The Great Pyramid: Early Reflections & Ancient Echoes

TestTones, Indiana Jones and the Lost Knowledge of Yore

By Tom Danley

Оригинальный текст *Тома Данли (лирика сохранена). Представленные в переводе на русский язык фрагменты выделены сиреневым цветом.*
Зелёным цветом выделен фрагмент, представленный в переводе в заключительной части текста о «Разгрузочных Камерах» Пирамиды Хуфу.

http://www.livesoundint.com/archives/2000/julyaug/pyramid/pyramid.php

Editor's Note: Sometimes a story comes out in a way that rolls the who le. What follows encapsulates audio, acoustics, truth, fiction, legend, innuendo, road rage, taboo, and prognostication. We hope you find it fine reading for an unspoiled moment.

For some twenty years I worked for Intersonics Inc., a company which developed experimental space flight hardware for sounding rockets and the space shuttle and also did contract R&D.

It was while there, the Boss let me launch the Servodrive part of the company. The caveat was “as long as all it costs was space and lights.” So we were off in our “spare time” to create some “perfect bass.”

MULTI-MODAL TEF

With so much of the company's NASA work having to do with acoustics and having good measurements, we were also one of the early companies to get a TEF machine. Being the main “acoustics guy,” I used the TEF to measure vibration resonances in space flight payloads and locate flaws in concrete blocks (looking for echoes) .

Another task set was to measure/develop new transducers for acoustic levitation, another for producing a sonic boom. I even used TEF for measuring resonant modes on pecan shells. Let's just say it got seriously “multi-tasked.”

While at Intersonics, a movie company asked to film the acoustic levitation process used by our space flight hardware.

I ended up demonstrating it and being in the movie (“Mystery of the Sphinx” with Charlton Heston) . During filming I had made a wisecrack to the producer about going to Egypt and measuring the Pyramids. Several years later, the same producer calls up out of the blue and asks if I was interested in “finding out why the inside of the Great Pyramid sounded so weird.” This would be for another movie — all expenses paid and a decent “nut” to boot.

Some quick research on the Pyramid revealed it was a lot bigger than I imagined. It had a number of chambers and levels above the “King's Chamber” — opening the possibility that it was not a “simple”acoustic system. A rough (and I mean rough) estimation of the resonance of the granite ceiling beams in the King's chamber put them at about 300Hz. A somewhat less rough helmholtz resonator and transmission line model suggested resonances starting at 2.5Hz or so.

OFF WE GO INTO THE WILD BLUE YONDER

My long, fairly comfortable flight on Egypt Air from New York City landed in Cairo where my Egyptian adventure got off to a bad start.

Not being sure what to expect, or if my modeling meant anything in the real world, I'd packed two speaker systems for producing test tones, one for above 100Hz and a second much larger unit for below. Both were shipped in sealed boxes containing a power amp, my trusty TEF 12, a B&K microphone and an accelerometer (and a brace of cables).

Unfortunately, my power amplifier “got lost,” when we arrived at the Cairo airport. I suppose they thought the elaborate “tour” they took me on, through the dank, dark caverns under the airport looking for it, would offset the loss. Maybe they hoped this search party experience would combine with relentless jet lag to dissuade my pursuit.

Come to think of it, they never did pay up on the insurance claim (grumble, grumble) . I was immediately on the phone to the Crown dealer in Helliopolis to arrange for indigenous amp rental. Thankfully several days of free time were scheduled before I was “on camera.”

My 01:30 trip from the Cairo airport to Giza, where the Pyramids are, documented the chaos of local Egyptian “road rules.”

Carhorns are the “linga franca” for inter-driver communication. Headlights are almost never used at night on highways, but are frequently flashed in a fashion similar to horn honking.

Also curious, a marked three-lane road can often have five lanes of door-to-door, bumper-to-bumper traffic, consisting of a zillion wannabe Formula 1 drivers in beat up cars. This routine requires constant lane changing, horn honking and jockeying for the pole position all at 15-30 mph.

During a return to Cairo proper, I discovered that even the traffic lights are different. Like everywhere else, green means “GO,” but yellow also means “GO” and red means “GO” if nobody is coming. A cop standing directly in front of your car means stop, but if you are in the car next to the one with the cop, you can go regardless of his hand motions or how hard he blows his whistle.

