

Fulldome Production using 3D Animation Tools at Home Run Pictures

BACKGROUND: Home Run Pictures has been involved in creating content for over 10 years to varied clients worldwide. The company's past successes have come in part from the attitude of always looking for the next challenge with passion. Although we have not been a large studio in size, that attitude has put us many times at the forefront of new trends and new technologies.

Our past experience has garnered involvement with a wide variety of media outlets... from animated films and television programming to scientific visualization and interactive applications. We have created animation for Discovery Channel, National Geographic, PBS, General Motors, and NASA.

CHALLENGE: Five years ago we were approached by a company that was developing projection tools to completely fill a traditional planetarium dome with a seamless video image... they had the projection system, but no content. The challenge was just what we were looking for and we slowly begin solving the technical and creative problems we faced with the new format. Our 3D animation toolset seemed well suited to address the problems we were facing.

Currently, we are one of few animation producers creating for these new fulldome video projection formats. Most systems uses multiple HD video projectors to create a seamless image over the entire surface of a traditional planetarium dome. Other systems incorporate a single fish-eye style projector to achieve the same imagery experience at a lower resolution. The result is an immersive experience that is captivating, practically transporting the audience into the scene with the ability to look all around at the 360x180 degree view.

DESIGN: The creative challenges of creating for the format are many... traditional film-making rules do not always apply. To effectively tell a story in a way that audiences have learned from experience with motion pictures and television, it is necessary to address the audience's frameless "free" viewing of the scene and come up with ways to direct their view to communicate important storyline events. And the dome must not be treated like a circle shaped viewport or the potential of the 360x180 degree immersive environment is lost... and the dramatic view becomes tiresome.

PRODUCTION: There also was the need to develop new proprietary software tools to deal with creating in the fulldome format... off the shelf tools, even those used to create today's motion picture special effects are not designed to deal with the immersive views created by the overlapping projection setup. Color and contrast control in a spherical environment where the image reflects onto itself had to be overcome. And previewing scenes intended for display on a full dome on two dimensional computer screens established the need to rethink the animation approval processes.

Following are several case histories of projects we have worked on recently with sample imagery and short descriptions of the creative and technical challenges each entailed.



Home Run Pictures has an extensive web page where sample imagery from past work is showcased on an ongoing basis. Check out <http://www.hrpictures.com> to see a variety of case histories in all the areas of animation production including fulldome work.

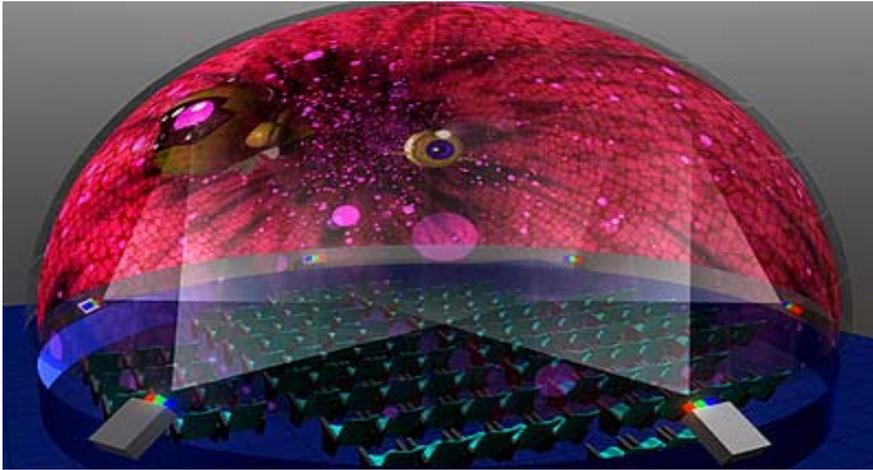
What's in the Siggraph demo....

The demo is a collection of various all-dome content we have produced over the past several years. Some sequences are shown as complete scenes and clips from longer works are shown to give you an idea of the overall content.

