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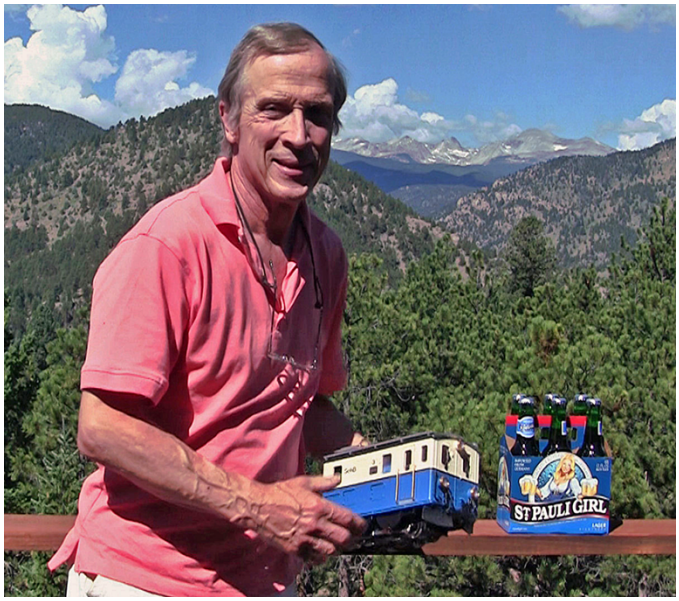
PRODUCTION NOTES 2020
by John Hart



INTRODUCTION
(included shows are cited in italics).

I have always been keen on photography, starting in the darkroom with black and white at age 8, and migrating from regular-8 to super-8 to 16mm movies back in the film days. After doing an awful lot of (2D) wildlife photography as a hobby from 1970 - 1995 I was ready to try something different. In the early 70's we could camp by ourselves out in the bush and enjoy reasonably-distanced encounters with bears, lions, elephants, tiny iridescent birds and everything in between (*WilDDDlife*). It was a

passion, exploring and photographing. But as the years went by more and more people got into it, and by 1990 it was hard to find a moose in Yellowstone, for example, without a whole bunch of manic photographers crowding in closer and closer until the poor animal spooked. I was once asked by a lady in the Hayden Valley if I had seen her husband (a photographer). Apparently he went into the forest chasing a moose and hadn't come back. It turned out he was lucky enough to make it up a tree when the moose charged, but had to stay there for several hours. While I have had my share of adventures and some close calls in doing wildlife photography (see "Reflections on Africa"*), it seemed time to migrate to something else, something different.
* www.hart3d/pages/travel/index.html

I vaguely remembered an adventurous friend of my father coming to our house in 1950 when I was 6 years old. As well as presenting 16mm B&W films of bears, stills of Mt. McKinley (as it was known then), he set up a polarizing screen and treated us to 3D Realist slides of some of his travels. I wish now that 3D had caught on then, instead of roughly 50 year later But at last, in 1998, I decided to give stereoscopic photography a try.

My first 3D rig was a pair of Pentax SLR 35mm film cameras on a slide bar. They had electronic cable release ports, and I found that by wiring the two cameras to a common trigger button, with some diodes to prevent cross-talk, I could get very good synchronization most of the time. Stereo synchronization is the degree to which both cameras fire together, and is necessary at the level of a fraction of a millisecond for recording fast action without painful viewing rivalries. It's tedious to actually measure stereo sync with film cameras since you have to take many test shots, get them processed, and try to measure tiny sync errors off the film chips. But most action shots in my early days of stereoscopic still photography came out OK.

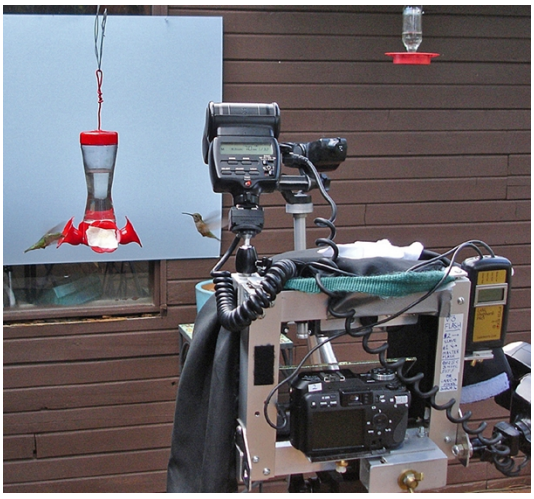
The first forays with the 3D film rig were into slot canyons of the American Southwest. I had gotten into canyoneering, the art of descending oft-water-filled narrow gorges with the aid of ropes, wet-suits, and other paraphernalia. It made for a heavy dry-bag pack when schlepping the twin Pentax with two or three pairs of prime lenses, but I found the shots inside these marvelous slots, with their divergent lines and incredible rock-glow (made when beams of light reflect multiple times off the sandstone) to be just amazing. I was hooked. A problem was that projecting the pairs of slides was difficult. You had to remount them in glass to correct any translational or rotational errors arising in the original paper mounts or in the camera setup itself. Then, to make an interesting 3D show, tedious programming of dissolves in four or more slide projectors was required. These were typically driven by a 4-track analog tape recorder, and the images were beamed onto a polarization preserving silver screen with everyone wearing polarized glasses. In the end the shows were fairly good , but very hard to setup and suffered ghosting (where some right-eye information leaks into the left-eye). The result was also pretty dim on a screen of 8 feet or more in width. Nonetheless I perservered and even made a micro-manipulator to help me register and glass mount a couple thousand slides. Most people were pretty amazed (there was no 3D commercial cinema then). Visiting Reunion Island*, out in the Indian Ocean with it's 1000 foot waterfalls to rappel, was the highlight of my 3D film career. Although I had wanted to get into stereoscopic movies, it seemed pretty impractical and difficult. Shooting with a twin Bolex 16mm rig, for example, would be a major struggle, even if you could mechanically sync them (via a common motor). Fortunately all that changed with the advent of decent digital cameras starting, for me, in about 2004.

