

## A Portrait of Humanity

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A portrait of Humanity is shown in Fig. 1 (see the end of this paper). The photograph was taken by Simon Bell, a photographer from Toronto who has long been my friend and colleague. It is half of a stereo pair, two images which, when properly focused together, reveal the scene's third dimension. The photograph was envisioned as part of a message for the *Cassini* mission to Saturn and its moon Titan, launched in late 1997. It would have been an artifact in the tradition of the Voyager Record and the *Visions of Mars* CD ROM. Unlike the Voyager Record it was not intended to leave the solar system to be found by the crew of an advanced starship. Unlike *Visions* it was not for humans in the next few centuries. Its fate would have been to remain on the surface of Saturn's moon Titan, waiting for eons of time against the slim chance that life might someday appear on that strange world, or that some other space traveler might visit Titan and find it. The image, inscribed on a diamond wafer about the size of a coin, was intended to show an intelligent alien on Titan viewer a little about our bodies, about our relationships with each other, and about our planet.

This message was never finished and never launched. Almost the only part of it that was brought to completion was this photograph. Even though it never left the Earth, I think it is instructive in demonstrating how such an image could be made. Envisioning its elements and designing its composition took almost two years. The Portrait of Humanity drew upon previous experience in selecting the many pictures of humans recorded on NASA's Voyager Record. [N.B.: Lomberg was Design Director for NASA's Voyager Record]. Comparing this image with them may show how their essence was distilled into this single photograph.

The photograph was taken on a beach in Kona, on the west coast of the Big Island of Hawaii, which has been my home since 1987. All of the models are residents of this island. None of the people are professional models, but are simply members of the community. Among their varied countenances you will find all the major groups of our species. Their postures indicate the range of human movement, their ages the human lifespan. A baby nurses at its mother's breast. Other children and adults are clustered around the eldest, who is telling a story, the story of the small object in her hand, which is the diamond wafer on which the photo is inscribed. In the background a couple walks hand in hand. A sailor prepares to launch a canoe on a voyage, as so many mariners have done for all the millennia of

human history and before. It was in larger version of canoes like this that the Polynesian people braved the Pacific, embarking on voyages longer than Columbus's, and requiring far better navigators.

The call of the sea is today echoed by the call of the stars. Our spacecraft, as flimsy and presumptuous as any canoe, embark on that ocean for the distant shores of our solar system and beyond.

I had first conceived the idea of an artifact for *Cassini* in July 1994, following the completion of my work on *Visions of Mars*. [Lomberg was Project Director of this message to the future human inhabitants of Mars, launched aboard Russia's Mars 96 mission.] NASA was sending a spacecraft to Saturn and landing a European Space Agency probe named *Huygens* on its moon Titan. A proposal I wrote to Carl Sagan and Lou Friedman about this mission read in part:

We should consider whether The Titan lander provides an appropriate opportunity for an artifact to ride down to the surface and remain on that satellite. There are two reasons why this might be worth considering:

1) Would the MAPEX or some variation of it be a useful "LDEF" [Long Duration Exposure Facility-- an experiment left in Earth for several years and recovered by the Space Shuttle to test to determine the results on certain materials of long-term exposure to space] to leave on Titan for subsequent generations of human or robotic explorers? How should the existing MAPEX be modified to afford longer lifetime and more valuable information in the denser Titanian atmosphere.

2) Does it make any sense to include a message?

a) To Whom?

Unlike Mars, Titan is unlikely to be settled by humans in the foreseeable future (though who really knows?), so a strong case cannot be made for a message along the same lines as *Visions of Mars*.

However, a much more fantastic possibility exists for an audience. In the far future, when the Sun enters its Red Giant

phase, Titan may thaw. The prebiotic organic compounds now thought to exist there may in fact evolve into biology, and that biology just might evolve intelligence. The Red Giant phase of the Sun's life can last up to a billion years, perhaps long enough for life forms to evolve and then adapt to a drop in temperature as the Sun cools and shrinks. In those far distant days the three innermost planets may cease to exist. If intelligence arises on Titan, human artifacts in the outer Solar System may be their only clue to the existence of the former children of the Sun.

Our message is for the inhabitants of Titan, 5 or 6 billion years hence.

b) How would this message be made survivable?

Making this artifact presents greater challenges than any previous "deep-time" communication (Voyager Record, WIPP Marker, Visions of Mars). The time scales are greater and the environment less forgiving than Voyager, and we can make even fewer assumptions about the nature of the discoverers (with Voyager we could at least presume spaceflight).

But I do not think the task is so clearly impossible as to preclude some viable message strategies. There is a precedent for "messages" surviving for comparable periods: the 4 billion year old fossils of algae discovered by Schopf.[N.B. This was written two years before the discovery of the Martian "microfossils"] I propose that our message form be an "artificial fossil", a message sealed inside some very durable mineral, glass or plastic whose external form implies its artificial nature (possible shapes are a square, a 3:4:5 right triangle, or the shape of the planet Saturn). This artifact would be designed to last even after the lander itself had crumbled to dust.

c) What would the message say?

Perhaps not much. Certainly all the problems of message contents faced on Voyager are compounded by the fact that we cannot assume high technology on the part of the discoverers, much less a knowledge of English or Russian! The basic message should be some information about how the solar system looked in our epoch. Perhaps a variation of the TPS logo, with the arrow leading to Titan, would be

enough. Perhaps some more detailed information about the size and masses of the vanished planets (referenced to Jupiter) and some chemical symbols and diagrams showing their rocky composition would be achievable and decipherable.

Carl and Lou encouraged me to pursue my idea. Eventually I proposed my idea to Carolyn Porco, a scientist working on the *Cassini* mission, who presented the concept to both NASA and the European Space Agency. Dr. Tobias Owen, a senior scientist on the mission, was very helpful in this regard. We not only received permission to continue, but was informed that NASA would carry a copy of the diamond on the *Cassini orbiter*, as well as on the *Huygens* lander, doubling the chances of the artifact someday being found. Over the next two years Porco, Simon Bell, and I fleshed out the idea into a final design and secured most of the funding for the project. During this period I benefited from the advice and expertise of colleagues in disciplines ranging from materials science to cognitive psychology, many of whom I had worked with in the three previous message projects. Porco assumed the task of acting as liaison with the *Cassini* project and administering the funds I had raised, through her university. Bell began thinking through the intricacies of a complex photograph of a group of humans. We were soon joined in the task of envisioning the details of the message by Gregory Benford, as described below.

Shortly after beginning work on the project I received an appointment as a Regents' Lecturer at the University of California at Irvine, a post given to non-academics whose presence on campus could make some contribution to enrich the university community. I was delighted to be able to spend more time with Louis Narens with whom I had served on the Nuclear Waste Markers Panel. [Lomberg served as Chair of an interdisciplinary team charged with designing a warning marker for a U.S. government waste repository]. Narens was a wonderful sounding board on all matters relating to the cognitive issues of the design.

Also at UCI was Gregory Benford, the physicist and science fiction writer who had served on the WIPP Futures Panel that preceded my Markers Panel. One of his stories, "All the Beer on Mars" had also been selected for the *Visions of Mars* CD ROM. Despite this common participation in what Greg called "deep time" messages, we had never met before my sojourn at UCI. We met shortly after my arrival on campus, and in the course of discussing the Mars disk and WIPP project, I informed him of the idea for a message to Titan, and asked for his thoughts on the idea. One problem I posed was the difficulty of conceiving an artifact that could survive for over a billion years in the frozen ooze of Saturn's largest satellite. "Send a diamond wafer" was his immediate response.

That was an inspired suggestion. In almost 20 years of discussion about interstellar message plaques, I had never heard of diamond being suggested as a message carrier. Yet the legendary durability of diamond made it, in retrospect, an obvious choice. And the microchip aboard the CD ROM label [on the Visions of Mars project] had shown how much information could be recorded on an object the size of a small coin. If diamond could be inscribed at the same resolution as silicon, a small and light diamond wafer could be an easily carried, inert and hardy addition to the spacecraft. Greg did some preliminary research on possible inscription techniques, and acquired information about the specific properties of diamond relevant to this project. He summarized his findings in the form of a memo, which read in part:

#### Physical Characteristics of the Huygens Marker

The extreme cold and strange weather of Titan suggest a message medium of great durability. The best candidate is probably a thin, single-crystal diamond disk, perhaps one or two millimeters thick and a centimeter in diameter. The message would be carried by a layer of boron inside the sheet, laid down using a template and chemical vapor deposition.

The utility of this approach lies in its economy, simplicity, readability, and the unequalled rugged properties of single diamond crystals. Diamond is robust, strong, inert, and resists abrasion. Only very high temperatures and aggressive oxides can damage it.

Further, it is transparent in the visible and a broad range of the infrared.

Many spacecraft use diamond windows for their infrared sensors. Its space-rating properties are well known. on Titan, infrared is probably the preferred range for best visibility. Diamond has no known chemical re-action with substances in the Titan atmosphere.

Greg offered to contact the manufacturer of such windows to find out the standard available sizes, prices, and technical characteristics. Eventually, DeBeers, the largest manufacturer in the world of diamond products, donated the diamond wafers we required at no cost.