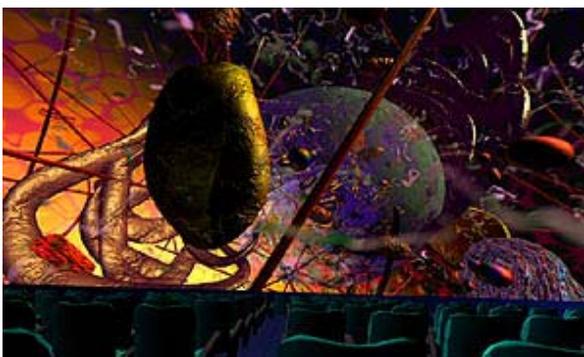
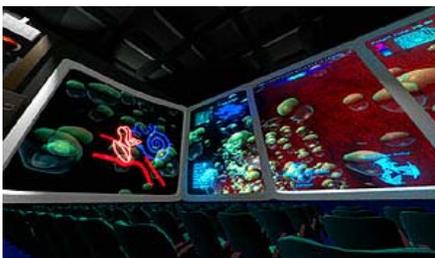
Fulldome Demo Listing:

- + Titanic
- + "Microcosm: The Adventure Within"
- + Big Bang
- + Wild Ride - Canyon/Thunderstorm
- + Dinosaurs
- + Cave Paintings/Mammoths

Fulldome Production of "Microcosm: The Adventure Within"

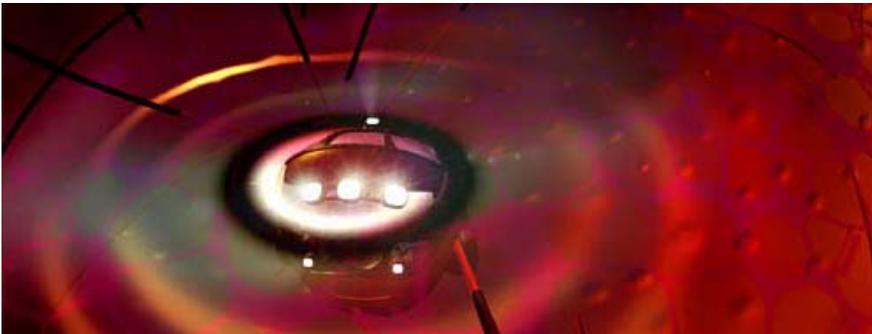
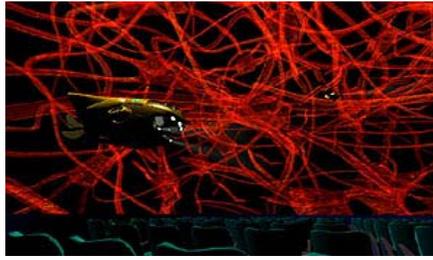
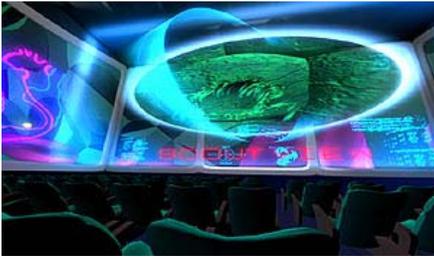


"Microcosm: The Adventure Within" is an immersive presentation employing a full-dome projection format... utilizing multiple video projectors to completely fill a planetarium style dome with imagery... resulting in the audience being immersed in our sci-fi styled story where a miniaturized sub, Alpha, is injected into a patient to seek out a stubborn infection and combat the nasty virus. The format allows the audience to go with the sub's crew and its humorous artificial intelligent-ROV, Scout, into the human body like never before... no longer looking at a traditional screen's "framed" view, but able to look left, right, up... all around as if they were actually sitting in the environment created by the dome's surface... imagine the excitement of riding along on the trip... the imagery projected on a 60+ foot 360x180 degree screen complete with surround sound audio effects.



As previously mentioned in the introduction, the creative challenges of creating for the format are many. To effectively tell a story in a way that audiences have learned from experience with motion pictures and television, it is necessary to address the audience's frameless "free" viewing of the scene and come up with ways to direct their view to communicate important storyline events. Our storyline required that we present the program in an edited scene to scene, multi-camera viewpoint. This would involve cuts and transitions, sometimes in quick succession, in the full-dome environment. The "frameless" view presented a problem for this style of storytelling... would the audience be able to follow the story without visual confusion.