I first discovered, by making careful sync measurements photographing a spinning wheel, that you couldn't just grab two identical digital cameras, parallel wire the triggers (like for the Pentax film cameras), and get good synchronization. Because most digital cameras (and all the early ones) poll the buttons and i/o ports every 1/30 of a second, randomly started and parallel-triggered cameras would have a sync error with a median of 1/60 second, which is not good enough for much. Furthermore, differential drift between the two oscillators in the cameras would cause the sync to get worse then better then worse, and so on, over time. Even when sync is decent for normal activities, say 1/300 sec, unfortunately (as verified by my measurements) 10% of the time you will get errors the same as the polling speed, or ~ 1/30 sec. I did discover that if you powered up the cameras at exactly the same moment, you could at least get good sync (albeit with the odd way-off outliers) for a while.

Then Rob Crockett invented a device he called the LANC Shepherd which not only would power up the cameras together and trigger them simultaneously, but by monitoring the video refresh for the camera screens the Shepherd measured how different the trigger response would be (down to a fraction of a millisecond). If the sync got bad, you could simply turn off and then power up the cameras to restore good sync. This remarkable innovation revolutionized amateur (i.e. inexpensive gear) digital stereography. Many cameras with the so-called LANC protocol (and connector) would work. And there were quite a few. My first pair was the Sony V1 in 2003, followed closely in late 2004 by the Sony V3. The latter proved to be a staple for me for several years. It had remarkably good image quality (7 Mpix, but with large pixels, competing well with cameras like the 2008 15 Mpix Canon G10 in terms noise and sharpness). The V3 had an 8 frame burst mode that would be in sync when using the Shepherd! The LANC unit could be set up so a camera flash on one camera would illuminate both camera frames fully. This is important because a common difficulty with twin 3D rigs is that the shutter curtain will appear in the left camera, say, when a flash is triggered by the right one.

HUMMINGBIRDS and KAYAKING

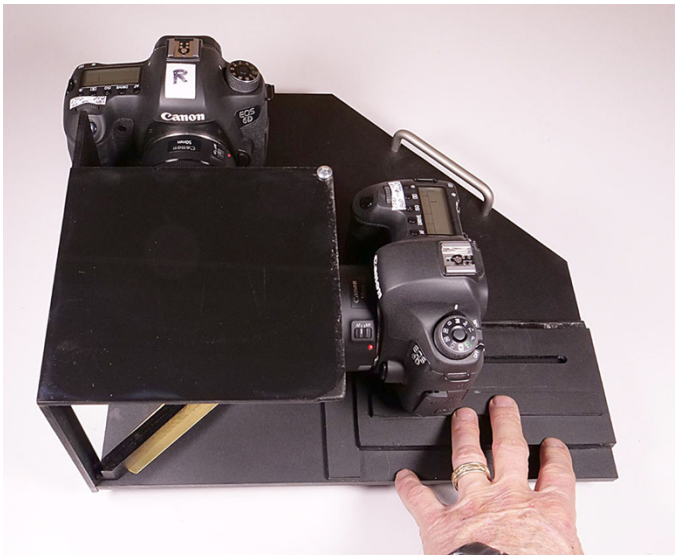
I was in heaven! The burst mode of the V3 let me do action sports. The flash sync allowed me to do hummingbirds. In this video Collection there are examples of such V3 work. "*Wicked Liquid*" has kayaking stills of intrepid boaters struggling to get through some scary roiling water. Shoot a burst of 8 and pick the key moment. Or sequence a few steps in running a hydraulic. "*Jewels of the Mountain Sky*" has some beautiful hummingbirds frozen in the air with three ~1/30,000 sec flashes. Just myself and some wonderful wildlife on our mountain-house deck. Perfect.