There are two core problems in a message artifact-- the material and the message. Greg had solved the materials question. We opened discussions with the same engineers at JPL who had made the MAPEX chip for the *Visions of Mars* project, who gave us further advice about how a diamond might be inscribed in a

manner similar to the MAPEX chip, containing a great deal of information, including the Portrait of Humanity that I had begun to envision.

Besides the photograph, the diamond was to contain some photographs of astronomical objects to show what the solar system was like at the time of launch. As on the Pioneer and Voyager messages, it was important that there should be some indication of where and when the message was made. Based on the previous use of astronomical time markers in the Voyager and WIPP markers projects, we conceived a series of stellar and galactic photographs, whose visible changes would provide a way of dating the epoch of launch, over time periods ranging from tens of thousands of years (in the case of the Big Dipper) and millions of years (in the case of galaxies). A photograph of the Big Dipper, whose shape would change over shorter time scales, had been suggested independently by Carl Sagan, Frank Drake, Woody Sullivan, and Ben Finney for use in the WIPP nuclear waste marker project, and it seemed suitable for use here as well.

This choice of a galaxy as a time marker was inspired the use of the Andromeda galaxy in the Voyager Record image sequence, where changes in that galaxy's structure could help alien astronomers deduce how much time had elapsed since the photograph was taken. Greg, an expert astrophysicist, supplied calculations that helped define the very long periods -- tens or hundreds of millions of years -- during which the motions of galaxies would provide useful information about the age of the artifact. For reasons having to do with my own theories on interstellar aesthetics, I preferred using a galaxy whose curvature more closely approximated the "golden section" curve also visible in the nautilus seashell lying on the beach in the Portrait of Humanity.

Another obvious picture to include was Saturn itself. During my work as a reporter covering the Voyager Encounters, I had learned that the positions of the major gaps in Saturn's rings were determined by the distances of some of the planet's moons. Over long periods of time, the orbits of these moons would change, and hence the location of these gaps. An astute planetary astronomer millions of years from now could compare the appearance of Saturn then with its appearance now. The change in the gap's location could be used to determine how long ago our photo of Saturn had been taken.

A photo of the Earth not only would show where the spacecraft had originated, but the drift of continents over millions of years could provide an additional point of comparison to help future viewers of the diamond to guess how old it was-- assuming they knew how the Earth looked. We also wanted to include a map of the solar system, showing the spacecraft's trajectory from Earth to Saturn, and some diagrams of the *Cassini* and *Huygens* spacecraft themselves. If, by

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the time the diamond was found, the spacecraft has been eroded into a pile of junk, these diagrams would tell them how they had looked when they had arrived at Saturn. Porco began work on acquiring the graphics showing the Cassini Mission itself.

Soon after this initial conceptual work was complete, Greg left the team, but even though his participation was brief in duration, his contribution to both the form and the content of their message was invaluable in shaping this artifact.

The major technical problem to solve was how to inscribe the images and photographs on a diamond wafer. This had never been done before. Paul Maker of JPL, who had worked on the MAPEX project, gave particularly valuable advice in this regard. He tested some schemes for diamond inscription and ultimately referred us to the National Research Council of Canada. Dr. Lynden Erickson, the head of the Ottawa laboratory that had the unique equipment required, agreed to attempt the project. With enormous effort, he worked out some of the technical details with various JPL and *Cassini* scientists, including some suggestions from the two material science experts I had worked with on WIPP, Dr. Dieter Ast and Dr. Wendell Williams, who independently suggested similar techniques placing a microscopically detailed inscription into the surface of a pure diamond wafer.

Meanwhile, I concentrated on the overall layout of the diamond message, and in particular on the design of the photograph that would portray ourselves to the future inhabitants of Titan, or to whomever else might find the diamond somewhere down the long corridors of time.

On the Voyager Record we had 120 photographs to explain ourselves. On the Cassini Diamond we had room for only a few. Some of them would be the astronomical time markers described above. But if an alien on Titan, resident or visitor, should ever find the ancient diamond artifact, surely that being would be curious about us. Who made this message? What were we like?

I laid out the parameters of the photo in early 1996:

REQUIREMENTS:

- 1) The photo must work in black and white and at low-res.
- 2) Must show a representative sample of humans with regard to age, sex, coloring, ethnic type, body type, dress, hairstyle.
- 3) Must show the entire human body, from head to toe, in several different positions.

4) There must be a minimum of overlap of detail in the poses i.e. people not partially obscured by others. All objects clearly delineated from background.

5) The picture must be representative of the planet without being too specifically identified with only a single nation.

6) The background must contain additional information about the planet, species, and culture without compromising any of the above goals.

7) It must be a wonderful picture.

8) It should contain some object identical to something on the spacecraft (one person holding the diamond itself, for example) to provide an unambiguous check of scale of objects in the photo.

9) There will be no copyright, permission, or future reproduction problems.

DESIGN FOR PHOTO

The scene is a sandy beach, with submerged lava rocks partially visible, showing waves rolling in, clouds in the sky, and possibly the moon. The beach will not be easily identified but seem a generic beach that could be found on any continent or island of Earth (except possible Antarctica, though perhaps even there some sandy beaches exist, though not at the temperatures implied.) A beach has strong mythic and biological associations that enhance its appropriateness.

This photo could contain all of the information and meet all of the requirements listed above. Additional information is more subtle: the use and role of boats; the importance of water; the nurturing of children; information about the water cycle (and thus the approximate temperature). Cast shadows might imply the latitude or time of day, etc.

A group of people of different ethnic types and a variety of dress is on the beach. They are broken into three small groups: three children playing, a group of adults, and a group of old people. One of them is holding a replica of the diamond in her hand, facing directly into the camera and pointing at it. In the ocean behind the people are a few small

powerboats and sailboats. People are visible in them.

The poses maximize the range of arm and leg positions and illustrate how we stand, sit, and bend.

One of the adults is holding the diamond disk, which is very clearly outlined against the background. All the people are looking at it. One is pointing and talking.

DRESS: The adults and older child are clothed; the younger child might be nude, seen from rear. The man wears a loose bathing suit. The woman wears loose shorts and a halter top. The older child wear a bathing suit or sun suit (and perhaps a sun hat) The clothing is solid-colored and is chosen and shot in a way to make it as easy as possible to see that it is a covering, and not a growth of the body.

The woman is wearing little make-up (if any). Some small jewelry (ring, bracelet) OK, if it is obviously an artificial object. No cross or other religious symbol visible.

(RATIONALE: Many people will object to or be embarrassed by pictures showing naked adults. If we want this photo to truly be representative of all the Earth, it is no small matter to alienate a large portion of the viewing audience.

Also, the fact is that people hardly ever walk around naked. In most cultures there is some sort of dress. Shadows on the ground and the sun hat might give the very important information that we cover ourselves for protection from the environment. Astute observers might even draw some conclusions about the existence of solar UV at the Earth's surface!

And in a single photograph the genitalia, even if shown, give no clue to their function. Sexual differentiation will be guessable purely by more obvious shape differences and the existence of breasts on the woman. If these aren't enough, the genitals wouldn't provide much more revealing clues. And there will be many parts of the body that will unseen (soles of the feet, the inside of the mouth, etc.). The purpose of this picture is not to explain human biology or reproduction fully, but to satisfy the simple question: What did the creators of this message look like?

BACKGROUND: The shot might work well as an angled shot along the beach, showing the wave trains more clearly, and perhaps some of the palm trees along the shore as well (and thereby including the other great kingdom of life in the photo). We could have a sailboat in the background (or a few boats of different types-- wooden canoe, modern sailboat, fishing boat with motor) might suggest our interest in traveling and vehicles, of which Cassini is one of the ultimate expressions. The size of the sails and the height of the mast could be used to make a rough estimate of wind speeds and atmospheric density on Earth. Birds in the sky would be great, but how can we count on it?

TIME OF DAY: Sun angle should be low enough to cast some nice shadows (which imply lots of information) but not so low as to cause problems with exposure). Because this will be low-res B&W, with little dynamic range, the main goal is clarity and clear outline of objects (though the stereo for the humans and foreground interest will help a lot in sorting out what's what)

On Voyager, we had shown a variety of landscapes of our planet. On the Portrait of Humanity, we could show only one. But which one? The sea is the most evocative and universal background. In a sense, we all came from the sea in the distant era when our vertebrate progenitor first heaved itself out of the surf and lay gasping on the beach. Mountains, forests, deserts, these are all too provincial. The sea is the one universal. The beach scene shows the importance of oceans and water to our biology. Three-quarters of the Earth's surface is covered with water. The clouds, waves, and sand provide many important clues about our planet's atmosphere, winds, pressure, and temperature. The shadows in the photograph indicate the location of the Sun in our sky.

We could not be sure when we would be able to take the photograph. Too much depended on obtaining the required funding and solving the technical issues of diamond inscription. The safest bet was to plan to take the photograph in Hawaii, when we could shoot at anytime of the year. An additional advantage was that I live in Hawaii and could take as much time as necessary to scout possible locations and begin to assemble a group of candidate models who could represent Earth's diverse peoples. Fortunately, there is no better place on Earth to do that than in Hawaii, where people from every part of the planet may be found.