Relying on skills from traditional "framed" animation work, we were able to expand the principles to the full-dome environment through tests and motion testing to achieve a new set of film-making rules. Our story would bring the audience into the human body in ways that the full-dome environment was best at. Since you are continually inside some variety of sphere or cylinder, the immersive view was a perfect fit for the subject. During the program, the audience



follows along as the little sub's crew explores arteries, the inner ear, the eye, the heart, the workings of a living cell, and even an attack by virus invaders.

New tools were developed to handle the full 360x180 degree image creation... problems inherent in the available software applications were discovered early on. Creation of full-dome masters required the stitching together of multiple camera rendered views, an atypical requirement that software designers have ignored in their attempt to create faster tools. What lies outside the rendered frame is generally considered superficial until you begin to butt images up to one another and discover that sampling and clipping issues do not allow for a seamless match across the dome's surface. Color and contrast control in a spherical environment where the image reflects onto itself had to be overcome as well. And the management of the massive amounts of rendering and finishing required, while still maintaining creative quality, prompted the development of a specialized production pipeline.

The end result is an immersive environment that is quite dramatic for the viewer. Starting with the traditional planetarium dome configuration... video projectors are positioned around the base of the dome... These hi-definition projectors are specifically modified to project a properly focused and "vignetted" image on a section of the dome's interior surface... By overlapping the projected areas, the seamless image is created. These new projection systems further open up possibilities beyond the traditional planetarium realm and are just beginning to be realized.

Home Run Pictures president Tom Casey produced and directed for the production along with lead animators Desiree Roy and Tom Nypaver handling the bulk of the animation effort. Animator Gerry Wagner contributed by creating various display graphics and models. Software tools used varied, but Alias/Wavefront Maya and PowerAnimator were the main animation applications. A network of SGI unix workstations, PC's and Macs were employed. Approximately eight months of rendering on a 12 processor render farm was needed to finish the 15 minute program. Data storage for the finished program and intermediate layered elements was near two TeraBytes and secured against failure by a RAID5 disk array.

Production of "The Night of the Titanic" in Fulldome



"The Night of the Titanic" is an immersive presentation employing the full-dome projection format... utilizing multiple video projectors to completely fill a planetarium style dome with seamless imagery... the audience is treated to a "you are there" style drama, just as if they were one of the survivors in the Titanic's few lifeboats... the immersive all-dome view no longer limits the viewer to looking at a traditional screen's "framed" view, but enables you to look left, right, up... all around at the imagery created by the dome's 360x180 degree surface.

In one scene, the audience is transported two miles down to the bottom of the ocean where the wreck of the Titanic now sits... the viewer is immersed in the cold, secluded underwater environment... only the handful of people who have gone down in the few submersibles that can dive this deep have had the experience of seeing the Titanic where she now rests... in a full-dome theater, it's just like you are there... as the popular story is retold, the audience is given panoramic views of the last two hours of the famous liner's life... just as if they were one of the few survivors seeing it from one of those lifeboats.

One issue that needed to be solved was that the viewing frame of a typical dome makes it difficult to show a scene involving a flat plane/landscape (or in this case waterscape). Some dome setups are actually tilted up to 30 degrees to avoid this problem. In the end it was discovered that the audience is able to accept a tilted image orientation as long as it is consistently presented.

Other scenes created in the full-dome format include a dramatic view of the



iceberg strike from below the water line as only an immersive full-dome projection setup could reveal... the audience can be seen craning their heads as the ship passes overhead... a true indication of the effect the environment has on the viewer. The underwater sequences were a perfect fit to the immersive feel in full-dome presentation.



The story is further told with standard video imagery vignettted into full-dome scenes... this "framed" imagery is actually the same animation sequences used by The Discovery Channel in its documentary series on the Titanic... made available to the museum through a special arrangement with Home Run Pictures who worked with Discovery to produce the broadcast series.



All the Titanic imagery is presently available should a planetarium, science center or museum at some time in the future plan an educational program on the Titanic. The night scenes feature an accurate starfield, so stories dealing with what survivors saw in the sky that night can coexist with a dome's sky projector.

