin expertise, consider their bubble rings. Dolphins blow bubble rings, then make them larger or smaller (from about the thickness of a straw to 1 to 2 feet in diameter). The rings stay submerged instead of rising to the surface! Dolphins play with the rings - moving them around with their rostrum, bouncing the rings off a wall, or elongating them with a flick of their dorsal fins into 15 foot spirals.

Doing all this requires direct and active control of the vortex rings through sound. Otherwise, the rings would rapidly break up and disperse or float to the surface.²⁷

Vortex rings can be formed in water and can contain and transport acoustic energy for long distances rapidly. Such vortexes could account for the tightly focused, powerful sounds the dolphins use.

Human High Frequency Saccula Perception

We recently learned the surprising capability of the saccula, part of our vestibular system, having primarily to do with balance. It is now demonstrated that the saccula responds to sound frequencies of up to 250 kHz, giving us direct perception of ultrasound well into the dolphin range. Our ordinary frequency limit of hearing through the ears is about 20 kHz. It can be shown that people can discriminate high frequency sounds with the saccula and “feel” the sounds. We have yet to learn what specific physiological effects this might have.²⁸

Ultrasound, Sonochemistry & Sonoluminescence

The high frequency sounds made by dolphins can cause the same effects as medical ultrasound, such as **microbubble formation** and **cavitation**. A bubble is a cavity and the collapse of a bubble can heat the steam inside it to some 6000 degrees Fahrenheit (near the surface temperature of the sun!). At such temperatures novel chemical reactions occur called **sonochemistry**.

The chemical effects of ultrasound, sonochemistry and sonoluminescence arise from acoustic cavitation: the formation, growth, and implosive collapse of bubbles in a liquid. Cavitation collapse produces intense local heating (~5000 K), high pressures (~1000 atm), and enormous heating and cooling rates (>10⁹ K/sec).

²⁷ <http://planet-hawaii.com/earthtrust/delrings.html>

²⁸ G. Patrick Flanagan, **FlanTech**, Personal Communication

Acoustic cavitation provides a unique interaction of energy and matter, and ultrasonic irradiation of liquids causes high energy chemical reactions to occur, often accompanied by the emission of light... Thus, cavitation can create extraordinary physical and chemical conditions in otherwise cold liquids.²⁹

Through these mechanisms, ultrasound causes improved healing of bone fractures and non-unions and improves healing soft tissue injuries etc. Ultrasound can affect cell membranes, and chemistry and even **alter gene expression**.

...exposure of cells to therapeutic ultrasound under nonthermal conditions modifies cellular functions...[can] modulate membrane properties, alter cellular proliferation, and produce increases in proteins associated with inflammation and injury repair. ... these data suggest that nonthermal effects of therapeutic ultrasound can modify the inflammatory response. Exposure to ... therapeutic doses of US ... alter[ed] the expression of both the ALP and OP genes ... in osteoblast-like cells. The two highest doses showed that ALP and OP expression were clearly up-regulated, particularly ALP, whereas at the lowest dose of 120 mW/cm², the OP gene was down-regulated. ...recent reports demonstrat[e] that ultrasound affects enzyme activity and possibly gene regulation [We]...present a probable molecular mechanism of ultrasound's nonthermal therapeutic action. The frequency resonance hypothesis describes possible biological mechanisms that may alter protein function. [By] absorption of ultrasonic may...modify...[a protein's] 3-dimensional structure ...and alter [its] functional activity. Second, the resonance or shearing [caused by] the wave ...may dissociate a multimolecular complex, thereby disrupting the complex's function.³⁰

Acoustic Control of DNA

J. Harle & J. C. Knowles show that different power levels of ultrasound (US) can change gene expression in osteoblasts (bone forming cells).³¹ They state in part:

Ultrasound ...is commonly used [to] aid ...injury to soft connective tissues and for fracture healing. However, the precise effects of therapeutic US on tissue ...are not clearly understood although they are likely to involve changes in key cellular functions. The ...study ...examined the effects of ...US on the activity of two bone-associated proteins, alkalinephosphatase (ALP) and osteopontin (OP)... ALP showed progressively higher expression with increasing US intensities, whereas ...show[ed] down-regulation at 120 mW/cm², the lowest US exposure. ...ALP and OP clearly exhibited gene-specific response profiles. These findings suggest that ...US exposure could ...improve repair and regeneration processes...

²⁹ Suslick, K. S.; Didenko, Y.; Fang, M. M.; Hyeon, T.; Kolbeck, K. J.; McNamara, W. B. III; Mdleleni, M. M.; Wong, M., *Acoustic Cavitation and Its Chemical Consequences*, Phil. Trans. Roy. Soc. London A, 1999, 357, 335-353.

³⁰ Lennart D. Johns, *Nonthermal Effects of Therapeutic Ultrasound: The Frequency Resonance Hypothesis*, J Athl. Train. 2002 September; 37 (3): 293-299

³¹ J. Harle & J. C. Knowles *Effects Of Therapeutic Ultrasound On Osteoblast Gene Expression*, Journal of Materials Science: Materials in Medicine 12 (2001).

Ultrasound is known to do the following:

- [1]. *Improve healing rates and tissue strength.*
- [2] *Benefit soft tissue wound sites and the elbow joint.*
- [3] *US treatment of hard tissue injuries, such as bone fractures, [show] ...markedly improved healing rates ... (approximately 30±40%) while animal studies [show] enhanced fracture healing ...improved rates of bone regeneration and ...suggest ... the use of US to enhance tissue repair and regeneration ...it is possible that US exposure ...may modulate gene transcription processes, perhaps by a mechano-transduction pathway...*

So effects similar to those seen with dolphins occur with medical ultrasound. We infer that dolphins, with intelligent and precise control of sound could accomplish similar or greater feats.

It is worth noting observations of *sonoluminescence* where a strange blue light comes from breaking bubbles acoustically stimulated at about 30 kHz. This light has a unique spectrum and some investigators report *nuclear “cold” fusion events* occur in the vibrating bubble. I therefore speculate, along with physicist Tony Smith ³², that the dolphins may even be able to generate fusion events!

Piezoelectricity and the Effects of Electrical Signals on the Body

Key to our next discussion is the *piezoelectric effect*. To illustrate, if a quartz crystal is *bent*, it will produce an electric charge. Quartz is *piezoelectric*. In phonographs, a quartz crystal needle rides in the groove of a phonograph record. As the record turns, the groove, cut according to the recorded sound, bends the quartz crystal needle back and forth. This creates electrical signals that are amplified into the sounds we hear. The piezoelectric effect works the other way as well: if an *electric charge* is placed across the quartz crystal, it *bends*. This aspect is used in current smoke alarms, where a *piezoelectric speaker* is used. Electrical energy causes the crystal in the speaker to deform rapidly and create the alarm's sound.

Some 60% our bodies are piezoelectric, especially bone. Bone is a many-layered sandwich of *hydroxyapatite* (a form of calcium carbonate) and a protein *collagen*. Both are piezoelectric, but of opposite sign. That is, if bending a hydroxyapatite crystal causes a *plus/minus* charge; collagen bent in the same way would generate a *minus/plus* charge.

So, bone, when *bent*, creates *electrical currents*. The bone forming cells, *osteocytes*, follow these currents. When bone is stressed it creates electrical charges which signal the osteocytes to *thicken* the bone where there is *more* load or *remove* bone where there is *less* load, automatically shaping our bones to match the stress on them.

Similar low frequency electrical currents in the body cause many effects, including directing the pioneer fibers of neurons, causing changes in reaction times or circadian rhythms, and

³² <http://www.innerx.net/personal/tsmith/TShome.html>

even inducing limb regeneration as documented by Cyril Smith³³ and Robert O. Becker, M.D.³⁴

Dolphin's sounds vibrate our bodies and create piezoelectric currents. A key point to remember is that *internally* and *externally* generated electromagnetic signals *are the same at the cellular level*; cells respond in the same way.

So dolphin sounds, through their direct acoustic effects of the micro-currents generated by the acoustic vibration of our piezoelectric tissues, especially bone, can clearly cause changes similar to ones already observed in electromedicine and ultrasound therapy.

Cyril Smith³⁵ found that low power electromagnetic signals of the proper frequency can improve allergic reactions, among other things. He found a correspondence between the effects of herbal and homeopathic treatments and electromagnetic frequencies such that the proper electrical frequency had the *same* effect as the *physical remedy*!

We know that electromagnetic fields at the proper frequencies resonate with specific biological structures. Royal Raymond Rife and his intellectual descendants have found frequencies that resonate with and destroy pathogens. To understand how this works, we must briefly explain *nuclear magnetic resonance* (NMR).

If one stimulates molecules, crystals or tissues with EM fields (usually in radio frequencies, "RF") while holding them in strong, steady magnetic fields, one finds frequencies at which protons absorb the RF strongly and spin rapidly. The resonant frequencies differ for protons in water or in fatty tissue, for example.

Protons absorb electromagnetic energy only at specific combinations of radio frequency and magnetic field – the point of *nuclear magnetic resonance*. For example, in a *magnetic resonance imaging* (MRI) system, a person is placed in a strong magnetic field to "lock" the protons in place. Then a radio signal is scanned through many frequencies to find the NMR spectrum. Using computer processing, detailed images of the body, brain and other tissues are created that reflect differences in tissue chemistry. One can even detect specific elements, such as calcium.