The pose was suggested by the circles of people so common in the Voyager photos. That is how people

naturally arrange themselves. The design for the pose began to take shape, following the initial guidelines I had laid down. It would be a group of people representing the human family, on a beach, with a boat in the background. [See Fig. 2, my initial pencil sketch of the pose]

I began the effort to secure the money to do this project. NASA was not giving us one cent. Porco had managed to raise a small amount through her University, but not nearly enough. Even though the Ottawa laboratory had agreed to work at a very minimum cost, there were expenses they would incur that we would have to cover. If we were to mount a major photo shoot in Hawaii, the expenses would quickly add up to several tens of thousands of dollars. For the photo alone, there would be the costs of film, processing, and renting all the photographic gear we would need, not to mention the money to bring Simon Bell out to Hawaii, and a hundred other hidden costs, from renting vehicles to phone bills. Fortunately an "angel" appeared in the person of a Japanese scholar and businessman named Jihei Akita, a professor at MIT's Media Lab. Mr. Akita had arranged for the broadcast of the television series *COSMOS* in Japan. He later was instrumental in having Carl Sagan's books published in his country and has continued to play a major role in the awakening of Japanese interest in solar system exploration. When I told him about the planned message for *Cassini*, he volunteered to seek funding through some major Japanese corporations. Over several months he and I worked together presenting the message concept to various interested parties in Japan, and finally we received enough money to allow the work to proceed as envisioned.

In Toronto, Simon Bell reviewed the sketches I had drawn of various poses and began experimenting with camera and lighting angles. Simon is a master of nature photography, who has shot wildlife and landscapes from the Galapagos to Baffin Island. He specializes in stereo photography, in which two photographs of the same scene are combined into a three-dimensional image. He then uses these images in multi-media 3d projections, sequenced and mixed to music, which have been presented at venues around the world. He has also published several books of his 3d nature photography. His experience working in outdoor locations as well as his ability to work in stereo made him the ideal photographer to create this unique image. He used a special stereo camera made in Germany that combined two 35-mm. camera bodies in one housing. There are many ambiguities in a single flat photograph. It is not always obvious if something is close and small or large and distant. Adding the third dimension could resolve these ambiguities and provide a fuller sense of the volume of the objects depicted, as well as showing the contours of the sand, rock, and waves much more clearly.

But how would recipients know that this was a stereo pair? They would see that there were two seemingly identical photos on the diamond. Why would we have done that? Close inspection would reveal very small differences in the position of objects, because the right camera sees the scene a little differently from the left camera. If the recipients have binocular vision, or can guess from our two eyes that we have binocular vision, we hope it will occur to them to try to recombine the images into a stereo scene. Professor Louis Narens, a mathematician and cognitive psychologist and my colleague from the WIPP Marker Panel, consulted with us on this aspect of the photograph and was able to demonstrate that there is a unique solution (in the mathematical sense) of how to recombine two images to obtain the third dimension.

During the summer of 1996, Simon made numerous test shots on the shores of Lake Ontario, a rehearsal stand-in for the beaches of Hawaii. We were especially interested in testing whether the diamond wafer-- or its Plexiglas counterpart that we would use for a prop in the photo-- would be visible. [See Fig. 3 test shot on Lake Ontario]. The reason for having the wafer in the scene was to provide an absolute way of determining the size of objects in the picture. If recipients recognized that the wafer in the photo was the same object as the wafer containing the photo, they could measure the size of the humans and thus obtain a proper scale for the entire scene. One essential piece of information to reconstruct the image into stereo is the separation of the two cameras. The ideal separation is identical to the average separation of our two eyes, called the interocular distance. The diamond wafer, the absolute unit of measure available to recipients, would allow them to measure the interocular distance of the people in the photograph, and therefore calculate how to reconstruct the two photographs into a stereo image.

In November, I went to Toronto where we refined the pose of the group. The models for these test shoots volunteered their time for nothing more than pizza and the pleasure of helping. They knew they were only stand-ins and their images would never go into space. Nevertheless, the special allure of the project did not fail to move them. (I had invited Judith Merrill to participate in the test shoots, acting the part of "Grandmother Earth", the storyteller holding the diamond. But by this time her health did not permit it.) [Science fiction writer and editor Judith Merrill was Senior Editor on the Visions of Mars project] We tried different positions and arrived at a few new ideas not suggested by my sketches, such as having one figure prone, back to camera, completing the circle. We also needed to suggest that this group in a circle as simply part of a larger Earth community. I asked two of our models to walk in the background. This would suggest the presence of other humans and would also show people in motion, contrasting with the static position of

the group in the circle. Our pose was beginning to firm up. [See Fig. 4]

There was one additional detail in the photo: a chambered nautilus seashell. The curve of this beautiful shell follows the mathematical ratio known as the Golden Section. From a time pre-dating my involvement with the Voyager record, I had been interested in what aesthetic principles of human art might be shared with other intelligent beings in space, and my favorite candidate had been the Golden Section. This proportion and the number series related to it appears in biological forms as diverse as pine cones and dandelions, the curves of ram's horns and the branching pattern of trees. Artists from Pythagoras to Leonardo had used it as a touchstone in design in painting and architecture. Including a chambered nautilus, such a natural addition to a beach scene was meant to suggest the universality of this pattern of beauty, telling any extraterrestrial aestheticians that they had kindred spirits among the artists of Earth. This message was reinforced by the selection of an astronomical object whose photograph was to appear among the astronomical time-marker photos -- the galaxy M74 in Pisces. (M101 was another candidate.) M74's curving spiral arms match almost exactly the curve of this seashell, proving that this extraordinary proportion is not confined to our little world but graces the universe as a whole. [I had published several papers on the topic of interstellar aesthetics over the years, including one entitled "Are there any universal principles in science and aesthetics that could help us to set the unknown parameters for interstellar communication" co-authored with the Argentine radio astronomer Guillermo Lemarchand and presented at the International Bioastronomy Conference held in Capri in July 1996.]

Meanwhile in Hawaii I began searching for locations. Nobody can guarantee weather during a planned shooting day, so we needed to plan for at least two days of photography, with a third day as a back-up. We also wanted to shoot in two different locations. The scene was to be a generic beach, not one that specifically shouted Hawaii, so that meant diminishing the role of the evocative coconut palm, in favor of more prosaic bushes and pines. We also did not want structures in the background, but a pristine natural setting to convey a little about the beauty of our planet.

I found two locations that seemed to meet all the requirements. One was world famous: the Kona Village Resort at Kaupulehu, a hidden getaway that lives up to its motto "The Most Dreamed-of Spot on Earth Really Exists." A perfect curve of pristine beach, trees and bushes right down to the shoreline made the setting ideal. Additionally, the logistics of shooting at Kona Village were very simple, since it had on hand all the facilities our crew and models would need for a long day's shoot. Fred Duerr, the General Manager of Kona Village, not only agreed to let us photograph there,

blocking access to part of the beach from his paying guests, but offered us two of their prime beach bungalows for the models to change, shower, and rest. Fred even invited cast and crew to partake in their gourmet buffet lunch, all at no charge and during their busiest time of the year during the Christmas holidays.

The other location was a beach at a place called Makalawena, a few miles north of the Kona Village Resort. Makalawena is a beautiful site, accessible only on foot or by a long drive down one of the worst four-wheel drive roads on the island. The remote loveliness of the beach and its ironwood groves was worth the effort involved getting there. Simon had advised that the best time to shoot would be early or late in the day, when the low Sun angle would light the scene the way he wanted. This meant that we would have to arrive at Makalawena the night before and camp out, shoot until we lost the light, and camp out again, so we could continue shooting the following morning if necessary. Makalawena had no services at all, so we would have to transport the score of models, along with all our photographic equipment plus tents, food, water, cooking gear, even the portable toilets that the owners of the beach required us to bring in order to allow us access. We intended to bring 40 people down to that beach -- including old people and small children-- and keep them happy and comfortable enough to look relaxed in front of the camera.

This shoot began assuming the proportions of an expedition. I enlisted the aid of my friend Miles Mulcahy. Miles, who has been at various times a paramedic, ski patroller, and carpenter on the Alaska pipeline, is an expert camper and outdoorsman. He is also one of the most efficient and reliable people I know. I delegated to him the planning of the transportation and camp logistics, handling everything from the required 4-wheel drive vehicles to the cell phones, the marshmallows to the toilet paper. Once Simon arrived in Hawaii about 2 weeks before the shoot, Miles also supervised the construction of the various reflectors, wind baffles, and other gear Simon wanted to have on hand for the photography.

It was clear that to photograph a group of a dozen models, one would have to have at least twice that many available. Since some of the models were old people and small children, replacements would be needed to rotate in as models became tired. Yet as the group changed throughout the day, every combination would need to preserve the desired age, gender, and ethnic mix. I began looking at my friends and neighbors, and people in the post office and supermarket for candidate models. I must have described the project 40 times to various possible models, and my delivery became very polished.