DON'T WORRY, GO WITH THE FLOW

I settled in at the Movenpic hotel near the Pyramids. Several days of pre-film preparation remained. It was immediately clear that many production details remained undefined.

When I asked whether or not we had any sort of production schedule, outline or anything, the answer was “it isn't ready yet…don't worry.” I thought that maybe that's the way Hollywood is…real casual. So I made my best attempt to go with the flow.

The first day we went to look around the Great Pyramid and the area where we needed to get to inside. The thing is huge! It's 500ft(152m) across and 480ft(146m) high, and made of about 2.5 million 3-4sqft(1sqm) blocks of limestone with interior constructed of Red Granite.

To enter the Great Pyramid, one must first enter the cave El-Mamun. A would-be robber bored into the limestone here in around 600AD. This tunnel goes in approximately 50ft(15.2m) to a point they were supposedly about to give up, but heard a noise inside and re-directed the tunnel to the left. There they hit the Red Granite casing on one of the interior passages and by following it (the tools they had couldn't cut granite), they eventually located the Great Pyramid's interior. From the end of this tunnel, one climbs about 120ft(36.6m) stooped over in a space barely one yard/meter high.

This section is fairly steep with an approximate 30-degree incline. Without the wooden boards fastened to the stone for footing, it would be almost impossible to make this climb while carrying gear. For me, this path created a whole new meaning to the term “walk like an Egyptian.”

WALKING WITH THE KING

Next you enter the Grand Hall. It's also inclined but now about 40ft(12.2m) tall with a corbled (stepped) ceiling. After trudging up another 120ft(36.6m) up the grand hall one finally reaches the entry to the King's Chamber, which is another tunnel. This time, however, it's level and about 10sq.ft(1sq.m) and perhaps 20ft(6.1m) long.

The King's Chamber is about 40ft(12.2m) long, 20ft(6.1m) wide and 20ft(6.1m) high. The walls, floor and ceiling are all made of Red Granite. The granite blocks that make up the walls are huge. The one over the door is nearly 8ft(2.4m) high 14ft(4.3m) long and 5ft(1.5m) thick, yet all the blocks fit so tightly you can't get a business card between them. They are polished to a surprisingly smooth finish.

However, it was kind of a pain just to get this far (and this was the easy part) . When I expressed concern about getting the gear up to the King's Chamber, I was encouraged to hear the Producer's plan to hire some locals to haul our gear in and out. He acknowledged the degree of difficulty, and he was right. The Producer was also right about the acoustics in the King's Chamber. It sounded very weird inside there. Think of the “livest room” you've ever experienced, and then double that. It was acoustically “solid as a rock.” Given a minimum of 200ft(61m) of stone in all directions, it should be.

ON THE SKIDS

Our crew had a heavy heap of equipment (larger than my gear pile) . So, our fearless leader decided we would go to a wood shop and have a skid made that could be dragged up the incline. After measuring the passages, we were off the next day to find a “wood shop” known to the staff's hired Egyptian cab driver.

When we arrived at the shop, I was underwhelmed to say the least. Our wooden skid was promised to be ready in a few days. The crew were already scheduled to explore/plan for other parts of the film, so I tagged along.

During these few days it became obvious that the producer and his financial backers were following two somewhat different game plans.

“Plan A” included the production goals that included me. Specifically, we sought to access the cavity they had found with sonar and ground penetrating radar under the paw of the Sphinx. Psychic/cult hero Edgar Cayce predicted this cavity to be there in the 1930's. “Plan B” was to produce a TV documentary, which overlapped Plan A as much as possible. We had permits that essentially gave us free access to everything, so we spent a couple days filming at the Sphinx compound. (see Photo #3) Note: I ate lunch one day sitting between its paws. The radar also suggested there was an underground tunnel leading from the cavity, under the sphinx and continuing on.

At the rear of the Sphinx, the sound guy and myself saw an opening at the bottom of its rear and after seeing no one was around, both of us went in. (see Photo #4) This cave has two forks. One fork goes down about 12ft(3.6m) and sounds hollow if you stomp on the floor. The other fork goes up into the body and stops.

There were no other ways of reaching the cavity and by this time the permit to drill a hole for a fiber optic camera had mysteriously been yanked by the antiquities department. Being problem solvers, the bosses decided to look for another way to reach the Sphinx cavity.