There are approximately 15 minutes of Titanic imagery available, of which about 4 minutes are in all-dome format. The all-dome scenes are also available in standard format should a planetarium presently not have full-dome capability.

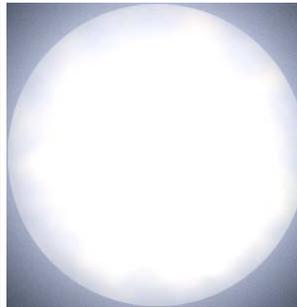
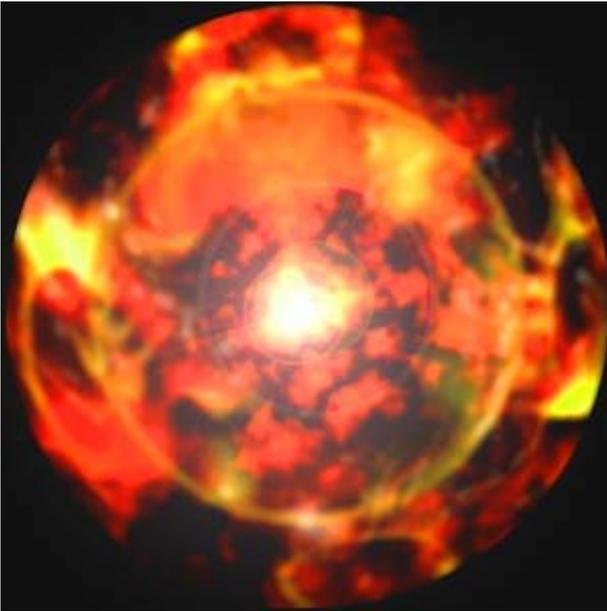


Home Run Pictures created the immersive presentation, "The Night of the Titanic" in cooperation with the Houston Museum of Natural Science's Burke Baker Planetarium. The program premiered at the planetarium on April 14, 2002, the 90th anniversary of the Titanic's sinking and has been extremely successful and well reviewed.

"Big Bang" Sequence for Fulldome Planetarium Show Use...

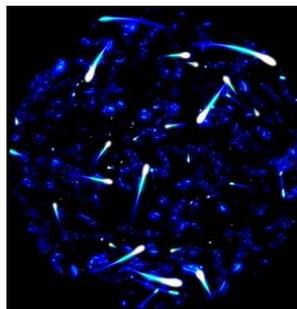
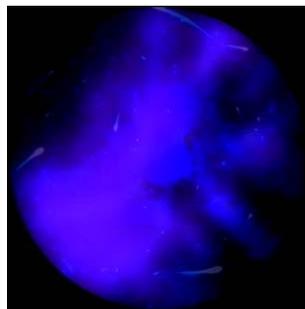
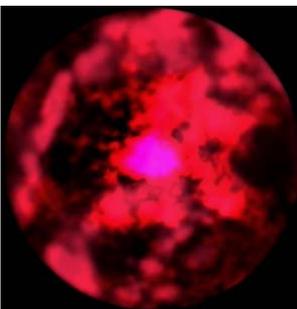


As part of their new Galileo's Legacy show, the Houston Museum of Natural Science's Burke Baker Planetarium asked Home Run Pictures to create a two minute sequence of the history of the universe from the Big Bang to present time. Nobel laureate Steven Weinberg was the consulting expert for the scientific theory. The sequence is in the new fulldome format where multiple HD video projectors are used to completely fill the dome and give the audience the feel of actually being in the scene... able to look right, left, forward, even behind for a truly immersive experience.