But as had been the case on the Voyager Record and *Visions of Mars*, most of the people we asked to participate didn't need much convincing. Once

they grasped the essence of my request, they were eager to come aboard. Some of the people are from a single ethnic background; others are of extremely mixed ancestry. The model pool represented a mix of peoples of Earth, from European, Asian, African, American Indian, Middle Eastern, Indian sub-continent, and Pacific Islander backgrounds. We had no Eskimos and no Australian aborigines, but other than that I think we had most of Earth's genes represented among our models.

At one point I wondered whether we should employ professional models or seek the participation of world-famous people of various ethnicity's (Magic Johnson, Sophia Loren, the sumo wrestler Konishki...) One day when I was at Kona Village, scouting the best positions of the shoot, who should I see a few feet away but supermodel Christie Brinkley. I considered strolling over and saying, "Excuse me, but would you like to have your photograph sent into space?"

No. The look I wanted was "jes folks." So I limited the search to ordinary people, acquaintances that happened to have the right characteristics. One man from India operates a nearby gas station where I fill up when driving my kids to school. A very tall and elegant black man, nicknamed "Stretch" who jogged on the road outside my home most mornings was enlisted, as was Terry, A Japanese-American man with whom I sometimes played tennis. The children were for the most part the children of friends. None of the models had ever posed professionally. I took snapshots of every model and sorted them into various groups, which could be called in rotation during the shooting. Because many of the models had known each other at least slightly before the project began -- Kona has that sort of small-town community feel where everyone seems to know everyone else--- there was an easy familiarity, especially among the children, which encouraged the informal feeling the photo needed to have. I doubt if we could have achieved that with any group of professional models

Each combination of models during the shoot would also need to include a nursing mother and an infant. My children's pediatrician, Dr. Robert Laird, suggested some new mothers who might be willing to bare their breasts to the universe. One family would have been perfect: the mother a woman from India, the father a Caucasian. The mother agreed, but the father later retracted her agreement for unexplained "religious reasons". But "Dr. Bob" was able to suggest some other candidates who were more than willing to participate. In fact, he became so intrigued by the project that he and his wife Mary (a pediatric nurse) volunteered to come to Makalawena as our medical team. We would be in a remote location, with infants and elderly people. We might be wrestling heavy canoes through the surf and hauling other gear around. Somebody could easily get

hurt. Dr. Bob and Mary were a welcome addition to our crew.

One of the thorniest issues on the Voyager record had been whether to show nude humans. The only picture that NASA would not allow us to record on that disk was a nude adult couple. And that was in the permissive 1970s. How much more difficult would it be to get nude humans past NASA in the more puritanical 90s? The solution I came up with was to have two of the youngest children appear nude. A friend of mine in Kona was the father of two beautiful twins, a boy and a girl, about 3 years old. He and his were honored, to have Sara and Nicholas among the models. They, like the nursing mother, were in virtually every photograph we shot. The two children are fraternal twins: same age, same size, same coloring. The only visible difference is their sex. In scientific terms, this allowed us to suppress all the other variables to allow an extraterrestrial viewer to see the gender difference between the two.

Another problem was selecting a boat. The vessel I wanted for the shot was a Hawaiian canoe. The Polynesians were among the greatest seafarers in history, accomplishing incredible feats of point-to-point navigation over vast distances of ocean without compass, sextant, charts, or all of the other equipment developed in Europe. They sailed by the stars and by their incredible sensitivity to natural phenomena-- currents, water temperature and salinity, birds, clouds, floating vegetation. Their navigators were even able to detecting the incredibly subtle reflection of waves from islands over the horizon.

Until the 1970s, anthropologists and historians doubted that the ancient Polynesians had the ability to navigate over thousands of miles of open ocean. Then in 1973 a group called the Polynesian Voyaging Society was formed to attempt to re-enact these ancient voyages, using the techniques of the Pacific peoples before contact with Europeans. The first replica sailing canoe was completed in 1975 and named *Hokule'a* the Hawaiian name for the star Arcturus, a major guide star used by Pacific navigators to find the latitude of Hawaii. After a great deal of effort in relearning the techniques of sailing and navigation, *Hokule'a's crew* sailed her from Hawaii to Tahiti and back. Later she sailed to Samoa, Fiji, and ultimately to New Zealand, proving that the original voyages that united the Pacific islands and allowed the Polynesian culture to spread were intentional, not accidental.

[Since moving to Hawaii in 1987, I had become entranced by the story of the *Hokule'a*. Ben Finney, one of my colleagues on the WIPP nuclear waster marker project, was one of the original founders of the Polynesian Voyaging Society and a member of *Hokulea's* original crew. Now chairman of the Department of Anthropology at the University of Hawaii, he has written extensively about Polynesian navigation and how the experience of Pacific peoples,



moving their culture from island to island, may be the best historical analogue to the future settlement of space by the human species. Ben's book *From Sea to Space* provides a perfect introduction to this topic.]

A Hawaiian canoe would symbolize ocean voyaging stripped to essentials, and also symbolize the eternal desire of the human spirit to explore and the courage required to embark on these dangerous journeys. If any of this could be communicated by the presence of the canoe, a great deal would be conveyed about humans.

Additionally, even though our photograph was not to be site specific, the fact that it was taking place in Hawaii, and with a group of models consisting entirely of Hawaiian residents, deserved some acknowledgment. So I set about trying to find a Hawaiian canoe and crew for our shot.

The Pu'uhonua O Honaunau is a few miles from Kealahou Bay, one of the most sacred and historically important areas in pre-contact Hawaii. It was near this spot that Captain James Cook made the first European landfall in Hawaii in 1789, and where he was received by King Kamehameha I, the first king to unite all the islands of Hawaii under one rule. The Pu'uhonua is a so-called "place of refuge", where in ancient times lawbreakers could receive absolution for misdeeds. It has been restored as a national monument and is part of the United States National Park system. Polynesian crafts and folklore are regularly presented there. While I was preparing for our *Cassini* shoot, there happened to be a special program showing some of the basics of Hawaiian sailing canoes, presented by a man named Kiko Johnston-Kitazawa. He had been a member of *Hokule'a's* crew on one of her epic voyages. Kiko is a man of great presence and authority, who's mixed European, Asian, and Pacific ancestry made him almost a one-man representative of the human family. I approached him on day at the Park and told him about our project. Could I persuade him to bring his beautiful canoe to our shoot? "It's not every day you get to sail to Saturn" was his reply.

But though Kiko's canoe was majestic, it was also large, and required a heavy boat trailer to transport it. Driving that trailer to Kona Village was no problem, but getting it down the rocky road to Makalawena could be very difficult. It might be sailed to Makalawena, but the possibility of heavy swells at that time of year could not guarantee that it would be possible to land it there. Through Kiko I met another Hawaiian sailor, named Mac, who had a much smaller canoe, which could be broken down and carried on the roof of a car. That would be our back-up canoe for Makalawena.

Kiko's canoe had the traditional Hawaiian "crab-claw" sail. But Mac's canoe used a trapezoidal European sail design. Kiko explained to me that while the crab-claw was an efficient design, the European design could sail closer to the wind. One of the first

positive cultural imports Cook's men brought to the islands was the introduction of this sail. Within a few years of their arrival, the Hawaiians had started using that design for the smaller, coastal and fishing canoes. Mac had offered to replace his European style sail with the traditional design, but we decided it was better to keep the European sail. This message was to be from a world united in the spirit of exploration, and the European sail on the Polynesian canoe symbolized this synthesis of cultures.

Once all the models had been selected, I sent each of them an information sheet that gave some instructions. The matters regarding clothing, make-up, and jewelry reflected the lessons learned from the Voyager Record photographs:

#### WHAT SHOULD I WEAR?

During the shooting we would like you to wear ordinary beach clothes: a bathing suit, shorts and a top, jeans, wraparound sarong or cover-up, etc.

In general, we would like as much of the human body visible as possible. The older women may wear muumuus or similar dresses. Simple cotton clothing is probably best.

We will ask most of you to be barefoot; some of you may wear beach sandals or thongs. Bring a hat to wear in the sun, but we will ask most of you to remove your hats for the actual photography. Bring and wear sunblock, if you need it.

We may ask you to change from one of your outfits into another (private changing areas will be provided.) During the rest period you may change into anything you like.

#### WHAT COLOR SHOULD THE CLOTHING BE?

Do not wear anything white or black. They don't photograph well.

Wear shades that contrast with your skin. (We want it to be very clear where clothing ends and skin begins). If you have light skin, wear dark colors. If you have dark skin, wear light colors.

Solid colors are best. Stripes and simple print patterns are OK. But please avoid very complicated patterns, or patterns with many different shapes or colors.

PLEASE DO NOT WEAR ANYTHING WITH ANY WRITING, NAMES, LOGOS, OR ANY SPECIFIC SYMBOLS ON IT!!!!

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WHAT ABOUT JEWELRY?

Do not wear bracelets, watches, or earrings. Very simple necklaces, anklets, or rings are OK. But we would prefer you wear as little jewelry as possible.