Hummingbird setup with V3's and beam-splitter.

A key ingredient of this latter work was a home-made "beam-splitter" that allowed the two cameras to be effectively separated by far less distance than if they were simply mounted side-by-side on a bar. To control the stereoscopic deviation it is often necessary, especially in close-up photography, to reduce the "stereo base" by somehow getting the lenses closer together. The well-known way is to use a half-silvered mirror at 45 degrees. One camera looks straight through the mirror, and the other looks down and out. With suitable baffling you can get a separation of zero, and up to some centimeters depending on the size of the mirror, the cameras, and the lenses field of view. Using a table saw, drill press, and some hand tools, a macro-splitter became reality. After a little tedious alignment, it worked wonders allowing an effective lens separation of about 1.5 cm for the hummingbirds. Over the years I have built beam-splitters for just about every pair of cameras I have owned. From the tiny GoPro H3+black dual 3D videocam, to the large Canon 6D twin. The beam-splitter is an indispensable tool for stereographers, but each camera has different dimensions and usually demands its own design.

Front view of V3 beam-splitter and flashes.



Side by Side (vs. over-under) beam-splitter for Canon 6D.

FRACTALS

In 2007 I met Jerry Oldaker at the Boise NSA/ISU 3D convention. He was a very charismatic and dedicated 3D cgi (computer generated imagery) enthusiast, who had brought some very large prints of fractal art to the convention for cross-eyed viewing. I had initiated a "stereo art gallery" for this convention. It has since become a standard event, run expertly and enthusiastically every year by Claire Dean. Jerry had used his computers to generate some mathematical structures that are technically known as "iterated function systems" or IFS. These other-worldly graphical objects are remarkable; cosmic, abstract, meditative, you name it. I loved them. This was partly because my initial training as a scientist had been in the lab of Prof. Edward Lorenz at MIT. He was the genius who discovered "deterministic chaos" in 1962, and in 1966 I had a desk as a student researcher in his lab while his magnetic drum personal computer (that could do maybe 100 multiplications per second) spit out line after line of evolving chaos on a teletype machine. Rat-a-tat-a-tat-a-tat. I appreciated and understood the math behind what Jerry was doing, but he had a leg up on the art of the fractal and his work was visually incredible.

So I said to him, "you should make a digital movie of fractals evolving, that would be so awesome". By 2007 digital projectors had taken over from laborious, dimly lit, and hard-to-run banks of Ektagraphic slide projectors that had previously been used at 3D conventions and stereoscopic home theaters. Thus, it was becoming possible to show near-HD-resolution stereoscopic video; bright and sharp, with full motion. At the Boise convention, projection was with two ProjectionDesign units

with with 1400x1050 resolution. Each projector had high contrast and were 7500 lumens bright (vs. 1300 for an Ektagraphic). Most of the 3D programs in 2007 were stills. A few had Ken Burns animations where one zooms into and walks around a still image, but full-motion video was becoming a real possibility. Anyway, Jerry and I agreed to make a stereoscopic fractal-art video. It would take eons of computer hours, but we were keen. Our first production was Fractal Fantasy (2007), which was all Jerry's work, animated Ken Burns style. This was quickly followed by the full-motion Fractal Odyssey (2008). These went on to win several film festival awards. I'm amazed to this day to see all the citations if you Google these shows. In Odyssey, half the show was of IFS evolving fractals that Jerry had spent thousands of hours of CPU time on. He had a knack for choosing the best parameter sets and adjustments over time to morph the objects and make fantastic art in motion. I had gotten into fractal plasmas, more transparent gaseous semi-transparent structures, that mathematically are closer in their origins to the original work of Edward Lorenz. Basically a mathematical dynamical system runs orbits around in XYZ-space. The density of orbits close to each other leads to transparency (more orbits, near a point in space, means it is more opaque there). Colors are related to the speed of the orbits at each point, or some other measure. So between Jerry's solid objects and my semi-transparent ones, we had quite a good show.

After Odyssey I continued to be interested in stereoscopic fractal art and made more complex and exotic renders of fractal flames. This involved modifying several well-known programs (like Apophysis) for 3D left-right output and parameter evolution and control. I had 4 quad-core PC's running 24/7, which boosted my electric bill up by $200 a month. Jerry, meanwhile, had a render farm in Eugene, Oregon. He was living, part time, in Arizona, and sent his parameter sets and commands, and previewed results, over the internet from there. We had planned for one last opus, a culmination of the best we could do in motion-animated 3D fractals. His render-farm had dozens of CPU 'blades', all laboriously working to evolve his complicated IFS fractals. We worked more than two years designing artsy morphing objects and computing them. Just at about the time we had decided to put it all together in an edited video, I got a call from Jerry. He told me that his entire computer operation in Eugene had been hacked and that all his data, backed up on several devices, had been destroyed. As hard as he and several computer wizards tried, nothing could be recovered. OMG. He was totally crushed. Years of hard work and dedication were all lost. I couldn't believe it. So sad. Although Jerry continued in 3D for a while afterwards, the passion seemed to be gone. He resisted my request to make Fantasy and Odyssey available in a Blu-Ray package of fractals I eventually released some years ago. He didn't want our joint work mixed with stuff that was purely mine, which is too bad because Odyssey was the first, and is still among the best, 3D fractal motion-art video produced for stereoscopic viewing.

