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### Constructing an Odyssey

The genre of science fiction is one that has persisted throughout the history of film, tracing back to Georges Méliès' *A Trip to the Moon* in 1902. While primitive by today's standards, the film was highly influential, inspiring countless successors in the genre. One of these successors is Stanley Kubrick's *2001: A Space Odyssey*, a 1968 film which is also considered to be very influential, albeit for different reasons. There are 66 years of progress between these two films, and the development of film as a whole in that time is very evident. Yet even compared to the films of its era, *2001* was still groundbreaking. The film attempted to do things that no other film had done before, and in many ways, it succeeded. One of the main ways in which it succeeded was through its use of visual effects. Visual effects are a critical component of science fiction, as they allow filmmakers to present things that are impossible to film, such as spaceships, zero-gravity, or other planets. Some of these effects are almost trivial now thanks to computer graphics, but in a time before digital editing or computer-generated imagery, creating realistic effects required filmmakers to get creative.

Any film taking place in outer space must depict space travel in some capacity, and the most common way that science fiction films do that is through spaceships. In the absence of computer modelling, the way that most films portray spacecraft is through miniature models. These models are crafted by hand, then can be filmed over a background, or over a blue screen to be composited in later. The use of miniatures in science fiction starts at the beginning with A

*Trip to the Moon*, with a model capsule landing in the eye of the moon in the film's iconic scene. *2001* was no different, using carefully crafted miniatures for the ships and stations seen throughout the film. Models were also created for the Clavius moon base and were used in shots overlooking the base as well as the scene where the ship Aries IB descends through the airlock into the base. Special effects supervisor Douglas Trumbull comments on all of these models: "The models in "2001" are probably the most precisely detailed ever constructed for a film ... Every minute facet of each model had to be perfect, so that photography would not be restricted in any way, and during shooting the cameras came relentlessly close with no loss of detail or believability" (19-20). It took months of constant work to complete the models, but the result was that each ship looked very intricate and realistic, even when compared to effects made over 50 years later. Some modern films still use miniature models, as they allow for very realistic visuals without having to build a full-scale set. Another challenge that comes with working with miniatures is what scale to make everything. Trumbull explains, "Each spacecraft was built to a scale which best suited that particular model, without any particular regard to scale relationship between models. Only the Discovery spacecraft and the pod were on the same scale, since they had to work so closely together. Very tricky calculating had to be done for the approach of the Orion spacecraft to the space station because both models couldn't be built to the same scale" (21). In a case like this, the technique of forced perspective can be used to make objects look bigger or smaller than they truly are by moving the models closer or further from the camera. A challenge that arose when filming these miniatures was keeping them in sharp focus. Using more light would break the illusion of there being a single light source, so instead they opted to film all the shots in extreme slow motion, exposing the camera for around four seconds per frame. As Kubrick noted, "if you were standing on the stage you would not see anything moving. Even the

giant space station that rotated at a good rate on the screen seemed to be standing still during the actual photography of its scenes” (Johnson 130). Although these shots took a long time to film, the final cut shows the miniatures sharply in focus, moving gracefully through space. The realism and flexibility of miniatures are what make them a staple of the science fiction genre, and *2001* was able to bring them even further by paying extra attention to detail.

Another very important part of portraying outer space is the backgrounds. Many of *2001*'s shots are backdropped by stars and planets, which have to be created and composited into the final cut. Initially, they attempted to make starry backgrounds by drilling holes through thin sheet metal, and shining lights through the holes, creating the effect of stars. However, they encountered issues with the brightness of the stars, so afterwards they instead used an animation stand (see fig. 1) with splatter-airbrushed stars.



Fig. 1. The moon being photographed on an animation stand from: Agel, Jérôme. *The Making of Kubrick's 2001*. The New American Library, 1970.

The animation stand was also used for the planets, which were transparencies shot from a larger painted artwork. Most notable among them is the Moon, which was “a series of actual astronomical glass plates produced by the Lick Observatory. These plates were used only after

nearly a year of effort at the studio to build a moon model – several attempts, in fact, by different artists, and all were unsuccessful” (Trumbull 9). While the animation stand was not the only method used to composite the backgrounds and foregrounds, it was widely used throughout the film, especially in the outer space scenes. Some shots were made solely in the animation stand, while others combine live performances with composited backgrounds, as done in the moon excavation site scene: “the [excavation site] set itself only included a small portion of terrain at one end for the astronauts to walk on, so shots that included the complete Moon terrain, stars, and Earth, were held undeveloped for nearly a year until these other elements could be completed, tested, and then exposed onto the held original negative” (Trumbull 18). Compositing together the foregrounds and backgrounds of each shot was a challenge, but the resulting shots look very realistic and convincing. Another method that was used was rear projection, a technique primarily used for the digital screens. With rear projection, a projector behind the set casts an image onto a surface, such as a screen. Then while the camera is rolling, it also captures the projections, creating the illusion of digital screens. This can be seen with each of the screens that appear throughout the film. Such effects are very easy now with computers or LED screens, but it is impressive to see how filmmakers created these seemingly simple effects in the absence of modern technology.