WHAT ABOUT MAKE-UP?

Wear as little make-up as you are comfortable with.

DO YOU GUARANTEE THAT I WILL BE IN THE PHOTO SENT TO SATURN?

No. Since some models may get sick on the shooting day, or become fatigued, we are bringing extra models to each shoot. We will try different combinations of people during the shoot, and select the best overall photograph from the many we will take. We will not know ahead of time which group of people, time of day and weather, etc. will result in the best photo. Good luck!

WELCOME ABOARD!

We look forward to working with you on this exciting project. On Dec. 13 there will be an informal pre-shoot get-together, with pupus and refreshments from 4-7 p.m. at the picnic area at Pu'uhonua O Honaunau. It will be a chance to meet the other people involved in this project. We can answer all of your additional questions then, and tell you more about the project. Please bring the clothes you intend to wear for the shoot so we can see them and tell you if they are OK. If the weather is clear, we may be able to view Saturn through a telescope!

This preliminary get-together allowed the models to meet each other. Many recognized old friends among the group. After a heart-stopping Kona sunset, the stars and planets appeared. I set up my telescope and we all had a look at Saturn. The lovely rings drew gasps of amazement, as they always do from those who had not seen them before. Next to Saturn was a tiny dot -- the moon Titan where our photograph would be going.

Finally, just before Christmas 1996, the shooting days arrived. Our group arrived at Kona Village at an overcast, drizzly dawn. Kiko had brought his canoe the previous day, and set up down the beach from where the models would be posed, and with his crew re-enacted again and again the act of launching the canoe into the surf. Eleanor Makida, one of our

“Grandmother Earths” was known to all at Kona Village as “Auntie Eleanor” from her years of conducting Hawaiian crafts and music programs there. She helped calm the children with her soothing presence. We shot all day, varying the composition of the group, rotating out grandmothers, babies and children as they became fatigued, hoping for a break in the overcast so we could get some decent lighting. After the lunch break, I gave all the models T-shirts I had made showing a picture of Saturn and the words “Cassini Message Photo Team”.

The following day we prepared to head down to Makalawena. At the top of the road we received a disturbing report from the caretaker of the beach. Heavy swells were coming in threatening to wash out part of the road. Kiko's heavy canoe trailer might get stuck on the road and block it. “Mac, today it's your turn” I said. A disappointed and tired Kiko took his canoe home. Should the rest of us risk it? There were worse places to be stranded, if the road became impassable. We made the decision that to go on as planned.

We bounced down the rough road to Makalawena and set up camp for those models who chose to spend the night there. By the following morning the clouds had cleared and the day was perfect. Miles and his team drove up and down the rocky road, ferrying models from a meeting point in the nearby town of Kailua-Kona. These models included a very shy and very black teenage boy named Marcus, a last minute addition to the group, who knew nobody there, but quickly was adopted into what already felt like a family, our own microcosm of the larger human family. But two key models were missing: Diana and her infant daughter Tatiana. Miles headed out to look for them. As Diana had started driving early that morning to the rendezvous point, her car had broken down. She was so dedicated to the project that she had abandoned her vehicle and hitchhiked with her baby to as close as she could get to the top jeep road. Then she started walking carrying Tatiana in the hot morning sun, hoping that somebody would come looking for her. That's where Miles found her and brought her down.

We began shooting, calling the various groups in turn. Stretch and Terry, two of our male “walkers”, played chess while waiting to rotate in. Teenage model and veteran baby-sitter Lea kept Sara and Nicholas where they should be in shot after shot. (She is posed behind the twins in the final shot we selected). One of our Grandmother Earths, Fanny Au Hoy, kept the older children happy by leading them in Christmas carols while Simon checked his light and camera angles in the intervals between shots. (I wish I could report that in the spirit of the endeavor the group also sang songs from the Jewish and Hindu winter festivals of Hanukkah and Diwali, but the truth is it was Christmas carols only).

Another of our Grandmother Earths, Joanne Sterling, who had the rare honor of having been another *Hokule'a* crew member, used her free time to search for

rare Hawaiian herbs in the rough lava fields near the beach. During the afternoon infant Tatiana was bitten by some venomous bug and, after being attended by Dr. Bob, sat out the rest of the shoot. Infant Breanna had to represent the infants of Earth in all the remaining shots, and she did this superbly, blissfully nursing in mother Nancy's arms without a murmur. Our walking couple strolled hand in hand in the background, back and forth along the beach. Mac pushed his canoe in and out of the surf all day long.

Late in the day, as the low Sun angle turned the light to gold, a group of models took their positions. Jack Terry, one of the men in this group, was off taking a call on his cell phone. "We're losing the light" Simon called. "Miles, get in here," several people said. Miles had not been one of the models but took Jack's place for a couple of shots. As it happens, it was the one we finally selected as the best of the hundreds Simon had shot. Miles is the smiling, bearded man on the right, bound like the others to have his likeness engraved on a diamond crystal and placed aboard a spacecraft bound for Saturn's moon Titan. There it will rest for many thousands of millennia, perhaps to the end of the solar system, guarded by the permanence of its imperishable diamond medium.

Or so it was planned. The photograph was taken, but the diamond was never inscribed with its message.

The Portrait of Humanity foundered even before leaving the Earth. First differences arose between Carolyn Porco (the Cassini liaison scientist) and I over the issues of who had the right to complete the project, determine its final contents, and receive credit for it. Meanwhile, NASA was growing increasingly nervous about the fact that the funding for this project had come from Fuji-Xerox, a Japanese company, who in return for their money expected -- and had been promised -- to have their corporate logo placed somewhere on the diamond. NASA had at first acquiesced to this, but later changed its mind.

The Cassini project referred the both these matters to NASA Headquarters in Washington, who observed unfolding events with lofty composure, saying nothing and doing nothing, until they decided to cancel the project entirely, announcing in a one-line letter that *Cassini* would not carry the diamond.

It may have been the right decision on NASA's part. By descending into conflicts about credit, money, and corporate logos, the message project may have lost its purity of motive and, in some sense, its right to fly.

If I have any regret it is that the image of the human family, serene and harmonious on its beautiful planet, did not make its trip. The Portrait of Humanity that Simon Bell photographed could not have represented us better. It deserved its berth on a craft bound for the ocean of space. But it stayed on the beach.

## WHO ELSE SPEAKS FOR EARTH?

The "Deep Time" message projects I have been fortunate enough to work on have attracted great popular interest. The notion of sending a message across space or time is something everyone can understand. Even first graders grasp the concept easily and offer creative suggestions of what such messages might contain. The idea of time capsules dates back at least a century, when objects representing a certain time and place have been deposited for future times. Most of the contents of these time capsules have been a random assortment of printed materials and objects from the culture. The idea that such capsules might be intentional messages, complete with their own means of being decoded is a newer concept that had its origins in the searches for extraterrestrial intelligence. We learned in the research for *Visions of Mars* that the early radio pioneers speculated on how intelligent radio signals might be constructed to establish communication between earth and Mars. These ideas were elaborated into the modern SETI efforts. The Pioneer plaque, Voyager Record and *Cassini* diamond showed that artifacts could carry the same kind of messages. The WIPP nuclear waste marker and *Visions of Mars* CD ROM showed that the same principles could be applied to communicating with humans of the distant future.

With these as precedents, it is natural that others have been inspired to attempt to speak for Earth. In fact, Earth has been unintentionally announcing her presence ever since the dawn of the broadcast communications era. All broadcast television, FM radio and radar signals produced on Earth leak out of our atmosphere and continue on to the stars. In that sense, Earth has been speaking to the rest of the Universe ever since the first radio and television broadcasts, a sobering thought when one considers the contents. Fortunately, this expanding sphere of advertising jingles, soap operas, and war news loses coherence very quickly. The carrier waves travel many light years, announcing our technology, but they carry no decipherable content.

Deliberate beacons, on the other hand, more suitable for carrying information between the stars, consist of narrow-band signals directed in a particular direction in the sky. SETI looks for this type of broadcast, sent out to attract the attention of whoever is listening. If we were to transmit a message intended for other than human ears, the signals would be of that sort as well.

In 1974, Frank Drake had devised a short message sent out from the world's largest radio telescope in Arecibo, Puerto Rico. He sent a string of binary ones and zeroes that could be reassembled into a crude diagram of the solar system and human beings. Drake's "Arecibo message" demonstrated the feasibility of interstellar radio messages. But, by common

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agreement among the world's radio astronomy community, no other messages have been sent since.

However, there have been a few attempts. A few years ago the Sci-Fi Channel, a cable television company, sent a letter to the Australia Telescope National Facility (ATNF) requesting their cooperation in an unusual project. They wanted to broadcast a large number of email messages, to be collected on the Sci-Fi Channels Internet site, as a "digital time capsule" to announce Earth's presence to the Universe. Ray Norris, the Director of the facility responded:

Thanks for your note, which [has been] forwarded to me, requesting use of our facilities to send an announcement of humankind's presence to other civilizations. I regret that the ATNF has no transmitters, as all our research is done using passive (listening) equipment, and so we cannot help you.