After that I continued off and on to generate more videos of fractal morphology. The computers were getting faster and it was getting so one PC could render one frame every ten minutes (or maybe a second of video in 6 hours, or a short clip every few days or so). There are three selections in this Collection, *Morpheos* (morphing world objects), *Neo-Morpheos*, and *Morpheos Reloaded*. The first two are primarily fractal flames (transparent gases), and Reloaded is mostly hybrid "Mandelbulbs", which are more solid. They were only discovered in 2007 by Daniel White and others as a generalized mathematical system by expanding on the fundamental work of Benoit Mandelbrot. *Alien Gardens* also has a set of these exotic looking "bulbs" at the end, posing as fractal flowers in an off-world botanic park! In making fractals, certain symmetries can be important. One of the simplest is reflection symmetry, where half of the fractal, say, is the mirror image of the other. I

applied this simple symmetry in a video called *Life Over Under*, which depicts other worlds (possibly), with buildings floating in the sky, mega-cities trapped in the gap between parallel earth's, and people living and playing as a duo, with actions mirrored in an upper reflection. This is only one simple morph. I am currently interested in other more complex ones as a way to make abstract stereoscopic motion-art.

SCIENCE AS ART

The intersection of art and science has been a backbone of my work. My mother was a math teacher, a classical pianist, and a landscape painter (as well as a good photographer and lover of all the arts). Can 3D allow us to see science (as well as math) in a new way that is both beautiful and educational? Of course!

After success with the hummingbirds, I thought that 3D of faster events would be equally interesting. Harold Edgerton, the father of stopping time, had indeed made at least one stereo-view (that Ron Labbe had sent me a copy of). But in 2010 stereoscopic images of ballistics were uncommon. At least I didn't know of any others than the one Ron had supplied. Unfortunately, for faster events, like bullets hitting fruit, you need a much shorter flash duration than can be obtained from normal camera flashes, even when their power is dialed all the way back by a factor of 32 or so. I worked with Prism Science to build two "micro-flashes". They had to be adjusted to go off exactly together. Two were needed to get even and bright enough lighting. These flashes used air-gap sparks of very high voltage and amperage to generate a bright white-light pulse ~0.5 microsecond long. *Homewrecker* is a hokey little piece about a dog setting off a paint-ball machine gun, and showing all the damage that results. *Stop Time 3D* describes the photographic setup in detail and shows some remarkable examples of bullets going through various targets. In 3D you can see some science that would be missed if you only had 2D pictures. There are also some intricate and beautiful patterns like the lace structure an exploding paintball makes.

One day I was out in the garage "shooting". A 44 magnum was on the stand and a couple of apples were on the stage. Some other guns were sitting on a bench. The place was getting filled with gunsmoke, so I opened up the garage door to let some fresh air in. To my surprise, two guys were walking up my driveway. As they got closer I saw that they had DEA (drug enforcement administration) jackets on and were packing. I was so lucky not to have been holding a firearm when the garage door rose up amidst a haze of smoke! Turned out they were investigating a possible grow operation in the woods down the road. They were curious what I was doing, and with hands always visible I explained I was making 3D images of bullets going through stuff. They were quite impressed and bid me good luck with it. Why are so many of my gigs borderline bad?

I had been into microscopy since 1984, originally making normal 2D still images on 4x5 sheet film of crystallized organic chemicals using polarized light. These were used to hand-print large Cibachromes which were popular in several galleries in Colorado back in the day. The remarkable colors in such images are a result of differential rotation and interference of various colors as a polarized light beam passes up through the crystal. The color depends on the thickness of the crystal, the axis of the crystal compared to the polarization direction of the illumination beam, and the crystal's material properties By looking at two different wavelengths you can, very roughly, extract the thickness. This technique was used to make the movie of crystal growth called *Microscapes*. A

similar color-to-thickness construction was used to make *A Soap Film*, which I briefly considered calling "A Soap Opera". It uses the relation that interference colors are related to specimen thickness in order to make a 3D movie of the rapid and spectacular events that occur as a film of soap evaporates. It shows the evolution of both horizontal and vertical films, which are very different dynamically. The thin film of soap does indeed have thickness variations that are, however, very small compared to how wide it is. These variations are stretched way up in the video. More art than science? Maybe.