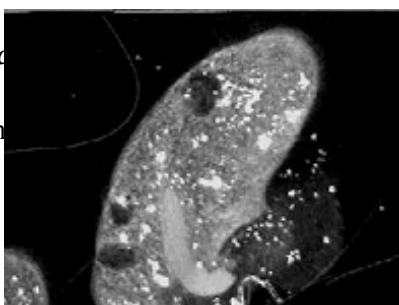
³³ Cyril Smith & Simon Best, *Electromagnetic Hazard in the Electrical Environment*, Macmillan, 1989.

³⁴ Robert O. Becker, M.D., *Selden*

³⁵ Smith & Best, op cit.

Hazard in the Electrical

New York, 1985.



Paramecium undergoing electroporation from a 1150 Hz EM signal

As Rife and others found, some frequencies can disrupt cell structures. Above we see a *Paramecium caudatum*, a single celled animal, undergoing evisceration, electroporation, and disintegration when exposed to a 1150 Hz AC field from a Rife/Bare plasma device.³⁶ What determines the effective frequency is the 0.5 Gauss magnetic field of the Earth. If we include the Earth's magnetic field in our consideration, we find that the NMR frequencies are lower and that even a 1050 Hz signal is at the NMR frequency for key elements in the cell wall of the *Paramecium*.

Another effect similar to electroporation is known as ***Voltage Dependent Ion Gating (VDIG)***. Ion channels in the cell open in the presence of an external voltage. By creating a charge differential at cell walls, Rife generators and other electromedicine devices can give pain relief, cause relaxation or stimulation. VDIG occurs at an electrical field of only 1/10 the intensity necessary to produce electroporation and is thought to produce a flow of ions, like calcium, potassium, and sodium, across the cell wall.

The above discussion shows that resonances occur which can disrupt cell membranes and the frequencies are well within a dolphin's frequency range and as we shall see, dolphins can create electromagnetic fields that can cause effects identical to those seen above and in electromedicine in general.

While the examples given have to do with resonances that kill cells, we also know from the work of Robert Beck³⁷, Robert O. Becker, Royal Raymond Rife, and Cyril Smith, *et alia*, there are many frequencies that heal and promote well being, and can even cause limb regeneration in mammals. There is a vast landscape to explore here.

Dolphin Electromagnetic Effects

The dolphin effects go beyond sound alone and piezoelectric effects. Dean Rollings and Eldon Byrd discovered that the dolphin *melon* is *piezoelectric*. Sonic excitation of the melon will therefore create electromagnetic fields. The melon in a dolphin contains perhaps one-quarter gallon of a special oil called ***valproic acid***. Because of its large volume, the melon could produce quite powerful electromagnetic fields, especially when vibrated by about 1 kW of acoustic power. Assuming a conversion efficiency of about 10%, the peak

³⁶ www.rifetechnologies.com/

³⁷ <http://www.quantumbalancing.com/who.htm>

electromagnetic field generated by the melon would be on the order of 100 Watts. So dolphins are *radio transmitters*.³⁸

Dr. Byrd measured electromagnetic, magnetic and electrostatic fields made by the dolphins. He measured EM fields while the dolphins were swimming with people and found EM fields in the same frequency band of our EEG or “brain waves”. He felt they were attempting to communicate with us in the EEG band.

Our human sensitivity limits to electric and magnetic fields are about seven *picowatts* electric and 1 *milligauss* magnetic. Biologically significant events are affected even at these tiny levels. For example, changes of respiration, reaction time, navigation in birds, growth and direction of nerve cell pioneer fibers and changes in circadian rhythms occur at gradients of 1-2 volts per meter and about 1-3 milligauss magnetic.

The electromagnetic fields produced by dolphins are sufficient to affect our biology and could even deliver a sizable shock! This opens many possible mechanisms that we can only cover briefly here. Dolphins generate fields similar to those found effective in electromedicine, such as extremely low frequency (ELF) fields, and can cause effects similar to Rife generators or similar devices.

Changing Gene Expression

The acoustic and electromagnetic fields of the dolphins may change our gene expression. According to theoretical biologist Jeremy Broner³⁹ the best models for the operation of DNA are based on Irene Cosic’s resonant model of biomolecular recognition.⁴⁰ According to this model, control of DNA is done by sound, light and EM resonances. This is key to dolphins’ effect on our wellbeing.

Active or “puffed” DNA (that DNA which is being read or used) is in resonant coupling with the protein or products being produced. This suggests that the entire cell is under tight light and sound-based resonant signals. Further, according to Dr. Broner, *phonon* or *sound* energy in the DNA sets up standing waves along the DNA - a musical chord - that determines what areas of the DNA become active or are “turned off”. DNA absorbs in acoustic, magnetic, electromagnetic (microwave) and visible light bands. Should all this be so (and this whole field in great flux) we surmise that electrical, magnetic, acoustic and light energy all affect the state of DNA in complex ways. (See also Appendix IV.)

We explore below the control of DNA by microwave and sound and relate this to dolphin capabilities.

Microwave Control of DNA

³⁸ Eldon Byrd, *The "Hello, Dolphin" Project*, International Symposium on Dolphin Assisted Therapy, Melia Turquesa Hotel, Cancun, Mexico September 8-10, 1995

³⁹ J. Broner, personal communication

⁴⁰ Birch, S. & Cosic, I., *Expansion of the Resonant Recognition Model to Incorporate Multi-variable Analysis*, Australian Physical & Engineering Sciences in Medicine 18(4) 1-12.

In 1987, Dr. Ross Adey, M.D., then at Loma Linda University in southern California, told me that particular frequencies of microwaves, pulsed at rather low rates could change brain state. For example, a signal consisting of 150 MHz microwave pulsed at 10 cycles per second will change calcium levels in isolated brain slices plus or minus some 20% or more. These results were obtained about 1970. Dr. Adey went on to discover that there are combinations of frequency and pulse rate that will trigger "oncogenes".

Oncogenes are genes in our chromosomes which, when triggered, cause cells to become cancerous. Dr. Adey said proper EM signals could trigger ANY gene.⁴¹ Therefore, the sound and electromagnetic field around DNA determines, in part, its pattern of gene expression. For this to occur, DNA must absorb and radiate energy in these bands and we know DNA absorbs and emits sound, light, other electromagnetic frequencies. Adey's work shows that these *bio-photons* and *phonons* (a quantum unit of sound) can change gene expression.

Dolphin sounds can affect the DNA directly and by piezoelectric effects generate micro-currents in our bodies, so dolphins may be capable of regulating aspects of our gene expression.

Changing the Structure of Water

Dr. James Clegg, University of Miami, (who studied the structure of water in cells) showed that all proteins, chromosomes, etc, in cells have a layer of bound water about 10 molecules thick. Therefore, when an enzyme reacts with a substrate, the only substance that actually touches the substrate molecule is *water*. Since other substances in the cell are also coated with packed water, the chemical reactions in the cell are mostly interactions of shaped layers of water molecules.

Clegg found that water in our cells is similar to a semiconductor, virtually solid, and usually bound to a surface, except where ongoing chemical reactions occur and even there, only a few molecules at a time are involved.⁴² The structured or packed water in cells is stiff and approximates the qualities of water *ice*. Structured water has clusters and long strings of ordered molecules that conduct electricity more easily.

Any water we drink must be conditioned to match our blood's surface tension of 42 dynes/cm. Structuring water lowers surface tension (to at least 68 dynes/cm² versus distilled water at 72 dynes/cm²) and has an effect on the water similar to adding soap. Substances dissolve more easily in water with lower surface tension. Boiling water, for example, has a surface tension of about 68 dynes/cm and easily dissolves many things. Structured water at room temperature with 68 dynes/cm surface tension has the same "dissolving power" as boiling water! Therefore, drinking structured water allows the body to "wash" itself more effectively.

⁴¹ Ross Adey, Personal Communication

⁴² James Clegg, University of Miami, 1973, Personal Communication

The water in the areas where people have the longest life spans all share characteristics like lowered surface tension indicative of being structured.⁴³ For example, the Hunza mountain water has a surface tension of some 68 dynes/cm.⁴⁴

According to Igor Smirnov (who works with structured water, in part, as a way to improve the health of people exposed to Chernobyl) the nucleus of the cell has two layers of membrane which makes it difficult to introduce agents to modify, say, gene expression. Yet, structured water easily reaches the nucleus and can carry information and change the gene state.⁴⁵

Structured water packs along the DNA backbone and forms the *tensile* part of the DNA structure. The molecules themselves are *compressive* members. Thus the structure of DNA is like Buckminster Fuller's *tensegrity mast*, in which tensile and compressive forces are balanced. Such structures are flexible. The state of each part affects the whole. If you play with a tensegrity mast you find that any change in the tension of any of the cables will twist or bend the whole mast. Tensions and lengths must be balanced for the mast to be straight. Similarly, the packing of water in DNA is important to maintaining its proper shape.

DNA and its protein scaffold assume many information-carrying shapes. We know that acoustic and electromagnetic fields change the structure of water and this in turn changes the DNA. EM and acoustic fields in the range of 0-30 Hz can structure water. One of the best signals mimics the geomagnetic field.⁴⁶ Steven Birch found the average frequency of sound emitted by dolphins when swimming with people was 26 Hz, an effective frequency for structuring water.