However, I would like to discourage you from attempting to send such a message, and my guess is that other institutions will do likewise. You should be aware that you are likely to encounter substantial criticism in your endeavor, as it has been agreed by all relevant groups that we should \*not\* be actively sending out messages to try to reach other civilizations. Indeed, the last such attempt was in the early 60's at Arecibo. The storm of protest which followed this has discouraged other responsible groups from attempting any such experiment.

The argument is that, by sending out such a signal, you \*may\* be exposing the Earth to risk in some way. Although everybody agrees that the chance of this is tiny, it is argued that, as a matter of ethical principle, no small group of individuals should take it upon themselves to expose the earth to a risk without the consent of humanity (as represented by some body such as the UN). Although it can be argued that a great deal of electromagnetic radiation already routinely leaves the Earth, from TV stations, radar, etc., this is undirected, with a broad transmission beam, and so has a much smaller range than a directed transmission, beamed tightly towards a "likely" star. Furthermore, TV transmissions etc. have the implicit consent of humanity (since all nations operate such equipment). Therefore, using a large antenna to transmit a signal out to other solar-type stars does indeed, in principle, expose us to risk.

So, I would urge you to consider your position as a responsible corporate citizen, and consider the ethical aspects of what you are proposing, before you venture any further with this proposal.

For more information on these issues, I suggest you visit the WWW page of the SETI Institute on <http://www.seti-inst.edu/> In particular, you will find a discussion paper, which raises some of the ethical questions involved, on <http://www.seti-inst.edu/iaa-position-paper.html>.

Regards,

Ray Norris

CSIRO Australia Telescope National Facility

The international community of radio astronomers is generally opposed to such attempts, and has taken the precaution of drafting statements governing messages broadcast from Earth. There are two documents often referred to as "protocols. One addresses the procedure for replying to any alien signal that our SETI programs detect. It is called the "Declaration of Principles Concerning Activities Following the Detection of Extraterrestrial Intelligence"

The full text of this protocol can be seen on the Internet at <http://www.seti.org/post-detection.html>). The essence of this is that no individuals or radio astronomy facility should take it upon themselves to reply to a message without the sanction of various international scientific organizations. Most entities world wide conducting SETI have endorsed this, and even those who have not would most likely follow the general guidelines if a detection should occur.

The case of Earthlings initiating radio transmission, or creating radio beacons to announce Earth's presence on galactic radio is the subject of another document entitled "A Decision Process For Examining the Possibility of Sending Communications to Extraterrestrial Civilizations", which can be also viewed on the Internet at <http://www.seti.org/iaa-position-paper.html>).

The main idea is similar to the protocol regarding replies. The argument is that speaking for Earth is not something that should be done by a single person or group without approval by the rest of the world scientific community. This document, which applies to radio signals, not artifacts on spacecraft, is not currently in force in any formal way. It is a merely a Position Paper of the International Academy of Astronautics. This open document is a proposal to begin serious international consultation on the question of future attempts to deliberately transmit signals from Earth to extraterrestrial civilizations. It was prepared over a number of years in the SETI Committee of the

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IAA by a special subcommittee under the leadership of Michael Michaud. It has been endorsed by the Board of Trustees of the Academy, which decided to make it a formal Academy Position Paper. It has also been endorsed by the Board of Directors of the International Institute of Space Law. Both organizations consider that the questions raised in the document are of sufficient import to warrant sending it to many nations with a request that they consider bringing it to the attention of the Committee of the Peaceful Uses of Outer Space of the United Nations, for further study, and possible action, on behalf of all humankind. In September, 1996, the document was sent by the Academy to the Foreign Ministers of the sixty-three nations which make up this UN committee. The response process is still underway.

Tom Pierson is the Executive Director of the SETI Institute, an organization in Mountainview, California that was founded after NASA had canceled its own searches for alien radio signals. The founders were Frank Drake and other members of the NASA search group. Using private funds, they have continued the work of the NASA project under the name Project Phoenix. Tom sent me the information about the documents cited above, and it is at the Institute's web site that the full protocols may be read.

The reason I had contacted Tom about this was the PBS network also had the idea of sending an actual interstellar radio transmission as part of their documentary program about life in space. They had approached a friend of mine, the Director of a radio telescope in California, for permission, and he had asked me for my opinion. I referred the question to Tom, who added to his message containing these documents:

Now, having provided to you all the formal stuff, let me respond with my opinion. This is a bad idea to construct a signal as part of a TV show. It will inevitably be viewed as a stunt, and one that will not bring positive acclaim to the SETI enterprise. It will much more likely have at least the negative consequences you describe, and possibly more. You ask is there a "legal" reason not to proceed. I think that the Position Paper status of the IAA document does not establish a legal basis not to participate. It does provide guidance from the IAA and the IISL. You also ask what would be the SETI Institute's position on such a request: We would not participate. It is a stunt, with little scientific rationale. Perhaps some day humankind will be ready to step up to the plate and pay the price for admission to the galactic communication club (i.e. set up a beacon of our own), but a one time stunt for TV's sake doesn't qualify as good science,

and therefore the SETI Institute would not participate if asked.

I agree completely with this position, not only for the reasons he states, but because I don't think the Sci-Fi Channels or even PBS should be trusted to speak for Earth. That must sound amazingly arrogant, since I feel I was entitled to so speak. It's not the messenger that bothers me. It's the message. A message consisting of written email in any Earth language is as pointless a message as the slides showing the names of the Congressional Committees that we were forced to include on Voyager as a political expedient. Those images annoy me because they are an utterly meaningless inclusion, which cannot possibly add to the message. They merely introduce noise into the system.

A message from Earth should at the very least be a well thought out attempt to establish communication with an extraterrestrial intelligence. The problems associated with that attempt must be solved brilliantly, or at least addressed head-on, not completely ignored. Messages like those proposed by the Sci-Fi Channel are just a form of cosmic graffiti that will be unintelligible to any recipient. I don't know what the contents of the PBS message would have been. Perhaps it would have been a brilliantly conceived and carefully-constructed self-extracting anti-coded message. Perhaps not. But who would have the power to set guidelines or standards for such a message? Whatever the content of an interstellar message, at least the form should show some understanding of the issues of communication we addressed in the Voyager Record.

Radio messages travel at the speed of light. Physical artifacts are a different story. For a message attached to any present-day spacecraft, the interstellar travel time is so long, that any peril associated with detection could not possibly be a problem for millions of years. Before then both *Voyager* spacecraft will be so close that any aliens who find them will be in Earth's back yard already.

People inspired by the *Voyager* and *Pioneer* messages have begun proposing their own artifacts. In 1995, Carl Sagan forwarded a proposal to me, with a request for my advice, saying, "I dislike the commercial aspect but wonder if the idea is nevertheless worthwhile." A lawyer from Washington wanted to sell space on lightweight magnesium plates, which he imagined could be engraved with microfiche copies of personal messages from people of Earth, to be launched on a spacecraft leaving the solar system built expressly to carry the messages. The project, it was argued, would allow

....anyone who chooses to contribute a document, image, or sound to be engraved" [and therefore] give millions of people the opportunity to contribute some record of

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their own accomplishments, hopes, or prayers to a craft that would survive forever and would travel among the stars.

He goes on to suggest that the contents of these engraved plates could be

... a child's birth certificate, a marriage license, a diploma or award, a love letter, a poem or a prayer, a photograph or drawing, or any other momento..... *lawyers may preserve copies of their favorite briefs*" .  
(italics mine)

What an idea! Send legal briefs to the stars. It would no doubt appeal to these who required the inclusion of the list of Congressional names on the Voyager Record. (But there would also be room, it is claimed, for great religious texts and works of literature and art.)

Why am I opposed to opening up the process and allowing everyone to have their say as the Washington lawyer and the Sci-Fi Channel propose?

First, I worry about the content. Let me list just a few of the kinds of "messages", written and otherwise, that some people could find objectionable, if not downright illegal. Readers are invited to consider where they would draw the line in such free-for-all messages:

Capitalism is wonderful!

Communism is wonderful!

They should never have let foreign teams have major league baseball franchises.

Square dancers are the best people !

Caucasians are the best people!

The Holocaust never happened.

Jesus Christ was the greatest person who ever lived.

Stalin was the greatest person who ever lived.

Charlie Manson was the greatest person who ever lived.

A low-down dirty bastard named John Doe owes me \$2000 and that son-of-a-bitch better pay me or I'll kill him.

And so on. Issues are raised of free speech, hate speech, libel, pornography, and liability that would be

very thorny to navigate, and I for one would not want to launch *any* of the above messages into the galaxy. Who reviews the design for content?

And even if everybody's message was simply some good-natured version of a short resume and/or family history, it still seems to me somehow wrong. The Voyager Record tries to speak for humanity as one species, on behalf on the entire species, not as a myriad of isolated individuals and messages, but as one unified and coherent message. We resisted the impulse to take advantage of the opportunity and create some purely personal and private message. We tried to speak for Earth, not for ourselves. Appropriately so.