In the film there are a handful of scenes where actors appear to walk on walls. The first time we see this is rather early in the film, when a stewardess appears to walk up a circular wall, turning herself upside down. This effect was done by rotating the entire set, including the camera. The stewardess is always at the bottom, but as the camera rotates it gives the illusion of her turning upside down. We see this on a much greater scale midway through the film, during an incredible scene where an actor jogs around the Discovery. This shot was made possible in

the same way, thanks to another much larger rotating set (see fig. 2) that spun around as the actor ran, once again keeping him at the bottom.

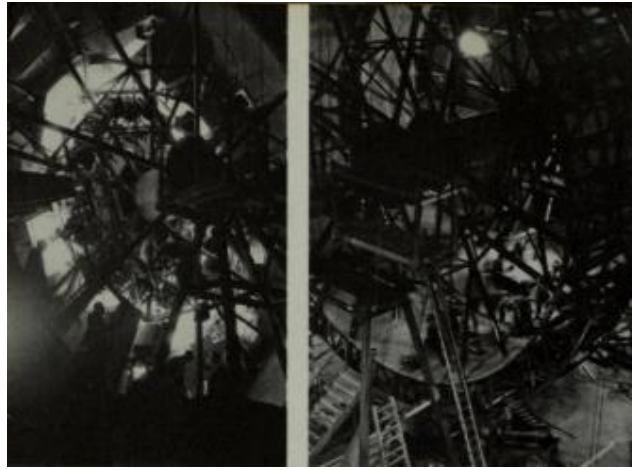


Fig. 2. Outside views of the Discovery set from: Agel, Jérôme. *The Making of Kubrick's 2001*.

The New American Library, 1970.

Kubrick himself explains the set:

Centrifuge set was constructed in a steel framework which looked very much like a ferris wheel. Set was made in such a way that it had the structural integrity to preserve itself while the frame rotated. Actor stayed at the bottom at all times. Camera was attached to set so that when set moved the camera didn't know it. It's a little bit like the relativity thing of somebody walking backwards in a train.

(Agel)

*2001* was not the first film to use a rotating set, but the scale of said set was very impressive. The centrifuge was nearly 40 feet in diameter and cost over \$750,000 to build (Trumbull 39). The effect worked wonderfully and had the added advantage of being a somewhat scientifically accurate portrayal of artificial gravity. Trumbull also notes one of the more impressive shots taken on the set:

In one of the most difficult shots Gary Lockwood was strapped into his seat and had to hang upside-down pretending to eat glued-down food while Keir Dullea climbed down the ladder at an angle 180 degrees opposed to Gary. As Keir began to walk around the centrifuge toward Gary, the centrifuge was slowly rotated until Keir and Gary were together at the bottom. The camera, which was locked down to the centrifuge floor, was then at the top.

(40)

Shots like this one are testaments to the skill and creativity of Kubrick and his crew. Many of these shots are executed so well, it is incredibly difficult to tell how they were able to pull them off unless you already know the secret. The Discovery set was certainly an important one for the film, but it is interesting to see how much work went into this single location, when a less drastic effect would have likely worked just as well. The centrifuge is a wonderful example of how special effects can be used to show the impossible.

Throughout the film, we see several shots of actors experiencing zero gravity. In each of these shots, the effect is very convincing, yet seemingly impossible. Wires are often used in films to making actors fly or float, yet in *2001* the actors are shown to experience zero gravity in tight corridors with no visible wires. The secret of this effect is that wires were in fact used, but the actors themselves were hiding them: “Kubrick was determined that none of the wires supporting the actors and stunt men would show. Accordingly, he had the ceiling of the entire stage draped with black velvet, mounted the camera vertically, and photographed the astronauts from below so that their own bodies would hide the wires” (Johnson 130). By placing the camera below the actors, they can control how they move around the frame, and give the illusion of floating while

hiding their own supports (see fig. 3). With clever framing, the audience can never tell which direction the camera is facing, and the effect succeeds.



Fig. 3. Actor hanging from wire on ceiling from: Agel, Jérôme. *The Making of Kubrick's 2001*. The New American Library, 1970.