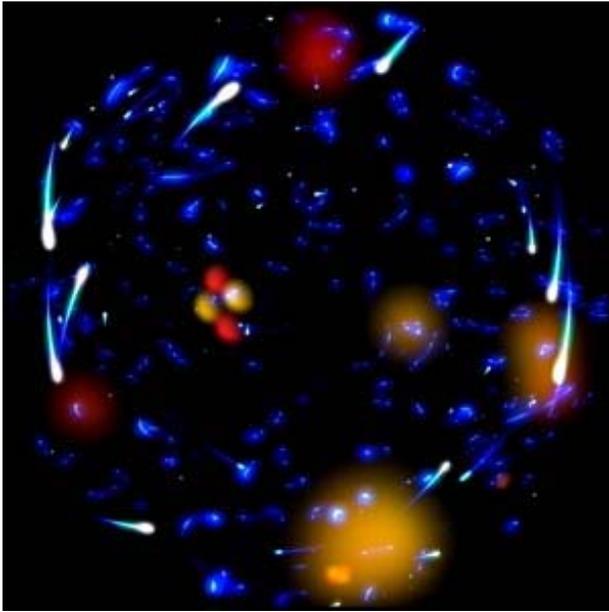
Newly developed software tools were necessary to deal with this subject-matter in the large scale imagery of the fulldome format. Creative director Tom Casey produced and directed for the production along with lead animators Desiree Roy, Tom Nypaver and Gerry Wagner handling the bulk of the animation effort.

The sequence premiered at the Houston facility in March 2003 and will be available as a separate sequence to planetariums, science centers and museums worldwide who have a fulldome projection capability. Select frames from the sequence are shown here.



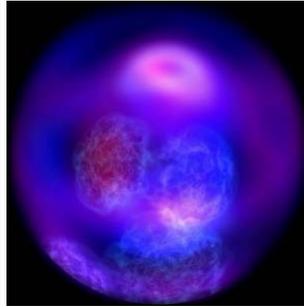
We begin with our all-dome view in black and suddenly the entire view explodes everywhere at once with hot energy... a small digital clock begins ticking off the time in very small fractions of a second...

Still less than a second on our clock (our time is greatly expanded from reality), the energy cools off to an overall blue... we see electrons and quarks zooming around us like

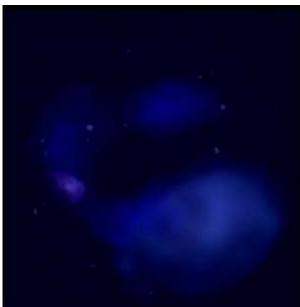
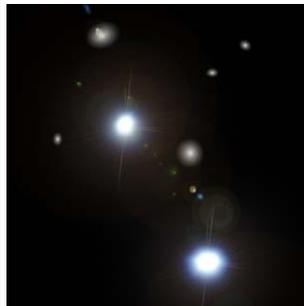
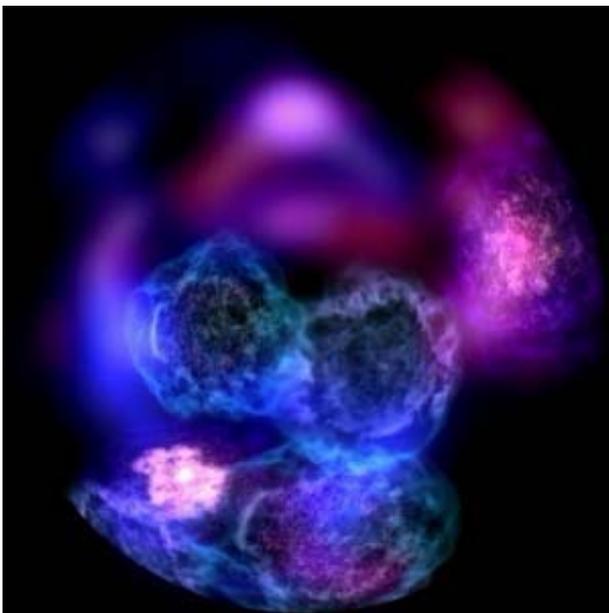


bees, some pass close by our view... as we approach 1 second of time on our clock, cooling continues and some of the particles begin to collide and clump into protons and neutrons...

As we approach 3 minutes of time on our clock, the universe continues to cool... our clock time unit begins to speed up exponentially into years of time and at around 300,000 years, atoms of hydrogen and helium begin to form and clump into cloudy collapsing masses... proto-stars begin to form and quickly explode as super novae creating heavier atoms of matter...



The clumping continues as proto-galaxies begin to form... our clock is now at 1 billion years, time is passing ever faster... one galaxy begins to form close in our front view... other galaxies begin forming off in the distance all around us... we are now close to 10 billion years from the initial explosion... the close galaxy evolves into our Milky Way and M31 can be seen as the other major spiral in the Local Group... the other galaxies all around us slowly expand/move away from our point of view... our clock is now at 15 billion years, the present day.