Most significantly, there is a world of difference between a memorial and a message. Messages must be designed to be read and understood, and for a different species this entails attempting to define certain things from first principles or to make some explicit attempt to design message that could be decoded by an alien intelligence. Could birth certificates and legal briefs be anything other than white noise, meaningless patterns? There's something horribly inelegant about sending an unreadable message to the stars. It divides rather than unifies. Particularly telling is a statement in one proposal that

... there will be others who fear the end of the millennium who see [the message project] as a chance to preserve some shred of their lives.

This is a sad motivation for creating a message—the fear that our species has no future and the only way to be remembered is on a high-tech tombstone in space.

However, the free-for-all, or grass roots, notion appears to have won the day. The *Cassini* spacecraft, launched in October 1997, does not carry our diamond, but it does contain another artifact, though I hesitate to call it a message. Perhaps inspired by the Planetary Society's inclusion of the names of its members on the MAPEX chip, NASA invited anyone put their name on a CD ROM that would go on the spacecraft. Just send in a postcard with your signature and we will send it into space, NASA announced. Touted as a way of involving the general public in planetary exploration, this harmless and well-intentioned project received so much world wide attention that the *Cassini* mission asked The Planetary Society's help in managing the huge task of indexing, filing, and scanning all the postcards people sent in. As a message for extraterrestrials, it is hard to think of anything more impossible for an alien intelligence to understand than a collection of signatures. Even we humans have trouble reading each others' signatures in the majority of cases. It would have been much simpler for NASA to scan the telephone books of all the major US cities and include those names. Why

not? There was no merit at all attached to having your name aboard. At least the Planetary Society members had shown their support of the space program, so in some sense they had earned the right to have their names attached (and that was aboard an artifact destined for other humans, who would be able to understand what the names represented.)

But the *Cassini* signature CD was entirely a promotional stunt, and one without any value that I can discern. I doubt it generated any greater interest in the exploration of Saturn or any wider support for planetary exploration in general. The Voyager Record team realized that we were not only making a message from Earth, we were making a message to Earth. We were demonstrating that our civilization had evolved to the point where we could send spacecraft out to the stars, and that we were interested in establishing communication with others who might be living out there.

The Cassini signature CD is a message only to Earth, and what does the message say? That we are interested only in ourselves, in the puny ego trip of carving our name on the spacecraft, much as tourists of earlier days chiseled their names on the California sequoias or on the megaliths at Stonehenge. Today we deplore this, but is the signature CD any less tacky?

Such is the nature of the curious times that NASA has opted out of the real message business and prefers the promotional stunt. In mid-1998 they announced that they were making another signature CD ROM, this one to be attached to the Mars Polar Lander. At the time of this writing, they had already signed up half of the million names they had room for. On the other hand, NASA has declined an offer to carry the *Visions of Mars* CD ROM. Their lawyers were worried about carrying materials that were held in copyright by others, even though the Planetary Society has signed releases from all copyright holders giving permission, and even though there had never been any legal problems with the hundreds of copyrighted materials on the Voyager Record. But in these litigious times, the lawyers at NASA decide what messages best speak for Earth. Read over the chapter in this book "A Gift for Mars", and imagine yourself a human colonist on Mars a few centuries from now. You find an old spacecraft. It contains a CD ROM. Which CD would you rather it be?

If signatures lack merit, what other kinds of contents would be suitable for artifacts destined for an extraterrestrial audience? What about including a dot of crystallized DNA, as a kind of scratch-and-sniff interstellar message? This is the ultimate message in a sense, where the contents are the information for regrowing the sender. This idea has its origin in the long literature about the concept of panspermia, the notion that life may be seeded between planets and solar systems by wandering spores, able to survive the long journey in deep space. The Swedish biologist Svante

Arrhenius proposed the idea in the 19th century, and it has lingered at the margins of thought about the origin of life. The discovery that meteorites traveling from Earth to Mars might bear signs of microbial life has freshened the hypothesis.

At the end of Olaf Stapledon's visionary novel *Last and First Men*, written in 1935, the 18th Men, our remote descendants living on Neptune, face extinction as the Sun nears the end of its life. In an effort to preserve something of themselves, they launch spores into the depths of space, perhaps to find nurturing soil on the shores of some distant planet. The idea has appeared many times in science fiction.

The discovery in 1996 of possible evidence of biology within a meteorite from Mars has revived interest in panspermia. Could biological materials travel between planets by natural processes? Could Mars have seeded Earth with life in the distant past by such means? If it can be done naturally, might it not be done with technology? Greg Benford in fact proposed including a sample of human DNA in one of our early discussions about the Cassini Diamond Message.

Such a message is already technically feasible. But not only does this violate the existing international protocols about sending biological materials into space, it also seemed to me to pose a very difficult ethical decision. Let us assume the DNA was someday recovered and new organisms successfully grown. Would you feel comfortable condemning some future person, perhaps in some sense your own child, to be grown in an alien laboratory, in isolation from his or her entire species, with no parents?

I wouldn't do it to a dog. It makes a fascinating premise for science fiction, but seems too hard a fate to inflict on any real descendent, however small his or her chances of being born.

Yet if I were to predict what form future interstellar messages will take, I would say that, in the long run it will be these sorts of DNA messages. They still lack radio's advantage of traveling near the speed of light. Why not dispense with the "wetware" (as computer scientist refer to biological materials) entirely and transmit the genetic information required to grow the visitor in vitro.

However, since artifacts seem to appeal to our sense of permanence more than streams of photons, future spacecraft leaving the solar system, like the proposed Pluto Fast Flyby, will undoubtedly carry some message artifacts. And they will reach the stars quite reliably, if not very swiftly.

As I write this text, I find that events have overtaken me. A private company intends to do the signature CD one better. It will send an actual piece of you to the stars, for a fee of \$50, by attaching a tiny piece of your hair on a spacecraft. The company claims that this cosmic hairball will be launched as a payload on an Ariane 5 rocket from French Guiana, on a spacecraft

that will allegedly swing around Jupiter and be flung out of the solar system. You can also attach digitized pictures and short messages. Hair from people's pets, however, will not be allowed. We wouldn't want to trivialize this message.....

In the short run, if the projects cited above are any guide, message artifacts will increasingly become a random collection of submitted material-- signatures, hair, legal briefs, whatever---with no thought given to overall message architecture or how to make the message a self-extracting file (in computer terms), that is, a message that helps you read it and understand it.

The message we made for Voyager consisted of materials that were carefully selected and organized to be self-extracting. We had themes and determined that some content was to be included and some excluded. We imposed a great deal of structure on the material, rather than let it simply speak for itself. How much better will this communicate to alien recipients than a more randomly ordered collection?

I would be happier if the randomness were an intentional design decision rather than a consequence of NASA's concern about litigation, or a private company's desire for profits. The standards for spacecraft are very high. Standards for artifacts speaking for Earth should be equally high. The message artifacts have enormous popular appeal and present great potential for education about the difficulties and rewards of trying to communicate with another species. They should be conceived with the same care NASA brings to its science and engineering.

Some formal process should be instituted to evaluate and select any artifacts to be sent out from Earth. Experts in the relevant disciplines should critique message designs and content. The teams that put the messages together should be chosen and supervised with the same care and insight that Carl Sagan and Frank Drake showed in creating the Voyager Record. Part of the reason the *Cassini* diamond message failed was that there was no proper oversight of the process.

I hope that NASA or some other scientific agency someday gets back into the serious message business. For example, suppose we do receive a message from the stars and decide to construct a reply. What properties should a message from Earth have?

Here are some I would think are acceptable to all: It should be truthful. It should be ecumenical or at least nondenominational. It should be well-crafted, elegant in both the artistic and scientific sense of that word.

Truthful sounds easy but is very hard. Everyone has a bias. On the Voyager Record we decided to put our best foot forward and avoided depicting war, poverty or disease. For various reasons I stand by this position and would probably make the same decision today. But many people criticized us for telling a half-truth, if not an outright falsification about what Earth is like.

Deliberate deception is easy to forbid. But the decision about which information to include also excludes. That is the hardest choice. My friend Mark Washburn, who viewed the email exchange that marked the demise of the Cassini diamond project, quipped that we should send those emails on the diamond instead of the Portrait of Humanity, as being a more accurate representation of what humans were really like. There is a fine line between putting your best foot forward and outright hypocrisy. Does Mozart or Auschwitz best describe who we are? Perhaps this decision is best made in good faith by one group and judged in good faith by another.

Nondenominational is a little easier, but only a little. The message can't come from Mecca, the Vatican, or the US Congress. It must avoid endorsing any particular religion, philosophy or ideology. Again, this sounds easier than it is. Isn't belief in the scientific method a kind of ideology? Is a message that implicitly extols our scientific accomplishments but excludes our spiritual beliefs nondenominational?