Effects of Structured Water

Structured water can encode patterns. We know this from the work of Cyril Smith. Briefly, Smith found frequencies, idiosyncratic to each patient, which would improve their allergic symptoms. Simply holding a vial of water that has been exposed to "calming" frequencies would damp their allergic reactions. The water in the vials was exposed to very low power electrical fields in the Extreme Low Frequency (ELF) range (below ~1000 Hz). He showed that water so exposed had measurably different light absorption spectra, especially in the UV range. This shows that a pattern was impressed on the water that was maintained, or "remembered" by the water. So, when we can impress water with the correct patterns, it can enter the cell nucleus, affecting the packed water around the DNA and change its state leading to different patterns of gene expression.

⁴³ G. Pat Flanagan, Flantech, Scottsdale, Arizona.

⁴⁴ Flanagan, *ibid*.

⁴⁵ Igor Smirnov, www.elixer-health.com/mret/mret_mretr.htm

⁴⁶ Igor Smirnov, Personal Communication, 2002

Overall Summary

We now see that sound and electromagnetic fields can change gene expression and water structure. We have determined that the proper EM and perhaps acoustic frequency can trigger **any** gene. We have seen how the packing of water affects the DNA. We further see that the dolphin's sound and electromagnetic fields are well suited to cause such effects.

We now know the dolphins can cause micro-bubbles in tissues with their ultrasound signals and likely speed bone break healing.

There exists experimental data that unifies the effects we have been exploring. Berkshire Labs (Appendix IV.) has shown, among other things, that acoustic and electromagnetic fields can profoundly alter chemistry. They have found, for example, that the effects of a platinum catalyst can be duplicated by introduction of only the energy spectrum of the platinum! This suggests that energy fields are paramount, superceding mere matter.

Dr. Stephen Birch has demonstrated that free dolphins swimming with people generate a fundamental tone on average of about 26 Hz. This can cause a piezoelectric effect in our bodies which can cause a cascade of effects that lowers the frequency of the electroencephalogram and increases its power. This is consistent with his model and indicates an increase in the levels of endorphins. We would also suggest that compounds new to us may be released as well. We propose to call them **EnDolphins** as coined by Paradise Newland.

Dr. Birch developed an electro-acoustic-endorphin model consistent with his results. To quote from the abstract of his thesis **"Dolphin-Human Interaction Effects:**

Dolphin assisted therapeutic effects include alleviation of pain in spinal patients, improved learning in neurologically impaired children and alleviation of depression." Some of these effects are specifically neurological, for example: "Following dolphin contact, noticeable changes in subject EEG activity are observed. These are characterized by a decrease in frequency and an increase in amplitude, with some evidence of hemispheric synchronization. In this study, 85% of subjects displayed these modifications following dolphin contact, these findings correlate with findings by other research groups. A hormonal mechanism has been postulated... which cause[s] analgesia, improved learning and potentiate[s] psychological self-reward mechanisms.

His overall model of dolphin-human interactions is summarized the figure on the previous page. There is a vast territory to be explored here. We see that dolphin therapy has the potential to improve many conditions.

The dolphins can likely do the following:

- Change body structures with tightly focused, high-power "beams"
- Change brain states
- Stimulate the saccula up to frequencies of 250 kHz
- Stimulate the entire body causing acoustic and electrical effects
- Create electromagnetic fields and thereby change things such as calcium levels, reaction times, circadian rhythms and gene expression.

Dolphins can closely observe our internal structures, with their sonar and then focus their sounds and electromagnetic fields to specific locations or immerse the whole body in a myriad of electromagnetic, magnetic, and electrostatic fields corresponding to their sounds created either singly or in pods.

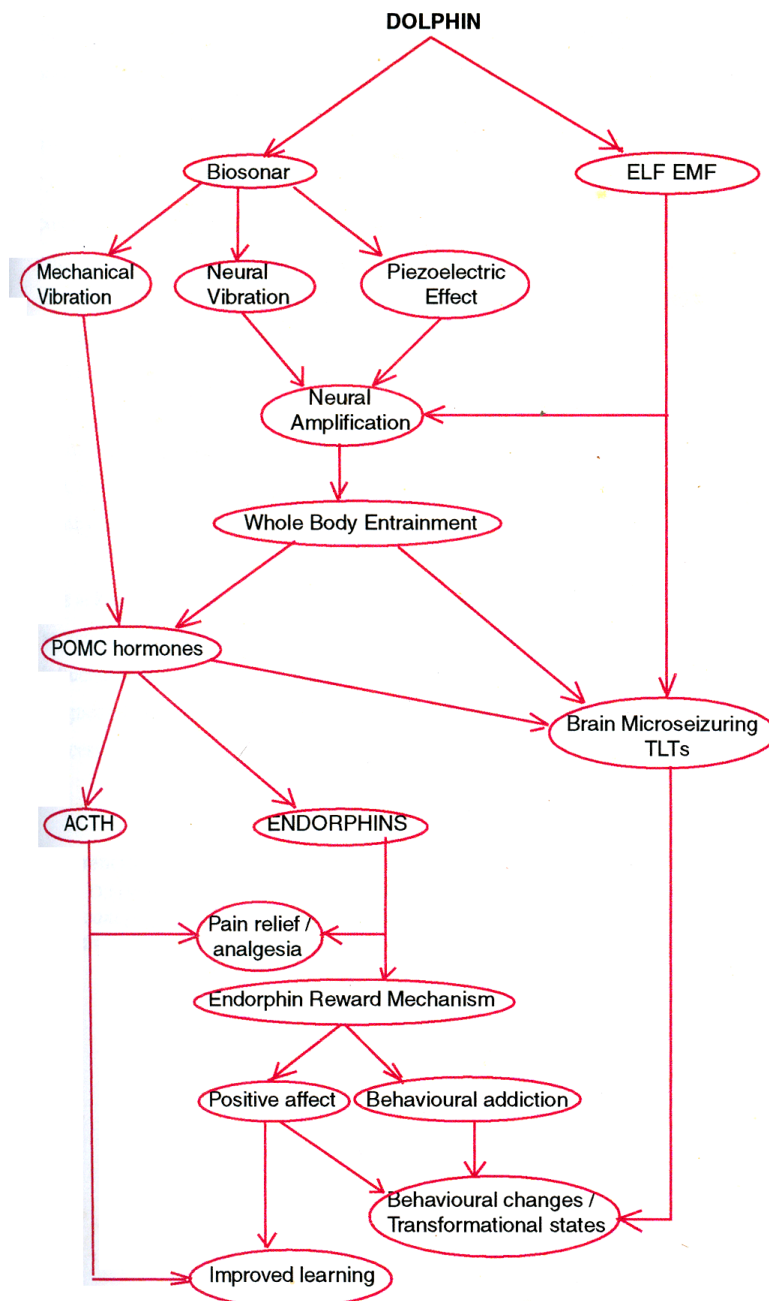
So we find that dolphins have at least the following therapeutic modalities:

- Dolphin sounds have direct acoustic effects
- Electromagnetic fields generated by the dolphin melon
- Micro-currents generated by the dolphin sounds vibrating of our body's piezoelectric tissues, especially bone

Imagine the fields a pod of 20 or more dolphins might create with all of them singing their songs with up to 5 unique sounds each, all of it blended into a harmonious and *in phase* symphony, with their electromagnetics combined with their acoustic fields, all changing dynamically with the pod's underwater ballet. A milieu of such richness can easily duplicate and surely go far beyond current ultrasound therapy and electromedicine. The dolphins have yet to show us all they know. Their potential goes beyond what we have observed. Some of these are summarized in the figure below.

So we come to the end of the beginning of our tale. Dolphins can change us in many ways, through their love, joy, empathy, and touch, or produce sharply focused, precisely targeted, high-intensity sound and ultrasound capable of changing bones and joints, resonating specific structures, entraining brain waves and the heart. Through piezoelectricity, electromagnetic fields are generated that can affect tissues, neurons, behaviors like circadian rhythms and, ultimately, gene expression. These results correspond with known effects of ultrasound and electromedicine.

The dolphins are masters of all these realms and more yet to be realized.



Dolphin sounds vibrate our bodies, creating piezoelectric micro-currents resulting in a cascade of events that cause release of endorphins [and EnDolphins] which reduce pain, increase learning, reduce EEG frequency and increase EEG power. (After Birch 1997) ⁴⁷

⁴⁷ Steven Birch, Ph.D., *Dolphin-Human Interaction Effects*, Monash University, Melbourne, Australia, 1997.

The Future

Unless we put medical freedom into the Constitution, the time will come when medicine will organize into an undercover dictatorship to restrict the art of healing to one class of men and deny equal privileges to others: The Constitution of this Republic should make a special privilege for medical freedom as well as religious freedom. - Dr. Benjamin Rush, signer of the Declaration of Independence

With increased experience, knowledge, better communication and communion with the dolphins, therapeutic results will improve and expand. We need a Dolphin-Human Habitat where we are free to explore all this together with free dolphins that choose to be with us. I feel current DAT is too structured and mainly uses dolphins as “rewards” in behavioral modification programs. This minimizes the time clients have in the water with the dolphins and forces the dolphins to perform stereotypical behaviors on cue. This minimizes the chance the dolphins can apply the capabilities we have reviewed here.