"Wild Ride" Canyon Sequence for HMNS Burke Baker Planetarium



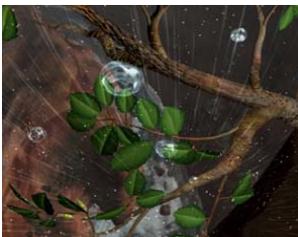
The final closing sequence in the HMNS Burke Baker Planetarium show "Earth's Wild Ride" is a fast roller coaster ride down a canyon during a torrential thunderstorm. If you would like to experience the need to grab onto your chair during an immersive full-dome show, this one's for you. The motion is designed to give the audience the thrill of flying down a canyon with a rapidly moving river just inches below their view. Near misses of lightning, falling trees, landslides, diving through tunnels, full 360 pitches and eventually a plummet over a waterfall all are part of this sequence.



The three-minute sequence took almost eight months of production time to create and the various scenes required hundreds of layers to give it a natural look. Using a combination of 3D, matte paintings and particle effects, animator Tom Nypaver and painter/modeler Gerry Wagner attempted to give the viewer a real wild ride... everything except really getting wet.



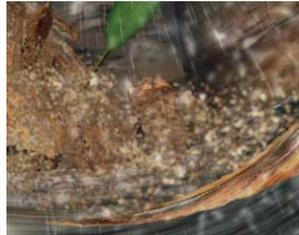
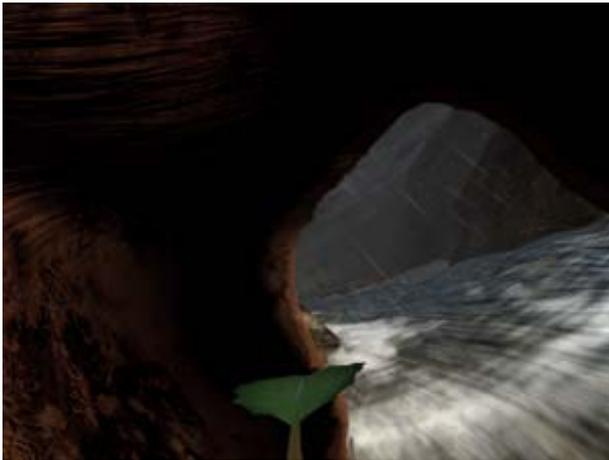
Opening with a dry desert scene, a lone hawk-like bird floats high above us. We follow the bird as our view rotates and we see an anvil-shaped thunderhead... lightning arching across the menacing dark cloud. We move towards the storm.



Faster and faster, like the first hill on a roller coaster, we descend into the cloud... water and hail strobbing in the electrically charged environment. The camera rotates down and chases a single drop as it falls rapidly toward Earth. The drop gets blown from side to side and the camera continues to correct and center the drop as we plummet.



We can begin to make out ground details and we see the beginnings of a canyon cut by a mighty river flow. Our drop is heading towards a lonely tree growing near the topside of the canyon wall. The drop hits a leaf on the tree and our view follows the leaf as it swoops and banks in the wind on a ride down the river. We ride the leaf over the rapids as the canyon walls rush past at alarming speed.



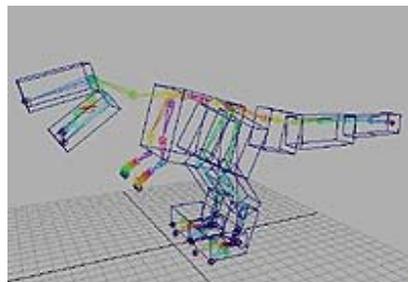
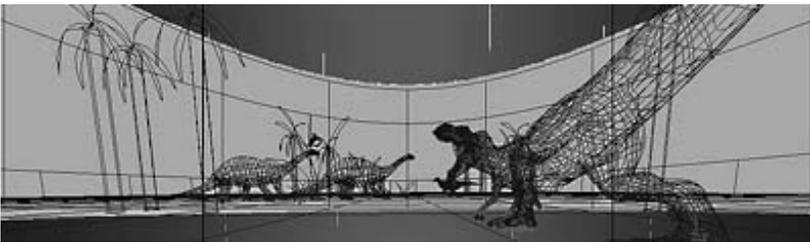
A lightning strike fells an old tree above us and it comes crashing down nearly hitting us. We dive through a tunnel-like pass and are nearly buried by a mud slide... the wind picks up our leaf and we spin 360 degrees. The roar of the wind and the water grows and we are suddenly perched high above a waterfall and begin the stomach wrenching dive down. The view fades to black as we reach the bottom.