OPTIONAL METHODS (PLANS C, D & E ???)

The producer lived in Egypt part-time and had heard about a waterwell on the causeway. The causeway, by the way, is the big stone ramp used to haul the stones up from the Nile for the Pyramid. One enters from the side through a short tunnel into the side of the actual roadway. From here, you carefully climb over an iron gate and try NOT to fall into the 30ft(9.1m) deep hole immediately on the other side. Then you carefully descend a decrepit iron “ladder” down into the dark.

The bottom opens in to a room about 20x20ft(6.1x6.1m) . At the far side is a down shaft about 6x6ft(1.8x1.8m) or so. You carefully get on another iron ladder (looks to be like 3/8in round rusty steel bar) and climb down into the blackness about 60ft(18.3m) . This was spooky. All we had for light was a helmet mounted flashlight. (see Photo #5) This climb ends by opening into a tomb with three sarcophagi. They are set into deep niches in the walls. One is very large, made of smooth black stone, apparently precision made, with sharp corners even on the inside edges.

How did they do that? The other two made of limestone much smaller and in poor shape. All had been robbed.

GOOD TO GO

After the lighting gear made it down and was set up, I immediately noticed the room was rectangular with square corners and had about eight foot ceilings. At one edge was yet another downshaft. This one was smaller (maybe 4x4ft (1.2x1.2m) and went down quite a long way.

After climbing down an even worse ladder with ropes for safety, one encounters two pillars which would have held up the ceiling of the next “space” that once seemed to have been a two story room. The remains of the substantial rubble pile disguises that this room was ever man made. This level was a fairly creepy place with ample broken pottery shards and many human bones in the rubble.

The back walls are squared off. There's a 7ft(2.1m) deep trench- like affair (full of water) around the back and two sides. It was like we were standing on top of the rubble pile created when the second story collapsed on the first. Anyway, they dug away a little at the center mound and about 10in(25cm) below the surface was a large granite slab. Radar detected a cavity below this slab about 6ft(1.8m) tall, and it seemed to lead off towards the Sphinx.

At this point more permits were needed so this discovery and all further work was snatched up by the head of the antiquities department.

SHOWTIME

We had gone as far as we could in the waterwell. The wooden skid was now done, and it was time for my part of the show. We had the Great Pyramid to ourselves every night after about 20:00 when the last of the sightseers depart and only the Bedouin guards remain.

As to not look the “wimp,” I grabbed a decent sized handful of cables and trudged up the slanting tunnel. When you get to the King's Chamber, most people will have worked up a sweat. I am no marathon runner, and I had to stop at the top and catch my breath for a bit. These skinny kids come staggering up to the top with the gear and turn around go back down and get more.

The same guy carried my TEF 12 (which isn't light), my main woofer (which was 80lbs), and three trips of lighting batteries (each is a big car battery in a plastic cooler) . I was impressed. And I realized that I was a wimp and there was no way around it. From then on when the crew hired locals to carry everything I knew they were earning a good wage — by local standards.

The lighting guy tapped into the AC mains (240V 50Hz) and set up his transformer, and we were ready. I picked a spot on the wall in the King's Chamber to set up my stuff. I placed the source at one wall and the microphone at the opposite wall and was ready to go.

COMPLIMENTARY SLOPES

I had figured the use of a “known” sealed box woofer (whose roll-off slope would roughly compliment room gain slope) that would allow useful measurements to extremely low frequencies (LF) .

The producer wanted to get the sound on film clearly. He asked that I test it at as loud a level as practical.

I applied the first loud slow sweep starting at 200Hz to 10Hz — a comfortable level. Around 90Hz I observed a strong room mode and sweeping at 1.1Hz/sec — some real energy was transferred.

What really made everyone get up and run to the exit was the resonance near 30Hz. At that moment I aborted that test. This was a good resonance, it got nice and strong and scared the wits out of a several crew members. Frankly, I was a little concerned myself. High-Q resonances at low frequencies can be very exciting!

The chances of something bad happening are small, but the consequences are large. Not wanting to be known as the first person in modern times to be buried in the Pyramid, I moved the TEF and myself to the tunnel entry way instead of inside the King's Chamber.