TIMELAPSE

Back in 1982 I had been fascinated by Koyaanisqatsi, Life Out of Balance. It was the work of the genius cinematographer Ron Fricke, who went on to make several follow ups (Chronos, Samsara, and others). It features vastly sped up video of life's beauty, as well as its tragic failings such as pollution and overcrowding. It was made using time-lapse photography, where a sequence of stills taken at some interval, typically between a fraction of second and up to a few seconds, are played back at normal speed. Everything flies by. For slowly moving subjects like clouds, it brings the turbulence and cloud structure to light. For normal scenes, like pedestrians piling in and out of subway cars, it can suggest the futility of human existence. Anyway, I decided to make a modest attempt at stereoscopic time-lapse. Homemade circuits were built to fire two Canon Rebels, as well as a pair of Canon A590's. The Rebels had interrupt-driven remote ports and so they synced very well just by pulsing them together. The 590's were synced by similarly pulsing the cameras but with a new piece of software called SDM, that hacked the cameras' firmware to vastly increase their remote ports' polling speed, leading to good synchronization of the pair. Once the parts were working, it was a pretty easy shoot, mostly around home and town. The result was *Fastlife* (2008), which was the hit of the ISU2009 convention in Austria. The hardest shots were inside the Denver International Airport where security did not at all like what I was doing (hence there are not a lot of such shots in the piece). While shooting traffic looking down from a bridge over I25, somebody called the state police who came to investigate. I talked my way out of that one. I then decided to try Water World. My son said I would never get away with setting up a tripod and doing time-lapse clips for ten minutes each of little kids and such in the water. Their security guard did indeed check me out, and I explained (truly) that I taught oceanography at the University of Colorado and was making a time-lapse film on wave action (also true - the clips were shown in my fluid dynamics classes :-). I showed him the camera screens and explained that no individual was big enough to be recognized. I wanted it to look like a sea of fish bobbing and circle in the big rollers made by Water World's giant wave-maker. Anyway, I got the green light, but didn't chance my luck there another day.

Since then time-lapse has become a way of life for many photographers, and even a number of 3D'rs. Along with Fricke's work, among the best (flat) indie movies is Timescapes (2012), and a lot of incredible mono time-lapse stuff is discussed and linked at the must see website www.timescapes.org.

I finally pulled off one project that I had long wanted to do in 2018; videoing the Albuquerque Balloon Festival in 3D. In addition to the normal stuff about how hot air balloons work and such, a major thrust was making hyper time-lapses of the mass ascension at dawn. This involved spacing two Canon 6D's about 20 meters apart on a bluff overlooking the field, and using a home-built timer and a

long wire to again trigger the remote ports of the two cameras in parallel. Getting everything set up correctly, in the dark, was an issue I would experience again later. But I got several really good clips of hundreds of balloons ascending, circling through the "Albuquerque Box" (described in the film), with some of them coming back to land very near to where they took off from. *The Way Up* (2018) was successful and inspired me to try two other even more difficult subjects for time-lapse; the Milky Way and violent storms.

To make photography of the Milky Way interesting you have to have a good foreground, and to make it even better most serious time-lapsers use a "MOCO" motion control slider-rail to slowly move the cameras past the foreground subject (with perhaps tilt and rotation added at the same time). The result is extremely nice, but hard to pull off. The arches, hoodoos, and canyons of Utah are great objects that reside in one of the darkest sky areas of the U.S. Perfect. However, light painting has become popular. Hordes of people descend on the arches and do long exposure photography while running flashlight beams all over the rock. If you are just taking one single long-exposure image of the arch and the night sky this is not usually a big deal. You just wait until they give up, or ask for them to take a break for your picture. But for time-lapse it's a disaster. The Milky Way clips take many hours for the constellations to move across the sky, and interspersed frames with painters' beams splashing on the rocks completely ruins the shot. The result is that you have to pick a remote location and hike with the gear far enough off the beaten track to get way from the light painters. This can mean a couple miles, or up steep hills or through nasty brush, all in the dark! The pack-load is heavy with two DSLR cameras, four fat (low f-stop) 35mm lenses, two tripods, a ten foot slider rail with motors and controllers, lights for illuminating the subject and the hiking route, water, warm clothes, bear spray, and a first aid kit). It's a whole night of very hard work for one 10 second clip! Best to arrive at dusk to set up. This can be done in the dark but it's not fun. Once the rail-shot is all programmed and ready, we wait until the sky is dark enough and then shoot for 4-6 hours. Sleep on the rocks if you can. Check on operations occasionally. That last step was a disaster once. I bent down in the dark to look at a camera screen, while forgetting I had set the rail very close to a cactus bush. Sure enough a thorn nailed me smack in the eye. Fortunately it didn't hit the cornea, but it did lead to a trip to the Moab hospital, a place I visited twice on that same trip.