As the scene fades up again all is calm, the sun is shining as we see a grasshopper contentedly chewing our battered leaf. We hear a screech from behind us then a fluttering noise as a bird dives out of nowhere, grabbing the grasshopper, leaving our leaf, and then slowly the bird glides up into the now clearing sky.

Several other scenes are now in production for this immersive full-dome show, including subjects ranging from dinosaurs and mammoths to volcanos and asteroid strikes.



Panorama Style Earth Theater Shows Life-sized Animated T-Rex



The new overlapping multiple projection systems now available for presenting video programs allow for filling full or partial dome screens with imagery and immersing the audience in the scene. Typically used in the latest planetarium shows, The Carnegie Museum of Natural History (Pittsburgh) decided to use the capability to create their "Earth Theater," 210 degree (partial dome) wrap-around experience, to supplement its internationally known dinosaur exhibit.

Multiple camera views are rendered and then "stitched" into a single image that is seamlessly projected with vignettted-edge projectors, creating a panorama view. Surround sound audio completes the experience... watch out for that T-rex to your right!

In order to accurately create what would end up being viewed as a life-sized version of the extinct animals... Home Run Pictures' animators created bio-mechanically correct controls to "keyframe" the motion of the T-Rex... based on current research studies.

Over a gigabyte of hand painted imagery was used to color and texture the animals in what scientists today believe may have been a possible "look" for our big friends. During the motion test phase of the project, animators placed the T-Rex in present day scenes to better comprehend the scale of these now extinct creatures.

The sequences were used in the Carnegie's premier Earth Theater show and, in audience polls, they were sited as the most popular scenes by 80% of attendees.



Future projects in the Fulldome Format...



" Apollo 11." It's a wonderful story filled with all the wonder of what can be accomplished when you try. It's full of science, engineering, and the passion of people. It has always been a perfect subject for a planetarium show... but... now with the ability to fill the entire dome with a seamless video image, it can be told like never before.



Imagine moving up through the Earth's atmosphere with the powerful Saturn 5 rocket from a viewpoint just ahead of the Apollo capsule. Watching the Moon grow larger and then looking behind you to see the Earth getting smaller. Racing over the cratered surface of the Moon as the LEM departs to descend to the surface. Seeing the LEM land as if you were an imaginary Moon inhabitant watching from a few feet away and then standing on the surface with the first two humans to walk on the Moon... all with an immersive view and the freedom to look all around at your slightest whim.



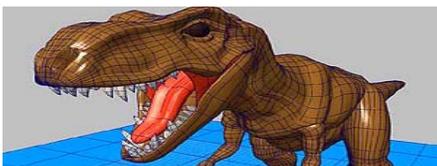
" Dinosaurs." An ever popular subject in whatever visual media that is employed. Just imagine what could be seen if you could go back in time and experience these great animals. Using the "framelessness" of the fulldome format could be the next best thing to actually being there.



Imagine standing just under the belly of a stalking Tyrannosaurus as he hides just out of sight of a herd of Hadrosaurs and then bursts out to attack. Or walking with a herd of saurapods, their long necks towering high above your view. Or moving rapidly through the low lying plant life with a small group of Velociraptors chasing a Gallimimus. Or experiencing the hatching of a baby Maisaura in its nest.



With the immersive feel of the fulldome view, this will be a remarkable experience...



H o m e R u n P i c t u r e s

Home Run Pictures has an extensive web page where all-dome immersive projects that we produce are featured as each project is completed. Please feel free to check out new postings...

<http://www.hrpictures.com>

*For further information on these projects or all-dome immersive production in general, contact: Tom Casey:
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