Dolphin therapy is best approached by letting the clients become friends with the dolphins and to permit this, one should allow as much time as possible in the water with them over as many days as possible. There should be more study of the acoustic and electrical environment produced by the dolphins as part of the therapy and interaction. This will move us to an era of documented results and eventually to extensive interaction with M.D.’s (Medical Dolphins).

Some of our progress is currently hampered by laws based on obsolete views of the Cetacea that still consider them lowly animals. This currently leads to whaling, destructive fishing practices, military operations that threaten the Cetacea and an overall lack of concern for their home, the waters of the Earth. In reality the Cetacea are members of a vast, ancient culture that have been and are always offering us their assistance. We have only to realize this, respect the Cetacea and rejoin our age-old partnership. It is we who must remember our connection with the waters of the planet and their loving inhabitants.

For the benefit of all of us, especially the children, let us go to the essence of the Cetacea, learn to communicate fluently, then the humans, dolphins and whales can move forward together as co-species, in mutual love and respect and joy, as we have done for eons before.

In the spirit of Aloha,

Michael T. Hyson, Ph.D.
Research Director
Sirius Institute
Puna, Hawai’i
November 23, 2003

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Appendix I. Bernard Rimland on Autism

The Autism Epidemic Is Real, and Excessive Vaccinations Are the Cause

Statement by Bernard Rimland, Ph.D.

July 14, 2003

The vaccine manufacturers, the Center for Disease Control, the FDA, and the various medical associations have failed miserably in their duty to protect our children. Rather than acknowledge their role in creating the immense, catastrophic rise in autism, these organizations have resorted to denial and obfuscation. They stand to lose their credibility, and billions of dollars in liability suits will soon reach the courts.

As a full-time professional research scientist for 50 years, and as a researcher in the field of autism for 45 years, I have been shocked and chagrined by the medical establishment's ongoing efforts to trivialize the solid and compelling evidence that faulty vaccination policies are the root cause of the epidemic. There are many consistent lines of evidence implicating vaccines, and no even marginally plausible alternative hypotheses.

As the number of childhood vaccines has increased 700%, from 3 in the '70s to 22 in 2000, the prevalence of autism has also showed a parallel increase of 700%.

Late onset autism, (starting in the 2nd year), was almost unheard of in the '50s, '60s, and '70s; today such cases outnumber early onset cases 5 to 1, the increase paralleling the increase in required vaccines.

Thousands of parents report – and demonstrate with home videos -- that their children were normal and responsive until suffering an adverse vaccine reaction. (The Autism Research Institute has been tracking such autism-related vaccination reactions since 1967.)

Mercury, one of the most toxic substances known, is used as a preservative in many vaccines. Some infants have had 125 times the maximum allowable limit of mercury injected directly into their bloodstreams, in one day, in vaccines. (People vary enormously in their sensitivity to mercury, because certain genes predispose to mercury sensitivity. The highly-touted New England Journal of Medicine Danish study failed to mention the very convenient fact that none of the Danish children had prior exposure to mercury, since Denmark, unlike the U.S. had, banned mercury from childhood vaccines in 1992, the year before the birth year of the children in the study.)

There are numerous scientific studies showing large differences in clinical laboratory measures of blood, urine and biopsies which compare autistic children with normal controls. Such findings, pointing directly to vaccines as the cause of the group differences, are conveniently overlooked by those attempting to conceal the strong connection between the autism epidemic and excessive use of unsafe vaccines.

The truth must – and will – emerge. It is long overdue.

Bernard Rimland, Ph.D.

Director, Autism Research Institute

Editor, Autism Research Review International

Founder, Autism Society of America

The Autism Increase: Research Needed on the Vaccine Connection

Testimony of Bernard Rimland, Ph.D. Before
House Committee on Government Reform

April 6, 2000

My name is Bernard Rimland. I am a research psychologist (Ph.D.) and am Director of the Autism Research Institute, which I founded in 1967. I am also the founder of the Autism Society of America (1965), and the editor of the Autism Research Review International. My book, *Infantile Autism: The Syndrome and Its Implication for a Neural Theory of Behavior* (1964) is widely credited with changing the field of psychiatry from its claim that autism is an emotional illness, caused by destructive mothers, to its current recognition that autism is a biological disorder. I have lectured on autism and related problems throughout the world, and am author of numerous publications. I served as primary technical advisor on autism for the film *Rain Man*.

My son Mark was born in 1956. It was obvious from birth that this perfectly normal-looking infant had something drastically wrong with him. I had earned my Ph.D in experimental psychology 3 years earlier and had never encountered the word autism. Our pediatrician, with 35 years of experience, had never heard of autism either. Autism was extremely rare then – it is extremely common now.

Some supposed experts will tell you that the increase reflects only greater awareness. That is nonsense. Any pediatrician, teacher or school official with 20 or more years experience will confirm what the studies tell us: there is a real increase in autism and the numbers are huge and growing. The epidemic is serious and worldwide.

Soon after my textbook on autism was published in 1964, I began to hear from other parents. Many parents told me that their children were normal until getting a triple vaccine – the DPT shot. In 1965 I began systematically collecting data on the symptoms and possible causes of autism: In 1967—33 years ago—I began querying the parents, specifically about the child's response to the DPT shot. Many had reported marked deterioration.

During the past few years the Autism Research Institute has been flooded with an upsurge in pleas for help from parents throughout the world – from wherever the World Health Organization vaccine guidelines are followed. The majority of these parents say their children were normal until getting the MMR – another triple vaccine. Let me dispel several myths promoted by those who deny the autism-vaccine connection:

1. They claim the vaccines are safe, but physicians are indoctrinated to disbelieve claims of harm and are not trained to recognize nor required to report any adverse reactions. From 90% to 99% of the adverse reactions reported to doctors are never reported by those doctors to the government's extremely lax Vaccine Adverse Event Reporting System, known as the VAERS.
2. They say that the suspected linkage between the MMR vaccination and autism has been disproved by a study conducted by Brent Taylor and his colleagues in London, and published last year in *The Lancet*.

The Taylor study is seriously flawed in many ways, as had been noted in a number of letters to the editor of *The Lancet* and in a number of additional letters on the subject which have been posted on the internet. It was subject to strong attack at a recent meeting of the British Statistical Society. I have been a full-time researcher my entire professional life, for almost 50 years, and I respectfully asked Dr. Taylor for a copy of the data so that I could reanalyze them. He refused this ordinary professional courtesy, and I have subsequently written to the editor of *The Lancet* requesting that an impartial committee be asked to reexamine Dr. Taylor's statistical methods. If he refuses again, I urged *The Lancet* to retract his paper.

3. They say that autism has a large genetic component, and therefore vaccines must play a minimal, if any, role in the causation of autism. My book *Infantile Autism*, published in 1964, was the first systematic attempt to marshal the evidence for genetics as a contributing cause of autism, so I am certainly not hostile to that idea. However, genes do not begin to account for the huge increase in the incidence of autism, ranging from 250% to 500% in various places.

I might add that we have just reviewed all of the recent genetic studies for the next issue of the *Autism Research Review International*, which I edit. The results are spectacularly inconsistent. The best guess is that there are at least 20 different genes involved in the causation of autism. Gene therapy is decades off, and may be infeasible.

4. They claim that autism naturally occurs at about 18 months, when the MMR is routinely given, so the association is merely coincidental and not causal. But the onset of autism at 18 months is a recent development. Autism starting at 18 months rose very sharply in the mid-1980s, when the MMR vaccine came into wide use. A coincidence? Hardly! See the graph below.

Autism is not the only severe chronic illness which has reached epidemic proportions as the number of (profitable) vaccines has rapidly increased. Children now receive 33 vaccines before they enter school – a huge increase. The vaccines contain not only live viruses but also very significant amounts of highly toxic substances such as mercury, aluminum and formaldehyde. Could this be the reason for the upsurge in autism, ADHD, asthma, arthritis, Crohn's disease, lupus and other chronic disorders?

As a parent and as a full-time professional researcher, I am bitterly disappointed with the medical establishment's dismal record with regard to autism over the past 60 years. The medical schools, as well as the governmental agencies, have consistently supported outmoded, unproven and even disproven theories from the very beginning, and have actively opposed the most promising approaches for the treatment of autism. They supported the psychoanalytically based theories which held the mother responsible for causing autism through her supposedly hostile attitude toward the child. They opposed the use of behavior modification, the most uniformly beneficial treatment for autism, by claiming that it neglected the deep-seated emotional blocks that were supposedly at the root of autism. They have ignored, and continue to ignore, the long series of studies conducted both in the U. S. and Europe showing that the elimination of foods containing gluten and casein from the diet brings about marked improvement in many autistic children. They have consistently ignored the series of 18 consecutive studies, conducted by researchers in 6 countries, which showed that almost half of all autistic children and adults respond favorably to high doses of vitamin B6 and magnesium, with no adverse effects. Eleven of these studies were double-blind

placebo-crossover experiments. There is no drug that comes close to B6/magnesium in terms of safety, efficacy and positive research findings.

Tens of millions of dollars have been spent on non-productive lines of research, while virtually no money at all has been given to research on the methods of alternative medicine, which are far more promising in terms of both safety and efficacy.