To finish the film *Sky-Light*, I wanted to add time-lapse clips of clouds and storms. As a solo gig, stereoscopic storm chasing is another difficult and dangerous venture. You have to find the storm, set the cameras some 200-400 meters apart, align the shot, and get the radio link working to trigger the second camera from the first. That's all somewhat reasonable. The crunch comes when rain-shafts, or hail, or lightning approaches. While one camera is near the truck, the other is like a quarter mile away. There's a tension between wanting to stay to get more frames, and run/drive like hell to escape the damage (or death) that might ensue as the storm rapidly closes in. The main problem is, of course, the second distant camera (the one that mono photographers don't have). I would try to place it on a road. But that was not always the best location for composition since the stereo baseline should be perpendicular to the direction the lenses need to point. So a few times I had to run across a field to retrieve it. Once, for example, my computer reported real-time weather-radar data showing that there was 4 inch hail up inside a giant nimbus cloud that was approaching fast. Four inches? Yikes! That would be deadly for certain. Time to run for it. So both storm chasing and the all night astrophotography were a struggle. At age 73 who wants to run a quarter mile and back to save a camera? *Sky-light* (2018) does not have as many clips as I would have liked. But I had thoroughly burned out doing it, and decided to move on to something much easier and perhaps safer to do -- trains, which are discussed below.

MORE SPORTS

An old canyoneering friend of mine, Todd Martin, always the adventurer, had gotten into para-motoring. That's the art of flying a para-glider while wearing a gas-powered fan on one's back. Super! Let's try to make a 3D video of this wild and crazy sport.

In fact, for my 60'th birthday my wife had given me a gift of introductory para-glider lessons in Boulder. The goal was for me to use this as a spring board to get into para-motoring myself (as a platform for aerial 3D, so I thought). The lessons were to start a month before I was scheduled to go to Spain for some, as it turned out, fantastic canyoning in the Spanish Pyrenees. Then I started hearing stories about how people sprain or break an ankle learning to land in their first lessons. Another canyoneering friend had tried it and broke his back. With the European trip coming up I decided to bail out, and that was that. After working with Todd on the film *Sonora Air Safari*, I learned that para-motoring is for sure a two-hand operation, and flying and taking pictures, especially with a big wide base stereo rig, would be impossible. I decided to stick to drones for aerials.

The cute thing about *Air Safari* is the use of a stereoscopic "chase cam". Todd had built a chaser for mono-videos of his flights and it had worked well. We decided to adapt it to stereo. It allows the twin cameras to hang on a nylon line running down from the trailing edge of the para-glider (you can see it in the video if you look for it). The nose of a plastic soda bottle provides a smooth airfoil that keeps the camera rig pointed in the direction of flight (mostly). Unfortunately we needed about 9 inches of camera separation, and my widest synchronized GoPro stereo rig has just a 3.5 inch base. I decided to use 2 unsynchronized Hero 5's and shoot HD at 120 fps. Thus, the worst the sync could be is 1/250 second. Of course this will not work for the propeller (in fact neither did the gen-locked GoPros, due to slight but significant vertical misalignment inherent to these little cameras). But if you don't focus in on the propeller while watching the video, it's a pretty good ride. Todd and his buddies make for a wild flight, going thru pairs of cactus's like goal-posts, and around the peaks of

the SanTan mountains. He even performed a few tricks for me before landing. Nice. I even found some good music.

Speaking of rides, for some crazy reason (described in *The Last Ride* film) I took my mountain bike, with a low power electric assist, out on the slick-rock trail in Moab, Utah. I got some helmet-cam and ride-by footage, and shot a few fly-over aerials with a drone. At 73 I probably shouldn't have done this, because while using the motor to try and power up an extremely steep sandstone dome, the front wheel lifted up and I crashed. The bike was bent but could still be pedeled. The battery hit the cement-like slick-rock and its case and all connections were shattered. Fortunately it didn't explode or catch fire, as lithium-polymer cells have been known to do. My left elbow, arm, and wrist were bleeding and sore, but at least there were no bones poking out. I pedaled back to the car and limped back to my Moab campsite. Ice, ice, ice, and vitamin I (Ibuprofen). The next day was not too bad so I took the drone out and got some aerials of the trails and chasms. But on day three the swelling was so bad I headed back to the Moab hospital where the diagnosis was a fracture up near the elbow and a badly strained wrist. *The Last Ride* has this story, along with some nice drone footage of the spectacular area. To use a single drone for stereo, you just fly perpendicular to the lens direction Then lag the video stream against itself to get, say, a left (lagged) and right (normal) view. This obviously only works if the subject itself is static. Works well for rocks.....