I spent several nights taking measurements there and was filmed without incident. I observed a good distribution of room modes and curiously, the Red Granite Sarcophagus displayed several resonant modes, which directly corresponded to these room modes.

WHAT THE WITNESS HEARD

Lying in the sarcophagus, one finds it's nearly impossible to hum any note other than ones related to the main resonances. In that position when you do hum at the “right” frequency, it's easy to make it seem very loud. But for someone standing next to you, it's not loud at all. Also lying in it, the outside sounds that get coupled throughout, colors other people's voices for a very Darth Vador effect.

My general observation is that the Pyramid's dimensions, the Pyramid's construction materials, and the box inside the King's Chamber were designed to passively (as in zero electricity) enhance whatever sounds were present inside the King's Chamber.

It also appears that any wind pressure across the Pyramid's internal air shafts, especially when the Pyramid was new and smooth, was like blowing across the neck of a coke bottle. This wind pressure created an infrasound harmonic vibration in the chamber at precisely 16Hz.

Being a musician myself, I was especially interested to discover a patterned musical signature to those resonances that formed an F-sharp chord. Ancient Egyptian texts indicate that this F-sharp was the resonant harmonic center of Planet Earth. F-sharp is (coincidentally?) the tuning reference for the sacred flutes of many Native American shamans.

Bottom line: We have 2.5 million blocks piled up in Egypt. Halfway around the world you have a guy whittling a tree into a musical instrument with exactly the same F-sharp resonance.

HOW DID THEY DO THAT?

The producer and crew were hot to film me placing an accelerometer on the big Red Granite beams which make up the roof of the King's Chamber. Each of these beams weighs up to 90tons(91.444kg), and they were quarried at Aswan some 600mi(966km) away. They are also about 150ft(46m) high inside the Pyramid. Another…“how did they do that” question.

To reach the upper levels above the King's Chamber, one re-enters the grand hallway, then climbs 40ft(1.2m) up an old extension ladder to a hole in the wall. A small bundle of knotted cords comes out of the hole, which is also the entrance to a small tunnel. Once in the small tunnel, you make a right turn and crawl a little more to an enlarged area carved out around a red Granite wall with a hole in it.

Climbing through that opening, you come into the chamber directly above the King's Chamber. This room is only about 4ft(12.1m) tall but is the same length and width as the King's Chamber. The ceiling is flat and is covered with some very old graffiti.

The floor consists of big rounded bulges, which are the center beams that run the width of the room. It took some time to haul all the camera and lighting stuff up, set up, then blow all the dust out of the sensitive gear before preparing to roll.

LET ME TAKE YOU HIGHER

After filming at that level and climbing up through a tunnel, we got to the next level up to do the same filming bit. It was in this room that we found a huge pile of burlap sacks filled with the chips the diggers had removed from the level below. This room also featured a large trash pile and hundreds of water bottles from the diggers. It's clear they were at work for some time.

Our passage to the rest of the upper levels was a real pain. Whoever did this part of the work used explosives. Essentially, this turns the experience into rock climbing. I got as far as I was able to go without help.

Fortunately, the camera and lighting guys were climbers and helped me up the last step. The top level has a peaked ceiling. There I had some time to look into any and all cracks I could find with my headlamp.

I found a place which looked like it opened up into a room as I could not see anything past the edge I was peering in.

On the next trip up, the camera guy put a 40ft(12.1m) fiberoptic bundle into the crack to see what it was. It turned out to be a very long (couldn't see the end) row of blocks all aligned (instead of the normal stager pattern) together — all with big parts of the lower corner broken off.

While the accelerometer footage was good for the movie, the measurements were not informative. The signal was totally swamped by 50Hz and other electrical noise.

I had a DAT recorder on hand, recording the test and mic signal for later analysis.

After being home for a few months and trying to see what else might be revealed on the Dat tape using Hyperception software, I found several things I couldn't have seen with the TEF. The TEF showed a large number of room modes some going below 20Hz.

HOW LOUD DOES IT GET?

While doing an FFT on the between-sweep time or quiet parts of the recording I found some very LF sound — resonances which start at a few Hz and go upward to 15-20Hz or so. At least some of these were the same LF resonances I excited with my sweep, but not all of them. This sound was present even if everyone is silent.

I crunched the results of the measurements, and they were sent on to a musicologist that was part of the staff. As mentioned, he identified that there was a pattern of frequencies, which roughly form an F-sharp chord.