The most interesting questions are not being asked: Why does the majority of the population survive such epidemics as autism, the bubonic plague, Legionnaires' disease, polio and AIDS, while relatively few succumb?

The answer is that the survivors have a healthy, effective immune system. Would enhancing the immune system decrease the likelihood of adverse reactions to vaccines (including the anthrax vaccine – DOD please note!)? Very probably.

It is well known that the immune system must be adequately supplied with many nutrients if it is to function properly, including especially vitamins A, C, E, B6 and a number of minerals, including zinc, magnesium, and selenium. Nutritional levels of these substances are not only harmless, they are essential to good health. Since people do not change their diets readily, I believe that foods should be fortified with these nutrients – especially foods that will be consumed by infants and children. Research along these lines – as well as on the safety of the vaccines – is desperately needed.

As a parent and a researcher, I believe there should be a marked redirection of effort and funding, along the lines suggested above.

Appendix II. A Successful Treatment of Autism

By Karyn Seroussi

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When the doctors said our son would be severely disabled for life, we set out to prove them wrong.

When the psychologist examining our 18-month-old son told me that she thought Miles had autism, my heart began to pound. I didn't know exactly what the word meant, but I knew it was bad. Wasn't autism some type of mental illness -- perhaps juvenile schizophrenia? Even worse, I vaguely remembered hearing that this disorder was caused by emotional trauma during childhood. In an instant, every illusion of safety in my world seemed to vanish. Our pediatrician had referred us to the psychologist in August 1995 because Miles didn't seem to understand anything we said. He'd developed perfectly normally until he was 15 months old, but then he stopped saying the words he'd learned -- cow, cat, dance -- and started disappearing into himself. We figured his chronic ear infections were responsible for his silence, but within three months, he was truly in his own world.

Suddenly, our happy little boy hardly seemed to recognize us or his 3-year-old sister. Miles wouldn't make eye contact or even try to communicate by pointing or gesturing. His behavior became increasingly strange: He'd drag his head across the floor, walk on his toes (very common in autistic children), make odd gurgling sounds, and spend long periods of time repeating an action, such as opening and closing doors or filling and emptying a cup of sand in the sandbox. He often screamed inconsolably, refusing to be held or comforted. And he developed chronic diarrhea.

As I later learned, autism -- or autistic spectrum disorder, as doctors now call it -- is not a mental illness. It is a developmental disability thought to be caused by an anomaly in the brain. The National Institutes of Health estimates that as many as 1 in 500 children are affected. But according to several recent studies, the incidence is rapidly rising: In Florida, for example, the number of autistic children has increased nearly 600 percent in the last ten years. Nevertheless, even though it is more common than Down syndrome, autism remains one of the least understood developmental disorders.

We were told that Miles would almost definitely grow up to be severely impaired. He would never be able to make friends, have a meaningful conversation, learn in a regular classroom without special help, or live independently. We could only hope that with behavioral therapy, we might be able to teach him some of the social skills he'd never grasp on his own. I had always thought that the worst thing that could happen to anyone was to lose a child. Now it was happening to me but in a perverse, inexplicable way. Instead of condolences, I got uncomfortable glances, inappropriately cheerful reassurances, and the sense that some of my friends didn't want to return my calls.

After Miles' initial diagnosis, I spent hours in the library, searching for the reason he'd changed so dramatically. Then I came across a book that mentioned an autistic child whose

mother believed that his symptoms had been caused by a "cerebral allergy" to milk. I'd never heard of this, but the thought lingered in my mind because Miles drank an inordinate amount of milk -- at least half a gallon a day.

I also remembered that a few months earlier, my mother had read that many kids with chronic ear infections are allergic to milk and wheat. "You should take Miles off those foods and see if his ears clear up," she said. "Milk, cheese, pasta, and Cheerios are the only foods he'll eat," I insisted. "If I took them away, he'd starve."

Then I realized that Miles' ear infections had begun when he was 11 months old, just after we had switched him from soy formula to cow's milk. He'd been on soy formula because my family was prone to allergies, and I'd read that soy might be better for him. I had breast-fed until he was 3 months old, but he didn't tolerate breast milk very well -- possibly because I was drinking lots of milk. There was nothing to lose, so I decided to eliminate all the dairy products from his diet. What happened next was nothing short of miraculous. Miles stopped screaming, he didn't spend as much time repeating actions, and by the end of the first week, he pulled on my hand when he wanted to go downstairs. For the first time in months, he let his sister hold his hands to sing "Ring Around a Rosy."

Two weeks later, a month after we'd seen the psychologist, my husband and I kept our appointment with a well-known developmental pediatrician to confirm the diagnosis of autism. Dr. Susan Hyman gave Miles a variety of tests and asked a lot of questions. We described the changes in his behavior since he'd stopped eating dairy products. Finally, Dr. Hyman looked at us sadly. "I'm sorry," the specialist said. "Your son is autistic. I admit the milk allergy issue is interesting, but I just don't think it could be responsible for Miles' autism or his recent improvement."

We were terribly disheartened, but as each day passed, Miles continued to get better. A week later, when I pulled him up to sit on my lap, we made eye contact and he smiled. I started to cry -- at last he seemed to know who I was. He had been oblivious to his sister, but now he watched her play and even got angry when she took things away from him. Miles slept more soundly, but his diarrhea persisted. Although he wasn't even 2 yet, we put him in a special-ed nursery school three mornings a week and started an intensive one-on-one behavioral and language program that Dr. Hyman approved of.

I'm a natural skeptic and my husband is a research scientist, so we decided to test the hypothesis that milk affected Miles' behavior. We gave him a couple of glasses one morning, and by the end of the day, he was walking on his toes, dragging his forehead across the floor, making strange sounds, and exhibiting the other bizarre behaviors we had almost forgotten. A few weeks later, the behaviors briefly returned, and we found out that Miles had eaten some cheese at nursery school. We became completely convinced that dairy products were somehow related to his autism.

I wanted Dr. Hyman to see how well Miles was doing, so I sent her a video of him playing with his father and sister. She called right away. "I'm simply floored," she told me. "Miles has improved remarkably. Karyn, if I hadn't diagnosed him myself, I wouldn't have believed that he was the same child."

I had to find out whether other kids had had similar experiences. I bought a modem for my -- not standard in 1995 -- and discovered an autism support group on the Internet. A bit embarrassed, I asked, "Could my child's autism be related to milk?"

The response was overwhelming. Where had I been? Didn't I know about Karl Reichelt in Norway? Didn't I know about Paul Shattock in England? These researchers had preliminary evidence to validate what parents had been reporting for almost 20 years: Dairy products exacerbated the symptoms of autism.

My husband, who has a Ph.D. in chemistry, got copies of the journal articles that the parents had mentioned on-line and went through them all carefully. As he explained it to me, it was theorized that a subtype of children with autism break down milk protein (casein) into peptides that affect the brain in the same way that hallucinogenic drugs do. A handful of scientists, some of whom were parents of kids with autism, had discovered compounds containing opiates -- a class of substances including opium and heroin -- in the urine of autistic children. The researchers theorized that either these children were missing an enzyme that normally breaks down the peptides into a digestible form, or the peptides were somehow leaking into the bloodstream before they could be digested.

In a burst of excitement, I realized how much sense this made. It explained why Miles developed normally for his first year, when he drank only soy formula. It would also explain why he had later craved milk: Opiates are highly addictive. What's more, the odd behavior of autistic children has often been compared to that of someone hallucinating on LSD. My husband also told me that the other type of protein being broken down into a toxic form was gluten -- found in wheat, oats, rye, and barley, and commonly added to thousands of packaged foods. The theory would have sounded farfetched to my scientific husband if he hadn't seen the dramatic changes in Miles himself and remembered how Miles had self-limited his diet to foods containing wheat and dairy. As far as I was concerned, there was no question that the gluten in his diet would have to go. Busy as I was, I would learn to cook gluten-free meals. People with celiac disease are also gluten-intolerant, and I spent hours on-line gathering information.

Within 48 hours of being gluten-free, 22-month-old Miles had his first solid stool, and his balance and coordination noticeably improved. A month or two later, he started speaking -- "zawaff" for giraffe, for example, and "ayashoo" for elephant. He still didn't call me Mommy, but he had a special smile for me when I picked him up from nursery school. However, Miles' local doctors -- his pediatrician, neurologist, geneticist, and gastroenterologist -- still scoffed at the connection between autism and diet. Even though dietary intervention was a safe, noninvasive approach to treating autism, until large controlled studies could prove that it worked, most of the medical community would have nothing to do with it.

So my husband and I decided to become experts ourselves. We began attending autism conferences and phoning and e-mailing the European researchers. I also organized a support group for other parents of autistic children in my community. Although some parents weren't interested in exploring dietary intervention at first, they often changed their mind after they met Miles. Not every child with autism responded to the diet, but eventually there were about 50 local families whose children were gluten- and casein-free with exciting results. And

judging by the number of people on Internet support lists, there were thousands of children around the world responding well to this diet.

Fortunately, we found a new local pediatrician who was very supportive, and Miles was doing so well that I nearly sprang out of bed each morning to see the changes in him. One day, when Miles was 2 1/2, he held up a toy dinosaur for me to see. "Wook, Mommy, issa Tywannosauwus Wex!" Astonished, I held out my trembling hands. "You called me Mommy!" I said. He smiled and gave me a long hug.