TRAINS

From May 2019 to June 2020 I spent a lot of time photographing both model and real railroads. They are great subjects for 3D with steam and smoke swirling, dynamic action, and the beauty of witnessing history in motion. I visited several locations for restored-engine steam ups including: Nebraska (*Chasing Big Boy*), Durango and Cass, West Virginia (*Restoration Rail 2*), Georgetown and Strasburg PA (*Restoration Rail 1*), Ely Nevada (*Nevada Northern RR*), Hamburg Germany (*Miniatur Wunderland*), and various model garden railroad layouts around Denver (*Colorado Garden Rail*). The goal was to document the real-rail restorations and modeling re-creations using some tricks and specially developed hardware to get unusual shots. A neat mini-sized beam-splitter was built that holds two synced GoPro's. It is small enough to mount on a G-scale rail-car, allowing POV shots while "riding" the model train. A "zero" elevation tripod was made for placing a GoPro rig between or beside the rails of an actual railroad, and photographing in 3D the roll-over of huge steam engines, including the gigantic 4-8-8-4 Big Boy. We also spent time rebuilding our own outdoor garden layout, the Skyline and Scree, that has suffered through 25 years of Colorado summer heating and winter freezing. It was photographed many years ago in 2010, but I felt like that show needed an update with more interesting layout details as well as better cameras. It's now a great subject for 3D photography. While being forced to stay home because of Covid, it's marvelous to be able to walk out back and grab a shot or two when the weather and lighting are right. The main joy in all this travel was seeing the restoration process and its results up close. Witnessing the steam-punk gears and rods and valves making motion magic in both reality and in models is a treat.

The photography was not without hazards. Driving to chase the Big Boy was an adventure itself. For example, along the two-lane highway 30 in Nebraska the track runs right alongside the road. I would set up for a shot, video the Big Boy as it rolled by, then jump in the truck to get ahead for another setup. Unfortunately there was often a huge lineup of twenty or more slowly-moving cars, blocked by a couple of fools trying to stay right alongside the Big Boy engine, which was chugging at

30mph at the front. They were trying to shoot jerky video from a cell phone hand-held out the car window, and wouldn't relinquish their position, hence the long backup. To get ahead of all this, I had to pray for no oncoming traffic, hope that no people in the queue pulled out, and floor my old beater truck to ridiculous speed and try to pass all twenty autos at once. Very scary, something (train chasing) I have vowed not to try again anytime soon.

Then there was the day a vintage Shay geared locomotive was reversing, and I wanted to get a shot up close of the drive-train gears and drive rods while rolling along with it. I was up front on the platform of a car just behind the tender (which has driven wheels). With my trusty Zhiyun Crane gimbal, being held just at the end like gripping the knob of a baseball bat, and leaning way out and towards the front while holding onto the train with one hand, I was getting a pretty neat video. But while looking forward, I failed to see a tree coming up alongside from behind as the loco reversed. I took a solid thwack on the arm from a branch, almost lost my grip on the camera (with my right hand), and on the car (with my left). As in many other bang-ups, the GoPro twin-3D rig survived, as did the gimbal. My arm was pretty badly scraped. Once again I was reminded to check out all the angles and stay aware, 360 and 24/7. Lucky this time.

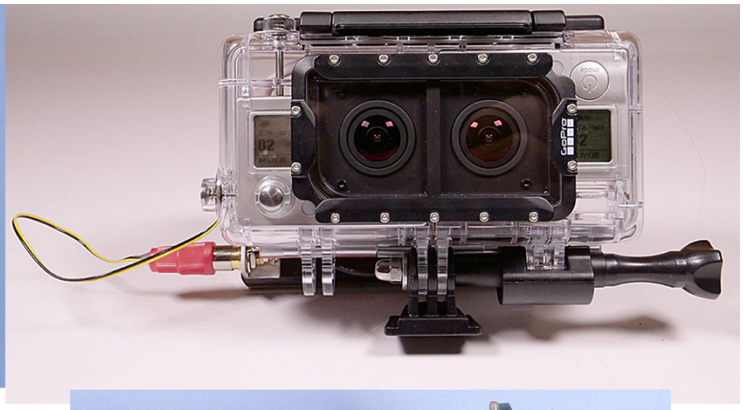
Another day I was trying to do a roll-over shot, where the 3D camera is placed on the ballast between the rails with the goal of getting the oncoming train racing over and seeing the undersides of everything. Awesome when it works. Once however, I forgot to plan for the fact that the very heavy engine would bend the old rails and rotten ties at this particular location and lower itself down closer to the camera. The locomotive that day also had a very low firebox. And, sure enough, it whacked the camera pretty hard causing it to tumble past a couple of ties. The train happened to stop with the engine out of sight around a corner. The flipped camera was sitting upside down under a freight car. I had the not-so-bright idea to crawl under and grab the camera in order to set up another (different angle) shot for when the train started up again. I knew that the train engine would give two or three whistles before moving and if I was fast enough..... So like a fool I scurried under, fumbled for the camera, and rolled out between the wheels. Then just a mere five seconds after I stood up the train started to move, only giving the whistles AFTER it had started to roll!! If I had been under there, it would have been the end. Especially when the low and sharp-edged firebox came along. Very dumb!!! Once again (after the slick-rock trail crash, and the poked eyeball) its good to try for innovation but best to be careful and safe, and live by the motto 'photography isn't worth dying for'. From now on I think I'll stick to model trains where it's hard to get killed on 18 volts.