Elegant. You know it when you see it, and when you do not. I find the trend away from the well-crafted message of Voyager to the signature CD ROMs extremely inelegant. These artifacts, it will be argued, are not intended as messages, but they will inevitably be confused in the public mind with messages. We put a record on *Voyager* and a CD on *Cassini*. Must be the same thing, right? But I can't think of a worse design for a message than an unorganized collection of written messages. Let's ignore the fact that a CD ROM is a terrible message carrier because no alien technology, no matter how advanced, could decode it. Unlike an analog record or engraved plaque, text and picture files can never be read without the correct software, which is impossible to reconstruct from first principles, even by a very smart ET. But even if it could be read, what would ETI make of a species so dumb they created an artifact without any attempt to make it a comprehensible, self-extracting, anti-coded, triply redundant, graduated content message? That our message was page after page of meaningless scribble? ETI could possibly conclude that we were interested only in speaking to ourselves.

Designing an interstellar message is a challenge that is both awesome and fun. Having made several such messages myself, I would love to see what messages others could devise. These projects are not simply sterile exercises, but good practice for the day when we have a message from somebody else that needs answering. We should have some model in mind. These free-for-all signature CD ROMs muddy the waters about what a message must be like, in exactly the same way that almond-eyed humanoid UFO aliens muddy the image of what real ETs might be like. It doesn't bother me that these messages are private and uncensored. It bothers me that they are so badly designed. Written notes in English are an annoyingly stupid way to present our civilization.



That is the error of the grass-roots message. Very naive messages get made by people who have not thought very hard about how utterly distinct species -- or even humans from widely separated epochs -- could say something understandable to each other.

The group that created the Voyager Record was successful because it was interdisciplinary (scientists, artists, writers, and musicians). Carl Sagan and Frank Drake deserve the credit for that. They could have kept it entirely the province of astronomers but chose not to. Our team made an honest attempt to rise above its own cultural biases and create message that represented all of Earth. How well we did that has been argued, but no one has disputed that we at least tried.

A single incident serves to illustrate the difficulty of creating a message that represents Earth when involving an organization like the United Nations. For the Voyager sequence of greetings in spoken languages -- intended to suggest the variety of spoken tongues on Earth -- we asked the UN to supply us with a very short "hello" from each delegate to the General Assembly. What we got back from the UN was a few long, utterly inappropriate speeches by the members of the Committee on Outer Space. We had to create the greetings sequence ourselves, recorded by speakers from the ethnically diverse Cornell University community.

There is a problem with messages made by large bureaucracies like the UN. They just don't get it. People accustomed to issuing noncommittal press releases reduce all messages to bland pap. Large governmental and scientific bureaucracies would certainly have to approve the message after it was made, but no such cumbersome organization could create a good message itself -- unless it farmed the message out to its own small group of specialists.

In 1991, when Sandia Labs had to design a 10,000-year nuclear waste warning marker for the U.S. Department of Energy, they organized things in a way analogous to the Voyager record. They convened a small panel of interdisciplinary experts in fields including geology, materials science, archaeology, linguistics, cognitive psychology, architecture, and graphic design (and including 4 SETI veterans-- me, Frank Drake, Woody Sullivan, and Ben Finney) and had us analyze the problem and create a design for a warning marker, meant to be comprehensible to all humans for the next 10,000 years, whatever their language, culture, or technological level.

The fact that a small group was ultimately responsible for both the Record and the waste marker allowed there to be a vitality and coherence in the design that would have been much harder to achieve in any larger working group with multiple layers of review and approval.

It would be better to entrust the task of speaking for Earth to various small groups, let them create the messages, and then have a panel of "experts"

decide which is the best. It will be a tough job figuring out who to place on that panel, but let's say for starters, eminent people in the creative arts, physical and social sciences, cryptography and language theory, religion (better to have them review a message than to make one) and, I suppose, international security and defense. This would, in my opinion, be better than trying to have hundreds people in many separate organizations try to design it together. It should be a design competition. Then it could be opened up widely to submissions from individual artists, universities, corporations, and ad hoc organizations created to construct this message.

Who would eventually make the best message? Who would best speak for Earth? My guess would be an interdisciplinary mix of creative people with backgrounds in a wide variety of fields, from semiotics to software design, from visual arts and music to game theory and particle physics. We do not know what the universal touchstones will be (maybe an incoming message will give some good clues). Whatever group speaks for Earth should touch as many bases of the human repertoire as possible

But the outgoing message should pool our particular cognitive and creative styles into a harmonious whole. How is this to be done? I think you will recognize it when you see it. I would like any message from my planet to be as rich in content and as clever in form as any great work of art. Lewis Thomas, in his book of essays *Lives of a Cell*, suggested Bach as our first ambassador to space. I agreed with Thomas before I had ever read that comment, when I lobbied for three Bach pieces on Voyager. Whenever I hear the Glenn Gould prelude and fugue, or the strains of that deceptively simple gavotte en rondeau for violin, I imagine They, whoever and whenever They are-- listening to it, and I wonder whether They will enjoy it as much as we do. Any message we send out from our planet and our century is a work of art, and it should be made using the great art of humanity as its model.

It would show that, whatever our many failings, we are a species worth a reply.

Opinions expressed in this essay are those of the author and do not necessarily reflect the views of *Contact in Context* or *The SETI League*.

**PORTRAIT OF HUMANITY ILLUSTRATIONS**

(Photographer: Simon M. Bell, ThirdSpace, <http://simonbellphotography.com/>)

**Figure 1.** The final Portrait of Humanity, taken in Hawaii.



Figure 2. Pencil sketch of the group photo concept.

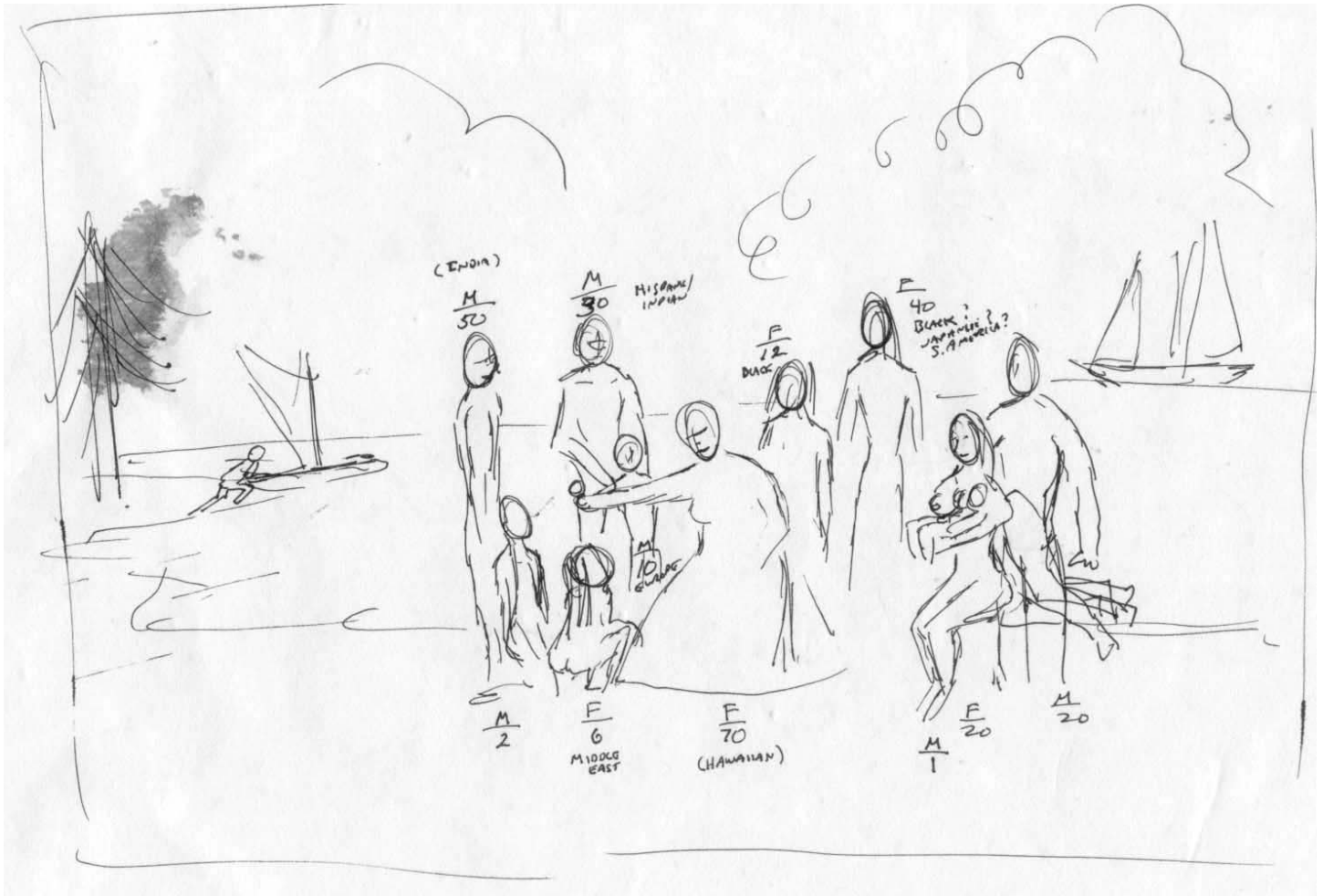


Figure 3. Toronto test shot (Lake Ontario beach)



Figure 4. Posing considered along the way to the final photograph.