By the time Miles turned 3, all his doctors agreed that his autism had been completely cured. He tested at eight months above his age level in social, language, self-help, and motor skills, and he entered a regular preschool with no special-ed supports. His teacher told me that he was one of the most delightful, verbal, participatory children in the class. Today, at almost 6, Miles is among the most popular children in his first-grade class. He's reading at a fourth-grade level, has good friends, and recently acted out his part in the class play with flair. He is deeply attached to his older sister, and they spend hours engaged in the type of imaginative play that is never seen in kids with autism. My worst fears were never realized. We are terribly lucky.

But I imagined all the other parents who might not be fortunate enough to learn about the diet. So in 1997, I started a newsletter and international support organization called Autism Network for Dietary Intervention (ANDI), along with another parent, Lisa Lewis, author of *Special Diets for Special Kids* (Future Horizons, 1998). We've gotten hundreds of letters and e-mails from parents worldwide whose kids use the diet successfully. Although it's best to have professional guidance when implementing the diet, sadly, most doctors are still skeptical.

As I continue to study the emerging research, it has become increasingly clear to me that autism is a disorder related to the immune system. Most autistic children I know have several food allergies in addition to milk and wheat, and nearly all the parents in our group have or had at least one immune-related problem: thyroid disease, Crohn's disease, celiac disease, rheumatoid arthritis, chronic fatigue syndrome, fibromyalgia, or allergies. Autistic children are probably genetically predisposed to immune-system abnormalities, but what triggers the actual disease?

Many of the parents swore that their child's autistic behavior began at 15 months, shortly after the child received the MMR (measles, mumps, rubella) vaccine. When I examined such evidence as photos and videotapes to see exactly when Miles started to lose his language and social skills, I had to admit that it had coincided with his MMR -- after which he had gone to the emergency room with a temperature of 106°F and febrile seizures. Recently, a small study was published by British researcher Andrew Wakefield, M.D., linking the measles portion of the vaccine to damage in the small intestine -- which might help explain the mechanism by which the hallucinogenic peptides leak into the bloodstream. If the MMR vaccine is indeed found to play a role in triggering autism, we must find out whether some children are at higher risk and therefore should not be vaccinated or should be vaccinated at a later age.

Another new development is giving us hope: Researchers at Johnson and Johnson's Ortho Clinical Diagnostics division -- my husband among them -- are now studying the abnormal presence of peptides in the urine of autistic children. My hope is that eventually a routine diagnostic test will be developed to identify children with autism at a young age and that

when some types of autism are recognized as a metabolic disorder, the gluten and dairy-free diet will move from the realm of alternative medicine into the mainstream.

The word autism, which once meant so little to me, has changed my life profoundly. It came to my house like a monstrous, uninvited guest but eventually brought its own gifts. I've felt twice blessed -- once by the amazing good fortune of reclaiming my child and again by being able to help other autistic children who had been written off by their doctors and mourned by their parents.

Appendix III. Dolphin Therapy Locations and Organizations

Some of the Facilities or locations used for DAT and known to exist

Note: Some programs are run in non-managed situations, using free Dolphins. Other programs provide access to dolphins by arrangement with other facilities.

Florida

Dolphin Research Center
Theater of the Sea

<http://www.gulfarium.com/jfdolphin.htm>

Water Planet
Tel: (850) 230-6030
Phone Toll Free: (866) 449-5591
E-Mail: info@waterplanetusa.com

5605 Sunset Ave. Unit B
Panama City Beach, FL 32408

<http://www.waterplanetusa.com/programneeds.htm>

Mexico

Mexico City (Delphinarium)

Bahamas

Grand Bahama (UNEXO)
Bimini (Spirit of the Dolphin and Dolphin Swim)

Israel

Eilat (Dolphin Reef Eilat)

Article on Eilat and therapy with an autistic child <http://www.mfa.gov.il/mfa/go.asp?MFAH0drd0>

Russia

Ukraine, on the Black Sea (Kazachya Bay Naval Base)

Hawaii

Big Island (Dolphin Connection)
Maui (POD Centre)

Australia

Sydney/Port Stephens (Dolphin Within)
Bunbury, WA. (Dolphin Discovery Centre)
Perth (UnderWater World)
Southport, Qld. (Sea World)
Coff's Harbour (Porpoise Pool)

Cooperating Organizations:

AquaThought, Miami, Florida

Dolphin Discovery: Fundacion Brewer, Mexico

Dolphin Connection, Hawaii

The Dolphin Society, Australia

The Dancing Dolphin Institute, Hawaii

Dolphin Reef Eilat, Israel

UNEXSO, Grand Bahamas

Upledger Institute, Florida

Dolphin Research Center, Grassy Key, Florida

Theater of the Sea, Little Duck Key, Florida

Dolphin Human Therapy

Others

Dr. Horace Dobbs, M.D.

<http://www.idw.org/html/home.html>

Dr. David Nathanson, Ph.D.

<http://www.dolphinhumantherapy.com/Welcome/WelcomePage.htm>

Dolphin's Plus (Island Dolphin Care, Inc.), Key Largo, Florida;

<http://www.linknet.com.au/dolphin/DAT2.html>

Clearwater Aquarium, Clearwater, Florida

Interspecies Technologies, Melbourne, Australia

Xcaret and Xel-Ha (Via Delphi), Cancun, Mexico

Delphinarium, Mexico City

Dolphins Down Under, Suffolk Park, Australia

[Dolphin Human Therapy](#)

13615 South Dixie Highway, #523

Miami, FL 33176-7252

(305) 378-8670

Fax: (305) 233-6383

Contact: David Nathanson, Ph.D.

Program consists of a 40 minute session each day Monday through Friday, for two weeks, at a cost of \$6,200.

[JF Dolphin Project](#)

1010 Miracle Strip Parkway, SE

Ft. Walton Beach, FL 32548

(800) 247-8575 & (850) 243-9046

Contact:

Janet Flowers, CCC-SLP, Ed.S.

Project Manager/Therapist

(850) 217-0099 for program costs

E-mail: jfdolphinproject@gulfarium.com

The JF Dolphin Project at Florida's [Gulfarium](#) is a one to two week therapy program for children with academic, communication, and/or physical therapy needs. It is a research based and cost efficient program designed to enhance traditional therapies. The JF Dolphin Project combines the expertise of State of Florida licensed therapists/teachers and the Gulfarium's experienced dolphin interaction trainers.

[Island Dolphin Care](#), Inc.

31 Corrine Place Key Largo

Key Largo, FL 33037

1 (800) 326-1618 or (305) 451-5884

Fax: (305) 453-5399

E-mail: Fonzie@IslandDolphinCare.org

A non-profit organization developed to help children and their families who are dealing with various developmental, physical, and/or emotional difficulties.

Appendix IV. BERKSHIRE LABS TECHNOLOGY OVERVIEW

<http://www.bkllabs.com/overview.htm>

I. BRIEF INTRODUCTION TO BERKSHIRE LABS' TECHNOLOGIES

The Berkshire discoveries are based on a unique and fundamental understanding of the true relationship between energy and matter. Although matter can feel solid to one's touch, it is really just configured energy fields. The energy fields of different types of matter produce different and unique energy signatures which can be measured by many standard spectroscopic techniques. Aspects of these signatures can in turn be used to influence and control the different types of matter. This new perspective provides a unifying framework for existing physics, chemistry, and biology, as well as a conceptual platform for further innovations in the use of these well-established sciences. The implications for this new framework and understanding affect fields as distant from each other as agriculture, computers, chemical processes, electronics and medicine.

Matter energy signatures are composed of many different kinds of energies such as electromagnetic (EM) waves, acoustic waves, electric fields, and magnetic fields. These energies exist in a continuous and interconnected framework from the largest structural levels down to the smallest molecular and atomic levels. The fundamental factor linking all these levels within the framework of matter energy signatures is frequency, from the 16 Hz brain wave frequency of an awake person to the 2.4×10^{15} Hz frequency of a hydrogen atom in that person.

Because of this energy framework, matter converts or transduces different kinds of energies when the frequencies of the matter and energy match. Matching of frequencies is called resonance. When energy is resonant with matter, the energy transfers to and accumulates in the matter very efficiently. A well-known demonstration of the selective power of resonance is the shattering of a glass by Ella Fitzgerald's voice. Scientists "know" why this works, as is also true of the science behind the Tacoma Narrows Bridge collapse. Far fewer have considered how this fundamental phenomenon of nature can be put to work in the continuous energy framework of matter. The Berkshire advances make use of the highly efficient transfer of energy at resonant frequencies, even in seemingly complex systems.

The Berkshire discoveries go further however, in making other, not quite so obvious, connections. Consider chemical reactions and physical catalysts. Generally speaking, catalysts speed up the rate of chemical reactions. Physical catalysts are composed of matter (configured energy) and thus absorb, transduce and emit unique energy signatures and frequencies. Berkshire has discovered that the energy patterns of physical catalysts resonantly transfer matching energies to other chemical species, thereby controlling chemical transformations and reaction pathways. For example, Berkshire has shown that when hydrogen and oxygen gases react over a platinum catalyst to form water, the physical platinum catalyst resonates with and transfers matching energy to the H and OH-intermediates, which in turn initiate a chain reaction from their more highly energized electronic states. The true role which physical catalysts play in chemical reactions is to energize other chemical species by the resonant transfer of matching energy. This energy can be used with, or in place of, physical catalysts. Because a catalyst's energy frequencies and

signature are measured by spectroscopy, Berkshire calls a catalytic energy pattern a "spectral catalyst". A spectral catalyst is an energy pattern that catalyzes a reaction, such as the electronic energy frequencies of platinum in the water formation example discussed above.