Not all the resonances fell in the right place but many did and some repeated the pattern for many octaves. In other words, it was roughly tuned to F sharp over many octaves.

It has been suggested (by others) that the Great Pyramid is NOT a tomb at all but actually a Temple of sorts and that these resonant frequencies were “designed into” the structure.

While many exotic and often far-fetched properties have been ascribed to “the power of the pyramid,” I see a possible argument that some of the phenomena people experience in it may be caused by the acoustical properties that were measured.

The effects of LF sound were extensively studied by various government agencies to determine the effects on humans, partly for the space program. One of the things that was discovered is that infrasound (very LF) can effect ones brain wave activity (Alpha rhythms, etc.) and other biological functions.

If, as some suggest, these Pyramids were constructed as a “temple” or for an initiation ritual rather than a tomb, then the LF sounds may be deliberate and have served a scared purpose — with the sound triggering and even forcing changes in brain wave state (i.e. one's level of consciousness) .

BRAIN WAVES, SOUND WAVES

One of the latest rages in controlling one's brain wave state are the light/sound machines which use black glasses and headphones with flashing lights in the glasses and LF pulsing sound in the headphones to literally trap your brain into synchronizing at the pre-programmed frequency.

It would seem like sort of a meditation ride. You need no practice to do it. It just takes you. The frequency range, which causes this effect, is at the low end of the audio spectrum or even below the LF that we hear (infrasound) .

Low pitched sounds have long been known to cause emotional responses. The massive pipe organs of the ancient cathedrals were built (at considerable difficulty one should remember) to produce powerful LF sounds to frequencies below “audibility” or infrasound because of the powerful emotional and physiological effects they have on people.

Music and movie sound tracks are reproduced loudly to have an emotional effect on most people. Before the industrial revolution (and the attendant noise pollution) humans had more sensitive hearing than we do now. Accordingly, to the ancients, the sound in the Pyramids would seem even more powerful.

HOW DID WE FORGET?

Apparently man has been intentionally designing acoustic spaces for quite some time. During 1996, A Journal of the Acoustical Society of America paper, authored by Paul Devereux and Robert G. Jahn, detailed a number of ancient structures in England and Ireland which were apparently designed to enhance the bass frequencies in the voice range. Among other conclusions, Devereux and Jahn believed this was done because of the group chanting used in their rituals. Mantra's were often part of the meditation process and are even now.

The dimensions of the Sarcophagus in the main chamber are also such that there's acoustical reinforcement of the LF voice range as well.

As such, it seems obvious that architectural acoustics are simultaneously very old, and yet a virtually new science. The ancients had a grip on these principles, yet acoustic sciences seemed nearly lost for thousands of years. We ask why, yet we have no answer.

In many cases, architectural designs made more than 100 years before the computer are still considered to be among the best there are. This is further evidence, it seems, of how cyber-analysis can never fully replace life experience. Still, these days, architectural acoustics exist almost entirely within the computer.

ONE LAST THING

Lacking a time machine, one cannot “know” what the designers really had in mind when they built the Egyptian Pyramids. Clearly, they went to an amazing amount of work and had a powerful reason for doing it. Equally clear, they had techniques and skills used in its construction that we are aware of, but what they did looks impossible with what is known about them. Still, it obviously was possible.

“High Technology” (aliens, etc.) seems very unlikely as the Pyramid's interior nooks and crannies are very roughly shaped. If they had a laser or other high-tech voodoo tools, logic predicts they would have used them everywhere, not just where it showed.

On the other hand, machining marks were visible on the inside of the sarcophagus wall from some “rotary” type cutting process. Obviously they had some mechanical help.

Anyone who has been in the Great Pyramid and chanted or hummed will tell you that it feels weird and that the acoustic effect is powerful.

In short, it is possible that the ancient builders may well have been aware that sounds, even inaudible ones, can have a profound effect on one consciousness.

The fact that they were able to quarry huge red granite blocks six hundred miles away, transport them, “machine” them to a precise fit and then polish them, implies that there is an ocean about the ancient's we don't know — especially regarding their application of acoustic science.

Tom Danley is the inventor of the ServoDrive, and at present he is the chief designer at Sound Physics Labs, Inc. (Chicago).

July/August 2000 Live Sound International