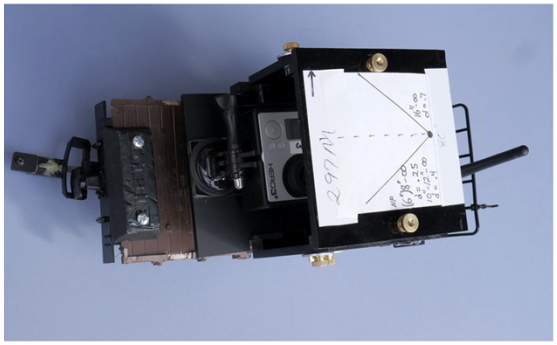
TECHNICAL NOTES

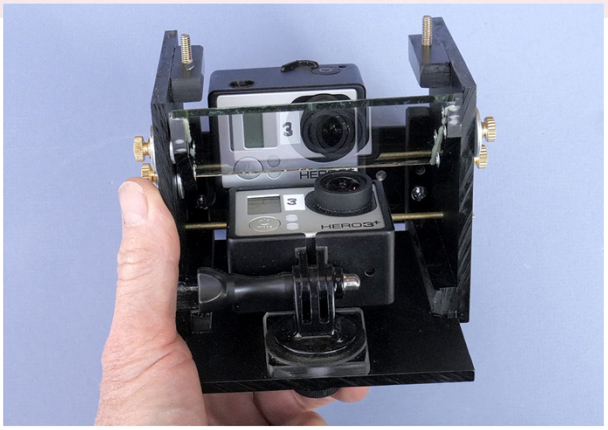
Here is a list of the equipment used in the non-cgi programs:

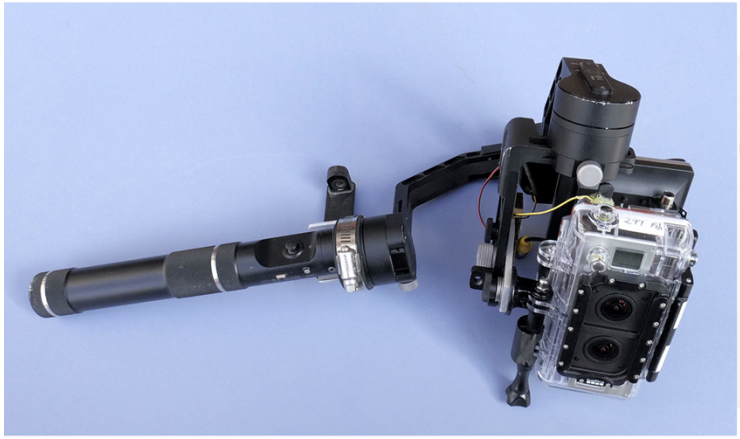
Wicked Liquid	Sony V3, Canon 1080i Videocam w/ LANC.
Jewels of the Mountain Sky	Sony V3 and Beam-splitter, camera flashes.
Fast Life	Canon A590, Canon Rebel, timer/ controllers.
Homewrecker/StopTime 3D	Canon G15 w/ beamsplitter, microsecond Flashes.
WilDDDlife	Olympus DSLR, Takahashi 800mmf8,Leitz 400mmf6.
Life Over Under	Pentax film DSLR, Canon 6D, Canon Rebel, helicopter.
Sonora Air Safari	GoPro3D 3.5" base, GoProH5 9" base.
Alien Gardens	GoPro3D 3.5", 1.3" bases, Lumix GH5 w/ Olympus macro lens for focus stacking, sliders, MOCO heads.

The Way Up	GoPro3D 3.5", twin Canon6D, twin Lumix GH5.
A Soap Film / Microscapes	Olympus microscope with Canon 6D camera.
Skylight	Canon 6D with slider rail and MOCO heads. Drone.
The Last Ride	GoPro3D 3.5" helmet cam, GoPro3D 1.3"base, Drone.
Model Trains	Lumix GH5 w/Lumix 3Dlens, GoPro3D 1.3"base.
Real Trains	Lumix GH5 twin on slidebar, GoPro3D 1.3" and 3.5"bases.









Upper left: GoPro 3.5" base 3D cam. Upper right: GoPro 1.3" base 3D cam. Middle left: mini beam-splitter on g-scale flat car. Middle right: GoPro mini beam-splitter (lid off). Lower left: GoPro with Gimbal. Lower right: GH5 w/ Lumix 3D lens (and G-scale model RR figure).