Many other factors besides physical catalysts affect the transformations and states of matter - environmental factors such as temperature, pressure, solvents, concentration, poisons, dopants, electric fields, and magnetic fields, to name a few. Science has studied these factors empirically for more than two centuries, without understanding the underlying mechanism shared by all these factors. Each of these empirically discovered factors have something in common - they each affect the signatures and frequencies of energy absorbed, transduced, and emitted by the matter. In so doing, those empirical factors alter the nature of matter's resonant transfer of energy. Thus all the above environmental factors share a common underlying mechanism, namely, they affect the transformations and states of matter by affecting the energy frequencies selectively absorbed, transduced, and emitted by that matter.

II. APPLICATION AREAS

A. Chemicals - Chemical Reactions and Transformations

Berkshire has numerous patent applications issued and pending relating to spectral techniques for selectively affecting chemical reactions and transformations in all manner of chemical systems and states of matter, including solid, liquid, gas, and plasma states. These elegantly simple techniques make selective use of the entire electromagnetic spectrum, the entire acoustic spectrum, electric fields, magnetic fields, and matter itself. The Berkshire technology transforms these previously empirical factors into straight forward and calculable adjuncts to existing chemical and materials sciences.

B. Crystallization - Materials and States of Matter

Berkshire innovations include a unifying framework of energy techniques for selectively modifying crystal nucleation, growth rate, morphology, size, shape, composition, structure, and properties. Berkshire has conducted experiments in-house and with the Materials Research Laboratory at Penn State which conclusively show that crystal growth is affected by applying Berkshire's spectral chemistry techniques. For example, Berkshire has demonstrated the spectral growth of crystals from unsaturated solutions (thought to be impossible), increased crystal growth rates up to 1,800 times greater than normal, selective inhibition of crystal growth (e.g. contaminants), and protein crystal growth equivalent to that achieved in the low gravity environment of the space station.

C. Acousto-EM

Berkshire has recognized that the same energy with which Ella Fitzgerald can shatter a glass can also be used to help living things grow and function better. For example, Berkshire experiments have shown that acousto-EM energy can increase growth rates in both plants and fish. Other applications areas include new types of spectroscopy, new medical or anti-terrorism diagnostics, and selective eradication of micro-organisms such as viruses and nuisance organisms such as barnacles. The first of several broad acousto-EM patents is issuing to Berkshire for the enhancement of plants and aquatic species using acousto-EM energy.

D. Computers - Storage/Memory Devices and Data Processing

The magnetic data storage innovations described by Berkshire make use of the fundamental frequency and resonance relationship between matter and energy. These varying frequencies are found throughout the electro-magnetic spectrum and can be selectively detected and measured. The Berkshire magnetic data storage discovery uses discrete strengths of stored magnetic fields to produce different and discrete frequencies in matter. The frequencies are then assigned different digital values, such as "0", "1", "2", and "3", as in a quaternary software code. The Berkshire concepts go further however, and allow significant innovations in analog systems. In this case, a continuum of varying strengths of stored magnetic fields produce a varying continuum of frequencies in a medium. When this continuum of frequencies is detected and measured, the frequencies correlate with various analog data values.

E. Energy

The unique Berkshire technology includes spectral techniques which have been shown experimentally to selectively affect batteries, fuel cells, hydrogen production, conductivity, and superconductivity. Additionally, the chemical applications are directly applicable to current fossil fuel and petroleum technologies.

III. SUMMARY

The Berkshire technologies unite the fields of chemistry, physics, and biology into a common framework. The new understandings provide far-reaching insights which have allowed conceptual leaps and innovations, such as those discoveries described above. Berkshire's continued exploration of the fundamental relationship between matter and energy is producing a chain of unique discoveries, linked by an elegantly simple and unifying framework.

For more information email

Mark Mortenson at Mortenson@bkllabs.com

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Why Are Dolphins So Intelligent?

A reaction to life in the sea

By **Stefan Anitei**, Science Editor

2nd of February 2007, 14:22 GMT

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The behavior and biology of dolphins caught the attention of humans since antiquity.

But their ability to train, their intelligence, memory, the lack of coagulant factor from the blood, their ability to dive to great depths without the peril of gas embolism have triggered the interest of the researchers.

The creation of oceanaria eased the research on dolphins, as they are much harder to study in the wild. They possess a high ability to learn and an impressive long-term memory. Dolphins do not imitate mechanically movements they are shown, but establish a link between gestures, voice and the trainer's intention and what they have to do.

There are many urban legends or sailors tails counting about their intelligence and goodwill towards human beings: shipwrecked persons helped or sustained to reach the shore or dolphin groups that headed fishing boats towards fish shoals.

In some harbors, individuals turned in local mascots, coming regularly at the same spots for decades. Sometimes, dolphins asked for human help in case of a fellow entangled in a fish net or a wounded offspring.

Dolphins belong to the order of cetaceans, which also includes the whales. There are 88 species of cetaceans, but 73 are dolphins or the so-called toothed whale. Cetaceans are marine mammals which 50 million years ago evolved from terrestrial hoofed mammals, and which are related to current hippopotamus.

When hunting or exploring their environment, the dolphins use echolocation employing ultrasounds, while on long journeys they seem to use the Earth's electromagnetic fields, two orientation systems also used by 🦇 bats!

Dolphins' intelligence is boosted by an unusual big brain (photo center, below).

A 120 kg dolphin possesses a 1.7 kg brain, while the human brain weighs on average 1.4 kg.



Sperm whales have a 7-9 kg brain, while the baleen whales a 5-8 kg brain.

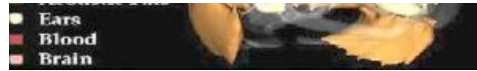
Only elephants have similar brains, of 6 kg weight.

Indeed, primates, cetaceans and elephants are seen as the most intelligent mammals.

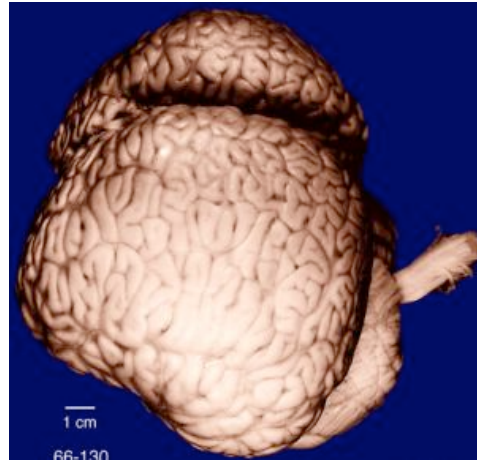
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Baleen whales have been found to possess in their brains "islands" and spindle cells, that till now have only been watched in apes and humans. The development of the cortex is linked to intelligence level in all mammals.



Scientists looked for the factors that produced the big brain of the dolphins:

_The possibility of movement in all directions (forward, backward, upward, downward, to the right, to the left), while their terrestrial ancestors moved only on a bi-dimensional plan; this developed the motor cortex;

_Fast swimming developed for catching very fast prey (fish, cephalopods); for fast speed and good space orientation the organism needed a more developed sensorial system, including sensorial cortex;

_The strong development of the auditory sense, which allows them to perceive a large spectrum of sounds, from a few hertz to 200 Khz (all the sound waves over 20 Khz are ultrasounds, undetectable for the human ears). Using ultrasound echolocation, dolphins can detect food (and its nature, size, distance) or the presence of their fellows;

_Group life and collective hunt, which triggered the development of a complex social behavior and communication system, based on sounds (clicks and whisperings) and ultrasounds;

_The protein rich food enhanced the brain development;

_The offspring stays for a long time with their parents, so they receive a long time "training" and the transmission of individual experiences (the so-called "culture", so typical to human populations and amongst animals found till now in chimpanzees).

And dolphins do live enough for cultural transmission (about 30-40 years). In fact, scientists even found that each dolphin population has its own dialect, and dolphins belonging to different populations cannot understand the callings of the others. But it is wrong to compare dolphins with the humans, as the causes that triggered brain development in the two evolutionary branches are different. In dolphins, this high intelligence level emerged as an adaptation to the water environment.

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Dolphin Intelligence Explained

Analysis by [Jennifer Viegas](#) | Fri Jan 22, 2010 01:21 PM ET

Today at [Discovery News](#) you can find out why dolphins are now believed to be the world's second most intelligent animals, with only humans displaying greater brainpower.

(An Atlantic white-sided dolphin; Credit: Carl Buell)



Intelligence itself is a very loaded issue. It's difficult to compare one individual's brilliance with that of another within the same species, much less to attempt to compare intelligence among multiple species. Intelligence is just one component of a species' survival, so one can argue that spiders have evolved to be as smart as they need to be for their species to continue, rats are as brainy as they need to be, and so on.