One of the most impressive instances of this effect shows up later in the film. In this scene, we see Keir Dullea as Dave Bowman reenter the Discovery through the airlock, flying around it in zero gravity until he can close the door. The shot is a short one, only lasting a few seconds, but the effect is very convincing. Wires were similarly used, but there was another element to this shot: “The wire was also attached to a roustabout from Eugene’s Flying Ballet, who acted as a counterweight so that Dullea could go down, then back up the shaft” (Benson 197). The stunt was somewhat dangerous, and there was no opportunity to use a stunt double, as Dullea’s face was fully visible. Reflecting on this performance, Dullea commented in a question and answer session, “I had been working with Stanley for months, and I really trusted him ... I thought ‘it’s going to be alright, Stanley Kubrick’s in charge’” (Dullea, 12:29-12:46). After the shot was taken, the action was emphasized by speeding up the camera slightly to give the scene more energy. This short scene has since become one of the most iconic of the film, thanks to the hard work by Kubrick, Dullea, and all the others who made the effect possible.

Right before the end of the film is the infamous ‘stargate sequence’, a mesmerizing light show of strange images and vibrant colors. The effects in this sequence are unlike those of any other film at the time, and in order to create them, Trumbull had to construct custom equipment. He used a variation of strip photography, which is a method of photography where a sequence of long, thin images is taken over time, then are stitched together. This was used in scientific and industrial fields in the form of image scanning. In order to use this technique for *2001*, Trumbull designed what he calls the slit-scan machine (see fig. 4).

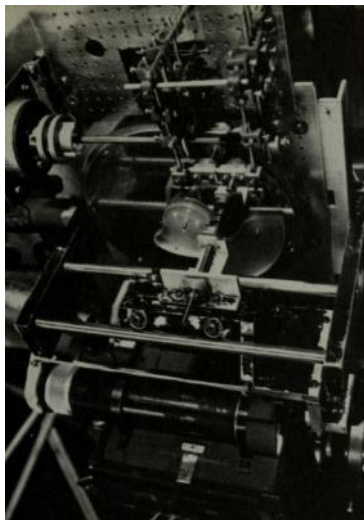


Fig. 4. Close-up of the slit-scan machine from: Agel, Jérôme. *The Making of Kubrick's 2001*. The New American Library, 1970.

The slit-scan machine was essentially a camera on a sliding track pointed at two vertical slits. Abstract artwork would be placed behind the slits, made up of “thousands of high contrast film negatives of op-art paintings, architectural drawings, moiré patterns, printed circuits, and electron-microscope photographs of molecular and crystal structures” (Agel). Then as the camera is moves closer or further from the slits, they appear to move left and right. The camera was exposed for roughly a minute per frame, but when stitched together, the effect worked beautifully. After the stargate sequence, there is a series of strange images that seem to emulate



galaxies, exploding stars, and other similar imagery. Trumbull briefly explains these effects, saying, “without revealing too much detail, I’ll merely say that these effects involved the interactions of certain chemicals within a camera field of a size no larger than a pack of cigarettes” (26). The strange assortment of effects in this section of the movie are the result of experimentation by the Trumbull and his team. There are several scrapped effects that have been documented, and surely many more that have not. Because Kubrick gave his visual effects artists room to experiment and be creative, he was able to present a one-of-a-kind experience.

*2001* was a film that completely changed the genre of science fiction, largely due to the visual effects it utilized. It was unlike any film before it, and it has inspired a countless number of films since. John Gaeta, a visual effects supervisor for *The Matrix* comments, “I could dot-connect where I am today back to being a young man watching *2001*. Kubrick allowed Douglas Trumbull to explore and envision things by any means necessary. And that led to startling breakthroughs and a level of immersion we haven’t seen before” (Hoad 6). In a sense, *2001* can be seen as a turning point in film history. It was able to usher in a new era of science fiction, but also of film as a whole. It was an example of the extent that visual effects could be used to captivate the audience and show them other worlds. Cinematographer Peter Sushitzky reflects, “Did *2001* start a VFX arms race? I think so. Science-fiction films are always trying to outdo the last one visually now, to push the boundaries. There’s been nothing as outstanding in science-fiction cinema since *2001*” (Hoad 10). A few years after *2001* released, George Lucas began working on *Star Wars*. He asked Trumbull to work on the effects for his film, but Trumbull declined, as he was already committed to another film. Instead, he sent along his assistant, John Dykstra. Dykstra and Lucas then went on to create Industrial Light & Magic, a company who has since revolutionized the field of visual effects (“Industrial Light & Magic,” 1999). Modern visual

effects are made with computer graphics, which can generate almost anything, yet *2001* still exceeds them in many ways. Many science fiction films still opt to use practical effects over digital ones for added realism, as proven by the timeless effects of *2001*. Film has come a long way since the time of Méliès' famous film over a century ago, and it has been able to progress thanks to the work of innovators like Kubrick. *2001* is not a film for everyone, but few can deny the impact it had on the world of cinema.

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