If human standards for intelligence are applied to non-human animals, however, dolphins come very close to our own brain aptitude levels, suggests Emory University dolphin expert Lori Marino.

She's performed MRI scans of dolphin brains. The scans prove dolphin brains are:

- big, relative to body size
- intricate, with a neocortex "more highly convoluted than our own"
- structured to allow for self-awareness and the processing of what Marino calls "complex emotions"

All animals share the capacity for emotions, she explained, but the part of the dolphin brain associated with processing emotional information is particularly expanded.

Why then did dolphins evolve to become so brainy?

Marino and her colleagues have analyzed modern dolphins and remains of ancient marine mammals to help answer that question.

The first jump in brain size happened 39 million years ago, when odontocetes (members of an order that includes dolphins, toothed whales, sperm whales, beaked whales and porpoises) diverged from their ancestral Archaeoceti group. When this split occurred, body sizes for some decreased and brain sizes increased, especially in the ancestors of modern dolphins. This coincided with the emergence of echolocation, so improved communication skills likely were tied to the brain size boost.

Fifteen million years ago yet another brain growth spurt happened. Marino and her colleagues speculate that changes in social ecology—essentially the dolphin's social lifestyle—probably contributed to the process. For example, the more a dolphin needed to communicate, benefiting its survival, the more its brain evolved to permit that interaction.

Moving to the present, dolphins have brains that are about "five times larger for their body size when compared to another animal of similar size," Marino said. "In humans, the measure is seven times larger—not a huge difference."

She concluded, "Essentially, the brains of primates and cetaceans arrived at the same cognitive space while evolving along quite different paths."

As a footnote to the above, it's important to remember that killer whales, also known as orcas, are actually the largest members of the dolphin family. Since this piece first ran, killer whales have been scrutinized due to a killer whale attack at SeaWorld. Trainer Dawn Brancheau died in the incident, which is still under investigation.

Lori Marino recently commented on the death, telling the [Los Angeles Times](#): "I'm not trying to second-guess what was in this particular whale's mind. But, certainly, if we are talking about whether killer whales have the wherewithal and the cognitive capacity to intentionally strike out at someone, or to be angry, or to really know what they are doing, I would have to say the answer is yes."

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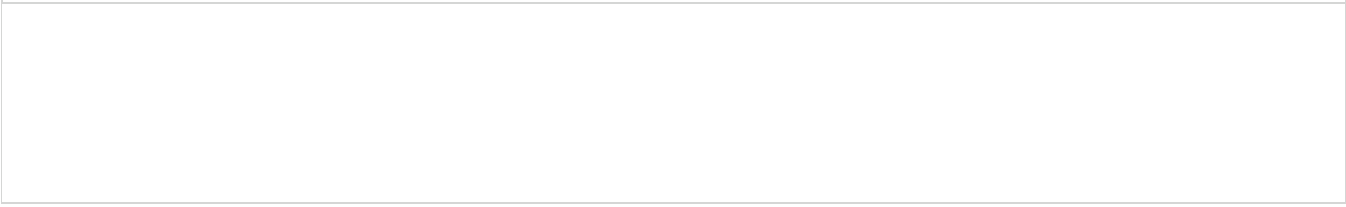
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[Admin](#)**Beth Hicks**

we're almost like ants to those whales. we know they're intelligent, yet we make them perform tricks far below their intelligence level and hold them captive. and we wonder why they would lash out? c'mon...what would you do? exactly the same.

March 19, 2010, 1:12:32 PM AKDT - Flag - Reply

**Arnel**

This very good, that explains why dolphins are very emotionally attached to humans. I wonder if in the future humans would be able to interact to dolphins in such a way a mode of communication would be use.

January 27, 2010, 8:09:20 PM AKST - Flag - Reply

**James Bernard Buchanan**

i sir am a dolphin so i am going to back up your idea

January 24, 2010, 7:24:52 PM AKST - Flag - Reply

**Tim**

@Robert this is very good point, I completely agree that intelligence and complexity of behavior are directly related. I still would be interested in finding out what their motivations are. Are they simply just removing non-kin from the gene pool? Are they trying to induce estrous in females? To me these causes seem too 'reptilian' for a complex species like dolphins. I suspect that they commit murder/infanticide for anthromorphic reasons like hate or revenge, but I am not a dolphin so I can't say for sure.

January 24, 2010, 11:07:13 AM AKST - Flag - Reply

**Robert Sloan**

The question to me, Tim, is how common that is. Humans have committed infanticide too yet many humans are



altruistic. A complex intelligence may lead to more variety in behavior and a wider range of behavior between individuals.

January 23, 2010, 6:23:18 PM AKST – Flag – Reply



Tim

Bats don't use echolocation to communicate; this a very significant difference. Since bats are nocturnal, they evolved to perceive their world via sonar. Communication is much more complicated, than simply interpreting your environment, which I believe explains why Bat brains EQ ratio (http://en.wikipedia.org/wiki/Brain-to-body_mass_ratio) is much less than that of Dolphins and other Marine Mammals.

I have also read reports of dolphins committing acts of infanticide. This surprised me more than anything, as dolphins are frequently reported as being incredibly altruistic, not only amongst dolphins but with other species as well. Any ideas as to why dolphins commit acts of infanticide? Are they known to be vengeful?

January 23, 2010, 3:17:30 PM AKST – Flag – Reply



Malcolm Brenner

What surprises me is that this is NEWS, since Dr. John C. Lilly reached exactly the same conclusion using the best tools and methods available to him in the 1950's and 1960's. For his ground-breaking research and suggesting that dolphins might approach us in intelligence he was roundly denounced as a drug-addled lunatic by every marine mammalogist in the world as well as quite a few ethologists, linguists, behaviorists and dolphin-trainers.

Since bats can do echolocation with brains that fit quite nicely on a dime, it seems we must look elsewhere for the seeds of dolphin intelligence. I think it has to do with language and imagination. For some reason it became important for dolphins to be able to communicate abstract ideas to each other (mere hunting calls could be done with a wolf-type brain). I also believe (though I cannot prove it) that dolphins have that most human of all characteristics, an imagination. They can not only remember the past but think of things that have not yet existed, do not exist and cannot exist.

As to why... perhaps we should wait until we can ask the dolphins? Now maybe we'll get some money thrown at this problem. Is the world ready for the answer that even here on Earth we're not alone?

January 23, 2010, 12:10:38 PM AKST – Flag – Reply



Jennifer Viegas

Thank you, Dan and Paul, for taking the time to write here. I read your comments with interest. "Communal prowess" is something that scientists have been studying quite a bit lately. Most recently, it was found that some insect colonies are so close knit and in sync that they act like a single organism. Dolphins aren't quite that organized– they don't have to be– but they do live within a close knit social environment. Different dolphin species will even come together to gang up against sharks, sort of like the marine mammal version of the UN. Young dolphins also practice their social skills on other species, perfecting their methods so that they will be more successful at mating when the time comes.

January 23, 2010, 6:24:03 AM AKST – Flag – Reply



sdmurphy

I've found the recent articles on dolphin intelligence to be fascinating and another example of how little we really know about the world around us. Thinking about the earlier comments, it seems to make sense that sophisticated social behavior is a significant factor contributing to the evolutionary need for a brain big enough to handle it. I would think that the need for complex communication and complex emotions would grow as an individual's ability to survive became more dependent on successful social interaction. I've also read anecdotal accounts of dolphins grouping together to protect human swimmers from sharks. In most cases, this occurred after the swimmers had been in the water interacting with the dolphins in some way. The ability of dolphins to extend altruistic behavior beyond their own species would say a lot about how close their intelligence really is to that of humans.

January 23, 2010, 10:57:43 AM AKST – Flag – Reply



Paul Radich

Interesting question. In preparation for Alisdair MacIntyre's book "Dependent Rational Animals" (about human



beings), he discussed the social characteristics of dolphins, and how they hunt together and are dependent upon each other in many ways. The article above notes the decrease in body size with the increase in brain mass – perhaps without physical prowess, they could survive only by "communal prowess" – I wonder what that says about us.

[MacIntyre also wrote "After Virtue" and "Three Rival Versions of Moral Enquiry" – some consider him to be one of the greatest living philosophers of ethics in the English-speaking world.]

January 22, 2010, 5:22:46 PM AKST – Flag – Reply



Dan Alger

I don't believe the argument for large brain size is echolocation. We would then expect all species with echolocation to have large brains, but they do not. The bat's small brain allows them to interpret echolocation signals pretty well.

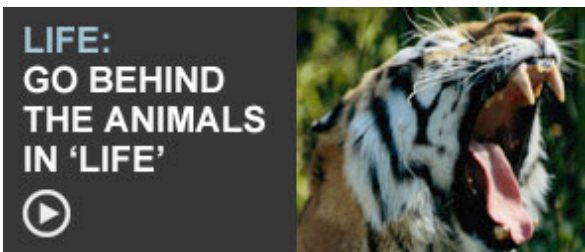
For humans, toolmaking and language are sometimes put forward for our big brains, but these face the same problem: other species would then face the same advantages of a big brain, but it didn't evolve for them. For that reason, the demands of living in close knit social environment seems to make more sense.

Do dolphins have a close knit social environment?

January 22, 2010, 1:05:21 PM AKST – Flag – Reply

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